BHAGYANAGAR GAS LIMITED
(A JOINT VENTURE OF HPCL & GAIL)

BID DOCUMENT FOR

LAYING & CONSTRUCTION OF 6" NB U/G STEEL P/L NETWORK & ASSOCIATED WORKS FOR CITY GAS DISTRIBUTION PROJECTS FOR CONNECTVITY OF CITY CNG STATION IN LUNGERHOUSE HYDERABAD

UNDER OPEN DOMESTIC COMPETITIVE BIDDING

Bid Document No. BGL/632/2024-25

Volume II of II

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SECTION 8 : SCOPE OF WORK

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4	Technical Specification for Concrete Weight Coating.	ENG-STD-PL-DOC-TS-003	1
5	Technical Specification for pipeline crossing, rail, road and minor water ways	ENG-STD-PL-DOC-TS-004	1
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3	Technical Specification for Gaskets Bolts and Nuts	ENG-STD-PI-DOC-TS-005	1
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6	Technical Specification for Welding of Station Piping	ENG-STD-PI-DOC-TS-009	1
7	Technical Specification for Fabrication and Installation	ENG-STD-PI-DOC-TS-010	1
8	Technical Specification for NDT	ENG-STD-PI-DOC-TS-011	1
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10	Technical Data Sheet of Flanges, Fittings	/ DS/ MECH/ 009,010,011	0
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12	Typical Support Drawings	ENG-STD-PI-DWG-TP-002,003,004,005	0
4.0	**Cathodic Protection**		
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2	Data Sheet for Cathodic Protection System	ENG-STD-CP-DOC-DS-001	0
3	QAP for Cathodic Protection System	ENG-STD-CP-DOC-QP-001	0
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3	Technical Specification for Plain Cement Concrete and Allied Works	ENG-STD-CV-DOC-TS-002	0
4	Technical Specification for Porta Cabin	ENG-STD-CV-DOC-TS-003	0
5	Technical Specification for Chainlink Fencing	ENG-STD-CV-DOC-TS-004	0
6	Technical Specification for Structural Concrete	ENG-STD-CV-DOC-TS-005	0
7	Technical Specification for Masonry Work	ENG-STD-CV-DOC-TS-006	0
8	Technical Specification for Plaster & Pointing	ENG-STD-CV-DOC-TS-007	0
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14	Technical Specification for Standard Field Quality Plan	ENG-STD-CV-DOC-TS-013	0
15	Technical Specification for Topographic and Route Survey	ENG-STD-CV-DOC-TS-014	0
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17	Typical Detail of Road Curves and Crossing	ENG-STD-CV-DWG-TP-002	0
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26	Typical Barricades drawing	ENG-STD-CV-DWG-TP-011	0
27	Typical Gate Detail	ENG-STD-CV-DWG-TP-012	0
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29	Typical Cross Section of Road	ENG-STD-CV-DWG-TP-014	0
30	Typical RCC Pipe Support	ENG-STD-CV-DWG-TP-015	0
6.0	**Instrumentation**		
1	Technical Specification for Pressure Gauge	ENG-STD-IN-DOC-TS-001	Rev. 1
2	Technical Specification for Optical Fibre Cable (OFC) And HDPE Duct	ENG-STD-IN-DOC-TS-002	Rev. 0
3	Data Sheet for Pressure Gauge, OFC & HDPE Duct	ENG-STD-IN-DOC-DS-001	Rev. 0
4	QAP for Pressure Gauge, OFC & HDPE Duct	ENG-STD-IN-DOC-QP-001	Rev. 0
7.0	**Minimum Equipment List**		
1	Minimum Equipment List	BGL-HYD-GN-DOC-EL-001	0
8.0	**Health Safety & Environment**		
1	HSE Management at Construction Site	BGL-HYD-GN-DOC-HS-001	0
9.0	**VENDOR LIST**		
1	Vendor List	BGL-ENG-GN-DOC-VL-001	0

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BHAGYANAGAR GAS LIMITED

CNG & CITY GAS DISTRIBUTION

SCOPE OF WORK

BGL-STL-GN-DOC-SW- 001

Rev	Date	Purpose	Prepared By	Checked By	Approved By

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1.0 INTRODUCTION

M/s Bhagyanagar Gas Ltd. is a joint venture of GAIL (India) Limited & HPCL Ltd. BGL has been set up to implement City Gas Distribution Networks at different geographical areas in the country. Presently BGL is expanding the City Gas Distribution Networks to supply natural gas to various Domestic, Commercial, Industrial and Automobile Consumers in Geographical Area (GA) of Hyderabad.

This tender deals with the Laying, testing and commissioning of underground Steel pipeline along with MDPE pipe in the above-mentioned location and associated works.

M/s Bhagyanagar Gas Limited intends to lay underground steel pipeline network of various sizes along with associated facilities from BGL existing pipeline / SV to make natural gas available for CNG & PNG facilities in the specified areas of Hyderabad.

1.1 PIPELINE FACILITY DESCRIPTION

Line Size	:	4" /6"/ 8"/10"/12" NB
Length	:	As per SOR/Scope of work
Line Pipe Specification	:	API 5L Gr. X42 / X52 PSL2 or Higher etc.
Line Pipe Wall Thickness	:	6.4 / 7.1 / 7.9 / 9.5 mm or Higher etc.
Line Pipe External Coating	:	3 Layer Polyethylene
Stations	:	Hook-up / Tap-off, Dispatch/Receipt Station / Customer End, SV etc. as applicable.

1.2 PROPOSED FACILITIES

The scope of work covered in this bid document broadly consist of Laying, Testing and Commissioning of 4" /6"/ 8"/10"/12" NB pipelines and associated facilities along with MDPE pipe of 125 mm dia PE100, SDR11 in the same trench for transportation of Natural Gas in Geographical Areas of Hyderabad as follows:

Sr No	Stretch Details		Dia	Length (Km) Approx
	From	To		
1	Attapur 6" Charged Line	M/s. M/s.Habeeb service station, langer House,	6"	1.1
2	M/s. Habeeb service station, HPCL, Langer house	M/s. Vamsi filling station, BPCL, Langer House	6"	1.4
			Total	**2.5**

Note: Laying shall be done as per the instructions of EIC, accordingly quantity may vary.

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The brief scope of work includes the following:

- Supply of bulk materials (other than free issue), pipe laying work including but not limited to Construction Management, HSE & Quality Management.

- Supply of L.R. bends, IJs, assorted piping, fittings, elbows, valves etc. to complete the entirework as per SOR.

- Laying, testing and commissioning of underground Steel pipeline of 4" / 8"/10"/12" NB size inthe above-mentioned locations.

- Laying of 125 mm MDPE pipe along with Steel Pipeline in same pipeline trench.

- Survey, grading, stringing, bending, welding, trenching, lowering, crossings. Tie-ins, NDTand destructive testing and backfilling.

- Crossing by HDD/ moling / boring, (wherever approved) – Type of crossing i.e., HDD / Moling / Boring / cased / Uncased / Open-cut and the length of the crossing shall be as perprior written approval of EIC.

- Hooking-up the pipeline to already laid pipeline by other contractors.

- Tap-off provision of all sizes made on proposed 4" /6"/ 8"/10"/12" NB pipeline network shall be kept underground.

- Installation of sectionalizing valves (SVs) including Valve pits shall be made at various locationson proposed steel pipeline network.All SVs shall be installed buried, without any stem extension, on the pipeline alignment itself with-in RCC chambers with RCC covers. The GPS co-ordinates of the valve location shall be provided for all the SVs.

- Entire buried pipeline network system shall be cathodically protected by providing TCP systemincluding design & engineering, resistivity data collection.

- Hook-up with existing facilities like MRS / DRS / CNG / PRS station and installation of insulation joint & laying of associated piping for the same as required.

- Line cleaning, flushing, Hydro testing, drying, nitrogen purging, pre- commissioning & assistance in commissioning of entire pipeline and piping system. In case if the pipeline segmentis executed by multiple contractors the above activities shall be done by the respective contractors as per their limit.

- Nitrogen purging and retaining pipeline at 2 kg/cm^2 pressure were required for preservationpurpose.

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- M/s BGL reserves the right to change the pipeline sizes in any of the above mentioned pipelinestretches and lay pipelines in any other areas in Hyderabad Geographical Area, at the contracted SOR rates.

Description of the facilities covered in the above are described in following clauses.

Main Pipeline for all sections

•	Line Size	:	4" /6"/ 8"/10"/12" NB size
•	Line Length	:	Approx 2.5 km approx. including all pipelinesizes.
•	Class	:	300 #
•	Design Pressure	:	49 kg/cm^2(g)
•	Material of Pipe & Grade	:	API 5L Gr. X-52/X42 /Gr.B
•	Wall Thickness	:	6.4 mm
•	Coating Material	:	3 Layer PE
•	Location Classification	:	Zone IV as per OISD 141
•	Design Code	:	ANSI / ASME B31.8 (Latest Edition) / T4SE
•	Corrosion Allowance	:	0.5mm
•	Road Crossings	:	As per SOR
•	Rail Crossings	:	As per SOR
•	Drain Crossings	:	As per SOR
•	Gas Temperature (Design)		
	- Buried	:	45°C
	- Over ground	:	65°C
•	Cathodic Protection Works	:	As per SOW & SOR
•	Pipeline Safety System Works	:	As per SOW & SOR

Associated underground piping works along with installation of Barred Tees, Insulating Joints, all type & sizes of valves; Civil Works, Structural Works and Instrumentation Works.

Terminals / Stations

i) **SV Stations & Hook-up with CNG Station/DRS/MRS etc**

- Buried installation of full bore ball valves, Buried installation of ball / plug valves ofdifferent sizes with underground gas venting facilities shall be provided at specifiedSV Station as per drawing.
- Buried installation of future tap-off provision at all SV Station.
- Buried installation of Insulating Joints at all tap-off points, wherever requiredin-addition to SV stations.
- Buried installation of all types and sizes of valves on mainline & branch line.
- Associated piping, civil, structural & instrumentation works.
- Installation of Tees / Barred Tees/, flanges & pipe fittings s per drawings.

Construction Fronts

The contractor shall mobilize equipment's and deploy manpower as per the instructionof owner to work on multiple fronts / spreads as per PMC / owner's instructions

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- This document covers the details of work tendered, scope of work, and scope of material supply pertaining to pipeline and associated facilities. All works and clauses of this document shall be applicable unless specifically mentioned otherwise.

- This document shall be read in conjunction with List of Attachments, Schedule of Rates,specifications, standards, drawings and other documents forming a part of the Tender Document.

2.0 WORK TENDERED

The work tendered in this bid package consists of supply (in CONTRACTOR's scope), fabrication,installation, testing and commissioning of the mainline, SV stations including all associated mechanical, civil, structural, instrumentation works.

All works of the section & terminals included in the scope will be done simultaneously fromthe date of issue of FOA. Bidder will organize equipment and manpower accordingly to meet this requirement as per instruction of Engineer-in-charge.

Any other work not mentioned but required for successful completion of work.

Work may be allotted to Contractor in multiple Front. Contractor shall be required to plan andmobilize his resources accordingly to meet completion target Schedule of Owner.

3.0 SCOPE OF WORK

The work shall be completed conforming to Engineering Design Basis, technical specifications, drawings, data sheets as furnished in the tender and any other information provided by Engineer-In-Charge. The general scope of work includes the following:

I. SITE VISIT (PIPELINE & TERMINALS)

- Site visit: Contractor shall make site visits along the pipeline route, identify all the salient features ofterrain, availability of ROU and infrastructure along the pipeline route. Contractor shall also make site visits for terminal stations as per bid requirement.

II. PROCUREMENT OF MATERIALS & SUPPLY AT SITE

a) Contractor shall procure and supply all materials other than Company supplied materials, required for permanent installation of pipeline and piping system in sequence and at appropriate time as perapproved schedule requirements. All equipment, materials, components etc. shall be suitable for the intended service.

b) Recommended vendor list has been enclosed with the bid package for various items. For items which are not covered in the vendor list, Contractor shall obtain Company's prior approval for the vendor. Equipment/ material offered shall be field proven. Equipment requiring specialized maintenance or operation shall be avoided, as far as possible.

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c) Stores management including receipt, warehousing, preserving the material in good condition, issue of material to construction site, reconciling/ handing over surplus material to Company for Company supplied items at Company's storage yard.

d) Carryout proper documentation of inspection and quality assurance programmers for bulk materials duly approved by Company. Contractor shall maintain an accurate and traceable listing ofprocurement records for the location, quality and character of all permanent materials in the Project.

e) Contractor shall immediately report to the Company of all changes which will affect material quality,and recommend any necessary corrective actions to be taken.

f) Submit periodic manufacturing progress reports highlighting hold ups and slippages, if any, to Company and take remedial measures.

g) Interact with authorities such as Sales tax, Octroi, Excise, GST etc. as necessary and arrange for dispatch of materials to site.

h) All purchase requisitions including purchase orders shall be approved by Company.

i) Compliance with vendors and supplier's instructions and recommendations for transportation, handling, installation and commissioning.

j) Contractor shall provide inspection of the items at vendor's works by the reputed inspection agencyand shall submit inspection reports of OWNER's clearance. In case of pressure containing materials, contractor has to provide as per OWNER's approved QAP, by the approved inspection agency without any extra cost to the owner. In addition to the same, OWNER reserves the right to inspect any material supplied by the contractor at any stage of manufacturing and delivery by themselves orthrough their representative. Contractor scope includes to provide the intimation to the owner, for inspection at any stage. This intimation shall be given at least 10 days prior to the inspection. Any extra payment will not be release to the contractor due to this inspection. Contractor shall appoint anyone of the following TPIA for inspection purpose.

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i. Lloyd Register of Industrial Services
ii. Det Norske Veritas (DNV)-GL/ Germanischer Llyod
iii. Bureau Veritas (BV)
iv. SGS India
v. ABS
vi. International Certifications Services (ICS)
vii. RINA India
viii. CEIL
ix. Moody International
x. TUV India
xi. TUV Norde
xii. Applus Velosi
xiii. Meenar Global Consultant

A. Materials to be Supplied by Company as Free Issue

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i. Company shall supply following materials as free issue:

- 3 Layer PE externally & epoxy internally coated line pipe for main line
- Metering Skid, pressure reduction skid, filtration skid
- Permanent Scraper Trap
- Insulating Joints
- Flow Tees

ii. Free issue material shall be supplied from M/s BGL designated stores in Hyderabad/Vijayawada/Kakinada or other locations as instructed by Engineer In charge. Further,Contractor shall also return any unused materials after completion of work to owners designatedstore in Hyderabad/Vijayawada/Kakinada or as directed by owner/ Engineer-in –Charge at its own cost.

B. Materials to be supplied by Contractor

All materials (other than those mentioned in clause A above, consumables, equipment required for completion and successful commissioning of entire pipeline system shall be procured and supplied by the Contractor As a minimum, the materials to be supplied by Contractor shall, but not limited by any way, be as follows:

i. The procurement and supply, in sequence and at appropriate time, of all materials and consumables required for completion of the Work as defined in this bid document except the Company free issue material, shall be entirely the Contractor's responsibility and price quoted forthe execution of the Work shall be inclusive of supply of all these materials.

ii. All materials supplied by the Contractor shall be strictly in accordance with the requirements of relevant Company material specifications enclosed with the tender document.

iii. All equipment's, materials, components etc. shall be new and specifically purchased for this job.All material to be supplied by the Contractor shall be purchased from the recommended vendorsof the Company, duly inspected by BGL/ Third party inspection agencies like Lloyds, Bureau Veritas etc. The list of recommended vendor is enclosed along with bid document.

iv. All valves of all sizes and & ratings for mainline and at terminals, All Casing Pipes, Assorted pipesfor all sizes and thickness fittings, flanges, O'lets (weldolets, sockolets, nippolets, threadolets etc.), spectacle blinds, spacer & blinds required for permanent installation in the system. Each item shall be inclusive of commissioning spares. List of such spares shall be made part of the offer and the quoted unit/total price shall be inclusive of the spares. In case of exigency of work,BGL may procure valves, pipes as per SOR item list.

v. All stud bolts, nuts, all type of gaskets (metallic spiral wound / ring type) in required quantities tobe used for permanent installation into the system for all sizes and ratings of flanges and flangedvalves, equipment etc.

vi. All consumable such as welding electrodes, oxygen, acetylene, inert gases, all types of welding electrodes, filler wires, solder wires, brazing rods, flux etc. for welding/cutting and soldering purposes.

vii. All materials for all types of markers including paints Normal corrosive environment, cement, sand, reinforcements, structural steel, etc.

viii. All materials, equipment's, consumables including pigs required for magnetic cleaning and EGPfor piggable pipeline.

ix. All materials required for weld joint coating, corrosion coating of LR bends, and repair of damagedcorrosion coating of line pipe. Contractor shall confirm that proposed field joint coating material is suitable for type of

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terrain encountered along pipeline route. Contractor shall take prior approvalfrom Company for field joint coating material to be used.

x. Dirax field joint coating material for HDD works.

xi. All materials required for sand/soft soil padding around pipeline and optical fibre cable, select backfill of recommended quality, wherever required.

xii. All materials including consumables required for hook-up with adjoining pipeline section or wherever required.

xiii. All primer and paints for painting above ground piping shall be as per specification enclosed withthe bid package.

xiv. Corrosion monitoring system wherever specified as per specification.

xv. Material for the maintenance of sand ridges and other materials for pipe stacking at Contractor's warehouse/storage yards/work site/ROU.

xvi. All materials for skin measurement instrument.

xvii. All temporary materials and consumables required for filling and pressurizing in connection with hydrostatic testing, dewatering, swabbing and pre-commissioning activities, etc. including pipes, flanges, fittings, gaskets, bolts, nuts, etc. required for fabrication of temporary pig traps and /or test headers.

xviii. All materials required for repair/restoration of pavements, roads, canals, temporary water pipes,walls, other structures affected/damaged by Contractor's construction activities. Materials shall be equivalent/superior to those used for original construction of the facility.

xix. All pigs for cleaning, gauging, de-watering, swabbing, filling, pre-commissioning and commissioning of the pipeline.

xx. Pumps and water to be used for hydrostatic testing/ flushing. All materials & consumables such asCorrosion inhibitor, oxygen scavengers and bactericides, required during hydro-testing and idle time preservation, as required.

xxi. All casing pipes, casing insulators and end seals including materials for vent and drain and strapping CS conduit with pipe and carbon steel pipes for optical fiber cable (OFC)conduits in required quantities. Size of casing pipe for carrier pipe and carbon steel conduit for OFC (if applicable) shall be as follows:

a) 219.1 mm, O.D. (8"), API 5 L Gr. B/ IS: 3589, for 4" carrier pipe
b) 355.6 mm O.D. (14"), API 5 L Gr. B/ IS: 3589, for 8" carrier pipe
c) 168 mm OD, Sch.40 API 5L Gr-B steel conduit with HDPE inner duct for laying of OFC at crossings.

The Minimum thickness of casing Pipe shall be as per API 1102. All CS casing Pipe/conduit shallhave 300 micron external epoxy coating.

xxii. All consumables and equipment's required for all types of tests and NDT such as radiography, ultrasonic testing, magnetic particle, dye penetrant examination etc. including radiography film etc.

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xxiii. All safety tools and tackles, devices, apparatus, equipment, personal safety gazettes to be used as personal protective equipment (such as helmets, safety belts, safety shoes, etc.) including ladders and scaffolding etc. complete as recommended by Engineer-in-Charge as per relevant safety standards.

xxiv. All structural steel material for all types of supports.

xxv. All materials and equipment for excavating trench or grading the Right-Of-Use pipeline andpipe laying/installation and other works.

xxvi. All steel materials such as structural steels, reinforcement steels and steel for all types of supports,foundations, ladders, platforms etc. including Bolts, nuts, washers, U bolts, clamps, clips, gaskets,Shims, wedges and packing plates (Machined wherever required)and materials required for fabrication of low friction sliding bearing supports.

xxvii. All fencing, gate and steel materials such as structural steels, reinforcement steels and steel for alltypes of supports, foundations, ladders, platforms, etc.

xxviii. All materials, manpower, spares, tools & tackles and consumables for carrying out pre- commissioning activities and during commissioning (including bi-directional and foam pigs, Air compressor, nitrogen required for achieving the specified criteria for pipeline purging prior to declaring pipeline fit for commissioning) necessary piping and instrumentation connection for measuring flow rate, pressure, temperature etc., temporary facilities for blow down/ venting/ flaringalong with necessary piping, valves &instrumentation as well as consumables and manpower required during pre-commissioning and commissioning.

xxix. All materials (100% solid epoxy coating 500micron thick) for corrosion protection of buried piping(pipes, fittings, flanges, valves, etc.).

xxx. Required quantities of Nitrogen for pre-commissioning & commissioning works.

xxxi. All spares for pre-commissioning and commissioning as required for all items supplied byContractor for the entire pipeline system.

xxxii. All Civil/Structures items, Electrical, Instrumentation, Telecom, Cathodic Protection materials incomplete as per requirement specified in all different sections.

xxxiii. Any other material not specifically listed herein, but required for successful completion of the Work.

C. Conditions for Company Supplied Material

i. The Contractor shall be responsible for taking over of the material and subsequent handling, hauling, transportation to the actual work site(s)/fabrication yard(s) and storage &safe keeping ofthe materials.

ii. The Contractor shall inspect all Company supplied free issue materials at the time of taking over from the Company and defects noticed, if any, shall be brought to the notice ofCompany/Company representative and jointly recorded. Once the material has been taken overby the Contractor, all the responsibility for safe keeping of the materials and repair of damage/defects to pipe & pipe coating shall rest with the Contractor.

iii. Contractor shall receive and take over the pipes progressively as per construction requirements. At the time of taking-over from Coating Contractor/BGL's designated storage, Contractor shall perform inspection of pipes and pipe coating for all defects in the presence of Company's

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Representative. Contractor shall repair all defects occurring after taking over including those during transportation and handling. Rebuffing for dents (in bevels) less than 1 mm in depth shall be carriedout by Contractor ahead of welding in the field at no extra cost to Company. Contractor shall progressively takeover the required quantity of bare & coated line pipe from the warehouse.

Return of surplus bare & coated line pipes at warehouse to Company's designated storage yard is installation Contractor's scope including loading, transportation, unloading, handling, stackingof pipes at company's storage yard and getting the pipes inspected from Company's representative at storage yard.

Any repairs to 3-layer polyethylene coating shall be carried out by Contractor using suitable material compatible with parent coating system and meeting the requirements of coating system specified in specification attached with the Bid Package. The coating repair material andprocedure for application shall be submitted to Company for approval prior to start of construction.Repair of PE coated pipes in field shall be carried out as follows in accordance with bid specification.

iv. Rebuffing of dents in bevels less than 1 mm in depth shall be carried out by Contractor ahead ofwelding in the field at no extra cost to Company.

v. On completion of the works Contractor shall submit a "Material Appropriation Statement" for all materials supplied by the Company as free issue materials.

vi. Every month the Contractor shall submit to the Company an account for the material issuedto the Contractor in the Performa prescribed by Engineer-in-Charge.

vii. For the purpose of accounting of pipes all cut pieces in length of 2 m and above where turned tothe Company's storage point shall be considered as serviceable material. All pipes measuring less than 2 m shall be treated as scrap/wastage.

viii. All unused pipes and serviceable/ scrap material shall be the property of the Company and shallbe returned by Contractor to Company at Company's designated storage point(s)

D. Storage of Materials

i. All materials shall be preserved against deterioration and corrosion due to poor or improperstorage while under the custody of the Contractor.

ii. All materials shall be duly protected by the Contractor at his own cost with the appropriate preservatives like primer, lacquer, coating, grease etc. and shall be covered with suitable materialto prevent them from direct exposure to sun, rain, wind and dust.

iii. Pipes shall be stacked according to the identification marks and stacks shall be arranged on sleepers / sand bags at least 300 mm above ground.

iv. The Contractor shall check that valves, fittings, specials etc. are not subjected to corrosion from hydrostatic test water remaining in the piping. Any such condition when detected should be broughtto the notice of Engineer-in-Charge and remedial measures taken as directed.

v. All machined surface shall be properly greased and should be maintained and protected from damages.

vi. Openings of equipment, machinery, valves etc. shall be kept blocked / covered with blinds toprevent entry of foreign matter.

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vii. As far as possible materials shall be transported to the site of erection only just prior to the actual erection and shall not be left around indefinitely on ground but kept on packing/sleepers etc. to maintain the minimum distance from the ground as specified and/or as per directions of Engineer- in-Charge.

III. QUALITY ASSURANCE & QUALITY CONTROL

a. Contractor shall prepare Quality Assurance & Quality Control Plan for project.

b. Contractor shall ensure adequate quality assurance and control including stage wise inspection,testing and certification.

c. Contractor shall appoint an independent TPIA for supply of material (Other than free issue) fromOwner's vendor list. The TPIA appointed by contractor shall be common for inspection of complete scope of supply. All inspection reports shall be submitted for owner's review/approval.All materials like station pipes, fittings, valves etc. shall be supplied with required certificate / approved document/Approved QAP.

d. Contractor shall Carryout proper documentation of inspection and quality assurance programm for all equipment and bulk materials duly approved by Owner.

e. QAP samples are enclosed as part of bid shall be followed by Contractor without any deviation asis basis.

IV. CONSTRUCTION: INSTALLATION, ERECTION & TESTING

a. Contractor shall carry out construction work as per "Issued for Construction" drawings, procedures, specification and applicable codes and standards. Any changes at site shall need prior approval from the Engineer-In-Charge.

b. Contractor shall receive and takeover of all owner supplied free issue materials from the designated place(s) of issue. The transportation including loading, unloading, handling, storing tillinstallation of materials shall be the responsibility of contractor.

c. Contractor shall be responsible for delivery and handling of bought out material at site.

d. Contractor shall prepare planning and monitoring schedule.

e. Contractor shall obtain no objection certificates (NOC) from authorities, land owners or any other statutory body. Company has obtained most of the clearances, No objection certificates (NOC) forlaying pipeline & for stations from concerned authorities. However, for some of the permissions, ifnot available, Contractor shall do the follow up with the concerned authorities to get the permissions to execute the job in time. In such cases, all statutory payments required for such permissions shall be reimbursed by Company at actuals. Contractor shall obtain permits/clearancefrom concerned authorities before actual commencement of the job at site including preparation and establishment of safety procedures for laying pipeline.

f. Contractors shall Liaison and coordinate with all statutory authorities having jurisdiction during the actual execution of work.

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g. Contractor shall also coordinate and use his best deeds to carry out the construction of pipeline with the general permission provided by client.

h. Contractor shall mobilize adequate manpower, machinery, tools, tackles, consumables etc for construction.Immediately after award of individual work, Contractor shall make a visit to the route to establish the route and familiarize with the working conditions so as to plan for deployment of manpower and machinery.

i. Contractor shall arrange and take possession of any additional land required for construction purposes.

j. Contractor shall do clearing and grading of ROU and station plots.

k. Contractor shall do stringing, welding and lowering of main pipeline.

l. Contractor shall do work in restricted ROU along with large number of utilities & utility crossing. Most of the areas the Pipeline shall be laid along the road and industrial area. The ROU shall be restricted. Excavated trench & pits in area near heavy traffic and other areas of movement, shall not be left open without barricading.

Contractor may plan to work in the Night shift to avoid traffic while crossing roads & utilities. But Contractor has to plan and take approval from Engineer-In-charge/ Client and Concerned Authorities before start of construction. Contractor to arrange all lighting and safety precaution forthe same.

In some areas where mechanized excavation is not possible, Contractor shall have to do manual Excavation also.

m. Contractor shall do earthwork such as excavation, trenching for all depths and all types of soil,rock blasting and back filling including bottom/top padding as per specification.

n. To ensure adequate quality control, contractor shall make arrangement for stage wise inspectionand testing during construction work at site.

o. Contractor shall carry out NDT as specified in the tender along with selection of production jointsand carrying out the relevant tests as specified in the bid document.

p. Contractor shall carry out concrete coating of Line Pipes, wherever required in addition to the location specified in Alignment / Crossing Drawings as per approved design. All materials, equipment, instruments and consumables required for concrete coating for providing anti- buoyancy to the pipeline, concrete slabs for pipeline protection, crossing bank protection including slope breakers wherever required as per applicable specification/drawings.

q. Contractor shall make Cold Bends from API 5L Gr. X42 / X52 / X60 grade CS Line Pipe (Line Pipe shall be supplied free issue by owner/company). Line pipe grade can be changed dependsupon the requirement and availability by BGL.

r. Site restoration shall be done by Contractor as per original condition and to the satisfaction of BGL Project Manager/designated authority/owner/farmer and NOC to be obtained to this effect.

s. Contractor shall carry out Cleaning, Hydro-testing, Swabbing, Drying, Gauge Pigging, includingsupply of materials, consumables, tools and tackles, equipment/machineries and manpower.

t. Pipeline gauging shall be performed prior to install any elbow in between two sections. Allindividuals sections shall be checked in same method for pipeline gauging.

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u. No branch connection or Tee, underground Valve shall be installed before hydrostatic test.

v. After welding of elbow with pipeline section, one-gauge pig run has to be carried out as per 95%ID of Elbow on or before water filling for hydrostatic test.

w. If any section is less than 50 meters then 98% Dia. of Mainline ID pull through shall be carried outinstead of section wise pipeline gauging.

x. If pipeline passes through the edge of small lined drain/ RCC Drain/ Stone Pitching required restoration shall be carried out after completion of laying works. Prior approval needs to be takenregarding construction and restoration procedure from Engineer-In-Charge.

y. Contractor shall carryout AC & DC interference surveys and shall take suitable measures for the mitigations of AC & DC interference.

z. Contractor shall carry out Installation, Testing &Commissioning of TCP (Temporary Cathodic Protection) and PCP (Permanent Cathodic Protection).

aa. Contractor shall carry out Land and site development work for stations including earth filling wherever required.

bb. Contractor shall carry out Civil works for stations including RCC approach road wherever required.

cc. Contractor shall carry out Installation of Electrical items like Distribution Boards for Porta Cabin, Cables, Poles, Solar Lights, Earthing Materials etc. as applicable as per Technical specification of RFP document.

dd. Contractor shall carry out Mounting/Installation of all field instruments like Pressure Gauge (PG),etc. as per P&ID.

ee. Contractor shall carry out HDD crossing (wherever applicable) as specified in the tender specification.

ff. Hydrostatic testing of Pipeline shall exclude valves at tap off stations, and terminals and facilitiesthat are to be installed as a part of the stations. Temporary test headers shall be provided and the pipeline shall be hydrostatically tested between the temporary test headers only. The pipelineshall be hydrostatically tested at least 1.5 times of Design pressure. But the maximum hydrotestpressure shall not exceed 90 % SMYS of the pipe material at any location and at any point of time of the lowest wall thickness of that section. The highest point of the test section shall be subjected to the minimum test pressure as specified above. Hydrotest shall be for 24 hours duration.

Hydrotest shall be done with corrosion inhibitor and dosage of corrosion inhibitor shall be suitablefor 3 months.

Subsequent to separate hydro testing of pipeline and associated facilities, tie-in/hook up shall be carried out by the Contractor. Pipes/prefabricated assembly used for such tie-in shall be pretestedto a test pressure specified for the pipeline. All materials required for the fabrication of the test headers shall be provided by the Contractor at no extra cost to Company. After successful completion of hydrostatic testing, the Contractor shall de water the pipeline as per the directions ofEngineer-in-charge.

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gg. Piping facilities between the insulating joint and hook up point/battery limit and all above ground facilities installed by Contractor shall be hydrostatically tested to a test pressure equivalent to 1.5times design pressure in accordance with "Standard specification for Inspection, Flushing and Testing of Piping System" enclosed with the Contract document. Duration of testing shall be minimum 6 hours. All valves in the piping network being hydrotested shall be kept in the crack open position.

hh. For any welding the electrodes, consumables and flux shall be of same manufacturer. Weld abilityTest Shall be carried out on line pipe segment of 12 meter each. Thereafter, RT will be taken of joint after 24hours and 72 hours followed by destructive testing as per QAP.

ii. Contractor shall carry out minimum one sample considered for Production Weld Test sample. Thesample selection shall be selected by TPIA/Client/Client Representative.

jj. Contractor shall carry out fabrication of station piping and construction & installation of pipe supports.

kk. Contractor shall carry out installation, commissioning of free issue material like filtration and metering skid including loading, unloading, transportation from anywhere of BGL designated store location.

ll. Contractor shall carry out Hook up / tie-in of pipeline and piping system with terminal facilities.mm.

Contractor shall carry out Idle time preservation of the pipeline (if required).

nn. It is envisaged that dewatering and swabbing operations shall be carried out as a part of pre- commissioning activities. Dewatering of pipeline after hydrostatic testing shall be taken up by Contractor only when Contractor is ready for swabbing operations.

oo. Contractor shall carry out Pre-hydro testing and Post-hydro testing of all cased crossings and after major crossings and or additionally imposed by Engineer-In-Charge/ Concerned authorities.

Contractor shall submit a detailed procedure for leak detection during hydrotest. Such method ofdetection shall consume minimum possible time to complete the hydrotest activity within contractual completion schedules. This procedure needs approval of the Engineer-in-charge.

pp. Contractor shall make proper waste disposal system for construction and related works.

qq. Contractor shall carry out all incidental and associated works and any other works not specificallylisted there in but are required to be carried out to complete entire work related to pipelines and terminals.

rr. Contractor shall carry out Induction and strict implementation of Health, Safety & Environment (HSE) procedures including safety organization, HSE plan, providing PPE, providing adequate barricades at work site wherever required, conducting periodic audit and ensuring the implementation of HSE measures. Contractor shall be fully responsible & liable for ensuring & implementing HSE at site & shall hold Engineer-In-Charge fully indemnify from all liabilities & consequences.

ss. Welder qualification test shall be required for each welder, If welder is not working from last 3 months then destructive testing shall be compulsory for welder qualification.

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Following points shall be taken care by the contractor before/ during execution works.

i) Contractor shall be responsible for taking necessary precautions regardingtraffic (installation of notice / warning boards).

ii) Contractor shall be totally responsible for the occurrence of any accident during excavation of road and shall be liable for damages / expenses due to the same.

iii) Concerned authority / Owner shall not be responsible for any loss / damage.

iv) One copy of the permission shall be made available with contractor's responsible workman at the place where excavation is undertaken.

v) While executing the subject work, excavation shall be done in consultationwith the concerned authority engineer of that area.

vi) Necessary safety measures shall be taken for the gas pipeline, since high tension lines and other services carriers are running alongwith in gas pipeline route in thearea.

V. PRE-COMMISSIONING & COMMISSIONING

Contractor shall carry out Golden joints clearance. Contractor shall carry out Drying as per specifications.
Contractor shall carry out Gauge pigging of main line as described.
Contractor shall carry out Pre-Commissioning of complete system including, Filtration, meteringand Pressure Reducing skid (If applicable)

Overall commissioning activities including drying, nitrogen purging etc. for entire pipeline and terminals shall be performed the Contractor. Contractor shall mobilize all equipment, consumables,nitrogen and manpower for carrying out pigging, drying, inertisation and commissioning activities.

VI. PROJECT MANAGEMENT INCLUDING DOCUMENT CONTROL SYSTEM

Preparation of detailed project schedule.

Preparation of Project Execution Methodology.

Material Management Plan

Planning & Scheduling

Monitoring and Reporting of progress on each front of the project.

Contractor shall be required to work on the material management module of BGL. Service entrysheet of goods received and invoice entry in SAP capturing to be done by the Contractor.

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Deployment of competent qualified & experienced Project & Construction Personnel. Key manpower shall meet the requirements specified in bid document. Contractor shall submit site organogram with CV of respective personnel to Engineer-In-Charge.

Expediting and Monitoring of all procurement excluding free issue material and construction activities with recommended vendors / sub-Contractors.

Contractor shall submit following deliverables for adequate monitoring of project:

- Daily Progress Report (DPR) for construction works of project
- Weekly Progress Report (WPR) for Procurement covering all stages of material Including construction progress.
- Monthly Progress Report (MPR) with comparison.

The details of content of the above reports shall be prepared by the Contractor for approval ofEngineer-In-Charge.

Receipt of BGL free issued materials i.e. Line Pipe, Filtration, Metering, IJ, Valves and other freeissue materials if any.

Installation of all free issue material including Filtration and Metering with necessary modification ifneeded.

VII. PROJECT CLOSE OUT

Submission of all as built documentation (4+4 Set), inspection reports, purchase orders, materialreconciliation report, NDT records both in soft and hard copy duly approved by Engineer-In-Charge.

Submission of all NOC's from landowners, statutory authorities and agencies having jurisdiction.

Submission of relevant documents, Operation & Maintenance manuals, guarantee/ warrantee testcertificates of all the items supplied by Contractor for the execution of the complete scope of work.

Note: Contractor has to provide Test Certificate of the materials are being used for construction purpose. For small quantity supplied items, to be verified by PMC/TPI, contractor fails to provide TCin such case branded material to be used for construction purpose and have a picture of item with brand and other details etc. and same will be provided with Contractor undertaking response. It willnot be applicable for pressure bearing material.

Submission of operational acceptance report including all the documents, test certificates etc.Pre-

Commissioning and Commissioning

- Pre-commissioning activities such as Hydro-testing, Swabbing, Drying, Gauge Pigging,Vacuum drying and nitrogen purging for mainline & station piping system for mainline.
- Pre-Commissioning of complete system including Filtration and Pressure Reducing skid (If applicable)

- Commissioning with Natural Gas. This also includes commissioning of complete pipeline system i.e. pipeline, spurline, Civil, Electrical including Cathodic Protection, Instrumentation and associated works / facilities.

- Commissioning of Pipeline and associated systems including supply of materials (temporary,permanent or

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consumables), tools and tackles (including special tools & tackles) andmanpower.

VIII. OWNER'S RESPONSIBILITY

a) Issuing clearance to contractor to work in the ROU only
b) Land for Stations
c) Providing all free issue materials
d) Providing Approved "Issued For Construction Drawing"(shall be issued by Engineer-In-Charge)
e) Refer commercial volume

4.0 DETAILED SCOPE OF WORK

4.1 PIPELINE LAYING WORKS

I. "Receiving and Taking-over" as defined in the specifications stacking in the yards / dump site andstringing of pipes in Right-of-use (ROU), including arranging all necessary intermediate storage area(s) required there till the coated pipes are installed in permanent installation.

II. Transportation of pipes from the designated dumpsite to designated ROU/ROW for stringing.

III. Carrying out inspection of OWNER supplied materials if any at the time of receiving and taking- over.

IV. For pipes where cutting out involves more than 25 mm from pipe ends, ultrasonic inspection shallbe carried out at pipe ends as per relevant clause of line pipe specification enclosed with the tenderincluding supply of all equipment's . Contractor shall take prior approval from Company for the agency engaged for carrying out ultrasonic inspection.

V. Loading, unloading, handling stacking, storing and transportation to workshop / work site of all materials that may be used for the construction of pipeline system supplied by Client/Contractor attheir designated stack yard /dump site /store.

VI. The contractor shall notify the owner the probable date of commencement of work at ROU site at least two (2) weeks in advance to enable the owner to arrange handing over of the ROU / site on the date requested. Should contractor fail in such notification, the owner shall not be liable for anyclaim by contractor, of whatsoever nature, for delay in the available of a ROU / site.

VII. Mobilizing and providing all equipment's , manpower (skilled and unskilled), consumables and otherresource etc. as required for the execution of complete work and thereafter demobilizing the sameupon completion of work.

VIII. Contractor shall mobilize the machinery and manpower as defined in the tender document. Each contractor shall be responsible for the entire scope of work of individual part including commissioning and gas in and shall mobilize the equipment and manpower accordingly.

IX. The Company shall obtain a general permission from most of the authorities having jurisdiction over the area as necessary for construction of the pipeline. However, for some of the permissions,if not available, Contractor shall do the follow up with the concerned authorities to get the permissions to execute the job in time. However, all statutory payments required for suchpermissions shall be reimbursed by Company at actuals. Contractor shall also obtain the necessary permits like work permit/ excavation permit/ trench opening permit etc. for all works from the authorities having jurisdiction before the actual execution of various phases of the

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works and all stipulations/ conditions/recommendations of the said authorities shall be strictly complied with no extra cost to Company. Contractor shall also obtain all necessary permissions from the concerned authorities for installation of pipeline at railways, roads and water/nala, drain crossings. Companymay, however, assist Contractor in obtaining such permissions, wherever required, by issuing recommendation letters etc. In case of damage to other utilities/infrastructure, Contractor shall beresponsible and the required compensation, as per the directions of concerned authorities, shall be paid by the Contractor. After completion of work, Contractor shall obtain a certificate from the concerned authorities that the job has been completed as per their requirement and the area/landhas been restored to their satisfaction.

X. Staking, clearing, grading, fencing of Right-of-Use (ROU) as required, trenching to all depths in alltypes of soil including soft, hard rock, controlled rock blasting / rock blasting by special techniques, chiseling or otherwise cutting etc. to a width to also accommodate the cable conduit as per relevantstandards, drawings, specification etc. Transportation of coated pipes to ROU along the route, stringing, aligning, bending, welding, NDT including radiography by X-ray/Gamma and ultrasonic inspection, field weld joint coating including supply of all materials, protective coating of long radiusbends including supply of all materials, protective coating of long radius bends if applicable including supply of materials as per specification sand padding, laying and lowering of the pipeline,back filling, slope breakers as required, carrying out rail, road, canal, utility and submerged minor and major water course crossings including installation of carrier pipe inside casing pipe at cased crossing wherever required, bank stabilization of water course crossing as required, crossing of river / canal by conventional method and arranging all additional temporary land / area required for construction purposes. Supply and installation of anti-buoyancy measures viz. continuous concrete coating, saddle weights, extra cover etc. on pipeline as shown in approved drawings and as directed by OWNER, installation of supports wherever required, supply of select backfill material as required, clean-up, pigging, flushing, gauging, hydrostatic testing with quantity of inhibitor as required, dewatering with the additive, at required dosage, swabbing, pre-commissioning and commissioning of complete pipeline system, including all associated works as per relevantspecifications, standards and approved drawings.

XI. Welding of all **Golden Tie**-in joints including tie-in joints and bends on either side of water body crossing / with adjoining pipeline installed by others / other facilities as required, cutting of test header, rebevelling and tie-in with adjacent pipeline segments. The welding shall be mainly semi-automatic/ manual type and contractor shall follow the technical specifications as defined in the tender document.

XII. Field weld joint coating shall be by heat shrink sleeve / other suitable material as per specificationenclosed with bid package compatible of pipe coating material. Any damage in coating shall be repaired as per the approved procedure and the same shall be holiday tested after joint coating.

XIII. Carrying out corrosion coating of Long Radius (LR) bends if any. Coating shall be carried out by heat shrink sleeve / other suitable material as per specification enclosed with bid package for fieldjoint coating.

XIV. Supply and Installation of casing pipes (by open cut / jacking / boring) assembly, including supply of all material viz. casing pipe, casing insulators and end seal, vents and drains etc. complete, at cased crossings as per the drawings / specifications enclosed with bid package.

XV. All works / provisions including installation of slope breakers to be provided in the trench in areas where slope is more than 1 in 10.

XVI. Sand / soft soil padding around pipe wherever required in areas where trenching has been done inrock including supply of sand / soft soil. The thickness of sand / soft soil padding at the bottom of pipe shall be 300mm in rocky areas.

XVII. Installation of all inline / online instruments / valves / insulation joints / appurtenances etc. as per requirements of approved drawings.

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XVIII. Providing 300-micron high built abrasive resistant epoxy on the external surface of 6" CS conduitsmeant for OFC (in crossings) wherever required.

XIX. Indian Railways shall approve the crossing drawing for railway crossings and construction shall becarried out accordingly. The Contractor shall make these drawings available at appropriate time during the execution of the project. Pipeline at railway crossings shall be provided with a casing pipe. The railway crossing shall comply with the requirements of API 1102 and Indian Railway regulations.

XX. Contractor shall firm the method of crossing of roads such as open cut / boring / HDD up in consultation with concerned authorities and Company. The Contractor shall also take due care toidentify and take due precautions so as not to disturb or damage the utilities like cables, water linesand other structures.

i. No damage should be caused to any irrigation sources, while laying the pipeline through road crossings.

ii. The flood banks of the River / Canal should be brought to the original condition, if they are damagedwhile the laying of the pipeline. Stabilization of banks shall be carried out as per requirements of concerned authorities.

iii. In general the top of the pipeline shall be taken at least 2.5 meter below the scour level of river crossing. The top of pipeline shall be at least 1.5m to 2.0m below the drain / canal bed unless specified otherwise. The minimum cover requirements shall be as defined in drawings/ technical specifications as defined in the bid document.

iv. Pre-construction survey, preparation of the detailed construction methodology / plan and time etc.shall have to be finalized by Contractor in consultation with concerned authorities having jurisdiction over canals / rivers. Company shall provide assistance by providing introductory letters.

v. Pre-construction surveys, preparation of detailed construction method statement and calculationsfor Owner's approval.

vi. Surveys like Geo-technical, Hydrological and Topographical for pipeline route, Station plots, Rail and Road crossing etc and water crossings.

vii. Site preparation, arranging required land for setting up of string fabrication yard and obtaining necessary permissions from concerned authorities.

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viii. Preparation of pipeline Launch way, continuous concrete coating of pipes, repair of damages to corrosion and concrete coating, string preparation, field welding, NDT including radiography, pre- test for completed strings, corrosion and concrete coating of field joints, trenching, laying at approved depth, stabilization of banks, post installation hydro-test, capping, providing and installingof markers, etc.

XXI. Contractor shall cross the road / canal etc. by HDD/ trench less method at locations as directed byOwner / Consultant as per crossings survey drawing done by contractor. Before start of HDD, thecontractor shall ascertain by pre-construction survey all underground obstacles namely electrical /telecommunication cable, foreign pipeline water line, drain / sewerage line and prepare crossing profile drawings showing all elevation & levels. The contractor shall also ascertain the type of soil & their terrain whether rocky or normal by way of trial pit etc. before start of job. The contractor shall submit procedure; profile drawing with complete design calculations of HDD as per requirement of ASME B31.8 / OISD norms and safety requirement that pipe is not under stress during and after crossing for Owner / Consultant's approval prior to start the execution of work.

XXII. Contractor shall ensure all safety norms regarding distances from end point or from bottom of crossing and also ensure that external coating of pipe is not damaged during pulling & handling ofpipe for crossing. For field joint coating in pipeline string made for HDD, special type of heat shrinksleeve shall be used as per specification enclosed with the tender. For line pipe coating repair, special type of high shear strength repair patch material shall be used which characteristic shall besame or equivalent as original wrap round heat shrink sleeve used in pipeline string for HDD crossing.

XXIII. The contractor shall ensure that no any underground existing utilities / pipelines / cable etc. is damaged. It shall be responsibility of contractor to compensate any loss or damage while crossing.Contractor shall arrange all statutory permission from concerned authority before start of job. Contractor shall deploy only BGL recommended HDD agency and approval of agency shall be sought before deploying HDD agency.

XXIV. Where the pipeline route passes through forest / plantation areas, Contractor shall clear only the minimum width required for laying the pipeline as per Owner approved procedure for pipeline construction. Number of trees / plants to be felled down shall be restricted to a minimum.

XXV. Clean-up and restoration of ROW and other conveniences like road, rail, canals, cultivable land etc. to original conditions as per specification and drawings to the entire satisfaction of OWNER and / or authorities having jurisdiction over the same, including disposal of surplus construction materials to a location identified by CONTRACTOR approved by local authority without causing any disturbance to environment, location and to the entire satisfaction of OWNER.

XXVI. Upon restoration of ROU the Contractor shall furnish documentary evidence in support of acceptance of he same duly signed by land Owner without any extra cost.

XXVII. Carrying out Intelligent Pigging & Electronic Geometric/calliper pigging (EGP) for feeder line as applicable including supply of all types of pigs, pig locating and tracking device, spares, consumables, manpower etc. as per specification enclosed with bid / contract document.

XXVIII. Carrying out repair of all defects found during Geometric/calliper pigging including locating, digging,cutting, welding, NDT etc.

XXIX. Carrying out cleaning, flushing, swabbing (as applicable), dewatering, testing and pre- commissioning of pipeline and associated facilities at Dispatch Station, Sectionalizing Valve

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Stations, Tap-off and Receipt Station up to the respective battery limits. Locating all major andminor leaks during hydro testing if any.

XXX. Repair of any leaks / burst occurring during testing of main pipeline. In case of failure duringhydrotest the entire section shall be re-hydrotested.

XXXI. Tie- in with the pipeline at rail, road and other crossings including cutting of test headers as requiredand tie-in with terminal piping & with existing facilities as applicable.

XXXII. Idle time preservation of the pipeline (if required) for the specified period by filling with nitrogen to a positive pressure of 1 bar (g) including supply of nitrogen etc. as required.

XXXIII. Installation of carrier pipe in canal / road (NH / Express Highway) / railway crossings by boring / HDD / Trench less method, as directed by Company. Contractor to note that the minimum elastic bend radius to be adopted, shall be as per pipeline engineering design basis enclosed with the tender.

XXXIV. Obtaining hot work permits from Company / concerned authorities having jurisdiction there of to work within existing and operating terminals including strictly complying with all stipulations / conditions recommendation of the concerned authorities and providing all safety appliances, gas detector, fire screens required during execution of the work as per the direction of Company / Engineer –in-Charge. Coordinating all activities with Company for movement of men and materialfrom and to existing and operating terminals shall be the responsibility of the contractor.

XXXV. All incidental and associated works not specifically listed herein but are required to be carried out to complete entire work related to pipelines and the associated facilities and making the entire pipeline system ready for operation.

XXXVI. The contractor shall be responsible for taking over of the material and subsequent handling, hauling, transportation to the actual work site(s) / fabrication yards(s) and storage & safe keeping of the materials.

XXXVII. The Contractor shall inspect all Company supplied free issue materials at the time of taking over form the Company and defects noticed, if any, shall be brought to the notice of Company / Company representative and jointly recorded. Once the material has been taken over by the Contractor, all the responsibility for safe keeping of the materials and repair of damage / defects topipe & pipe coating shall rest with the Contractor.

XXXVIII. Removal of dents in bevels less than 1 mm in depth shall be carried out by Contractor ahead of welding in the field at no extra cost to Company.

- <u>Pipe off cut</u>

The contractor shall keep a detailed inventory of the pipes received, per type of pipe & a note of their location.
The contractor shall provide summary of the above to the owner.
The pipes off-cut can still be used in the life time of the contract. Before the end of leak test the contractor shall provide the owner with an inventory of the surplus pipes.
The term" surplus pipe" defined as "Any pipe that can immediately be reused (undeformed, numbered, coating & is in good condition) bearing individual pipe number, stamp of the recognizedinspection agency, origin, type & length".
Only complete lengths of pipe element will be taken back by the owner. All other pipe surplus is the responsibility of contractor. Before termination of leak tests the contractor will draw up a final account of the pipes & transmit to owner as per following settlement formula.

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Settlement Formula

X = Tr – (Tp + Tc + Cr + Lr)

Where,

Tr = Length of the pipes delivered & accepted on the working sites and issued to contractor.

Tp = Length of the pipes effectively laid.

Tc = Permitted loss (=0.3% of effective length of the pipe laid)Cr

= Length of the returnable pipe (2m & above)

Lr = Length of defective pipes element rejected for reasons which are not attributable to contractor.

X = Length involved to the contractor.

- **Returnable minimum length of pipe:**

Minimum length of pipe to be returned shall not be less than 2m. All pipe elements shall bear the individual pipe number, stamp of the recognized inspection agency, original typeand length.

- **Returning the Surplus Material**

Only the material supplied by the owner as free issue material should be returned in good conditions and while returning, should be accompanied by all needful certificatory. If the free issuematerial is damaged or misused by the contractor, he will be charged twice the cost of the material.The contractor shall be solely responsible for any damage or misuse of the material supplied by him and no extra compensation either by way of time or cost shall be admissible.

- On completion of the work contractor shall submit to the company, an account for the material issued to the Contractor in the Performa prescribed by Engineer – in –Charge.

All such works which are not indicated here but otherwise required to complete the work in all respect in accordance with the specifications, drawings & other requirements of bid package shallalso form part of Bidder's / Contractor's scope of work.

- Carrying out temporary and permanent cathodic protection works as defined in the bid package.
- Loading, unloading, handing over and transportation of all surplus Company supplied free issue line pipe after completion of works Company's designated warehouse as directed by Engineer-in-Charge and stacking the same. Stacking of surplus pipe shall be inclusive of supplying of sand bags etc. at Company store for proper stacking.

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4.2 TERMINAL PIPING WORKS

I. Receiving and Taking-over" Company supplied free issue Filter, Metering and PRS skid from designated warehouse, loading, transportation, unloading, at Contractor's worksite(s)/ workshop tillthe skid is installed in permanent installation. The contractor shall make his own arrangement of crane for lifting of all free issue material.

II. Supply, fabrication and erection of pipe/ equipment supports (for all sizes/ thickness) including shoes, pipes, cradles, turn buckles, T-posts for all types of guides, anchors, all necessary equipment,consumables, labour etc. for completing all works including supply of bolts, nuts, washers, U-clamps,wooden blocks etc. as required for supporting.

III. Hook-up of piping with skids, equipment's & vessels, with the existing facilities, with the pipeline andat the battery limit with the facilities installed by others by welding or by flanged connection includingcutting, fit-up, welding, NDT, radiography, interface/coordination as required with other Contractor(s)/Agencies.

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IV. Painting of all equipment's, structural steel elements for pipe supports, above ground piping and allrelated miscellaneous items as per company specification enclosed with the bid document. Application thickness shall be as per painting specification.

V. Protective coating of 500 micron thick two component epoxy (achieved by application of three coats)duly recommended by Company for all underground piping, valves, fittings, etc.as per specificationsincluding supply of all materials.

VI. Hydro testing, dewatering, flushing & pre-commissioning activities of piping system of all sizes as per specifications enclosed including supply of all materials and manpower that are required during pre-commissioning and all associated works. Identification of leaks during hydrotesting & repair of defects.

VII. Final clean up and restoration of site, facilities etc. as per the requirement of Company/Engineer-in-Charge.

VIII. Preparation of General Arrangement Drawings (GAD), isometrics and/or fabrication drawingsrequired for the purpose of fabrication during execution of work.

IX. Preparation of as-built drawings, documents and project records as per instructions of Engineer-in-Charge.

X. Co-ordination as required with other Agencies/Sub-Contractor(s) till the time the commissioning operations are complete.

XI. Any other works not specifically listed herein but required for completion of the works in all respects.

4.3 HOT TAPPING WORKS

I. Laying contractor shall engage a specialized agency as per approved list of BGL for supply and installation of Hot taping works. Works of Hot tap includes but not limited to the following:

II. Contractor shall submit design calculation for review and approval before taking up manufacturingof Split tee.

III. Carry out testing of split tee as per standard. Inspection shall also be performed by a designatedThird-Party Inspection agency approved by BGL

IV. Split Tee shall be used for Natural Gas/ R-LNG services. Accordingly, Impact test and hardness testshall be carried out

V. Mobilization of necessary hot tapping equipment and Installation of hot tap connection Survey toascertain the thickness of the parent pipe.

VI. Developing WPS for welding and establishing the same with qualified welders before actual Hot tapwelding works.

VII. Hot Tapping work shall confirm to ASME B 31.8 and API Recommended Practice 2201.

VIII. Obtaining all hot work permissions/ clearances/ permits from owner/ concerned authorities.

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IX. Carry out Hydrotest and Commissioning of Hot tap works as per Specification and Standard.

X. Follow-up of activities including Mobilization & demobilization of hot tapping machine.

XI. Hot tap machine operators and welders must be qualified in accordance with applicable codes and specifications. They should be thoroughly familiar with the welding and hot tap equipment and procedures to be used. Only skilled competent personnel should mount and assemble the hot tapping machine. These skills may be achieved either through on-the-job training or by a formal training program provided by the manufacturer of the hot tapping machine.

XII. All safety precaution shall be taken by the Contractor as advised by concerned authorities/ BGL

XIII. Any other works not specifically listed herein but required for completion of the works in all respects.

4.4 CIVIL / STRUCTURE WORKS

The scope of civil / structural and Architectural works under this Contract shall include Residual Engineering, detailing, supply and construction of all relevant civil / structural and Architectural worksas per Design Basis, Specifications, standards, Addendums and Drawings enclosed with the bid document.

The Civil scope of work shall consist of below ground / above ground RCC Valve Chambers at Sectionalizing Valve Stations & Tap-Off stations or as per the issued drawings.

The chambers shall be covered at top with removable Pre-cast RCC covers / slabs / chequeredplates and provided with an access steel ladder and floor sump.

Provision for bolting the precast /chequered plate covers shall be made.

The valve chamber shall be provided with a 750m wide walkway all around with 100 mm thick PCCsloping away from the chamber or as per the issued drawings..

Providing foundation for DRS / MRS unit, Pipe Supports (as applicable at Compressor / DRS /MRS end).

The foundation shall be 200 mm thick Rubble soling, 100 mm thick PCC and 300 mm thick RCC with reinforcement or as per the issued drawings.

4.5 CATHODIC PROTECTION WORKS

I. Scope is including Design, Engineering, supply, installation, field inspection, testing, commissioningof TCP.

II. Preparation of Design package of TCP.

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III. Issued for Construction drawings and documents and As-built drawings and documents.

IV. Supply, installation, pre-commissioning and commissioning and monitoring TCP till handover to owner.

V. Checking and Mitigation of any AC/DC interferences on pipeline.

VI. TCP of Pipeline as applicable as per approved design document during detailed engineering.

VII. All equipment and materials including cables, CPTR/CPPSM units, various types of test stations, junction boxes, anodes, grounding equipment/items/anodes, polarization cells, polarization, coupons, surge diverters, spark gap arrestors, bonding stations along with diodes, shunts and variable resistors etc. as required for Temporary cathodic protection & Permanent cathodic protection system of pipelines in line with standard specification, design basis and datasheet are included in the scope of supply of the contractor.

VIII. Installation, Commissioning & monitoring of TCP till commissioning o for main pipeline.

IX. Post commissioning surveys as per defined in standard specifications of Cathodic Protection system.

X. Pipeline is passing through many foreign lines & other utilities either parallel or diagonal, CP interferences shall be mitigated in permanent measures.

XI. Any other work not specifically mentioned above, but required for the proper execution of the cathodic protection.

4.6 INSTRUMENTATION WORKS

The scope of work & supply shall generally be as follows, however Contractor to The scope of work& supply shall generally be as follows, however contractor to provide all materials/instrumentation,install & commission them as per P&IDs and other data provided in tender to complete the work inall respects.

- Supply, installation, calibration & commissioning of all the instruments (like Pressure Gauge etc.)as per P&IDs, Data sheets, Technical standard / specs.
- Supply of Firefighting system i.e. fire extinguishers as per PNGRB / OISD requirement.
- Installation, testing & commissioning of Filtration + PRS + Metering Skid as applicable.
- Any other work not specifically mentioned above, but required for the proper execution of the instrumentation erection work.
- As-built drawings and final documents etc.

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5.0 CONTRACTOR'S RESPONSIBILITIES

Contractor's responsibilities, besides the scope of work to be performed by him defined earlier, shallalso include the following:

a. Appraisal and taking cognizance of site-conditions, pipeline route, Central Government, State Government rules and regulations/ bye-laws, applicable Indian Standards and Codes, authorities having jurisdiction over the work site(s), environmental and pollution concerns including conditions/stipulations laid down by the concerned authorities etc. The Contractor is deemed to have recognized any restrictive features and constraints of the site(s), pipeline route and /or specific requirements of the work and made due allowance for it in the work to be performed by him.

b. Company shall provide the available information and survey data along pipeline route and crossings.Company gives no guarantee or warranty as to the accuracy or completeness of the information provided. It is the Contractor's sole responsibility to obtain sufficient information / data along pipelineroute and crossings to allow safe and sound design and installation of the proposed pipeline. Wherever company's survey Alignment & crossing drawings are not available, Contractor shall survey for Pipeline Alignment & all crossings and collects all information to submit in the form of Pipeline Alignment and crossing drawings as per engineering standards. Contractor also carryout Topographic and soil investigation survey for the terminal plot within 7 days from LOI date and submitto company for finalisation of Plot Plan and foundation drawings to start the construction work.

c. Interpretation and verification of data/information furnished by Company in respect of pipeline routesurveys, crossing details, contained in the bid package. Any additional information/data/surveys etc. required by Contractor for detailed engineering and execution of the works shall be obtained by him.Company may assist him in obtaining such information/ data by issuing recommendatory letters.

d. Residual engineering including drawings and installation procedures, engineering for procurement & fabrication, engineering for installation including drawings, QA/QC procedures, etc performed by the Contractor shall be reviewed and approved by Company. Contractor shall submit engineering documents, drawings, procedures in hard copy to Company before start of construction work at site.All works shall be executed based on approved documents only.

Contractor shall prepare general arrangement drawing, isometric drawing & bill of materials, HDD design & drawing, Crossing drawings, Pipeline Alignment sheet including detour portion(wherever applicable), Topography & Geotechnical survey, CP design, vendor engineering drawing & documents etc. and submit the same from Owner/ consultant's approval/ record. Contractor shall prepare drawing for utilities line as required as per SOR and submit the same for Owner/ Consultant's approval /record.

e. Review and approval of Contractor's entire work(s) or approved IFC drawing provided by Companyshall in no way relieve the Contractor of his sole responsibility for safe and efficient design, engineering, installation and subsequent operation of pipeline system.

f. Furnishing and mobilizing at site(s) of all construction equipment, manpower, tools and tackles, construction spreads, fully equipped and fully manned with other required support facilities etc. commensurate for spreads needed for successful execution of the works.

g. Contractor shall depute independent third-party inspector for carrying out radiographic inspection/ UT and interpretation of radiograph/ UT of welds. Third party inspector shall be approved by Company.

h. Pre-commissioning/ commissioning of entire pipeline/piping system.

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i. Preparing and furnishing calculation books, pipe books, material/ purchase requisitions, finalpurchase orders including specifications, Vendor's data books (including Guarantees), fabrication and construction drawings, all survey reports, inspection and testing reports, as-built records for allphases of work.

j. The Contractor is cautioned to exercise extreme care and take necessary precautions to prevent damage to the existing pipeline(s), facilities, electrical and other cables during execution of the entire works. Restoration/reconstruction of all structures/ facilities affected during pipeline construction shall be carried out by Contractor.

k. Wherever Contractor comes across water lines/open channels/drains in the fields used for cultivation, suitable arrangements similar to or higher specs than the existing type shall be made bythe Contractor for ensuring water supplies across the fields and maintain the same till construction is completed in that stretch. Any claims arising out of noncompliance to the above requirements, asgranted by competent authorities shall be to Contractor's account.

l. Contractor shall carry out all testing and inspection of materials, equipment etc. in independenttesting institutions, laboratories, if so desired by Company.

m. Disposal and treatment of treated hydro-testing water, excavated materials, surplus materials etc.as per local authority's requirements.

n. All works shall be carried out by Contractor strictly in accordance with the drawings/documents/specifications indicated in the list of attachment document.

o. Any other work not specifically listed but required for successful completion of entire pipeline system.

p. Contractor shall prepare the As-built drawings and documents parallel during the execution of work.

q. Contractor shall deploy the multiple welding crew and machinery like Rock cutter, Rock breaker, excavator, poclain, breaker with poclain etc. to execute the work successfully.

- **AS BUILT DOCUMENT**

On successful completion of hydrostatic testing, the Contractor shall prepare As Built drawings / reports for entire pipeline/piping system as specified in scope of work. All "As Built" drawings / reportsshall be submitted as below.

a. Main Pipeline

- As laid alignment sheets and crossing drawings/details.
- As built HDD crossing details, as applicable.
- All Inspection, Testing and NDT records. Radiographs/ UT of all weld joints packed kilometer wisein separate card board boxes in one set.
- Pipe and calculation books/records.
- All WPS and WQT
- All NOC from authority
- All inspection & testing documents.
- All purchase specification & procurement documents.

b. CNG/DRS/MRS Stations etc.

- All piping GA drawings and supports at terminals.

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- All piping line history sheets
- Installation and testing reports.
- All Test reports, IRN's for procured materials
- All purchase specification and procurement documents.

After completion of construction & commissioning of Terminal, contractor shall incorporate all the correction in drawings, prepare and issue all the "As-built drawings" to the owner as final submissionof drawings.

- For Mainline, pipeline alignment sheet, all X-ing details, all CP drawings, pipe book etc
- For Station, layout drawing, Piping GAD, Isometric, all electrical / instrumentation drawings, all civildrawings.

For final submission only 4 sets of document plus the original transparencies shall be handed over by the contractor. Any construction done by the contractor without duly approved by the drawings shall be wholly at risk and cost Contractor shall also submit soft copy of pipe book in excel along with hard copy. Soft copy of all as-built drawings shall be also submitted in AutoCAD. Videography/ photograph of all major activities/ milestone achieved shall also be arranged and submitted by the contractor. For details of documentation to be submitted form a inline and terminal refer "Specification for pipeline construction" enclosed elsewhere with tender.

Note: Contractor has to submit the below listed documents within 7 days from the date ofHydrotest for the commissioning permission from PESO/CCOE.

S No	Name of Document
1	As Built Schematic Drawing
2	As Built P&ID Drawing (Stations as applicable)
3	As Built Plot Plan (as applicable)
4	As Built Route Map (Turning Points & Chainage)
5	As Built Line Route Map (With Dimensions)
6	As Built Alignment Sheet
7	As Built Isometric of Dispatch Terminal
8	As Built Isometric of Receiving Terminal
9	As Built HDD Drawing (If HDD done)
10	Pipebook Final (Part C)
11	LHS Final
12	Hydrotest Report (Station Piping & Mainline)
13	Hydrotest Graphs
14	All Radiography Report (Mainline & Station Piping)Etc.

If Contractor fails to submit the as-built documents for commissioning permission withinabove time frame then BGL has no option but to prepare the as-built documents and the

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amount (Actual amount + 15% overhead) shall be recovered from Contractor's RA/Final billas a default.

Special note pertaining to Schedule of Rates (SOR).

i) All SOR item shall be quoted by the bidder in the price part of the bid, other-wisebid will be rejected.

ii) The quantities given above against individual items are indicative and shall not be considered to be binding. The quantities may be increased, decreased or deleted at site at the time of actual execution and as per discretion of Owner / Engineer-in-charge. The unit rate shall be operated to work out the final paymentdue to Contractor.

iii) The payment will be made as per actual certified measurement at site.

iv) The scope as mentioned in the SOR is of indicative nature only and shall include allactivities as detailed in the relevant clauses of the respective Particular Job Specifications, Technical Specifications, Data Sheets & drawings, etc.

v) The quantities mentioned in SOR for contractor supplied items shall be finalized and procured by contractor only after due approval of Engineer- in-charge. Contractor supplied any surplus item during reconciliation shall not be accepted /taken by the Owner.

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2 PIPELINE

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Sr. No.	Description	Document / Drawing No.	Rev. No.
IV	**Pipeline**		
1	Pipeline Design Basis	BGL-HYD-PL-DOC-DB-001	Rev. 0
2	Technical Specification for onshore pipeline construction	ENG-STD-PL-DOC-TS-001	Rev. 1
3	Technical Specification for onshore pipeline welding for Gas Transportation	ENG-STD-PL-DOC-TS-002	Rev. 1
4	Technical Specification for Concrete Weight Coating.	ENG-STD-PL-DOC-TS-003	Rev. 1
5	Technical Specification for pipeline crossing, rail, road and minor water ways	ENG-STD-PL-DOC-TS-004	Rev. 1
6	Technical Specification for field joint coating	ENG-STD-PL-DOC-TS-005	Rev. 1
7	Technical Specification for Casing Insulators and Casing End Seals.	ENG-STD-PL-DOC-TS-006	Rev. 1
8	Technical Specification for Long Radius Bends	ENG-STD-PL-DOC-TS-007	Rev. 1
9	Technical Specification for Inspection and Testing of Production Weld.	ENG-STD-PL-DOC-TS-008	Rev. 1
10	Technical Specification for Drying and Cleaning of Pipes.	ENG-STD-PL-DOC-TS-009	Rev. 0
11	Technical Specification for Major Crossing by Horizontal Directional Drilling.	ENG-STD-PL-DOC-TS-010	Rev. 1
12	Technical Specification for Pipeline Markers	ENG-STD-PL-DOC-TS-011	Rev. 0
13	Technical Specification for Hydro testing of pipelines	ENG-STD-PL-DOC-TS-012	Rev. 1
14	Technical Specification for Caliper Pigging	ENG-STD-PL-DOC-TS-015	Rev. 1
15	Technical Specification for Documentation of Pipeline Construction	ENG-STD-PL-DOC-TS-017	Rev. 0
16	Typical Trench Details	ENG-STD-PL-DWG-TP-001	Rev. 0
17	Cased Crossing Pipeline- Road/Highway	ENG-STD-PL-DWG-TP-002	Rev. 0
18	Cased Crossing Pipeline- Canal	ENG-STD-PL-DWG-TP-003	Rev. 0
19	Existing Underground Pipe Crossing	ENG-STD-PL-DWG-TP-004	Rev. 1
20	Typical ROU for Pipelines	ENG-STD-PL-DWG-TP-005	Rev. 0
21	Typical Underground Cable Crossing	ENG-STD-PL-DWG-TP-006	Rev. 0
22	Typical Overhead Power Line Crossing	ENG-STD-PL-DWG-TP-007	Rev. 0
23	Typical Aerial Marker	ENG-STD-PL-DWG-TP-008	Rev. 0
24	Typical Direction Marker	ENG-STD-PL-DWG-TP-009	Rev. 0
25	Typical KM Post Markers	ENG-STD-PL-DWG-TP-010	Rev. 0
26	Typical Pipe Line Warning Sign	ENG-STD-PL-DWG-TP-011	Rev. 0
27	Typical ROW Boundary Marker	ENG-STD-PL-DWG-TP-012	Rev. 0
28	Typical Parallel Pipe Line in Same Trench	ENG-STD-PL-DWG-TP-013	Rev. 0
	Index Pipeline		

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	BHAGYANAGAR GAS LIMITED **CITY GAS DISTRIBUTION PROJECT, HYDERABAD**	

PIPELINE DESIGN BASIS

DOCUMENT NO	**BGL-HYD-PL-DOC-DB-001**

BGL/632/2024-25

REV.	DATE	DESCRIPTION	PREP	CHKD	APPD
0	24.03.2024	ISSUED FOR APPROVAL			

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1.0 SCOPE

The design principles/methodology, design data, codes and standards, which shall be considered for design of the main pipeline & spur lines, are provided in this document. The general design procedure for the following item as a minimum has been covered. However, contractor shall adopt appropriate design techniques based on established principles, recognized codes & standards for other pipeline related design activities not covered in this document.

Design methodology for the detailed design of 4"/ 8"/10"/12" NB pipeline for city gas distribution in Lucknow is as follows:-

- Design of 4" / 8"/10"/12" NB pipelines.
- Design requirements for all TOP connections.
- Design of pipeline for major river crossings.
- General crossing design such as asphalt, metalled roads, national and state highways, railway tracks, canals / watercourses, rivers, streams, drains etc.
- Pipeline stress analysis at valve station, pig launcher & receiver stations (if any), HDD crossings and at other locations as per design & site requirements.

2.0 CODES / STANDARDS AND DOCUMENTS

The pipeline design shall be based on the following codes and standards.

- ASME B 31.8 - Gas transmission and distribution piping systems, 2007.
- API 5L - Specification for Line pipe, 2007 – 44th edition (Latest).
- API 1102 - Steel Pipelines crossing railroads and Highways, 1993.
- DIN 30670 - Standards for external coatings, 1991.
- API 1104 - Standard for welding of pipelines and related facilities, 2000.
- NACE RP 0169 - Recommended practices, control of external corrosion on underground or submerged metallic piping system, 1996.
- OISD 141 - Design and construction requirements for cross-country Hydrocarbon pipelines, 1990.
- API 1117 - Movement of in service pipeline.
- BS 8010 Part 2 - Code of practice for pipeline, 1992.

Wherever there is a conflict between codes, standards and specifications, the requirements of this criterion shall govern.

3.0 DESIGN DATA

3.1 The pipeline data, design pressure, temperature and material parameters etc. are specified in the following tables for total pipeline system.

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Table 3.1.1

A) MAINLINE PARAMETERS

Size (NPS), mm	As per Scope of work
Service	Natural Gas (Non-Sour)
Length of pipeline (kms.)	As per Scope of work
Design pressure (Barg)	49
Design temperature (^{0}C)	0 to +60
Max. Gas Velocity, m/s (Design)	20
Hydrostatic Test pressure	Note 2
Rating of pipeline system #	300#
Number of SV's	As per Scope of work
Number of TOP's	As per Scope of work
Design life, years	40
Operating pressure range (barg)	As per Scope of work
Operating Temperature , (Deg C)	0 to 60

Note : Minimum test pressure shall be 1.5 times the design pressure. However, the maximum test pressure at the lowest point of the test section or at the section with the least wall thickness shall be limited to hoop stress resulting in 95% of SMYS.

Table PIPE LINE COATING DETAILS

Application		Type	Thickness	Density kg/m^3
External anti corrosion coating	Main line	3 layer polyethylene coating	Min 3.2 mm @ weld seam Min 3.2 mm @ Pipe body	900
	HDD	3 layer polyethylene coating with epoxy thickness of 400-450 μm /3 Layer Polypropylene coating	Min 3.2 mm @ weld seam Min 3.2 mm @ Pipe body	
Anti buoyancy measures		Concrete Coating	Min. 75 mm thick & as required as per calculations	2500

NOTE: 6" Dia steel pipe for HDPE duct at HDD crossings and cased crossings shall be coated with 3 layer polyethylene coating as given in the table above.

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Table : BENDING DETAILS (Note 1)

Long radius bends (Induction)	Minimum radius 3D
Cold field bends	Minimum radius 21D

Maximum soil temperature, °C	30*
Relative Humidity, (min. / max.)%	50 to 95*
Max. & Min. ambient temperature, °C	4.7 to 47*

Note-1:

* These are indicative values, Contractor to verify the actual values.

3.2 Loading Parameters

The following loads on the highway crossings as specified in Section 4 of the API RP- 1102 shall be adopted for the loading evaluation. The details are given as below:-

- External Earth load: The earth load is the weight of overlying soil that is conveyed to the top of pipe. The contractor shall determine the density of the soil.
- Live load Highways 574kPa / 479 kPa for Single axle loading / Tandem axle loading

The depth of the cover for pipeline system measured from cover surface to top of the pipeline shall be as given below (Refer Note – 1):

a) Normal Excavation: 1.0 m

b) Drains, Ditches lined & unlined Canals, Nala, Streams and other: 1.5m (Ref. Note 3)

c) Uncased/Cased Road Crossings: 1.5m (Ref. Note 2)

d) Railroad crossing: 2.0m (Ref. Note 2)

e) River Crossing: 2.5 m (Ref Note 3)

Note:

1. Minimum depth of cover shall be measured from the top of the pipe coatings to the top of undisturbed surface of the soil, or top of graded working strip whichever is lower.
2. Cover shall be measured from the top of the road / rail road cross section to the top of casing pipe or carrier pipe as per type of crossing. The cover specified shall also fulfil the requirements of the permission authority.
3. In case of rivers/water bodies, which are prone to scour and erosion, minimum cover maintained shall be 2.5 m below the scour level for the lifetime of pipeline
4. Wherever cased-crossing is not envisaged, higher cover depths or higher wall thickness of the pipeline shall be considered as per design requirements.

4.0 PIPELINE DESIGN & STRESS ANALYSIS

4.1 Wall thickness design

For Gr. B pipe, the pipeline wall thickness is selected on the following considerations:

-Pressure confinement Criteria

-Longitudinal stress criteria

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-Overburden loads and live loads for highways

-Tensile load criteria for HDD sections

-Seismic design criteria

4.1.1 Pressure containment criteria

The nominal wall thickness 't' for a given design pressure shall be determined as per ASME B31.8.

$$t = PD/2S\,FET + CA$$

Where D = Nominal outside diameter of pipe

E = Longitudinal joint factor from Table 841.115A of ASME B31.8 (Latest Edition)

F = Design factor from Tables 841.114A & 841.114B of ASME B31.8 (Latest Edition)

P = Design Pressure

S = Specified minimum yield strength of line pipe material

T= Temperature derating factor from Table 841.116A of ASME B31.8 (Latest Edition)

CA = Corrosion allowance (Nil)

Selected wall thickness for the pipeline will be nearest higher nominal wall thickness as per API 5L.

Pipelines which are to be installed at terminal pigging stations, intermediate pigging stations and all MLV stations shall be considered in location Class 4. The design factor shall be considered till the plot boundary limit.

The wall thickness of the carrier pipe at all road crossings shall be calculated considering the following whichever is stringent.

- □Design factor for the pipeline section at road crossings shall be as per table 841.114B of ASME B31.8, Latest Edition.
- Next higher area classification zone shall be considered for road crossings than the adjoining normal class of main line.

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4.1.2 Pipeline stress criteria

The pipeline longitudinal and equivalent stresses shall be evaluated for operational, installation and hydro test design conditions.

Longitudinal Stresses

The total longitudinal stress S_L, in the pipe shall be calculated by the following formula.

$$S_L = S_E + S_B + S_S$$

Total longitudinal stress, S_L calculated by the above formula shall not exceed SMYS.

Where,

S_E = Existing longitudinal stress in the pipe.

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S_B = Longitudinal stress in the pipe due to net downward weight of pipeline including coating and contents.

S_S = Longitudinal stress in the pipe due to its elongation caused by the vertical deflection of pipe.

Generally, buried pipelines are continuously supported in the trench. However, as a conservative approach, free spanning of the pipeline (soil erosion/ soil liquefaction could cause free spanning of the pipelines) shall also be considered in the stress analysis.

Total existing longitudinal stress shall be computed considering pressure, temperature and bending effects.

$$S_E = S_P + S_N + S_{BC} \text{ (For restrained lines)}$$

$$S_E = S_P + S_{BC} \text{ (For unrestrained lines)}$$

Where,

a) S_P is the longitudinal stress due to internal pressure.

The longitudinal stress, (S_P) in the pipe due to internal pressure shall be calculated by the following equation:

$S_P = PD\mu / 2t$ - For restrained section

$S_P = 0.5\ PD / 2t$ - For unrestrained section

P = Pressure

D = Outside diameter of the pipe

μ = Poisson's ratio for steel = 0.3

t = Nominal wall thickness of the pipe

Wherever thick cylinder effects provide a more conservative estimate of the stresses, the same shall be considered. For operation and hydrotest condition the design pressure and test pressure respectively shall be considered for analysis.

b) S_N is the longitudinal stress due to temperature change.

The longitudinal stresses in the pipe due to a change in the temperature shall be calculated with following equation.

$S_N = E\ \alpha\ (T1 – T2)$ - For restrained section

E = Modulus of elasticity of steel.

α = Linear co-efficient of thermal expansion of steel T1

= Temperature of the pipe at the time of installationT2

= Maximum/Minimum pipeline metal temperature

c) S_{BC} is the longitudinal stress due to pipeline elastic curvature and /or stresses induced due to local bending moments

$S_{BC} = ED / 2R$

R = Radius of curvature of pipeline, in mm.

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d) Longitudinal stress in the pipeline due to local bending moments.

The longitudinal stress in the pipeline due to bending moments in the expansion zone or bending moments resulting from other sustained, occasional loads in the pipeline section shall be computed by the following equation.

$S_B = i\ M/Z$

M = Resultant Bending moment on the pipeline (in plane and out of plane)

Z = Elastic section modulus of the pipe

i = Stress intensification factor as per ASME 31.8.

e) Shear stresses due to torsion and shear forces applied to the pipeline shall also be considered in the stress calculations.

f) Longitudinal stress due to any other imposed axial loading shall also be considered as applicable.

4.1.3 Combined and equivalent stress checks

According to OISD 141 – The total of the following shall not exceed the SMYS of the pipe material.

a) The combined stress due to expansion (bending and shear stresses)

b) The longitudinal pressure stress

c) The longitudinal bending stress due to weight and external loads.

In addition to the above, a) shall be less than 0.72 of SMYS and the sum of (b) and (c) shall not exceed 75% of SMYS.

Further the equivalent stress computed considering the hoop and longitudinal stress shall not exceed 90% of SMYS. The equivalent stress calculations shall be based on maximum shear stress theory. The maximum combined and equivalent stresses shall be evaluated considering the signs of bending stresses.

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4.1.4 Pipeline stress analysis at crossings

Refer Section 5.0 of this document.

4.1.5 Additional requirements for pipeline wall thickness design at HDD sections

The pipeline wall thickness at HDD section shall be checked considering the overburden loads. In addition the combined stress criteria shall also be satisfied for all the design conditions.

Tensile Load Criteria

The pipeline wall thickness shall be designed for a maximum installation pull load. Specialist sub-contractor shall provide separate design calculations for HDD.

Combined longitudinal stress = Tensile stress + Bending stress < 90% of SMYS

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The equivalent stress calculations shall include torsional stress induced in the pipeline due to twisting during installation.

The equivalent stress based on maximum shear stress theory shall be less than SMYS.

In addition, as per OISD 141 – The total of the following shall not exceed 75% of SMYS of the pipe material at the HDD section during pipeline operation.

d) The longitudinal stress due to pressure and thermal loads

e) The longitudinal bending stress due to external loads

Further, considering the hoop stress and d) and (e) above the equivalent stress shall not exceed 90% of the SMYS.

Considering pipeline in-place operational analysis, the minimum allowable curvature of each HDD section shall be obtained so as to ensure that combined stress criteria are satisfied. The allowable bending radius shall be the maximum of the calculated allowable curvature for the operational stresses and the permissible minimum allowable bending radius of R = 1000xOD (meters) during installation so as to ensure that the geometry of the HDD section is acceptable.

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4.1.6 Seismic design criteria

CONTRACTOR shall design the pipeline for seismic loads. The subjected pipeline is in zone 5. The seismic design criteria shall be as below:

4.1.6.1 Seismic waves:

L – Waves are surface waves that cause horizontal movement of ground from side to side in horizontal plane, but at right angles to the direction of propagation.

P – Waves are body waves that cause movement of ground particles in the same line as the direction of wave.

R - Waves are surface waves that cause ground particles to oscillate in an elliptical path in the vertical plane along the direction of travelling wave.

S – Waves are body waves which cause material particles to oscillate at right angle to the direction of energy transmission, s-waves cannot travel through fluid.

4.1.6.2 Classification of Seismic Hazards

The seismic hazards which are directly related to pipeline failure can be classified as:

i. Permanent ground deformation related to soil failures:

- Longitudinal permanent ground deformation
- Transverse permanent ground deformation
- Landslide

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ii. Buoyancy due to liquefaction

iii. Permanent ground deformation related to faulting. (Abrupt PGD)

iv. Seismic wave propagation

4.1.6.3 Basic information required

i. Pipe Line Information:

- Pipe geometry (diameter, thickness)
- Stress-strain relationship of pipe material
- Pipeline function and its post seismic performance requirement
- External pipe coating specification
- Operating pressure in the pipe
- Operational and installation temperature
- Pipeline alignment detail (plan, profile, location of fittings, etc.)
- Reduced strain limit for existing pipelines.

ii. Soil Information:

- Burial depth of the pipeline
- Specification of backfill soil in the trench
- Depth of water table
- Basic soil properties (unit weight, cohesion, internal friction angle and in situ density)

iii. Seismic Hazard Information

- Expected amount of seismic ground motion at the site.
- Expected amount and pattern of permanent ground deformation and its spatial extent.
- Length of pipeline exposed to permanent ground deformation.
- Active fault locations; expected magnitude of fault displacement, and orientation of pipeline with respect to direction of fault movement.

a) Classification of Pipelines

The pipelines have been classified into four groups as per their functional requirement as follows.

Class-I: Very essential water pipelines required to serve for post earthquake response and intended to remain functional and operational during and following an earthquake.

High pressure oil and gas pipelines which are required to remain functional during and following an earthquake.

Pipelines which would cause extensive loss of life or a major impact on environment in case of failure or damage.

Class-II: Critical water pipelines serving a large community and having significant economic impact to the community or a substantial hazard to human life and property in the event of failure.

Medium pressure oil and gas pipelines which are vital energy serving facilities, but their service can be interrupted for a sort period until minor repairs are made.

Class-III: Most of the water supply pipelines for ordinary use.

Low pressure oil and gas pipelines.

Class-IV: Water Pipelines that have low or very little importance and effect upon the human life and society in the event of failure. Pipelines which do not require quick repair after a seismic event.

For oil and gas pipelines, internal pressure can be classified as (JSCE, 2000b):

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High Pressure: P ≥ 10 kgf/cm2

Medium Pressure: 3 < P < 10 kgf/cm2

Low Pressure: P ≤ 3 kgf/cm2

b) Design Seismic Hazard

The design seismic hazard for various classes of Pipelines may be calculated by multiplying importance factor (Ip) with Design Basis Seismic Hazard.

Table 1.1 Importance factor for Different type Classes of Pipeline (Ip)

Class of Pipeline	Wave Propagation	Faulting	Transverse and Longitudinal PGD	Landslide
I	1.5	2.3	1.5	2.6
II	1.25	1.5	1.35	1.6
III	1.0	1.0	1.0	1.0
IV	-	-	-	-

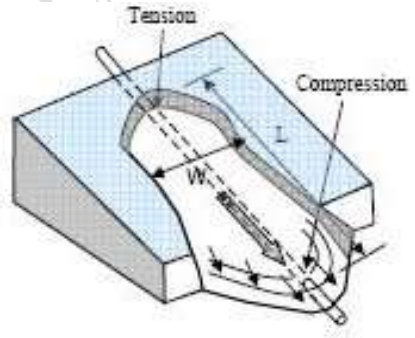
Note: - For IV Class of Pipeline seismic condition need not to be considered.

4.1.6.4 Design Criteria for Permanent Ground Deformation (PGD)

a) The permanent ground deformation refers to the unrecoverable soil movement due to faulting, landslide, settlement or liquefaction induced lateral spreading. In this clause the attention is restricted to the permanent ground deformation due to liquefaction-induced lateral spreading and landslide.

Two types of Permanent Ground Deformation (PGD) Considered for Design are:-

i. Longitudinal PGD



Longitudinal permanent ground deformation; pipeline crossing permanent ground deformation zone in the direction of ground movement.

Design Ground Displacement in Longitudinal Direction may be taken as:-

$$\delta^{l}_{design} = \delta^{l} \text{ x } I_{p}$$

Where:

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δ^{l} :- Maximum Longitudinal ground displacement (As per geotechnical Investigation)

I_p :- Importance Factor (Table 1.1)

Generally two types of models are used for buried pipelines subjected to longitudinal PGD

Case-I:-The amount of ground movement ($\delta^{l}{}_{design}$) is large and the pipe strain is controlled by length (L) of the PGD zone.

When $\delta^{l}{}_{design}$ is large, the pipe strain for both tension and compression can be calculated as:

$$\varepsilon_a = \frac{t_u L}{2\pi DtE}\left[1+\frac{n}{1+r}\left(\frac{t_u L}{2\pi Dt\sigma_y}\right)^{r}\right]$$

Where

ε_a :- Peak Axial Strain in Pipe

L :- Length of Permanent Ground Deformation Zone

σ_y :-Yield Stress of Pipe material

n, r :- Ramberg-Osgood Parameter

E :- Modulus of Elasticity of Pipe Material

tu :- Peak friction force per unit length of pipe at soil pipe interface

$$t_u = \pi Dc\alpha + \pi DH\gamma\left(\frac{1+K_0}{2}\right)\tan\delta'$$

c :- Soil Cohesion represented of the soil backfill

α :- Adhesion factor = $0.608 - 0.123c - \frac{0.274}{c^2+1} + \frac{0.695}{c^3+1}$ in which c is in kPa/100

δ' :- Interface angle of friction between pipe and soil = $f\varphi$

f :- Coating Dependent factor, depends on type of pipe coating

φ :- Internal angle of friction of soil

K0 :- Coefficient of soil pressure at rest = 1- sinφ

D :- Outside Diameter of Pipe

t :- Thickness of Pipe

Case-II:- The Length (L) of PGD zone is large and the pipe strain is controlled by amount of ground movement ($\delta^{l}{}_{design}$)

$$\varepsilon_a = \frac{t_u e L}{\pi DtE}\left[1+\frac{n}{1+r}\left(\frac{t_u e L}{\pi Dt\sigma_y}\right)^{r}\right]$$

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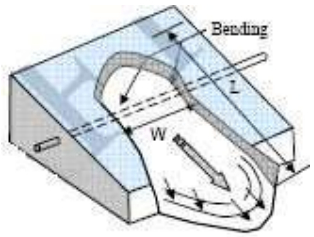
Where

Le :- Effective length of pipeline over which friction force tu acts, and can be evaluated from:-

$$\delta^{l}_{design} = \frac{t_u L_e^2}{\pi D t E}\left[1+\left(\frac{2}{2+r}\right)\left(\frac{n}{n+r}\right)\left(\frac{t_u L_e^2}{\pi D t \sigma_y}\right)^{r}\right]$$

The design pipe strain ($\varepsilon_{seismic}$) for longitudinal permanent ground deformation should be taken as lower of strain obtained from Case I and Case II. The design pipe strain in tension and compression should be less than the allowable strain.

ii. Transverse PGD



Transverse permanent ground deformation; pipeline crossing permanent ground deformation zone transverse to the ground movement.

Design Ground Displacement in Transverse Direction may be taken as:-

$\delta^{t}_{design} = \delta^{t} \text{ x } I_p$

Where:

δ^{t} :- Maximum Transverse ground displacement (As per geotechnical Investigation)

I_p :- Importance Factor (Table 1.1)

Peak bending strain in pipe may be calculated as least of two:-

Case I :- $\varepsilon_b = \pm \frac{\pi D \delta^{t}_{design}}{W^2}$

Case II :- $\varepsilon_b = \pm \frac{P_u W^2}{3\pi E t D^2}$

Where

D :- Outside Diameter of Pipe

δ^{t}_{design} :- Design Transverse ground movement

W :- Width of Permanent Ground Deformation

t :- Thickness of Pipe

Pu :- Maximum lateral soil resistance per unit length of pipe = $N_{qh}\bar{\gamma} HD$

The maximum strain obtained from Case I and Case II should be taken as design pipe Strain

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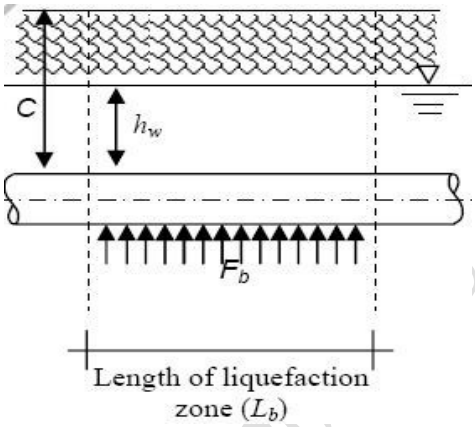
4.1.6.5Design Criteria for Buoyancy due to Liquefaction

b) When the liquefaction of soil around pipeline occurs, buoyant forces are exerted upon pipeline and must be resisted by anchors and the drag forces imposed by the liquefied soil as the pipeline begins to elevate.

Conditions for Liquefaction:

Three critical factors must be present for sediments to be prone to liquefaction. The sediment must be:

i. Saturated with ground water
ii. Composed of sand of silt-sized particles
iii. Compacted fairly loose.



Buoyancy effects are probably of greatest concern in areas such as flood plains and estuaries where massive liquefaction could take place in a large earthquake. When the surface liquefies, the pipe keeps uplifting at most to position where a portion of pipe is at ground surface near the centre of the liquefied zone. However, when a non-liquefied soil layer is present as a cover liquefied layer, the pipe come to rest at the interface of the non – liquefied and liquefied layer.

Buoyant Force on Pipeline:

The net upward force on unit length of pipeline is:

$$F_b = \frac{\pi D^2}{4}\left(\gamma_{sat} - \gamma_{content}\right) - \pi D t \gamma_{pipe}$$

Where:

Fb : - Upward force due to buoyancy per unit length of pipe

γ_{sat} : -Saturated unit weight of soil γ

$_{content}$: - Unit weight of pipe content γ

$_{pipe}$: - Unit weight of pipe material

The bending Strain in pipeline due to buoyancy is:

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$$\varepsilon_b = \pm \frac{F_b L_l^2}{3\pi EtD^2}$$

Where

E : -Modulus of Elasticity of Pipe Material

t : -Thickness of Pipeline

Ll : -Length of pipe subjected to liquefaction

While calculating the bending strain, the pipe is considered as a stiff beam restrained due to non-liquefied soil beyond the margins of liquefied zone.

4.1.6.6 Design Criteria for Fault Crossing

c) Fault is a zone of crack between two blocks of rock. Faults allow the blocks to move relative to each other. This movement may be due to sudden displacement or may be due to gradual accumulation. The sudden fault movement is mostly associated with the seismic event. For buried structures crossing the fault, like pipelines, this fault displacement has very significant effect.

The faults may be classified as per direction of motion as normal slip, strike slip or reverse slip faults. The normal, reverse and strike slip fault are formed due to tension, compression and shear stresses respectively. The combination of two fault movements may occur in many cases, and they are generally regarded as oblique faults. These are formed due to the combination of stresses acting both vertically and horizontally.

The amount of surface displacement depends upon many factors, but mainly is function of type of fault, size of earthquake, focal depth and the geology. Fault movements need not be confined to a single fault plane or zone, but may also occur at substantial distance from the pain trace of the fault (ASCE 1984).

Empirical relationship for fault displacement and moment magnitude:

For strike slip fault:

Log δfs = -6.32 +0.90M

For normal fault:

Log δfn = -4.45 +0.63M

For reverse fault:

Log δfr = -0.74+0.08M

For a poorly know fault or blind fault:

Log δfb = -4.80 +0.69M

δ = average fault displacement in meters

M = Moment magnitude of earthquake

As per the empirical values the fault displacement varies from 0.05 to 8.0 m for strike slip fault, 0.08 to 2.1 m for normal faults and 0.06 to 1.5 m for reverse faults. Hence when the fault characteristics are not well known, design may be based on strike slip fault displacement for conservative design.

For strike fault the fault movement along and transverse to the pipeline may be calculated as:

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$\delta_{f-ax} = \delta_{fs} \cos\beta$

Component of fault displacement in transverse direction of pipeline

$\delta_{f-lat} = \delta_{fs} \sin\beta$

Where

δ_{fs} : - Strike slip fault movement in meters

For a normal slip fault the fault movement along and transverse to the pipeline may be obtained as:

Component of fault displacement in the axial direction of pipeline is:

$\delta_{f-ax} = \delta_{fn} \cos\psi \sin\beta$

Component of fault displacement in the transverse direction of pipeline

$\delta_{f-lat} = \delta_{fn} \cos\psi \sin\beta$

The fault displacement in vertical direction pipeline (z)

$\delta_{f-ver} = \delta_{fn} \sin\psi$

Where

δfn = Normal fault movement in meters

ψ = Dip angle of fault movement

In reverse faults, the displacement components are considered in the same manner as normal-slip fault with negative slip.

For oblique faults, the strike slip displacement and normal slip or reverse slip displacement should be added algebraically in axial, transverse and vertical direction of the pipeline axis.

Design fault displacement can be considered as the expected fault displacement at the site multiplied by the importance factor (IP).

The expression for average strain in the pipeline is based on Newmark-Hall model. In this expression, δ_{f-ax} and δ_{f-lat} are the calculated values as per fault geometry and IP is the importance factor. A factor of 2 is also used to counterbalance the unconservatism involved in this method.

For the continuous pipeline the average pipe strain for fault crossing can be calculated as:

$$\varepsilon = 2I_p \left| \frac{\delta_{f-ax}}{2L_a} \pm \frac{1}{2}\left(\frac{\delta_{f-lat}}{2L_a}\right)^2 \right|$$

Where,

La : - Unanchored pipe length

The unanchored length of pipe line in the zone of fault crossing cab be taken as the least value among the following:-

a. When there are no bends, tie-ins or any type of constraints to the pipeline near the fault zone, the effective unanchored length of the pipeline may be taken as:

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$$L_a = \frac{E_i \varepsilon_y \pi D t}{t_u}$$,

Ei :- Modulus of Elasticity of Pipe Material

ε_y :-Yield Strain of Pipe material

D :- Diameter of Pipe

t :- Thickness of pipe

tu :- the ultimate friction force acting in axial direction of the pipe

IP : -Importance factor

b. Any anchorage provided by the pipe configuration (e.g., bends, elbows, change in soil cover, etc) shall be considered as the actual point of anchorage. And the length of pipeline from the point of anchorage to the fault line will be taken as the effective unanchored length of pipeline.

4.1.6.7 Design Criteria for Seismic Wave Propagation

d) The response of pipeline due to wave propagation effects is generally described in terms of longitudinal axial strains. Flexural strains due to ground curvature are neglected since these arerelatively small.

Design peak ground velocity (Vg) at the site can be determined as:

Vg = IP x PGVr

Where

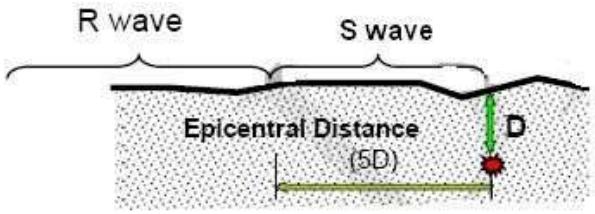
IP :- Importance factor

PGVr :- Peak ground velocity expected at he site at the base rock layer.

4.1.6.8 Apparent Wave Propagation Velocity

d.1) The apparent propagation velocity of both body and surface waves are of interest, since the pipelines are typically buried at shallow depth (1-3m) below ground surface.

For the evaluation of pipe axial strain, as a general rule shear wave should be considered for those sites whose epicentral distances are within 5 times of focal depth from the epicenter, and Rayleight waves are considered for the sites beyond 5 times focal depth from epicenter.



Consideration of S-wave and R-wave in Pipeline Design

For S-Wave:
The apparent wave propagation velocity (Cs_apparent) for S-waves can be calculated as:

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Cs_apparent = $\frac{Cs}{Sin\theta}$

Where

Cs_apparent :- Apparent wave propagation velocity of S-Wave

Cs :- Wave Propagation velocity of S-Wave

θ :- Angle of incidence of S-Wave

For R-wave

The apparent wave propagation velocity for R waves can be calculated as:

Cr_apparent = Cr_ph

Where

Cr_ph = Phase velocity of R-wave

The maximum longitudinal axial strain that can be induced in the pipeline due to wave propagation can be approximated as:

$$\varepsilon_a = \frac{V_g}{C_{apparent}} = \frac{V_g}{\alpha_\varepsilon C}$$

Where

Vg :- Design peak ground velocity

α_ε :- Ground strain coefficient

= 2.0 (for S-waves)

= 1.0 (for R-waves)

C :- Velocity of seismic wave propagation

= Cs for S waves (2.0 km/s may be considered conservatively)

= Cr_ph for R-waves (0.5 km/s may be considered conservatively)

The maximum strain induced in the pipeline by friction at the soil – pipe interface is calculated as:

$$\varepsilon_a \leq \frac{t_u \lambda}{4AE}$$

Where

tu:- Peak frictional force per unit length at soil –pipe interface

λ :- Apparent wavelength of seismic waves at ground surface (some times assumed to be 1.0 km in the absence of further information).

A :- Cross sectional area of pipe

E :- Modulus of elasticity of pipe material

The axial strain calculated as per the design strain. However, the design strain need not exceed the maximum strain that can be induced in pipeline by soil friction.

The strain calculated above should be less than the allowable strain limit as specified.

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4.1.6.9Recommendations

a) To Minimize The Buoyancy Effect Due To Liquefaction

i. Pipeline may be encased in concrete pipe to reduce the buoyancy effects, but the increase diameter will also increase lateral drag forces on the pipe.

ii. Concrete weights or gravel-filled blankets can be utilized to provide additional resistance to buoyancy.

iii. The buoyancy effect can also be minimized by shallow burial of the pipeline above the ground water level.

iv. Where uplift is the main concern, one may provide anchors at a spacing of up to 150 m to prevent uplift.

b) To Reduce The Risk Of Pipeline Subjected To Faulting

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i. The pipelines crossing fault line should be oriented in such a way to avoid compression in the pipeline. The optimum angle of fault crossing will depend upon the dip of the fault plane and the expected type of movement.
ii. Pipeline ductility should be increased in fault-crossing region accommodate large fault movement without rupture.
iii. Abrupt changes in wall thickness or other strain concentrators should be avoided within fault zone.
iv. In all areas of potential ground rupture, pipelines should be laid in relatively straight section avoiding sharp changes in direction and elevation.
v. To the extent possible, pipelines should be constructed without field bends, elbows, and flanges that tend to anchor the pipeline to the ground.
vi. If longer length of pipeline is available to conform to fault movement, level of strain gets reduced. Hence, the points of anchorage should be provided away from the fault zone to the extent possible in order to lower the level of strain in the pipeline.
vii. A hard and smooth coating on the pipeline such as an epoxy coating may be used in the vicinity of the fault crossing to reduce the angle of friction between pipeline and soil.

4.2 Expansion analysis (unrestrained sections)

The pipeline expansion 'α', due to the effects of design pressure and temperature difference in the pipe wall, shall be computed for pipeline, taking into account resisting frictional forces developed between the pipeline and seabed soils, and expansion stress shall be computed.

4.3 Stability analysis

In order to prevent flotation of pipeline in marshy areas, low laying areas, river crossing etc. concrete weight coating shall be provided a per design requirement. The thickness of the concrete coating and spacing of saddle weight shall be determined based on the following criteria.

Weight of the pipe Concrete coating thickness and spacing of saddle weight shall be calculated based on the following criteria. WP = W1 + W2 + W3

WP = Net downward pipe weight including coatings/unit run

W1 = Steel pipe weight/unit run

W2 = PE coating weight/unit run

W3 = Concrete coating weight/unit run

WB = (_D²/ 4) x density of water

D = Total outside diameter of the pipe including concrete coating

Factors of Safety = WP / WB > 1.3

Flotation check shall be carried out for buried pipelines under empty condition. A vertical settlement analysis shall also be carried out based on the soil data and should confirm no undue settlement of the pipeline.

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The following minimum concrete coating thickness shall be provided for the pipelines

Table 4.4 Minimum Concrete Coating Thickness Requirements

Sl. No.	Line	Pipe Size x Wall Thickness (mm)	Minimum Concrete Coating Thickness (mm)
1	Main Line	323.9. x 6.4	75

The above values are indicative and shall be evaluated during detail engineering based on pipe dia and anti-buoyancy calculation.

In the areas wherein soil is prone to liquefaction due to seismic loads or due to flooding, the effective liquefied slurry density shall be considered for the concrete coating calculations.

5.0 CROSSING DESIGN

5.1 Uncased crossing

All roads, water course, stream and river crossings shall be uncased, other than those which are mandatory requirement of concerned authority, crossings identified in the alignment drawings and for the crossings as stated in section 5.2. However local requirements will be dealt as per guidelines of local authority. The design of uncased crossing shall be as per Section 5 of the API RP-1102. Typical crossing analysis is to be carried out for a highway & railway crossings.

5.2 Cased crossings

All state and national highways, railways major canals and lined canals/distributors shall be executed by thrust boring with casing pipe. The design factors used for the carrier pipe design at cased crossings shall be the same as that considered for uncased crossings. All local requirements shall be dealt as per guidelines of local authority. The design of cased crossing shall be as per Sec 5 of API RP 1102. Next higher wall thickness (except for class 4) shall be considered for the pipeline sections at all road crossings, major rivers and canals than the adjoining wall thickness of the main pipeline.

For all cased crossings, HDD Crossings (as identified by OWNER) & open cut river crossings 6” steel casing pipe with two HDPE conduits shall be provided.

All major crossing should have two HDPE conduits in one steel pipe to take care of future OFC blowing.

5.3 Horizontal Directional drilling crossing

HDD (horizontal direction drilling) shall be carried out for the river crossings and other crossings, which are to be specified elsewhere in the bid. The detail design will be carried out by HDD specialist contractor. However, design criteria shall be as per the recommendations given in Section 4.1.6.

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6.0 STATION LOCATIONS

The sectionalizing valve stations shall be located as specified in P&ID. The minimum wall thickness of the pipeline and sectionalizing valve stations within and up till plot boundary limits shall be as per cl. 7.4 and as indicated on alignment sheets.

7.0 ADDITIONAL REQUIREMENTS

7.1 Cold field and Hot induction bends

After providing the allowance for wall thinning due to bending, the wall thickness at the cold field bends and hot induction bends shall not be lower than the minimum required as per section 4.1. No mitered bends are permitted. Hot induction bends shall not be cut and re welded except at the bevel ends.
For Mainline, except stations, Cold Field Bends (i.e No Induction bends) shall be used.
3D bends are acceptable only in stations in mainline.

7.2 Upheaval buckling

For pipeline section having minimum cover and at other locations wherein the pipeline vertical curvatures are extremely sharp (like at HDD inlet and exit points etc.,) the breakout of the pipeline from the trench due to upheaval buckling shall be checked and preventive measures shall be considered. Contractor shall also provide detail calculations during detail engineering to substantiate the methodology to be adopted.

7.3 Pre operational stresses

Stresses in the pre operational phase like transportation, stacking, stringing, fixed bending and back filling etc. shall be controlled and shall not cause any injury to the pipe.

7.4 Wall thickness selection

The minimum wall thickness to be provided for mainline and spur line are given in the SOR. This wall thickness shall be confirmed during detail engineering for adequacy.

Note: -

- Wall thickness shall be increased to the next higher class for all cased crossings. Further, the wall thickness shall be increased at major rivers, major unlined canals as per the governing laws of local controlling authorities.

ANNEXURE - 1

CHEMICAL COMPOSITIONS OF GAS

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Component Name	Mole Percent (%)
Methane	**92.53**
Ethane	**2.22**
Propane	**1.84**
N-Butane	**0.57**
I-Butane	**0.38**
N-Pentane	**0.14**
C6+	**0.26**
Nitrogen	**0.07**
Carbon Dioxide	**1.82**
Total	**100**

Oxygen : Not more than 0.5 mole%

Total Non Hydrocarbon : Note more than 2.0 mole%

Total Sulphur including H2S : Not more than 10PPM by weight expected H2S content not more than 4PPM by volume

Water Content : 112-144 Kg per MMSCM

Specific Gravity (SG) : 0.62 - 0.63

Gross Calorific Value : > 8500 Kcal/SCM

The gas to be supplied shall be preferably at ambient temperature. However the actual temperature shall be in the range of 20 degree C to 45 degree C.

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APPENDIX I

Table 1.2 Allowable Strain Criteria for Buried Continuous Pipeline

Allowable Strain for Buried Pipelines

Strain Component		Pipe Category	Allowable Strain	
			Tension	Compression
Continuous Oil and Gas Pipeline	For PGD εoper+εPGD	Ductile Cast Iron Pipes	2%	For PGD Onset of Wrinkling (εcr-c) (Clause-3.9.5)
		Steel Pipe	3.0 %	
		Polyethylene Pipes	20.0 %	
	For Wave Propagation εoper+εw	Bends & Tees	1.0 %	For Wave Propagation 50% to 100% of the Onset of Wrinkling (0.5 to 1εcr-c)

Where

εoper	Operational Strain in the Pipeline = εp+εt+εD+L
εp	Strain in the Pipe due to Internal Pressure
εt	Strain in the Pipe due to Temperature Change
εD+L	Strain in the Pipe due to Service Loads
εPGD	Induced Strain in the Pipe due to PGD Movement
εw	Induced Strain in the Pipe due to Seismic Wave Propagation
εcr-c	Critical Strain in Pipe in Compression

Notes:-

1. The Maximum Tensile Strain Should Not Exceed 4% in any Case
2. For Tees & Bends Maximum Strain is restricted to 2%
3. Limiting Compressive Strain is Strain at Onset of Wrinkling

Strain in Compression $\varepsilon_{cr-c} = 0.175 \frac{t}{R}$

Table 1.3 Friction Factor f for various external coatings

Pipe Coating	f
Concrete	1.0
Coal Tar	0.9
Rough Steel	0.8
Smooth Steel	0.7
Fusion Bonded Epoxy	0.6
Polyethylene	0.6

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Table 1.4 Values of Lateral Pressure Coefficient At Rest (K0) For Different Soil Conditions

Type of Soil	K_0
Loose Soil	0.5-0.6
Dense Soil	0.3-0.5
Clay (drained)	0.5-0.6
Clay (undrained)	0.8-1.1
Over consolidated soil	1.0-1.3

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR ONSHORE PIPELINE CONSTRUCTION

ENG-STD-PL-DOC-TS-001

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2	28.01.16	Comments incorporated & Issued for client approval				
1	22.01.16	Issued for client approval				
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Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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1.0 SCOPE

1.1 This specification defines the minimum requirements for the various activities to be carried out by Contractor for the construction of onshore pipelines.

1.2 The various activities covered in this specification include all works during the following stages of pipeline construction :

- Clearing, grubbing and grading of Right-Of-Way
- Staking of the pipeline route ;
- Handling, hauling, stringing and stacking/storing of all materials ;
- Trenching ;
- Field – bending of line pipe ;
- Lining-up and Welding
- Pipeline laying ;
- Backfilling ;
- Tie-in ;
- Hydrostatic testing, dewatering and drying
- Installation of auxiliary facilities and appurtenances forming a part of pipeline installation;
- Pre-commissioning and commissioning
- Clean-up and restoration of right-of-way
- Maintenance during defects liability period

1.3 CONTRACTOR shall submit detailed work procedures including drawings, calculations, as required equipment and manpower deployment details for the all pipeline activities to Owner for approval. Entire work shall be carried out as per approved procedures and to the satisfaction of Owner.

1.4 CONTRACTOR shall, with due care and diligence, execute the work in compliance with all laws, by-laws, ordinances, regulations etc. and provide all services and labour, inclusive of supervision thereof, all materials, excluding the materials indicated as "Owner Supplied materials" in the CONTRACT, equipment, appliances or other things of whatsoever nature required in or about the execution of the work, whether of a temporary or permanent nature.

1.5 CONTRACTOR shall be deemed to have obtained all necessary information regarding risks, contingencies and all other circumstances, which may influence the WORK.

1.6 CONTRACTOR shall be deemed to have inspected and examined the work area(s) and its surroundings and to have satisfied himself so far as practicable as to the form and nature thereof, including sub-surface conditions, hydrological and climatic conditions, the extent and nature of the WORK and materials necessary for the completion of the WORK, and the means of access to the work area(s).

1.7 CONTRACTOR shall, in connection with the WORK, provide and maintain at his own costs, all lights, guards, fencing, watching etc., when and where necessary or required by OWNER or by any duly constituted authority and/ or by the authorities having jurisdiction thereof for the protection of the WORK and properties or for the safety and the convenience of public and/ or others.

1.8 CONTRACTOR shall take full responsibility for the stability and safety of all operations and methods involved in the WORK.

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2.0 CODES AND STANDARDS

2.1 Reference has been made in this specification to the latest codes, standards andspecifications:

a.)	ASME B31.8	-	Gas Transmission and Distribution Piping systems
b)	API 1104	-	Standard for Welding Pipelines and related facilities
c)	API 5L	-	Specification for Line pipe
d)	OISD 141	-	Design construction requirements for cross-country hydrocarbon pipelines.
e)	OISD 226	-	Natural Gas Transmission Pipelines and City Gas Distribution Networks.

In case of any conflict in the requirements of above codes and this specification, the moststringent requirement shall be followed.

3.0 RIGHT-OF-WAY (ROW)

3.1 General

CONTRACTOR shall, before starting any clearing operations, familiarise himself with all the requirements of the Authorities having jurisdiction over the Right of Way for work along the pipeline route or in connection with the use of other lands or roads for construction purpose.

Contractor shall notify Owner well in advance during the progress of work, the method of construction for crossing road, pipeline and other existing installations, services and obstacles.

The right of ingress and egress to the ROW shall be limited to points where such ROW intersects public roads, Arrangements for other access required by the CONTRACTOR shall be made by him at his own cost and responsibility, and for such access, and the conditionsof this specification shall also apply.

Where the ROW comes within the area of influence of high voltage electrical installations, the special measures shall be taken.

This distance depends on the voltage carried. For individual pipelines the minimum distanceof the pipeline from the footing of the transmission line shall depend on the voltage. The following shall be the minimum Owner requirement for the clearance from power transmission lines:

Range of Voltage	Minimum Clearance
0 - 50 KV	3 m
51 - 200 KV	5 m
201 - 380 KV	8 m

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All necessary precautions shall be taken to prevent excavating and hoisting equipment from approaching high voltage lines to within above distances.

A minimum clearance of 500 mm shall be ensured when pipelines are to be laid parallel along underground power and/or communication cables, conductors or conduit. When such clearance cannot be maintained due to unavoidable reasons extra precautions shall be taken as approved by the Owner.

The Right-of-Way (ROW) will be handed over to Contractor by Owner as the work progresses. The Contractor is required to perform his construction activities within the width of ROW set aside for construction of pipeline, unless he has made his own arrangements with the land Owner and/or tenant for using extra land. Variation in the width of ROW caused by local conditions or installation of associated pipeline facilities or existing pipelines will be identified in the field or instructed to the Contractor by Owner.

The Right-of-Way boundary lines shall be staked by the Contractor, so as to prepare the strip for laying the pipeline. Contractor shall also establish all required lines and grades necessary to complete the work and shall be responsible for the accuracy of such lines and grades.

3.2 Staking

Prior to clearing operations Contractor shall carry out the following:

- Install bench marks, intersection points and other required survey monuments.
- Stake markers in the centerline of the pipeline at distances of maximum 100 meters for straight line sections and maximum 10 meters for horizontal bends.
- Stake two ROW markers at boundaries at least at every 100 meters.
- Install distinct markers locating and indicating special points, such as but not limited to:

  Contract limits, obstacle crossings, change of wall thickness, including correspondingchainage etc.
- All markers shall be of suitable materials so as to last till replacement with permanent markers and shall be colored distinctly for easy identification. Type, material and coloring of stake markers shall be subjected to approval of Owner. Any deviation from the approved alignment shall be executed by Contractor after seeking Owner's approval in writing prior to clearing operations.
- Contractor shall be responsible for the maintenance and replacement of the reference line markers until the permanent pipeline markers are placed.

3.3 Fencing

If Owner demands, Contractor shall install temporary fencing on either side of ROW wherever it is required to ensure safety and non-interference with others. For convenience of construction, Contractor shall install temporary gates to the fencing as per Owner's guidelines.

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3.4 Clearing and Grading

3.4.1 Clearing of Obstacles

Any obstacle, which may hinder the construction and laying of the pipeline along the approved pipeline route and for a strip of land of the size provided shall be removed.

3.4.2 Clearing of Vegetation

All grubbed stumps, timber bush, undergrowth and roots shall be cut and removed from the ROW and shall be disposed off in a method satisfactory to Owner and authorities having jurisdictions. ROW cross fall shall not exceed 10%.

3.4.3 Uprooting of Trees

All trees which may hinder the construction of the pipeline along the approved pipeline route that belong to the protected green belt, reserved forest and other areas demarcated by the government authorities and any other tree in the opinion of the Owner requiring relocation/ re-plantation shall be relocated and replanted by the Contractor at an alternate location as recommended by the jurisdiction authorities / Owner. All such uprooting and re-plantation of trees shall be carried out by the Contractor in a manner that is satisfactory to the jurisdiction authorities/ Owner.

Contractor shall submit a procedure for uprooting and replanting of trees to the Owner for approval.

Trees that are required to be uprooted and not specified / recommended for re-plantation by the jurisdiction authorities / Owner shall be disposed of as debris and cleared from the ROW/Project site by the Contractor.

3.4.4 Grading of ROW

Contractor shall grade the pipeline ROW as required for proper installation of the pipeline, for providing access to the pipeline during construction, and for ensuring that the pipeline is constructed in accordance with the most up-to-date engineering and construction practices. During entire period of pipeline construction and testing, Contractor shall maintain the ROW in motor-able condition. Final cleared & graded ROW shall be subjected to approval of Owner.

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3.5 Approach roads

Grading operations should normally be carried out along the Right-of-Way (ROW) with mechanical excavators or manually. In certain areas, grading may have to be resorted exclusively by blasting.

In plain, rough or steep terrain, Contractor may have to grade access roads and temporary bypass roads for its own use. Where such access roads do not fall on the Right-of-way, Contractor shall obtain necessary written permission from land owners and tenants and be responsible for all damages caused by the construction and use of such roads at no extra cost to Owner. Where rocky terrain is encountered, grading shall be carried out in all typesof solid rocks which cannot be removed until loosened by blasting, drilling or by other recognized methods of quarrying solid rocks. In certain areas where restricted ROU is available, contractor shall have to manage and follow other approaches to complete the job.

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3.6 Provision of detours

Contractor shall be responsible for moving his equipment and men across or around watercourses and road crossings. This may require the construction of temporary bridges orculverts. Contractor shall ensure that such temporary works shall not interfere with normal water flow, avoid overflows, traffic, keep the existing morphology unchanged and shall not unduly damage the banks of water courses. No public ditches or drains shall be filled or bridged for passage of equipment until Contractor has secured written approval of the authorities having jurisdiction over the same. Contractor shall furnish Owner a copy of all such approval.

3.7 Off right-of-way damages

Any damage to property outside ROW shall be restored or settled to the Contractor'saccount.

4.0 HANDLING, HAULING, STRINGING AND STORING OF MATERIALS

4.1 General

Contractor shall be fully responsible for all materials and their identification until the timesuch that the pipes and other materials are installed in permanent installation.

Contractor shall be fully responsible for arranging and paying for stacking/storage areas forthe pipeline materials. However, method of stacking/ storage shall be approved by Owner.

4.2 Line pipes

The Contractor shall load, unload, transport and stockpile the bare/coated pipes using approved suitable means and in a manner to avoid damage to the pipe and coating. Contractor shall submit to Owner a complete procedure indicating the manner and arrangement used for handling, transportation and stacking of bare/coated pipes for Owner'sapproval prior to commencement of handling operations.

Stacks shall consist of limited number of layers so that the pressure exercised by the pipes own weight does not cause damage to the coating. Contractor shall submit the stacking height calculations as per API RP 5L1 to Owner for approval. Stacks of different diameters, wall thickness and damaged rejected pipe shall be separately segregated and identified properly. The pipes shall be stacked at a slope so that driving rain does not collect inside the pipe.

The ends of pipes during handling and stacking shall be protected with bevel protectors. Supports shall be provided for at least 10% of the pipeline length. These supports shall be lined with rubber protection. The second layer and subsequent layers shall be separated from each other by material such as straw in plastic covers or mineral wool strips or equivalent.

Materials excluding line pipes shall be stored in sheltered storages.

4.3 Stringing of pipe

Pipes shall be unloaded from the stringing trucks/trailers and lowered to the ground by means of boom tractor or swinging crane or other suitable equipment using lifting devices. Dragging or sliding of pipe shall not be permitted. Special precaution shall be taken during stringing of corrosion coated pipe as per the special requirements of previous paragraph. Stringing of pipe shall only be carried out in daylight and after clearing and grading operations have been completed. Pipes shall not be strung directly on the ground and shall be adequately supported with the help of sand bags or other soft material support

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in order to avoid damage to the pipe coating. Pipe shall not be strung on the Right-of-Way (ROW) in rocky areas where blasting may be required, until all blasting is complete and the area is cleared of all debris. Contractor shall submit to Owner for approval a complete procedure forstringing of line pipes.

4.4 Repair of damaged pipes

After the pipe has been strung on the Right-of-Way (ROW), it shall be inspected by the Contractor and the Owner and all defective pipes & pipe ends shall be repaired. Defective pipe shall be repaired or rejected as the Owner may direct as per the requirements of specification.

4.5 Identification

CONTRACTOR shall provide all pipes, bends, etc. greater than 2" with serial numbers as soon as possible and measure their length and state is on the pipes, etc. Pipes to be bent shall be measured prior to bending. Identification (i.e. letter, number and length) shall be indelible.
All serial numbers shall be recorded in a list, which shall also state appurtenant pipe numbers.

Besides recording the stamped - in pipe numbers, length of pipe and painted-on serial numbers, the stamped-in numbers of T-pieces, bends, valves, etc. and the batch numbers ofbends, T-pieces, valves, etc. and the make of valves, shall also be recorded in said list.

Before a pipe length, pipe end, etc. is cut the painted serial number and stamped-in pipe number shall be transferred with the help of low stress punch by CONTRACTOR in the presence of OWNER to either side of the joint which is to be made by cutting, and the changes shall be recorded in the above mentioned list stating the (new) length. The results shall be such that all pipes, pups, etc. of diameter greater than 2" bear clear marks punched with a low stress punch.

CONTRACTOR shall explicitly instruct his staff that parts which cannot be identified must notbe removed, except after permission by OWNER.

As a general rule parts must be marked as described above before being moved. In no conditions may unmarked parts be incorporated into the WORK.

5.0 TRENCHING

5.1 Contractor shall excavate and maintain the pipeline trench on the stacked centre line of thepipeline taking into account the curves of the pipeline.

5.2 Excavation

5.2.1 Contractor shall, by any method approved by Owner, dig the pipeline trench on the clearedand graded Right-of-Way (ROW).

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5.2.2 In cultivated land the arable soil shall be properly prescribed and same to be replaced atoriginal place during backfilling as advised by Owner.

Care shall be exercised to see that fresh soil recovered from trenching operation, intended tobe used for backfilling over the laid pipe in the trench, is not mixed with loose debris or foreign material. The excavated material shall never be deposited over or against the strungpipe.

5.2.3 In steep slope areas or on the hillside, before commencing the works, proper barriers orother protection shall be provided to prevent the removed materials from rolling downhill.

5.2.4 In certain sloppy sections, before the trench cuts through the water table, proper drainageshall be ensured both near the ditch and the right-of-way in order to guarantee soil stability.

5.3 Blasting

5.3.1 Contractor shall execute the blasting as per approved procedures, which will also detail outsafety precautions to safe guard the existing pipelines.

5.3.2 No blasting is allowed within 15m of any existing pipeline or structures (either above orbelow ground).

Where blasting is to be carried out, between 50m and 15m away from any existing pipelines or structures (either below or above ground), the Contractor shall submit a procedure for controlled blasting e.g. break-holes, slit trench etc. Contractor shall perform a trial blast for Owner's approval.

5.4 Normal covers and trench dimensions

The trench shall be excavated to a minimum width maintaining clearance on both sides of the installed pipeline and to a depth to maintain the cover of the pipeline as indicated in the other contract documents or approved procedure.

Pipeline shall be laid with at least 500mm free clearance from the obstacles or as specifiedin the drawings or wherever it is required by concerned authorities.

The following minimum cover shall be maintained:

Location		Minimum cover in meters
a)	Industrial, Commercial & Residential	1.5 R2
b)	Rocky Terrain	1.5 R2
c)	Minor water crossings/ canals / drain / nala / stream	1.5 R2
d)	River crossings for which scour depthis defined (below scour)	2. 5 R2
e)	River crossings (Bank width < 50 m) (below lowest bed level)	2.5 R2
f)	Other crossings (Bank width > 50 m)(below lowest bed level)	2.5 (for normal soil) R2 1.5 (for rocky strata) R2

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g)	Water crossing by HDD (below leastbed level)	2.5	R2
h)	Uncased/ Cased Road Crossings/ Station approach	1. 5	R2
i)	Rail road crossings	1.7	R2
j)	Drainage, ditches at roads / railway crossings	1.5	R2
k)	Marshy land and creek area	1.5	R2

Note:

a) In case pipeline is located within 15 m from any dwelling unit, the cover shall be increased by 300 mm over and above that specified.
b) The above-mentioned minimum cover requirements shall be valid for all class locations.
c) Minimum depth of cover shall be measured from the top of pipe coating/ casing pipe to the top of undisturbed surface of the soil, or top of graded working strip whichever is lower.
d) In case of rivers, which are prone to scour and erosion, adequate safe cover (min.2.5m) shall be provided below the predicted scour profile during the lifetime of pipeline. Contractor shall establish the scour level based on data provided by authorities.

At points where the contour of the earth may require extra depth to fit the minimum radius of the bend as specified or to eliminate unnecessary bending of pipe or where deeper trench is required at the approaches to crossings of roadways, streams etc. contractor shall excavate such additional depths as may be necessary at no extra cost to Owner.

5.5 Negative buoyancy to the pipe

Contractor shall dewater if necessary, using well point system or other suitable systems, andthen install the pipe in the trench and backfill the trench. All underground utilities shall be located and protected as per the guidelines of jurisdiction authority/ Owner.

Contractor shall check if up-floating danger for the pipeline is present in open trench. If such danger of up-floating is present, Contractor shall take appropriate measures to prevent up- floating such as applying soil dams and dewatering of trench or temporary filling of water intothe line (in exceptional cases) as approved by Owner. Contractor shall furnish details of all negative buoyancy calculations to the Owner for approval. Contractor shall carry out any antibuoyancy measures only after obtaining Owner's approval for such calculations.

In case of presence of water on the ditch bottom when the pipeline is being laid, the ditch shall be drained to the extent and for the time required to make a visual inspection of the ditch bottom. After such inspection, the presence of water will be allowed provided its level does not cause sliding of the ditch sides and pipe floating before backfilling.

Wherever up-floating of the pipeline after backfilling is indicated, anti-buoyancy measures shall be provided by Contractor for areas indicated in the drawings or as may be encountered during construction using the following method:

- Applying a continuous concrete coating around the pipe

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Any other anti-buoyancy method adopted by the Contractor shall require prior written approval from the Owner.

The above provisions shall be in accordance with the relevant specifications and/or approved procedures / drawings and to the satisfaction of Owner.

5.4 Padding

In all cases where rock or gravel or hard soil is encountered in the bottom of the trench,extra padding shall be provided by Contractor as per Owner's instructions. The thickness of the compacted padding shall not be less than 150mm. In those areas that are to be padded,the trench shall be at least 150mm deeper than otherwise required, and evenly and sufficiently padded to keep the pipe when in place, at least 150mm above bottom ofexcavated trench.

The thickness of compacted padding on top of pipe shall be at least 150mm.Exact extent of trench padding shall be as per Owner's instructions. Padding materials that are approved byOwner shall be graded soil / sand and/or other materials containing no gravel, rock, or lumpsof hard soil.

Contractor shall keep the trench in good condition until the pipe is laid.

6.0 BENDING

Contractor shall preferably provide for changes of vertical and horizontal alignment by making elastic bends. Contractor may provide cold field bends, at his option for change of direction and change of slope. Owner at his option may authorize factory mad induction hot bends (LR bends) for installation at points where in Owner's judgments the use of such bends is unavoidable.

Over bends shall be made in such a manner that the centre of the bend clears the highpoints of the trench bottom. Sag bends shall fit the bottom of the trench and side bends shall conform and leave specified clearance to the outside wall of the trench.

6.1 Cold field bends

The minimum radius of cold field bends shall be as follows:

Nominal Pipe Size (NPS)	Minimum Radius of Cold Bend
Less than 12"	21D
14 "- 16"	30D
Greater than 16"	40D

Spiral SAW line pipes shall not be used for fabrication of cold field bends.

Contractor shall use a bending machine and mandrel and employ recognized and accepted methods of bending of coated pipe in accordance with good pipeline construction practice.

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However, bending machines shall be capable of making bends without wrinkles, buckles, stretching and with minimum damage to the coating.

6.1.1 Contractor shall, before the start of the work, submit and demonstrate to Owner a bending procedure, which shall conform to the recommendations of the bending machine manufacturer. The procedure shall include amongst other steps – lengths, maximum degree per pull and method and accuracy of measurement during pulling of the bend. This procedure and the equipment used shall be subjected to Owner's approval.

6.1.2 For welded pipes, longitudinal seam shall be suitably placed as per approved procedure so that the weld seam shall not be overstressed.

6.1.2 The ends of each bend length shall be straight and not involved anyway in the bending. Thelength of the straight section shall permit easy joining. In no event shall the end of the bend be closer than 1.0m from the end of a pipe.

6.1.3 The ovality used on each pipe by bending shall be less than 2.5% of the nominal diameter atany point. Ovality is defined as the reduction or increase in the internal diameter of the pipe compared with the nominal internal diameter. A check shall be performed on all bends in the presence of Owner by passing a gauging pig / buckle detector consisting of two discs with a diameter equal to 95% of the nominal internal diameter of the pipe connected rigidly togetherat a distance equal to 300mm.

6.1.4 Cold bend pipes on site shall have the corrosion coating carefully checked with the aid of a holiday detector for cracks in the coating down to the pipe wall. It must also be checked whether the coating has been disbanded from the pipe wall during bending by beating with awooden mallet along the outer radius. Any defects or disbanding of the coating caused during bending shall be repaired at the Contractor's expense in accordance with Owner's approved procedures.

6.2 Elastic Bends

The minimum allowable radius for elastic bends in the buried pipeline including that for continuous concrete weight coated pipe shall be in accordance with relevant job standards. The elastic bend shall be continuously supported over its full length. A radius smaller than permitted in elastic bending shall require a cold bend.

6.3 Miter and Unsatisfactory Bends

All bends showing buckling, wrinkles, cracks or other visible defects or which are in any way in disagreement, in whole or in part, with this specification shall be rejected.

No miter bends shall be permitted in the construction of the pipe line. CONTRACTOR shall cut out and remove any bend or bends which do not meet the specifications and shall replace the same with satisfactory bends at no additional cost to the OWNER.

In the event the CONTRACT provides for supply of line pipe by OWNER, the pipes required for replacement will be furnished by OWNER, but the cost of replacement of such pipes shallbe borne by CONTRACTOR. Cutting of factory made bends and cold field bends for any purpose are not permitted.

7.0 LINING UP

Each length of pipe shall be thoroughly examined internally and externally to make sure that it is free from visual defects, damage, severe corrosion (sea water pitting), dirt, animals or any other foreign objects. Each length of the pipe shall be adequately swabbed, either by

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use of canvas belt disc of proper diameter or by other methods approved by the Owner. Damaged/ corroded pipes shall be kept separate. Each length of pipe shall be pulled through just before being welded. Contactor shall submit a detail procedure for Lining of linepipe to Owner for approval.

7.1 Pipe defects and repairs

7.1.1 Acceptability of defects in the pipe detected during inspection at the work site shall be determined in accordance with approved procedures or Code ASME B31.8/ API 5L whichever is more stringent.

7.1.2 Repair on line pipe shall be executed as specified in specification or Code ASME B31.8/ API 5L whichever is more stringent.

7.1.3 Repair of damaged pipe ends by hammering and/or heating is not allowed. Contractor shall submit detailed procedure for pipe defects and repairs to Owner for approval

7.2 Skid spacing

7.2.1 A strip of soft material shall be placed in between skid and pipe to protect the external coating of pipe from any damage.

7.2.2 The pipes shall be maintained from skids at the minimum distance of 500mm above ground.

7.3 Night Caps/ Temporary Caps

After each day's work or when work is interrupted, the open ends of the welded strings of pipes shall be capped with a securely closed metal cap as approved by Owner.

8.0 LAYING OF PIPE

8.1 Lowering in trench

8.1.1 Lowering shall follow as soon as possible, after the completion of the field joint coating of thepipeline. In the case of parallel pipelines, laying shall be carried out by means of successive operations, if possible without interruption. Contractor shall submit a detail procedure for lowering of pipeline to Owner for approval.

8.1.2 Before lowering in, a complete check by a full circle holiday detector for pipe coating and for field joint coating shall be carried out and all damages repaired as agreed by Owner at Contractor's cost. All the points on the pipeline where the coating has been in contact with either skids or with lifting equipment shall be properly checked. Where water is present in thetrench, no laying shall be permitted until the ditch has been drained.

8.1.3 The pipeline shall be lifted and laid using, for all movements, necessary suitable equipmentof non-abrasive material having adequate width for the fragility of the coating. Care shall be exercised while removing the slings from around the coated pipe after it has been lowered into the trench. Any damage caused to the coating shall be promptly repaired. Lowering in utilizing standard pipe cradles shall be permitted if Contractor demonstrates that pipe coatingis not damaged. No sling shall be put around field joint coating.

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8.1.4 The portion of the pipeline between trench and bank shall be supported by as many side- booms as required and approved by Owner for holding the line in gentle S-curve maintainingminimum elastic bend radius as specified in approved procedure. Lowering in and back filling shall preferably be carried out at the highest ambient temperature.

In laying parallel pipelines in the same trench, the minimum distances between the pipelinesindicated in the approved drawings shall be maintained.

8.1.5 Over-head sections

a) The following works shall be completed before proceeding with the assembly and laying of overhead pipelines :

- Construction of the pipe support structures or of mounts on supports.
- Paints and/or coating of the pipe work, as indicated in the engineering specification.

b) The erection of the supports shall be carried out taking care that the elevation and alignment is in accordance with the drawings.

In the case of metal work supports, pre-fabrication and/or assembly shall take into account the maximum allowed free span and the supports shall not interfere with the pipeline welds.

c) In case roller supports are used, the rollers shall be lubricated, and then checked for smooth rotation. In case of seizure, the defect shall be repaired or roller shall be replaced. In the case of overhead section where the pipeline is slanting, the alignment of the end supports shall be made after placing the pipeline in position. Before installation of the pipe section, all the rollers shall be perfectly centered acting on the seat of the support plates.

The above alignment operations shall be carried out before connecting the overheadsection with the ends of the buried section.

d) Lifting, moving and laying of the pipeline shall be carried out in accordance with the provisions of this specification.

An insulation sheet shall be installed to isolate the pipe from the support or supportfrom the earth.
The sheet shall be hard polyethylene at least 5mm thick.
It shall extend to at least 25 mm outside the saddles or clamps.

e) Moving supports, if any shall be centered on their support and allow for a movement of at least 300mm in both directions.

f) A comprehensive report / method statement on the laying operation to be used shall be submitted to the Owner well in advance for approval. The report as a minimum shall include, but not limited to the following:

- Method of installation by lifting (as a preferred method).
- Pulling method and related calculations, whenever lifting method cannot beused.
- Pulling device and its characteristics.
- Method of anchoring the pulling device
- Characteristics of the pulling rope
- Braking device, if any.

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- Pipeline assembly system.

9.0 BACK-FILLING

9.1 Backfilling shall be carried out immediately after the pipeline has been laid in the trench, inspected and approved by the Owner, so as to provide a natural anchorage for the pipeline,thus avoiding long exposure of coating to high temperature, damaging actions of adverse weather conditions, sliding down of trench sides and pipe movement in the trench. If immediate back filling is not possible, a covering of at least 200mm of earth shall be placed over and around the pipe coatings. Contractor shall submit to Owner the detailed procedure for backfilling for approval.

9.2 Warning sheet / mat made of Polyethylene with fluorescent color shall be laid after toppadding of 300 mm. Prior to use, approval of the same shall be taken from client.

9.3 As directed by Client/ Consultant, wherever hard rocks/ soil are encountered, padding and rock shield shall be provided across the pipe to cover all exposed pipe area to avoid any possible damages during back filling of hard materials like rock, gravel, lumps of hard soil etc.

9.4 When trench has been dug through roads, all back fills shall be executed by sand or suitablematerial as approved by Owner and shall be thoroughly compacted. In certain cases, specialcompaction methods, such as moistening or ramming of the backfill in layer may be requiredas advised by Owner.

9.5 In areas prone to soil erosion, back filling shall be carried out as per approved procedures, carefully and to the satisfaction of the Owner/authorities having jurisdiction.

9.6 Contractor shall furnish materials and install breakers in the trench in steep areas (slope generally 10% and more) for the purpose of preventing erosion of the backfill. The type of breakers installed shall be as per the approved drawings. Breakers shall be constructed of grout bags filled with a mixture of 4:1 of Sand: Portland cement at Owner's direction. Separate detailed procedure with sketch shall be prepared and get approved by owner / authority.

10.0 TIE-IN

10.1 The unconnected sections of the pipeline at various locations have to be tied in after the sections are coated, lowered and backfilled. The sections to be connected shall have at the ends – sections of over lapping, uncovered pipe of sufficient length to absorb, without including excessive stresses in the steel, small displacements necessary for perfect alignment and connection of the ends.

10.2 If a pup end cannot be avoided for tie-in, the minimum length that shall be added is 1.0 meters and two or more such pups shall not be welded together. All cut-off lengths greater than 1.0 meters shall be moved ahead in order to be welded into the pipeline at a suitable location. Tie-in with two or more pups may be used provided that they each have minimum length of 1.0 meter and are separated by an entire length of pipe. In no case more than three
(3) welds shall be permitted on a 10 meter length of pipeline.

10.3 Tie-in shall preferably be carried out at ambient temperatures corresponding to the average operating temperature in the case of a pipeline conveying fluids at normal temperatures and at the maximum ambient temperature in the case where the pipeline is carrying fluids at hightemperature.

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10.4 CONTRACTOR shall carry out tie-in-welding (including necessary cutting, bevelling, grindingof pipe weld seams and line-up etc.) cleaning, priming, coating and backfilling for the tie-in portion as per relevant specifications. CONTRACTOR shall also excavate the required bell- holes for the connection. Bell-holes made to facilitate welding shall provide adequate clearance to enable the welders to exercise normal welding ability and skill. All tie-in welds shall be radio-graphically examined.

10.5 The tie-in should be done in such a way as to leave a minimum of strain in the pipe. If necessary, with respect to the trench, realigning of the pipe shall be done to eliminate force or strain in the pipe by the CONTRACTOR at no extra cost to OWNER.

10.6 For tie-in of adjacent sections of pipeline already pressure tested, the pup used for tie-in shall be of single length or off-cuts of pipe which have already been hydrostatically tested. CONTRACTOR shall take care that sufficient number of pretested pipes with different wall thicknesses are readily available.

11.0 CROSSINGS

Pipe line sections at all major crossings like State and National Highways, Railways, major canals and lined canal / distributaries shall be laid by boring with casing pipe complying with all other statutory requirements. All other crossings shall be executed by open cut method unless otherwise specified in the Contract or specified by statutory authorities.

12.0 SPECIAL INSTALLATION OF THE PIPELINE

12.1 Installation of Insulating Joints

12.1.1 Insulating joints shall be installed at the locations shown in the drawings. Contractor shall obtain approval from the Owner before installation of the insulating joints.

12.1.2 Handling and installation of the insulating joints shall be carried out with all precautions required to avoid damage and excessive stresses and that the original pup length is not reduced.

12.1.3 The insulating joints and the welded joints shall be protected by external coating as per the relevant specifications issued for the purpose.

12.2 Installation of Valves and Valve chamber

12.2.1 Isolation valve & its chamber shall be installed as shown on the approved drawings. It is CONTRACTOR's responsibility to have the units completely assembled, tested and made fully functional including all related instruments etc.

12.2.2 The civil and structural work shall be carried our in accordance with the relevant specifications issued for the purpose and in accordance with the approved drawings as directed by OWNER.

12.2.3 A suitable concrete foundation as directed by OWNER shall be constructed on which the valve shall be firmly installed, after embedding an insulating sheet of hard polyethylene with a thickness of at least 5mm or equivalent. Such insulating sheet is also to be installed under pipe clamps, etc.

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12.2.4 Valves with flow arrows shall be installed according to the normal flow in the pipeline. During,welding, the valves shall be in fully open position. In addition all manufacturer's instructions shall be followed. Care shall be taken to avoid entry of sand particles etc. to valve body, seals etc. during transportation, storage, assembly and installation.

12.2.5 For valves and piping installed below ground and/or above ground, the anti-corrosion coating/ painting shall be as per the requirements of the relevant specifications issued for thepurpose. The anti-corrosion coating below ground shall extend up to 500 mm above grade atthe lowest point.

12.2.6 Isolation valves shall be installed on sections of the pipeline in the horizontal position only or with an inclination not greater than that allowed by the valve manufacturer. Installation shall be done in such a way that there is no strain in the welded joint while the pipeline atupstream and downstream sides are straight. Local venting option at upstream and downstream of isolation valve shall be installed with Ball & Globe Valve arrangement.

12.2.7 All valves shall always be handled using equipment and methods to avoid impact, shaking and other stresses. In particular, the equipment and tools for lifting and handling shall never be done through hand-wheel, valve stem, joints and other parts which may suffer damage.

12.3 Installation of Scraper Launchers and Receivers, if applicable

12.3.1 Scraper stations shall be fabricated and installed as per the approved drawings and whenever applicable. It is CONTRACTOR's responsibility to have the units completely assembled, tested and made fully functional including all instruments & related piping.

12.3.2 The civil and structural works for the scraper stations shall be carried out as per the relevant specifications, in accordance with the drawings and as directed by the OWNER. The work asa minimum shall include site survey, site preparation, clearing, grading, fencing, foundations,etc. as required.

12.3.3 It shall be CONTRACTOR's responsibility to maintain elevations shown on the approved drawings and to carry out any pipe work adjustments, necessary for this purpose. Field cuts shall be square and accurate and field welds shall not be performed under stress of pipe ends.

12.3.4 The painting for the scraper stations shall be carried out as per "Specifications for Painting". The underground sections shall be coated as specified for the pipeline up to at least 300mm above grade.

12.3.5 The hydrostatic testing of the scraper stations shall be executed after installation in accordance with the relevant specification issued for the purpose.

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13.0 WORKING SPREAD LIMITATIONS

Contractor shall, in general, observe the following maximum distances between the workingmainline spread depends as the requirement is raised.

Between Row grading, clearing and backfilling	:	20 Kms.
Between Backfilling and final clean up	:	05 Kms.

The above limitations do not apply to point spreads such as continuous rock blasting, rivercrossing, etc.

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14.0 CLEAN-UP & RESTORATION OF RIGHT-OF-WAY

14.1 After all required tests have been concluded satisfactorily Contractor shall clean up the site as laid down in the specifications issued for the purpose. The site finish shall be graded in accordance with the approved drawings.

14.2 Contractor shall restore the ROW and all sites used for the construction of pipelines, water crossings and other structures in accordance with Owner's instructions, and deliver them to the satisfaction of Owner.

15.0 PIPELINE MARKERS

15.1 Contractor shall submit detailed drawings for pipeline markers to the Owner for approval. After approval, all markers shall be installed along the pipeline route as advised by Owner. As a minimum the markings shall be provided at intervals / spacing as follows:

Marker Type	Minimum Spacing Requirement
Kilo Meter Post	One marker every one kilometer
Aerial Marker	One marker at every five kilometers
Navigable Water ways/ Notice board	One each on either bank of the navigable water way
Boundary Markers	One each on either side of the boundary ofthe ROW at intervals of 250 m.
Direction Markers	One at the centre of curvature of the turning point. One each at a distance of 200 m on eitherside of the alignment.
Warning Signs: All road / railroad crossings Water course, nala, canal	One no. on either side of the road / railroad a) One no. for width less than 15m b) Two nos. on either side of the crossing for width greater than 15 m and all cased crossings

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16.0 MAINTENANCE DURING DEFECTS LIABILITY PERIOD

Defects liability Period (defined as period of liability in the CONTRACT) means the period of12 months calculated from the date certified in the Completion Certificate.

OWNER reserves the right to carry out instrumented pigging survey of the completed pipeline.

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CONTRACTOR shall be responsible for making good with all possible speed at his expense any defect in or damage to any portion of the Work which may appear or occur during the Defects liability Period and which arise either:

a) From any defective material (other than supplied by OWNER), workmanship or design (other than a design made, furnished or specified by OWNER and for which CONTRACTOR has disclaimed responsibility in writing), or

b) From any act or omission of CONTRACTOR done or omitted during the said period.

If such defect shall appear or damage occur, OWNER shall forthwith inform CONTRACTOR thereof stating in writing the nature of the defect or damage.

If any such defect or damage be not remedied within a reasonable time, OWNER may proceed to execute the work at CONTRACTOR's risk and expense, provided that he does so in a reasonable manner. Such defect or damage can be, but is not limited to:

- Clean up of ROW, including water courses

- Sagging or sinking of site level or pipe supports

- Sliding of ditch banks

- Repair of fencing or removal of construction fencing

- Repaving of pavements, repair of pavements, repair of coating, painting

- Realigning markers, signs

- Leak/burst of pipe, leaking flanges, washouts

- Short-circuit in casings

- Construction defects such as dents, ovality, welding offsets/defects, etc. detected duringintelligent pigging survey etc.

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OWNER reserves the right to have the required Computerised Potential Logging Test executed during the DEFECTS LIABILITY PERIOD and whenever conditions are more favourable for this job.

CONTRACTOR shall finish the work, if any outstanding, at the date of completion as soon as possible after such date and shall execute all such work.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR ONSHORE PIPELINE WELDING FOR GAS TRANSPORTATION

ENG-STD-PL-DOC-TS-002

BGL/632/2024-25

1	22.01.16	Issued for client approval				
0	25.11.15	First Issue				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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1.0 SCOPE

This specification defines the minimum requirements for welding of carbon steel pipes made as per API 5L specification.

2.0 CODES AND STANDARDS

The related, standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry:

a)	ASME B31.8	:	Gas Transmission and Distribution Piping Systems.
b)	API 1104	:	Standard for welding of Pipelines and Related Facilities.
c)	ASME Sec. II C	:	Specification for welding Electrodes and Filler Materials.
d)	ASME Sec. V	:	Non Destructive examination.
e)	ASME Sec.VIII Div. I	:	Boiler and Pressure Vessel Code: Pressure Vessels.
f)	ASME Sec. IX	:	Boiler and Pressure Vessel Code: Welding and Brazing Qualification.
g)	ASTM E23	:	Notched Bar Impact Testing of Metallic Material.
h)	ASTM E92	:	Test Method for Vickers Hardness of Metallic Materials.
i)	ASTM E709	:	Practice for Magnetic Particle Examination.
j)	ASTM A370	:	Standard Test Methods and Definitions for Mechanical Testing of Steel Production.
k)	ASNT-SNT-TC-1A	:	Standard for Personnel Qualification and Certification in Nondestructive Testing

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3.0 CONFLICTING REQUIREMENT

In the event of any conflict in the requirements of this standard specification, job specification, datasheets, statutory regulations, related standards, codes etc., the most stringentrequirement shall be followed:

4.0 WELDING PROCESS AND CONSUMABLES

4.1 This specification lays down minimum requirements for welding of various materials using Shielded Metal Arc Welding process (SMAW) with the approval of the Owner/ Consultant. Any other process of welding shall require prior approval from the Owner/ Consultant.

4.2 Welding consumables

4.2.1 The welding electrodes/ filler wires supplied by the Contractor shall conform to the class specified in the

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approved welding procedure specification. The materials shall be of the make approved by the Owner/ Consultant.

The Contractor shall submit batch test certificates from the electrode manufacturers giving details of physical and chemical tests carried out by them for each batch of electrodes to be used.

The certificates shall have as minimum, information such as batch number, date of manufacture, consumable cast number, consumable chemistry, weld metal chemical analysis, weld metal mechanical properties including Charpy impact energy.

Electrode Qualification test records shall be submitted as per relevant code requirements by the Contractor for obtaining the approval of the Owner/consultant. The following details shall be provided in qualification test records. All weld tensile test, base material used, pre-heat andpost weld heat treatment details, visual examination results, radiographic examination results, tensile test results (incl. UTS, and elongation), impact test values, chemical analysis report, fillet weld test results, other tests like transverse tensile tests and guide bend test results. The contractor shall give prior intimation to owner/ consultant regarding EQT. Each EQT shall be witnessed by owner/ consultant's inspector.

4.2.2 The electrode shall be suitable for the production welding process recommended and the basemetal used. Physical properties of the welds produced by the electrode & brand recommendedfor the welding of particular base metal shall not be lower than the minimum values specified for the base metal unless otherwise specified in approved Welding Procedure Specification (WPS). The choice of electrode shall be made after conducting the required tests on the electrodes as per relevant standards, and acceptance shall be the sole prerogative of the Owner/Consultant.

4.2.3 All electrodes shall be purchased in sealed, containers and stored properly to prevent deterioration. Electrodes shall be kept in oven, if required, at all conditions as per manufacturer recommended temperature. Different grades of electrodes shall be stored separately. The electrodes used shall be free from rust, oil, grease, earth and other foreign matter, which affect the quality of welding.

4.2.4 The composition and purity of shielding gas when required by the welding processes other than shielded metal arc welding, when permitted by the Owner/Consultant shall be submittedto the Owner/Consultant for approval.

4.2.5 Contractor shall supply all necessary equipment's such as welding equipment current and voltage meters, temperature measuring instruments, fluxes, gases, filler metals and testing equipment for satisfactory completion of all the work.

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5.0 WELDING PROCEDURE SPECIFICATION

5.1 Contractor shall submit the welding procedure specification indicating the proposed welding process to Owner/consultant for approval. Any deviation desired by the Contractor shall be obtained through the express consent of the Owner/Consultant.

5.2 A combination of different welding processes or a combination of electrodes of different classes/makes could be employed for a particular joint only after duly qualifying the welding procedures to be adopted and obtaining the approval of the Owner/Consultant.

Welding procedure qualification shall be carried out in accordance with the relevant requirements of API 1104 and other applicable codes and other job requirements by the Contractor. The Contractor shall submit the welding procedure specifications as per the formats given in API 1104 within one month after the receipt of the order indicating details of welding consumables, welding process, welding position, welders, destructive test sample

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positions, pre-heating requirements, voltage, current, heat input etc. The pipeline of maximum diameter and wall thickness shall be used for welding procedure qualification. Inter pass temperature shall be considered as an essential variable in the procedure qualification.

5.3 Owner/Consultant's representative will approve the welding procedure submitted and shall release the procedure for qualification tests. The Contractor shall carry out under field conditions at their own expense the procedure qualification test. A complete set of test results shall be submitted to the Owner/consultant representative Inspector for approval immediately after completing the procedure qualification test and at least 2 weeks before the commencement of actual work. All tests shall be carried out as per provisions of these specifications.

5.4 Radiography of the entire weld shall be carried out using the same source of radiation, radiographic technique and exposure time as that to be used for production weld.

6.0 QUALIFICATION OF WELDERS

6.1 Welders shall be qualified in accordance with the API 1104 and other applicable specificationsby the Contractor at their expense. The butt weld test pieces of the welder qualification tests shall meet the visual and the radiographic test requirements of this specification. The welder qualification tests shall be carried out using the welding procedure and the equipment that will be utilised during production welding. The welder qualification shall be done only on project line pipe. The Owner/Consultant representative inspector shall witness the test and certify the qualification of each welder separately. Only those welders who have been approved by the inspector shall be employed for welding. Contractor shall submit the welder qualification test reports and obtain express approval, before commencement of the work. It shall be the responsibility of Contractor to carry out qualification tests of welders. Guided bend tests shall also be conducted for welders to be qualified for station pipe welding. Retesting of a welder who has failed the qualification test shall be done only after approval of the Owner/ Consultantwho shall decide on the training requirements.

6.2 The welders shall always have in their possession the identification card and shall produce it on demand by the Owner/Consultant representative. It shall be the responsibility of the Contractor to provide the identity cards after it has been duly certified by the Owner/Consultant. No welder shall be permitted to work without the possession of identity card.

7.0 ALIGNMENT

7.1 Temporary attachments of any kind shall not be welded to the pipe. Welds joining the sections of the pipeline, valve installation or similar welds classified as tie-in welds shall be made in the trench. Otherwise the alignment and welding shall be made alongside the ditch with the pipe supported on skids, and pack pads or other suitable means placed at least 500 mm above the ground unless approved otherwise by the Owner/ Consultant in specific cases.

7.2 For welded pipes, longitudinal weld seams of adjoining pipes shall be staggered such that a minimum distance of 150 mm is maintained along the circumference and both longitudinal welds are at top 90º quadrant of the pipeline (Except for bends). A longitudinal joint shall pass an appurtenance of a structural element at a minimum distance of 50 mm. However theseshall not be applicable in case of a seamless pipe.

7.3 For pipe of same nominal wall thickness the off-set shall not exceed 1.6 mm. The off-set may be checked from outside using dial gauges. The welds for linings shall be so located that the toe of the weld shall not come within 50mm of any other weld. Cold dressing is permissible

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only in cases of slight misalignment and may only be carried out with a bronze headed hammer. Hot dressing shall not be permitted.

7.4 When welding pipes of different wall thickness, end connection shall be as per ASME B31.8. Ifrequired transition piece shall be used. This shall have a minimum of 1:4 taper. The welds shall be subjected to both ultrasonic and radiographic inspection.

7.5 The root gap shall-be accurately checked and shall conform to the qualified welding procedure. The use of internal Line-up Clamps is mandatory for pipe diameters 8" and above. However, in some cases (tie-in welds. flanges, fittings, small section etc.) where it is impossible to use internal Clamps, an external line-up clamp may be used.

7.6 The internal line-up clamp shall not be released before the entire root pass has been completed.

7.7 When an external line-up clamp is used, all spaces between bars or minimum 60% of the root pass length shall be welded before the clamp is released. The remaining pipe shall be adequately supported on each side of the joint.

Segments thus welded shall be equally spaced around the circumference of the pipe. Slag, etc. shall be cleaned off and the ends of the segments shall be prepared by grinding, so as to ensure continuity of the weld head.

8.0 JOINT PREPARATION

8.1 Before welding, all rust and foreign matter shall be removed from the bevelled ends by power operated tools at inside and outside edges for a minimum distance of 25mm from the edge of the weld bevel. Joints shall be swabbed with canvas belt or leather if required as per Owner/ Consultant's discretion. If any ends of the pipe joints are damaged to the extent that, in the opinion of Owner/ Consultant, satisfactory weld spacing cannot be obtained, and local repairby grinding cannot be successfully done, then the damaged ends shall be cut and bevelled to the satisfaction of the Owner/ Consultant, with an approved bevelling machine.

8.2 Manual cutting and repairing of bevels by welding is not allowed. In case laminations, split ends or inherent manufacturing defects are discovered in the pipe, then length of the pipe containing such defects shall be removed to the satisfaction of Owner/ Consultant. On pipes, which have been cut back, a zone extending 25 mm back from the new field bevel, shall be ultrasonically tested to the requirement of the line pipe specification to ensure freedom from laminations. The new bevel shall be 100% visual and 100% dye penetrate / MPI tested. A report shall be made and records maintained for all testing. The re-bevelled pipe heat number identification shall be maintained by transferring information to the new pipe end. Where the pipe is to be field cut and welded, the shop-applied coating shall be neatly peeled and grounded for a distance of 100 mm from the weld.

8.3 The parts and joints being welded and the welding personnel shall be adequately protected from rain and strong winds. In the absence of such a protection no welding shall be carried out. All completed welding work shall be protected from bad weather conditions.

9.0 PRODUCTION WELDING

Production welding shall be performed as per qualified welding procedure. If any change in essential variables is made then a new welding procedure has to be established and qualified.

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9.1 Welding Passes

a) Root pass is a critical welding activity, which shall be carefully carried out by the Contractor as per approved WPS. Root pass shall be made with branded electrodes/filler wires recommended in the qualified WPS. The size of the electrodes used shall be as per the approved welding procedure. It is recommend that immediately after the root pass the first hot pass is completed. However, Owner/Consultant's engineers at site can make this requirement mandatory as per site conditions.

b) Position or roll welding may be permitted. Separate procedures shall be submitted and qualified for up-hill, down-hill, vertical down and roll welding. Down hill welding shall be used when internal clamp is used. The vertical up method of welding shall be used for the root pass of the tie-ins, special crossings, fittings and special parts, fillet welds, repairs and when an external line up clamp is used. The down hill welding may be used for root run welding of tie- ins and special crossings when (i) the edges are machined or have equivalent preparation (ii) line up clamps are used and the fit up is geometrically and mechanically similar to one of the ordinary line welding without misalignment or unevenness.

c) Weld projection inside the pipe shall not exceed 2 mm.

d) Any deviations desired from the recommended welding technique and electrodes indicated in the WPS shall be adopted only after obtaining express approval of the Owner/Consultant.

e) Welding shall be continuous and uninterrupted during root pass. On completion of each run, craters, welding irregularities, slag, etc. shall be removed by stringing wire brush and chiselling. While the welding is in progress care shall be taken to avoid any kind of movement of the components, shocks, vibration and stresses to prevent occurrence of weld cracks.

f) The weld reinforcement shall not be in excess of 1/16" but the weld crown shall not be below the outside surface metal of the pipe.

g) Two welds shall not be started at the same location.

9.2 Joint completion

a) In general, single welder shall be used for welding of 6" pipe. The welding sequence shall be as per the qualified welding procedure specification. Once the deposit of the first pass has been started, it must be completed as rapidly as possible, reducing interruptions to the minimum. The welding and wire speed shall be approximately same as that established in the qualified welding procedure specification.

b) The interruption between completion of the first pass and starting the second pass shall be as stated in the procedure specification, normally not exceeding four minutes.

c) The time lapse between second and third pass shall be as stated in the procedure specification, normally not exceeding five minutes. Welding can be suspended, so as to allow the joint to cool down, provided that the thickness of the weld metal deposited is at least 50% of the pipe thickness. Upon restarting, preheating to at least of 100°C shall be carried out. Subsequent passes to weld completion shall be protected to avoid rapid cooling, if meteorological conditions so dictate. Cleaning between passes shall be done carefully so as toreduce the possibility of inclusions.

d) Electrode starting and finishing points shall be staggered from pass to pass. Arc-strikes outside the bevel on the pipe surface are not permitted, Arc-strike or arc-burn on the pipe surface outside the weld, which are caused accidentally by electrical arcs between the electrode, electrode holder, welding cable or welding cable round and the pipe shall be

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removed by grinding in accordance with a procedure approved by Owner/Consultant and the repair checked by ultrasonic, radiographic, magnetic particle or dye penetrate tests which the Owner/Consultant feels necessary. The pipe wall thickness after grinding shall not be lessthan the minimum thickness limit permitted for the pipe. Repair of arc strikes by welding is prohibited.

e) Tie-in weld shall be completed without delays and shall not be left incomplete overnight.

f) All Fillet weld and branch connections shall be as per ASME B 31.8. Pipes of equal diameter but unequal wall thickness shall be welded either with the help of transition piece or per weld design for unequal thickness as specified in ASME B 31.8. The completed weld shall be carefully brushed and cleaned and shall appear free from spatters, scales, etc.

g) During welding operation the coating shall be protected from weld spatter burning either by using a 600mm wide asbestos blanket or by Owner/Consultant approved procedures. The protection device shall be placed 50mm from the weld centre.

10.0 HEAT TREATMENT

10.1 Preheating

a) Preheating requirement for this project shall be minimum 100ºC or as per qualified welding procedure requirements if higher.

b) Preheating shall be performed using resistance, induction/heating methods or gas burners.

c) Preheating shall extend uniformly to at least three times the thickness of the joint, but not less than 50mm, on both sides of the weld. Preheating temperature shall be maintained over the whole length of the joint. During welding, temperature indicating crayons or other temperature indicating devices shall be provided by the Contractor to check the temperature.

d) Maximum interpass temperature shall be 250°C.

e) Pre-heating is also required prior to attachment of any branch connections or fittings on the line.

f) Asbestos blankets may be placed with the welds to slow the cooling rate as per procedure.

10.2 Post-weld heat treatment

a) The Heat treatment of welded joints shall be carried out as per the requirements laid down in ASME B.31.8 and other special requirements mentioned in approved WPS.

b) Post weld heat treatment shall be done by using an electric resistance or induction heating equipment, as decided by the Owner/Consultant.

c) While carrying out local post weld heat treatment, technique or application of heat must ensureuniform temperature attainment at all points on the portion being heat treated. Care shall be taken to ensure that, width of heated band over which specified, post weld heat treatment temperature attained is at least as that specified in the relevant applicable standards/codes.

d) Throughout the cycle of heat treatment, the portion outside the heat band shall be suitably wrapped under insulation so as to avoid any harmful temperature gradient at the exposed

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surface of pipe. For this purpose, temperature at the exposed surface of the pipe shall not be allowed to exceed 400°C.

e) Contractor shall submit detailed procedure for post-weld heat treatment specifying the temperature measurement, minimum no. of thermocouples to be used, details of the equipment to be used, method of execution etc. for approval.

f) Automatic temperature recorders that have been suitably calibrated shall be employed. The calibration chart of each recorder shall be submitted to the Owner/ Consultant prior to starting the heat treatment operation and its approval shall be obtained.

g) Immediately on completion of the heat treatment, the post weld heat treatment charts/records along with the hardness test results on the weld joints (whenever required as per the welding specification chart) shall be submitted to Owner/ Consultant for approval.

h) Proper identification of weld joint shall be maintained and same shall appear on the corresponding post weld heat treatment charts and in corresponding radiography films.

i) Hardness of the heat affected zone as well as of the weld metal, after heat treatment shall be measured using a suitable hardness tester by Vickers or Brinnel and shall not exceed the maximum hardness specified in the specification. The weld joint shall be subjected to reheat treatment, when hardness measured exceeds the specified Limit by the Contractor at his own expense.

11.0 INSPECTION & TESTING

11.1 Welding Procedure Qualification

For welding procedure qualification tests, standard tests as specified in the API 1104 shall be carried out in all cases. In addition to these tests, other tests like radiography, macro/micro examination, hardness tests, dye penetrate examination, Charpy V-notch etc. shall be carried out on specimens as per this specification. It shall be the responsibility of the Contractor to carry out all the tests required to the satisfaction of the Owner/consultant Inspector. The destructive testing of welded joints shall be as per Annexure-1.

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11.2 Visual inspection of the weld joint

Inspection of all welds shall be carried out by Owner/Consultant as per the latest editions ofthe applicable codes and specifications. All finished welds shall be visually inspected for alignment, excessive reinforcement, concavity of welds, shrinkage, cracks, under-cuts, dimensions of the weld, surface porosity and other surface defects. Under-cutting adjacent to the completed weld shall not exceed the limits specified in the applicable standard/code.

11.3 Non Destructive Examination

a) The non-destructive examination shall mainly consist of Radiographic examination and Ultrasonic Testing of the weld as detailed in Annexure-2.

b) Radiographic examination of all girth welds with 100% coverage of the weld shall be done as per requirement. All welds shall meet the criteria as set forth in API 1104 and as modified in this specification below

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Cracks	Cracks of any type size and shape including crater cracks are not acceptable.
Incomplete root penetration	Not acceptable
Lack of fusion at the root	Not acceptable
Burn through	Not acceptable
Excess weld penetration (internal)	> 2mm Not acceptable
Excess weld reinforcement (External)	> 3mm Not acceptable

c) Any weld which as a result of radiographic and/or ultrasonic examination in the opinion of Owner/Consultant exhibits imperfections greater than the limits stated in API-1104 latest edition or as superseded in this specification above shall be considered defective and shall be marked with an identification paint marker.

d) The Contractor shall make all the arrangements for the radiographic examination of work covered by the specification at his expense.

e) The Owner/Consultant will review all the radiographs of welds and inform the Contractor regarding unacceptable welds. The decision of the Owner/Consultant shall be final and bindingin this regard.

f) Ultrasonic inspection is required when 20mm or more are cut from the pipe. The pipe end as supplied shall be ultrasonically inspected for an additional length of 50 mm to assure no lamination exists.

i) In addition, ultrasonic inspection may be required for certain critical welding of the pipeline (i.e.tie-ins, welding of valves, flanges) randomly selected at Owner/Consultant's discretion. All tie- in welds shall be ultrasonically tested in addition to RT. All fillet and groove welds other than those, which are not radio graphically or ultrasonically examined, shall be examined by Dye Penetration or Magnetic Particle inspection techniques.

j) In case of gas cutting of pipe end, ultrasonic inspection shall be done for lamination/ checking before welding of Tie-in joints.

k) The Owner/ Consultant must approve all non-destructive test systems used for inspecting welds.

l) Suitable records shall be maintained by the Contractor as desired by the Owner/Consultant onthe day-to-day work done on welding radiography and ultrasonic testing. The Contractor shall present the records to the Owner/Consultant on a day-to-day basis and whenever demanded for approval.

11.4 Destructive testing

a) 0.1% of total number of welds completed shall be subjected to destructive testing by Owner/ Consultant as per Annexure - 1.

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b) In addition, welds already cut out for defects for any reason may also be subjected to destructive testing. If the results are unsatisfactory, welding operations shall be suspended and may not be restarted until the causes have been identified and the Contractor has adopted measures which guarantee acceptable results. If it is necessary in the Owner/Consultant's opinion the procedure shall be re-qualified.

c) If one production weld fails to conform to the specified requirements, the Contractors shall cut two additional weld joints from either side of the failed one and shall carry destructive testing as per the specification requirement. If both the joints fail the destructive examination, the entire length of pipeline under investigation shall be removed and the entire weld has to be cutand re-weld to the satisfaction of the OWNER/ CONSULTANT after conducting a root cause analysis.

d) Along with production weld destructive testing, base metal from same location shall also be removed and tested for all properties (Chemical and Mechanical) which are already performedin pipe mill except DWTT for verification, validation and acceptance.

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12.0 REPAIRS OF WELDS

12.1 With the prior permission of Owner/Consultant welds which do not comply with the standardsof acceptability, shall be repaired or the joint cut out and re-welded.

A separate welding procedure specification sheet shall be formulated and qualified by Contractor for repair welds simulating the proposed repair to be carried out. Separate procedures are required to be qualified for (a) through thickness repair (b) partial thickness repair. Welders shall be qualified in advance for repairs. Welders shall perform repair test weldbetween the 3 and 6 'O' clock positions for welding peel-earned in the 5G position. The root pass, for repairs opening the root, shall be replaced by the vertical uphill technique. The procedure shall be proven by satisfactory procedure tests pertaining to AP1-1104 including thespecial requirements of the specification, and shall also be subjected to metallographic examination, hardness surveys and Charpy tests to determine the effects of repair welding on the associated structure.

Root sealing or single pass repair deposit shall not be allowed. Internal root defects shall be grounded thoroughly and welded with a minimum of two passes. However, while grinding for repairs, care shall be taken to ensure that no grinding marks are made on the pipe surface anywhere. LPT shall be carried out to confirm removal of repair before welding.

The repair weld shall be subjected, as a minimum requirement, to the same testing and inspection requirements as the original weld, the entire joint shall be re-radiographed. A 100% ultrasonic inspection shall be done at the repaired area externally. Any repaired area that is wide, irregular or rough shall be rejected and a full cut out shall be done. The repair welding shall have a minimum preheat of 100ºC and shall be preheated for at least 150 mm on either side of repair.

Welds not meeting the specification after one repair shall be cut out. A report of all repairsshall be maintained by Contractor. All repairs shall be carried out on the day after initial radiography or earlier. A full report of all repairs made shall be submitted every day to the Owner/Consultant.

12.2 Elimination of repairs

Only one attempt for repair of any region is permitted. Repairs are limited to a maximum 30% of the weld length. For internal repairs or external repairs which open the weld root, only 20%

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of the weld length may be repaired. Repairs opening the root must only be carried out in the presence of Owner/Consultant. The minimum length of a repaired area shall be 100mm as measured over the-recapped length. Welds containing cracks shall be cut out and rebevelled to make joint. Owner/Consultant shall authorize all repairs.

12.3 Weather condition

Welding shall not be done in open areas during blowing sands, dust storms, high winds, rains or where relative humidity is higher than 75%. Welding at ambient temperature below 5ºC shall be done only with specially qualified procedure with controlled heating and cooling practices.

12.4 Marking

The Contractor according to the numbers assigned to the welders shall mark all welds on the top quarter of the pipe adjacent to the weld. Metallic dies shall not be used to mark on the pipe. Contractor shall furnish to Owner/ Consultant with all records of welder numbers and Joint numbers.

ANNEXURE – 1

1.0 DESTRUCTIVE TESTING OF BUTT WELDED JOINTS

1.1 Preparation

After the visual and the non-destructive inspection, the test weld shall be subjected tomechanical test.

After satisfactory completion of all visual and non-destructive testing the procedure test weld shall be set aside for a period not less than 72 hour. No further work on the test weld and no cutting of test specimens from the weld shall be performed until a period or at least 72 hours has expired.

Weld specimens shall be taken from the positions as per approved WPS. In addition to API 1104 tests the following tests of minimum numbers to be carried out as tabulated low:-

Type and Number of Test Specimens for Procedure Qualification Test and Production Welds

PIPE SIZE, OUTSIDE DIAMETER-INCHES	NUMBER OF SPECIMENS		
	MACRO	HARDNESS	IMPACT
Wall thickness- under ½ inch			
Under 2.375	0	0	0
2.375 to 4½	0	0	0
Over 4½ less than 14¾	2	2	12
12 ¾ and over	2	2	24
Wall thickness-over ½ inch			
4-½ and smaller	0	0	0

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Over 4 1/2 less than 12¾	2	2	12
12¾ and over	2	2	24

Macro and hardness shall be carried out, generally at the top and bottom of the joint suitablyas per approved WPS.

The test shall be carried out at laboratories approved by the Owner/Consultant. Thespecimens shall be prepared in accordance with the relevant standard code requirements.

1.2 Tensile strength

Specimens shall be taken from the position as per approved WPS. The test shall be carriedout in accordance with API 1104. Acceptance Criteria shall be as per API 1104.

1.3 Nick-break test

Specimens for nick-break test with notches, thus worked, can break in the base metal, instead of in the fusion zone; therefore an alternative test piece may be used after authorization by theOwner/ Consultant with a notch cut in the reinforcement of outside weld head to a maximum depth of 1.5 mm, measured from the surface of the weld head.

Acceptance Criteria shall be as per API 1104.

1.4 Macroscopic Examination

Specimens shall be taken from the positions as indicated in the approved WPS and shall be prepared in accordance with ASTM E2 and E3. One of the specimens shall be taken from the T-intersection at the line pipe seam weld.

The width of the macro-section has to be at least three times the width of the weld. The section is to be prepared by grinding and polishing and etched to clearly reveal the weld metal and heat affected zone.

Specimens shall be carefully examined under the microscope, with a magnification of at least 25 (25:1).

Owner/Consultant reserves the right to ask for a micrograph with 5 times (5:1) magnification, for Documentation purposes.

Under macroscopic examination, the welded joints shall show good penetration and fusion, without any defect exceeding the limits stated in the evaluation criteria of the Nick Break test.

1.5 Hardness Test

The prepared macro-section is to be used for hardness testing using the Vickers method (HV10). Test shall be made on selected specimen of weld joint. These series of reading shall be extended from unaffected base metal or one side across the weld to unaffected base metal on the other side. Three transverse shall be made as follows - first 2 mm from the outer edge, the second across the centre and third 2 mm from the inner edge. The specimen between the hardness impressions shall be 0.75 mm. The hardness impression nearest the fusion line shallbe within 0.5 mm.

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Hardness value shall not exceed 235 HV10 or as specified in approved WPS.

All the hardness values contained from the heat affected zone shall not exceed 40 HV with respect to the average hardness values obtained for the base metal. If these additional tests give hardness within the specification limit the slightly higher value may be accepted.

1.6 Charpy-V-notch Impact test

Specimens shall be taken from the position as per approved WPS. The test shall be carriedout in accordance with ASTM-370.

Five test specimens shall be taken from each sample and they shall be cut and worked so thattheir length is transverse and perpendicular to the weld bead with the notch position. The notch shall be perpendicular to the rolled surface. The test specimen width shall depend upon the pipe wall nominal thickness as following:

Nominal wall thickness in mm	Test specimen width in mm
6.4	2.5

The test shall be carried out as in accordance with ASTM-370.

Test pieces shall be immersed in a thermostatic bath and maintained at the test temperature for at least 15 minutes. They shall then be placed in the testing machine and broken within 5 seconds of their removal from the bath.

The test temperature shall be 0º and -20 °C.

The acceptable values of the impact energy shall be as follows:

Temp (° C)	Average of three specimens (Note 2) Joules (Minimum)	Any single value (Note1) Joules (Minimum)
0	100	80
-20	35	28

Note:

1. These values are specified for resistance to brittle fracture only. Where additional requirements are specified by Owner/Consultant, the same shall be followed.

2. Two samples of the highest and lowest values shall be discarded.

1.7 Bend test requirements

The Bend test Specimens shall be made and tested as per the requirements of API 1104.The

acceptance criteria shall be as per API 1104.

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ANNEXURE-2

1.0 ULTRASONIC INSPECTION

Ultrasonic inspection is required to be performed on the pipeline field welds as per conditions listed in this specification. This section concerns manual ultrasonic Inspection. However ultrasonic inspection by automatic equipment shall be used only with Owner's/consultant's approval.

1.1 Equipment and Operators

The operators shall be qualified by a Third Party Inspection Authority. All operators shall bequalified as per AST-SNT-TC-1A minimum level II.

The Owner/Consultant has the option of checking the ability of personnel employed forultrasonic testing by means of qualification tests.

1.2 Specification for Ultrasonic Testing Procedure Qualification

Before work begins, the Contractor shall present a specification describing the proposedprocedure qualification and calibration methodology.

This specification shall state, as an indication only but not limited to the following information:

- Type of UT equipment used
- Details for calibration
- Type and dimensions of transducers
- Frequency range
- Coupling medium
- Inspection technique
- Record details
- Reference to the welding procedure where it is intended to adopt the weld location.
- Temperature range of the joints to be inspected.

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The ultrasonic inspection procedure shall be approved by the Owner/ Consultant. The Contractor shall make welds (according to the same production procedure) having typical defects which are intended to be detected by ultrasonic testing.

This test shall be conducted in the presence of the Owner/ Consultant. The Ultrasonic inspection procedure shall be approved by the Company.

1.3 Test procedure

Circumferential welds shall be inspected from both sides using angled probes.

If, during the test, echoes of doubtful origin appear, it shall be necessary to inspect a convenient area on the pipe surface, close to the weld, with a straight beam transducer in order to check whether any manufacturing defects are present which could have interferedwith the ultrasonic beam.

The equipment shall include but not be limited to the following:

- Ultrasonic equipment and coupling medium
- Sample sections for calibration of instruments

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– Equipment for cleaning of surface to be examined
– Rules calibrated in centimeters for exact location of the position of defects.

1.4 Reference Blocks

The efficiency of the equipment used, the effective refraction angle of the probe, and the beamoutput point, shall be checked using a V_1 and V_2 sample block, IIW type or the calibrationblock ASTM E-428.

1.5 Amplification during production testing

The amplification during production testing shall be obtained by adding 2-6 dB (according to the surface condition of the pipe and its cleanliness) to the reference amplification.

1.6 Qualification of Ultrasonic Testing Operators

At any time during the project, Owner/ Consultant may ask for a qualification test for the ultrasonic equipment operator. Minimum qualification of the operator shall be ASNT-Level–II.

1.7 Evaluation of indications given by ultrasonic tests

Each time that echoes from the weld head appears during production testing, the instrument amplification shall be altered to coincide with the reference amplifications and the probe shall be moved until maximum response is obtained, paying attention all the time to the probe-tube coupling.

If under these conditions, the height of the defect echo is equal to or greater than that of the reference echo, the defect shall be evaluated according to section 15.4 of this specification. If the detect has also been detected by the radiographic and/or visual examination, the dimensions shall be judged according to the type of examination which detects the greater defect. Returns which are less than 50% of the reference echo will not be considered. If returns are above 50% but lower than 100% of the reference echo, and if the operator has good reasons to suspect that the returns are caused by unfavorably oriented cracks, he shall inform the Owner/Consultant. Moreover, when there is a defect to be repaired, such defect shall be removed for a length corresponding to the one where no more return echo is given.

1.8 Other equipment

The use of rules calibrated in centimeters, attached if possible to the probe, for the precise location of the position of welding defects, is recommended. Defect location is effected by measuring the projection distance between the probe output and the reflecting surface.

The operators carrying out the tests shall have, besides the probing instrument, tools for cleaning the pipe surface (tiles, brushes, etc.) as well as the coupling liquid or paste appropriate for the temperature of the section to be examined.

2.0 RADIOGRAPHIC TESTING

2.1 Proposed Radiographic examination procedure shall be submitted by the Contractor forapproval.

2.2 The procedure of radiographic examination shall be qualified to the entire satisfaction of Owner/Consultant prior to use. It shall include but not be limited to the following requirements

i) Only Lead foil intensifying screens, at the rear of the film shall be used for all exposures.

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ii) Type 2 and 3 films as per: ASTM E-94 shall be used.

iii) A densitometer shall be used to determine film density. The transmitted film density shall be between 2.0 and 3.5 throughout the weld. The unexposed base density of the film shallnot exceed 0.30.

iv) Radiographic identification system and documentation for radiographic interpretation reports and their recording system.

v) Film type and brand, film processing methods, exposure conditions (kV, mAmin, Cmin).

vi) Type of penetrameters, Radiographic technique and number of exposures.

vii) Type of radiation source (power, local spot size etc).

viii) Diameter and thickness of pipe to be inspected and weld/welder numbering system,

2.3 The Contractor shall qualify each procedure in the presence of the Owner/Consultant prior to use.

2.4 All the girth welds of mainline shall be subjected to 100% radiographic examination. Each weldshall be clearly and permanently numbered adjacent to weld or down stream side.

2.5 When the radiation source and the film are both on the outside of the weld and located diametrically opposite each other, the maximum acceptable length of film for each exposure shall not exceed the values given in API 1104. The minimum film overlap, in such cases, shall be 40mm. The ellipse exposure technique may be used on nominal pipe sizes of 2 inch and smaller provided that the source of film distance used is a minimum of 12 inch. When such a procedure is used exposure of 90º to each other shall be obtained.

Penetrameters shall be placed on both source and the film side. The sensitivity level achievedshall be satisfied by penetrameter on the source side.

2.7 Films shall have no fogs, spots or makes and shall not be exposed to back scatter radiation.All weld spatter, debris, foreign matter and other detects which interferes with the interpretation of the radiograph shall be removed from the weld area.

2.8 Three copies of each acceptable radiographic procedure and three copies of radiographic qualification records shall be supplied to Owner/Consultant. One set of the qualifying radiographs on the job shall be kept by the Contractor's authorized representative to be used as a standard for the quality of production radiographs during the job. The other two sets shall be retained by Owner/Consultant for its permanent record.

2.9 Three copies of the exposure charts relating to material thickness, kilo voltage, source of film distance and exposure time shall also be made available to Owner/Consultant by the Contractor.

2.10 The Contractor shall provide all the necessary facilities at site, such as a dark room with controlled temperature, film viewer etc. to enable the Owner/Consultant to examine the radiographs.

2.11 The Contractor, if found necessary, may modify the procedure of radiographic examination suiting to the local conditions prevailing. This shall, however, be subject to the approval of the

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owner/Consultant. Owner/Consultant shall have live access to all the Contractor's work facilities in the field.

2.12 Any approval granted by the Owner/Consultant shall not relieve the Contractor of his responsibilities and guarantees.

2.13 Radiation source

Radiographic examination shall be carried out using X-radiation's. Radiographic examination by Gamma rays may be allowed, at the discretion of the OWNER, in ease of inaccessible joints. X-ray equipment shall have sufficient power (voltage and current) for the diameter and thickness of the pipeline to be inspected.

2.14 Level of quality

The quality level of Radiographic sensitivity required for radiographic inspection shall be 2%.

2.15 Penetrameters

The image quality indicator (abbreviation: IQI) shall be used for the qualification of the welding procedure and during normal line production. Radiographic sensitivity shall be measured with the wire image quality indicator (Penetrameter). The penetrameter shall be selected according to DIN54109 or IS01027. The placement of the penetrameter shall be as per approvedprocedures.

The sensitivity limit may be considered to have been reached when the outline of the IQI, its identification number and the wire of the required diameter show up clearly on the radiograph.

The Owner/consultant may authorize use of types of IQI other than those planned, provided that they conform to recognized standards and only if the Contractor is able to demonstrate that the minimum sensitivity level required is obtained. For this demonstration, a test shall be carried out comparing the IQI specified and the Contractor's to show up the identification number and other details of the proposed IQI, which must be visible in the test radiograph.

2.16 Film Identification Markers

All films shall be clearly identified by lead numbers, letters, and/or markers. The image of the markers shall appear on the films, without interfering with the interpretation. These markers positions shall also be marked on the part to be radio graphed and shall be maintained during radiography.

2.17 Protection and Care of Film

All unexposed films shall be protected and stored properly as per the requirements of API 1104 standard and ASTM E.94.

The exposed and unexposed film shall be protected from heat, light, and dust and-moisture. Sufficient shielding shall be supplied to prevent exposure of film to damaging radiation prior to and following the use of the film for radiographic exposure.

Film processing (development, fixing, washing etc.) shall comply with supplier's requirements and as per ASME Section V SE-94.

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2.18 Re-Radiography

The weld joints shall he re-radiographs in ease of unsatisfactory quality of the radiographs, at the expense of the Contractor.

All the repaired weld joints shall be re-radio graphed at no extra cost to the Owner/Consultant in the same manner to that followed for the original welds. In addition, the repaired weld areas shall be identified with the original identification number plus the letter R to indicate the repair.

When evaluating repair film, radiographers shall compare each section (exposure) of the weld wall the original film to assure repair was correctly marked and original defect removed.

The Owner/Consultant will review prior to any repair of welds, all the radiographs of welds which contain, according to the Contractor's interpretation unacceptable defects. The final disposition of all unacceptable welds shall be decided by the Owner/Consultant.

2.19 Qualification of Radiographers

Pipeline radiographers shall be qualified in accordance with the requirement of API 1104 andto the full satisfaction of Owner/Consultant and as per AST-SNT-TC-1A Level II.

Certification of all the radiographers, qualified as per above, shall be furnished by the CONTRACTOR to the Owner/Consultant before a radiographer will be permitted to perform production radiography. The certificate record shall include:

The radiographers shall be required to qualify with each radiographic procedure they use, priorto performing the work assigned to him in accordance with the specification.

2.20 Preservation of Radiographs

The radiographs shall be processed to allow storage of films without any discoloration for at least three years. All the radiographs shall be presented in suitable folders for preservation along with necessary documentation.

All radiographs shall become property of the Owner/ Consultant.

2.21 Equipment and Accessories

Contractor shall make necessary arrangements at his own expense, for providing the radiographic equipment, radiographic films and all the accessories for carrying out the radiographic examination for satisfactory arid timely completion of the job. The Contractorshall be responsible for obtaining necessary permits regarding, holding use and transport of sources.

2.22 Radiation Protection

Contractor shall be responsible for the protection and personnel monitoring of every man with or near radiation sources.

The protection and monitoring shall comply with local regulations. Contractor shall be responsible for complying with all rules and regulation set forth by Atomic Energy Commission or any other Government of India agencies in this regard and Owner/Consultant shall not be responsible. Owner/Consultant shall be kept indemnified at all times by the Contractor.

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2.23 Safety Instructions

The safety provisions shall be brought to the notice of all concerned by display on a notice board at prominent place at the work spot. The person responsible for the "safety" shall be named by the Contractor.

3.0 MAGNETIC PARTICLE & DYE PENETRANT TESTING

3.1 For welded joints and for detection of surface defects that cannot be radio graphed or ultrasonic tested either dye penetrant or magnetic particle inspection shall be called out after approval of the Owner/consultant.

3.2 The procedure for magnetic particle examination shall contain as a minimum the following information for approval by the Owner/consultant.

- Type and size of material to be examined.
- Type of magnetization and equipment
- Type of ferromagnetic particles used
- Method of surface preparation
- Magnetization current
- Type of ferromagnetic particle used.

3.3 The area being examined shall be magnetized in at least two direction perpendiculars to each other. The non-fluorescent particles (wet order) shall have sufficient contact with respect to the surface to be examined.

3.4 The surface to be examined shall be made free of grease, dirt, oil, scale, oxides, etc.

3.5 MPE shall not be performed on parts whose temperature exceeds 300°C.

3.6 Magnetic particle operators and dye penetrant shall be qualified to ANSI-SNT-TC-1A Level II or equivalent as approved by Owner/ Consultant.

3.7 Dye penetrant examination procedure shall also be submitted to Owner/ Consultant for approval.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR CONCRETE WEIGHT COATING

ENG-STD-PL-DOC-TS-003

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1.0 SCOPE

This specification defines the minimum technical requirements for the materials, workmanship, application, inspection, handling and other activities for anti-buoyancy measures using external concrete weight coating of pipeline.

2.0 CODES AND STANDARDS

Reference has been made in this specification to the following codes and standards:

a)	ASTM A-185	:	Specification for Steel Welded Wire Reinforcement, Plain for Concrete Reinforcement
b)	ASTM C-642	:	Test Method for Specific Gravity, Absorption and Voids in Hardened Concrete
c)	ASTM C-138	:	Test Method for Unit Weight, Yield and Air Content of Concrete
d)	ASTM C-309	:	Specification for Liquid Membrane Forming Compounds for Curing Concrete
e)	ASTM A-82	:	Specification for Steel Wire, Plain, for Concrete Reinforcement
f)	ASTM C-39	:	Test Method for Compressive Strength of Cylindrical Concrete Specimens
g)	IS - 269	:	Indian Standard Specification for Ordinary and Low Heat Portland Cement (1959; Reaffirmed1999)
h)	IS – 456	:	Plain and Reinforced Concrete – Code of Practice (3rd Revision – 2000)
i)	IS – 6909	:	Indian Standard Specification for Super Sulphated Cement (1990; Reaffirmed 1997)
j)	IS-8112	:	Indian Standard Specification for Ordinary Portland Cement
k)	IS-383	:	Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete
l)	IS-2386 (PART I thru' VIII)	:	Indian Standard Methods of Test for Aggregates forConcrete

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m)	IS-516	:	Method of Test for Strength of Concrete
n)	IS:1566	:	Indian standard for Hard-drawn steel wire fabric for concrete reinforcement

3.0 MATERIALS

The Contractor shall supply all the materials necessary for the performance of the work.

All materials supplied by the Contractor, which in the opinion of Owner, do not comply with the appropriate specifications shall be rejected and immediately removed from site by Contractor at his own expense.

All materials for concrete coating shall comply with following requirements.

3.1 Cement

3.1.1 Portland Cement (conforming to IS-269), or High Strength Ordinary Portland Cement (conforming to IS-8112) shall be used. Cement which has hardened or partially set or has become lumpy shall not be used. Test certificates from the cement Manufacturer shall be supplied to the COMPANY for all cement delivered to site.

3.1.2 Super sulphated Cement shall be (conforming to IS 6909) used wherever the soil is corrosive.

3.1.3 Cement which is more than six months old shall not be acceptable.

3.1.4 In case concrete weight coating is to be provided at location affected by seawater tidal flats etc. Portland cement in accordance with ASTM C-150 Type III shall be used.

3.2 Aggregates

3.2.1 Aggregate shall comply with the requirements of IS: 383 and shall be tested in accordancewith IS:2386.

3.2.2 Fine Aggregates

'Fine Aggregates' shall mean any of the following, as defined in IS: 383:

i) Natural sand;
ii) Crushed stone sand;
iii) Crushed gravel sand;

Sand shall be well-graded from fine to coarse in accordance with Table 4 of IS: 383.

3.1.3 Coarse Aggregates
Use of coarse aggregates shall be subjected to Owner's approval.

3.1.4 Aggregates shall be clean and free from injurious amounts of salt, alkali, deleterioussubstances or organic impurities.

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3.3 Water

The water shall be fresh and clean and shall be free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. It shall not contain chlorides, sulphates, and magnesium salts.

Water from source shall be tested by the Contractor at his own expense before use and thetest reports shall be submitted to the Owner's representative for approval.

3.4 Reinforcement

Concrete coating shall be reinforced by a single layer or multiple layers of steel reinforcement according to the provisions hereinafter described. Reinforcement shall be Fe415.

3.4.1 Reinforcement shall consist of welded steel wire fabric manufactured in rolls (ribbon mesh) or in flat sheets and shall conform ASTM A-185. Steel wires in the ribbon mesh shall conform to ASTM A-82.

3.4.2 Steel wires shall be galvanized at finished size. The diameter of the wire and wire spacing (mesh) dimensions shall be selected according to the following criteria.

3.4.2.1 Wire fabric manufactured in rolls (ribbon mesh) shall be 25 x 50 mm of 14 gauge U.S. steelwires (2mm wire). The above dimensions will be applied unless otherwise specified by Owner.

3.4.2.2 Wire fabric manufactured in flat sheets shall be 50 x 100mm max. steel wire mesh, 13 gauge2.5mm thickness. As a rule wire fabrics (sheets) shall be used when concrete coating is applied by casting method, while ribbon mesh (rolls) shall be used when concrete coating is applied by impingement method.

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4.0 COATING REQUIREMENTS

Pipes shall be concrete coated to a thickness as specified in the relevant drawings and as per the design documents. CONTRACTOR shall be permitted to select any proportioning of materials to achieve the specified requirements of concrete density and weight by doing mix
design and trial tests.

Concrete shall conform to the following standards:

Property	Minimum Acceptable Value
Concrete Density	2400 Kg/m^3
Compressive Strength (After7 Days)	235 Kg/cm^2
Compressive Strength (After28 Days)	350 Kg/cm^2

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5.0 APPLICATION METHOD

Concrete coating shall be applied by casting or impingement method. Any alteration or modifications to the method described in the specification shall be submitted to the Owner for approval. The application method shall however ensure the basic characteristics of concrete coating in compliance with the minimum requirements of this specification.

Contractor shall submit to the OWNER, prior to commencement of work, the procedure ofconcrete application for approval.

Wherever practical, the specified total thickness of concrete coating shall be applied in asingle pass.

6.0 EQUIPMENT

The equipment used for performing the concrete coating shall be capable of doing so witha reasonable degree of uniformity with respect to density, thickness and strength. The proportioning equipment and procedure shall be of the type to ensure consistently proportioned materials by weight. Concrete shall be mixed in a mechanical mixer, which shall ensure thorough mixing of all materials. Any equipment that tends to separate the ingredients shall not be used.

7.0 MEASUREMENTS & RECORDS

Contractor shall submit detailed methodology in their procedure for measurement and logging. All Measurements as mentioned below shall be taken during the work stages and clearly logged in a proper logbook. A special logbook shall be used for recording tests and trial results. A logbook shall refer to pipe lengths having the same nominal diameter, and wall thickness.

7.1 The logging methodology shall include minimum the following details:

a) Line pipe

1) Field identification number
2) Mill serial Number
3) Length (m)
4) Average outside diameter (mm)
5) Weight (Kg)

b) Concrete Weight Coating

1) Batch identification number
2) Date of placing of concrete coating.
3) Average concrete coating thickness.
4) Wet weight of coated pipe (weight and date of weighing)
5) "Dry weight" of concrete coated pipe
   (Weight and date of weighing or related weight 28 days after placing of concrete andso identifiable).
6) "Unit dry weight" of concrete coated pipe.
7) "Negative buoyancy" (unit) of concrete coated pipe

7.2 No concrete placing shall be done before items 1 to 5 listed in 7.1(a) have been logged. In addition, each batch / shift shall be identified and logged against cube samples taken for compressive

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strength and dry density.

8.0 PROCEDURE QUALIFICATION

Before commencement of the work, Contractor shall perform all tests, either in thelaboratory or in field to properly select type of mix, which meets the requirements of section 5.0 of this specification.

8.1 The type of mix, i.e., the correct combination of the cement, aggregates and water which results in the desired properties of concrete shall be first determined. For each mix the following shall be accurately checked and recorded:

i) Proportions and weights of the respective materials used
ii) The water/ cement ratio
iii) The grading of the aggregates.

8.2 Samples shall be prepared and tested in accordance with ASTM C-642 to determine the dry specific gravity (28 days after placing).

8.3 When the results of the above tests do not meet the requirements, the mix shall be modified and concrete samples tested until a proper mix has been determined.

8.4 The mix so determined shall then be used for sampling of concrete to be submitted to compressive strength tests as per IS 456/ ASTM C-39.

8.5 Frequency of sampling for tests for density and compressive strength of concrete shall be asfollows:

Quantity* of Concrete (m^3)	**Number of Samples**
Up to 25	3
26 to 50	4
51 and above	4 samples and one additional sample for each additional 50 m^3 or part thereof.
* Quantity is the volume of concrete to be used for each qualified mix.	

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9.0 APPLICATION OF REINFORCEMENT AND CONCRETE COATING

9.1 Two test cubes each per day shall be obtained from batches and tested at the end of 7 days after coating, for compressive strength and specific gravity.

9.2 The moisture content of the aggregates used shall be such as to maintain a satisfactory control on the water / cement ratio of the concrete mix.

9.3 To maintain the water / cement ratio constant at its correct value, determination of moisturecontents in both fine aggregates and coarse aggregates (if used) shall be made as frequently as possible. Frequency for a given job shall be determined by the Owner according to weather conditions.

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9.4 Reinforcement application

9.4.1 Prior to placing of reinforcement, the protective coating of each pipe length shall be carefullyinspected visually and by holiday detectors. If damages are found, they shall be repaired

before start of the work. Foreign matters, if any, shall be removed from the surface of theprotective coating.

9.4.2 Reinforcement shall be placed around the pipe in such a way as to cover whole pipe lengthor sections to be concrete coated. The reinforcement shall protrude a minimum 75 mm from the finished concrete coating at the pipe ends.

9.4.3 Splices and attachments shall be done by binding with steel wire having 1.5mm diameter.

Circular and longitudinal joints of wire fabric in sheets shall be lapped at least for onemesh. The spiral lap shall be one mesh while the spliced lap shall be three meshes.

9.4.4 Reinforcement shall rest on synthetic resin spacers forming a "Crown" whose number shall be such as to avoid contact of the steel reinforcement with the pipe's protective coating. Spacing between the two consecutive 'crown' centres shall be 500 to 1000 m.

9.4.5 One layer of reinforcement steel shall be provided for concrete thickness up to 60 mm. The reinforcement steel shall be embedded approximately midway in the concrete coating thickness. For concrete thickness above 60mm two layers of reinforcing steel shall be provided. If application method requires more than one pass of concrete, one reinforcement layer for each pass is to be applied irrespective of the concrete coating thickness.

9.5 Concrete placing

9.5.1 Concrete shall be placed within a maximum of 30 minutes from the time of mixing (adding water to mix) and shall be handled in such a way so as to prevent aggregate segregationand excessive moisture loss. Concrete containers shall continuously be kept clean and free from hardened or partially hardened concrete.

9.5.2 Placement of concrete shall be up to the specified thickness in one continuous course, allowance being made for splices of reinforcement and providing reinforcement in the right location.

9.5.3 No passes shall be stopped for more than 30 minutes. Before placing fresh concrete against the joint, the contact surfaces shall be carefully cleaned and wetted to obtain a good bond between the fresh material and the previously placed material.

9.5.4 All pipes shall be kept clean and free from cement, concrete and grout either inside or outside of the uncoated sections.

9.5.5 The coatings at each end of the pipe shall be bevelled to a slope of approximately two-to- one (2:1).

9.5.6 Bevel protectors shall be kept in place throughout the coating application and even after the coating is complete.

Suitable means shall be provided to ensure that the temperature of the concrete, whenplaced, does not exceed 32°C.

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9.6 Winter concrete coating

9.6.1 In ambient temperatures below 4 °C concrete must be protected from the effects of frost by warming the aggregates and / or warming of the mixing water and additionally ensuring anair temperature of 6 °C in the vicinity of the concrete.

9.6.2 Storing and curing of coated pipe shall not take place at temperatures below 1.5 °C, until theconcrete has aged sufficiently to have achieved a crushing strength of at least 10 N/mm^2.

9.7 Reclaimed concrete

9.7.1 Use of reclaimed rebound shall be done only with the written permission of the Owner and tothe satisfaction of the Owner's inspector.

9.7.2 When use of reclaimed rebound is permitted by the Owner, this material shall be added to and thoroughly intermixed with freshly batched concrete in a secondary mixture of a type, acceptable to the Owner's representative.

9.7.3 The amount of reclaimed material used shall not exceed 5% of the total mix by weight and shall only be added in an even flow during a continuous coating operation.

9.8 Cut back on concrete coating

Both ends of each joint for the distance of 250mm or as specified in the Contract documentshall be completely free of concrete to facilitate field joints.

9.9 Handling after application

Contractor shall take precautions to prevent detrimental movement of pipe after coating andto minimize handling stresses whilst concrete is hardening and curing.

Identity of each pipe shall be preserved during and after the coating process by transfer ofpipe information to and outside of concrete coating at each end of the all pipes.

9.10 Curing

9.10.1 Immediately after concreting, the exposed surfaces of the concrete shall be protected during hardening from the effects of sunshine, drying winds, rain, etc., and then after the initial set has taken place, the concrete coating shall be properly cured. The coated pipe section shall be handled gently by suitable means to prevent undue distortion.

9.10.2 Curing shall be performed by application of an approved curing membrane using sealing compounds and shall meet the requirements of ASTM C-309. The curing compound material shall be stored, prepared and applied in strict conformity with the instructions of the Manufacturer. The ingredients of any such compound shall be non-toxic and non- inflammable and shall not react with any ingredient of the concrete, the reinforcement, the anti-corrosion coating or steel pipe. The application of the curing compound shall be done immediately after the coating is completed and preferably before the pipe is removed from the concrete coating apparatus. The surface of the concrete shall be lightly sprayed with water before applying the curing compound. The membrane curing period shall not be less than 4 days, during which period the freshly coated pipes shall not be disturbed. The pipe surface shall be kept wet during daylight hours for seven days after application of the concrete coating. The concrete coating shall not be allowed to dehydrate.

Before handling and hauling of the concrete coated pipes, a check shall be made to makesure that the concrete coating is properly cured. Stacking and shipment of the coated pipes

shall be initiated only after seven days provided that the concrete coating suffers nodamage.

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10.0 TOLERANCES

10.1 Contractor shall maintain a surface tolerance of ± 6mm on outside diameter of the coated pipes measured by diameter tape. The diameter of each coated pipe shall be obtained at five (5) points, spaced at equal intervals between end points.

10.2 The acceptance weight tolerance for any single pipe shall be limited to (-) 2% to (+) 5% ofthe calculated theoretical weight. The theoretical weight shall be calculated using total weight of the pipe with concrete and corrosion coating.

10.3 Acceptable weight tolerance from the approved mix, during production shall be as follows:

i) ± 3% for each type of aggregate

ii) ± 2% for aggregate as a whole

iii) ± 3% for the total quantity of water

iv) ± 3% for cement

11.0 WEIGHING

11.1 The test specimen shall be selected at equal intervals during the course of production.

11.2 Contractor shall weigh each pipe when dry prior to shipment and 28 days after placing of concrete and mark the weight with paint on the inside of the pipe

12.0 INSPECTION AND TEST

12.1 After curing, every length of concrete coated pipe shall be non-destructively tested by suitable means such as "ringing" to determine if any suspected defects are present. In case this indicates faulty coating, cores shall be removed from coating and inspected. When defective coating appears from cores, the concrete coating shall be removed from the pipe lengths.

12.2 Every length of concrete coated pipe shall be checked to verify insulation between steel reinforcement and pipe by means of a megger or equivalent device. For this purpose provisions should be made during placing of concrete such as to leave at least a point of exposed steel reinforcement whenever the latter shall terminate inside of concrete coating.

12.3 During the tests above and before transporting of concrete coated pipes, every pipe length shall be visually inspected to detect whether any damages and/or defects are present. Possible damages and/or defects with their allowable limits are described at following section. Repairable concrete coating shall be clearly marked while the non-repairable ones shall be removed from the pipe lengths.

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13.0 COATING OF FIELD WELDS

13.1 The CONTRACTOR shall coat the uncoated pipe surface at field welds in accordance with methods approved by OWNER. CONTRACTOR shall submit a detailed procedure for joint coating for OWNER's approval.

13.2 The reinforcement for the field welds shall be same as that for line pipe coating with thesame number of layers and the same space between layers as for the existing coating. The edges of this netting must be carefully secured with galvanized wire to the reinforcement extending from the existing coating.

The reinforcement shall not make direct /electrical contract with the pipe.

Synthetic resin spacer blocks shall be used to keep the reinforcement away from thecorrosion coated pipe surface.

13.3 The composition of the concrete shall be the same as that of the reinforcement free from the pipe coating.

13.4 When moulds are used, the CONTRACTOR shall prevent air being trapped by applying mechanical vibrators or by striking the outside of the moulds with suitable sticks.

14.0 REPAIRS

The following are repairs that will be permitted to coating due to unavoidable damage inhandling and in storage (This applies only to concrete that has set).

14.1 Spalling due to compression or shearing caused by impact against other objects. Spalling isdefined as damage, which causes a loss in concrete of more than 25 percent of the total thickness of the coating at the point of damage.

14.2 Damage due to spalling of an area of less than 0.1 m^2 (1 square foot) where the remaining concrete is sound will be accepted without repairs.

14.3 Damage due to spalling of an area of more than 0.1 m^2 and less than 0.3 m^2 shall have the concrete remaining in place over that area removed as necessary to expose the reinforcing steel throughout the damaged area. Edges of the spalled area shall be under-cut so as to provide a key lock for the repair material. A stiff mixture of cement, water and aggregate shall be trowelled into and through the reinforcement and built up until the surface is level with the coating around the repair. The pipe shall then be carefully laid with the repaired area at the top. The repaired area shall be moist cured for a minimum of thirty six (36) hours before further handling.

14.4 Should the damaged area be more than 0.3 m^2, coating shall be removed around the entire damaged area. A repair shall be made by satisfactorily restoring the reinforcement, forming the area with a metal form and pouring a complete replacement of materials similar to that from which the coating was made. The mixture shall be one (1) part of cement to three (3) parts of aggregate and the necessary water to produce a slump not to exceed 100 mm (four inches). The resulting coating shall be equal in weight, density, uniformity, thickness, strength and characteristics to the originally applied coating. The pipe shall then be carefullylaid in a position where it shall be allowed to remain for a minimum of 36 hours before furtherhandling.

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15.0 MARKING

15.1 Every concrete coated pipe length shall be clearly marked by a suitable type of paint (i.e.,red and/or white lead paint). Markings out of concrete coating shall be made inside of pipe close to bevel end, in such a way that the area involved by welding operations is not affectedby paint.

15.2 For each concrete coated pipe length, at one of the two ends, the field identification number and the date of concrete placing shall be marked, while the dry as well as the wet weight along with number of days after coating shall be marked at the other end.

16.0 UNLOADING, TRANSPORTATION, STORING AND HAULING

16.1 During loading, transport, unloading and hauling of inert aggregates, any contact and mixing with mud, earth, grease and any other foreign material shall be carefully avoided. Precautions shall be taken to prevent contamination, to maintain the cleanliness and against effects of hot or cold weather or other adverse climatologically condition.

16.2 During the operations of loading, unloading and stock-piling, the pipe sections shall be handled in such a way so as to avoid damages to pipe ends, protective and/or concrete coating.

16.3 Stacks shall consist of a limited number of layers such that the pressure exercised by the pipes' own weight does not cause damages to coating. Stacking with more number of layersshall be agreed upon with the OWNER provided that each pipe section is separated by means of spacers suitably spaced so as to avoid stresses and compressed points of contact on the coated surface.

16.4 Materials other than pipes and which are susceptible of deteriorating or suffering from damages especially due to humidity or other adverse weather conditions, shall be suitably stored and protected.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR PIPELINE CROSSING RAIL, ROAD AND MINOR WATER WAYS

ENG-STD-PL-DOC-TS-004

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1.0 SCOPE

1.1 This Specification defines the minimum technical requirements for the various activities to be carried out by Contractor for the installation of pipelines at rail, roads, minor waterways and other service crossings.

The provisions of this specification are not applicable for pipelines crossing water courses,which are specifically designated as "Major Water Courses" in the CONTRACT.

2.0 CODES AND STANDARDS

Reference has been made in this specification to the latest edition/ revision of the followingcodes, standards and specification.

a)	ASME B 31.8	:	Gas Transmissions and Distribution Piping System
c)	API RP 1102	:	Steel Pipeline Crossing Railroads and Highways
c)	RDSO report no. BS- 105	:	Guidelines on Pipeline Crossings under Railway Track

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3.0 GENERAL

3.1 Laying of pipeline at crossing of roads, railroads, buried services, canals and minor watercourses is allowed only after obtaining approval from the authorities having jurisdiction. Contractor shall make suitable arrangements for safeguarding the roads, etc., and the verges and/or banks thereof and the buried services with appropriate provisions.

3.2 Highways, main-roads and railroads and their verges and banks of water crossings are not allowed to be used for loading, unloading or stacking of materials and/ or equipment. For secondary roads, such loading/ unloading is permitted only after prior approval from the concerned authorities CONTRACTOR is not allowed to close or divert roads or water courses without prior approval from the COMPANY and the concerned authorities. CONTRACTOR shall never unnecessarily hamper the users of the roads, railroads, buried services and/ or water courses. The water flow shall not be obstructed in any way.

3.3 The Owner/ Consultant reserves the right to demand a detailed report including the following information for individual crossing for approval:-

- Time Schedule
- Working methodology
- Equipment and Manpower deployment
- Test Procedure
- Soil Investigation

3.4 Pipeline sections for crossings of roads, railroads, canals and rivers etc., shall be hydrostaticallypre-tested ex-site, prior to joint coating and post tested after installation, whenever:

3.4.1 Crossing is executed by boring/ HDD;

3.4.2 Crossing is installed in casing pipe;

3.4.3 River crossing pipes which are to be continuously concrete weight coated (to be tested priorto concrete coating);

3.4.4 Whenever, in OWNER's opinion, the repair of pipeline at crossing, in case of a leak during final hydrostatic testing, would require inordinate amount of effort and/ or time;

3.4.5 Whenever pretesting is insisted upon by the Authorities having jurisdiction over the utility crossed.

3.5 Cased crossings (rail/road) and rivers crossing sections shall be pressure tested before and after installation for a period of at least four (4) hours. Such sections shall be retested along with completed mainline sections.

3.6 Pipeline sections at all major crossings like State/ National Highways, railways, major canals and lined canals/distributaries shall be laid by boring with casing pipe complying with all other statutory requirements.

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3.7 Contractor shall take suitable measures for the protection of pipeline from overhead high tension power lines by providing plastic gratings/concrete slabs as per approved drawings/ jobstandards.

4.0 ROAD AND RAIL ROAD CROSSINGS

4.1 The work under crossing shall include necessary clearing, grading and trenching to required depths and widths, welding of casing (when required) and carrier pipes, coating, lowering-in, backfilling, clean-up, restoration to the original condition and further strengthening and protective works, testing, installation of assemblies, insulators and seals and temporary works such as sheet pilling, bridges, etc.

4.2 The work shall be carried out in accordance with the approved drawings/ job standards, as directed by Owner/Consultant and to the satisfaction of Owner/Consultant and the authorities having jurisdiction over the facility crossed. The work carried out for road and railroad crossings shall meet the minimum requirements of API RP 1102, latest edition.

4.3 Before the installation work of crossing commences the Contractor shall provide suitable barricade, temporary bridge/bypass work (especially where roads are open-cut) with railing, if required by Owner/Consultant for safety of traffic. Adequate traffic warning signals and/or traffic lights and suitable diversions shall be provided as directed by Owner/ Consultant or authorities having jurisdiction over these areas. Such diversions shall not cross the pipeline where it has already been installed, unless proper safeguarding at Owner's/ Consultant's opinion is ensured.

4.4 Prior approval from the statutory authorities shall be obtained to lay the pipeline across highways/roads either by boring or by open-cut method. Installation of the crossing shall be by the method (i.e., boring/ open-cut) approved by Authorities having jurisdiction. Railroad crossings shall always be bored/ jacked.

4.5 Pipeline can cross the road with open cut method without any casing pipe if there is no specificinstruction in concerned authority's permission. In such a case, crossing section shall be laid on soft soil/ sand bed of trench at specified required depth. The section shall be back filled with sand only. Subsequently the road shall be repaired/ constructed by appropriate methods to avoid sand erosion during monsoon. It shall be ensured that the road has been restored to it's original condition to the entire satisfaction of owner/ consultant and the authority having jurisdiction over the road.

4.6 Boring/ jacking of carrier pipes for crossings is allowed only if the pipes for boring/ jacking are provided with a suitable corrosion coating and CONTRACTOR remains liable for the suitability of the pipe and weld-coating of carrier pipes to be bored and for which coatingand method of application are anyhow to be authorised by COMPANY without prejudice to CONTRACTOR's liability. In all other cases the carrier pipes shall be cased.

4.7 Before start of the boring/ jacking CONTRACTOR shall execute a soil investigation and determine the ground water table. Based on these investigations CONTRACTOR shall prepare a construction drawing and submit to COMPANY for approval including time schedule and soil investigation report. The CONTRACTOR shall submit for approval of COMPANY the method of boring / trenchless to be carried out, depending on the nature of soil conditions, nature of crossing, local requirements etc.

4.8 During the execution of boring the ground water table over the length of the boring shall be lowered up to at least 0.50 M below bottom of the pipeline. This water table is to be regularly inspected and maintained by CONTRACTOR and reported to COMPANY. To safeguard the stability of the bore pit, CONTRACTOR shall, if necessary in COMPANY's opinion, use a closed sheet piling which shall extend at least over 50% of the length in undisturbed soil. The length of the boring shall be in accordance with the length of the ROW of the crossing (road, railroad, etc.) with minimum 0.6 m extra on either side.

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4.9 In approaches to the crossing, CONTRACTOR shall eliminate unnecessary bending of pipeby conforming to the contour of the ground by gradually deepening the ditch at such approaches as directed by the OWNER.

4.10 The bottom of the trench and/ or the pit for at least twelve (12) metres at the approachto each end of a casing shall be graded and if necessary backfilled with clean sand and compacted to an elevation that will provide sufficient and continuous support to the pipeline sothat the pipeline remains correctly aligned at the casing ends during and after backfilling.

4.11 The diameter of the hole for a bored section shall have a hole diameter as close as practicable to the outside diameter of the carrier or casing pipe. If excessive void or too large hole results, or if it is necessary, in the opinion of OWNER, to abandon the bored hole, prompt remedial measures such as filling the hole with suitable material shall be taken to the entire satisfaction of the OWNER and Authorities having jurisdiction thereof at no extra cost to OWNER. Equipment used for installation of casing pipe shall be of the type approved by OWNER.

4.12 An installation consisting of hydraulic jacks shall be provided with easily readable pressure gauges (in bar) and sealable pressure limits. Their proper operation shall be demonstrated before the work is started. COMPANY can request that the maximum pressing force be limited.

4.13 At the front of the pipe there may be a cutting ring which may be 12mm larger than the outside diameter for the pipe or casing. A lubricating pipe can also be used in jacking, the nipples of which shall not protrude from the cutting edge. Said lubricating pipe shall not befixed to the pipe casing. When jacking, only biologically degradable lubricants shall be used

4.14 Removal of soil from the pipeline during jacking shall be done mechanically by means of a standard, locked auger, which has to be safeguarded against jacking ahead of the pipe.

4.15 During jacking the progress of the pipe to be jacked and the cutting capacity of the augershall be mutually adjusted, by regulating the speed of the auger, to prevent the road from bulging (rpm too low) or cave-ins (rpm too high). In any case no more soil shall be removed than the volume of the pipe. The auger drive shall be provided with a clutch.

4.16 The progress in the work, the readings of the gauge pipes, the jacking pressures observed, etc., shall be recorded in a log book, to be shown to OWNER upon request.All information shall be supplied to OWNER on completion of the work.

4.17 If the jacking fails, the casing shall not be withdrawn. It shall be filled with sand and pluggedat either end. The diameter of the casing pipe shall conform to API RP 1102 recommendations or as directed by the Engineer – in - charge.

4.18 OWNER reserves the right to inspect certain lengths of pipes to assess damages, if any, to the corrosion coating of the carrier pipe used for boring. CONTRACTOR shall weld additional lengths of pipe and pull the required extra lengths of OWNER 's inspection. If during inspection any defects are noticed, CONTRACTOR, in consultation with OWNER, shallcarry out the remedial measures required.

4.19 While welding of the casing and vent/ drain pipes, internal high or low is not allowed.

4.20 Welding of casing and vent/ drain pipes need not be radio-graphed, however, only normal visual checks

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shall be carried out. Before welding, the single length of pipe shall be inspected in order to check that there is no out of roundness and dents. When such defects are noticed, these must be completely removed before joining the pipes. If these defects cannot be repaired, the defective section shall be cut out.

4.21 In the case of crossing where excavation has been authorised, the welding for the casing pipe and for a continuous section of the pipeline corresponding to the expected length shall be carried out in the proximity of the crossing. Casing must be laid immediately after the trenching. Casing pipe must be laid with a single gradient in order to allow for an easy insertion and, if necessary at a future date, to allow for the removal or replacement of the pipeline, leaving the casing undisturbed.

4.22 The assembly of vent pipe units as approved by OWNER shall be carried out by direct insertion and welding to the ends of the casing pipe before introducing the carrier pipe.The operation of assembling and extending the vent pipe shall be carried out in such a way that there is no contact with the carrier pipe. The painting/ coating of the vent pipes shall be applied before backfilling as per relevant specifications.

4.23 The casing pipe shall be considered ready for installation of the carrier pipe, after careful inspection and internal cleaning with the removal of soil, mud, stones and other foreign materials.

4.24 Insulators, as approved by OWNER, shall be securely fastened (cadmium plated) to the pipe with all bolts and fixtures firmly tightened. The number of insulators and spacing shall be as shown in the drawings or at 2.5m intervals (whichever is more stringent). At the end of both sides of the casing, a double set of insulators shall be installed.

4.25 Care must be taken in pushing or pulling carrier pipe into the casing so that the pipe is aligned correctly in the casing and that the pushing or pulling force is evenly and constantly applied to avoid damages to the insulators. A nose piece having a diameter equal to that of thepipe shall be welded on the front and back end of the carrier pipe to facilitate installation ofthe carrier pipe properly in the casing and to keep it dry and clean.

4.26 After installation of the carrier pipe section, the casing and the appurtenances, but prior to making tie-in welds and backfilling, an electrical test shall be conducted by the CONTRACTOR in the presence of the OWNER, to determine the resistance between the casing and the carrier pipe or the carrier pipe and the soil. These tests shall show at least a

resistance of 100 kΩ/m^2. After backfilling and compaction, additional tests shall be conducted to determine if the casing is electrically shorted to the pipe. If the installation is found to be shorted, CONTRACTOR shall make the necessary corrections and repairs at his cost, until a test to the satisfaction of the OWNER is obtained.

5.0 CROSSING OF BURIED SERVICES

5.1 The pipeline under construction may pass above or below the existing buried facilities such as pipelines, cables, etc. Type of crossing shall be such that a minimum depth of cover, as required in the drawings and specifications, is guaranteed. The minimum clearance required between pipeline and the existing facility shall be 500mm unless otherwise specified.

5.2 Whenever buried services in the ROW are to be crossed by Contractor, Contractor shall safeguard the buried facilities and the required protecting precaution shall be executed as approved by Owner/Consultant of the buried service.

For buried services to be crossed by boring /jacking, the provisions of relevant Operator specification shall be followed.

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6.0 MINOR WATER WAYS

6.1 Minor water crossing are crossings of (future) ditches, distributaries, canals, water courses, rivers, streams, etc., whether the bed(s) contain(s) water or not, and not being specified as 'Major Water Crossing' in the Contract.

6.2 Whenever minor water crossings in the ROW are to be crossed, Contractor shall install suitable temporary bridges as advised by Owner/consultant / Authority jurisdiction and further comply with the provision as laid down in this specification.

6.3 Before executing the work, Contractor shall carry out detailed survey to determine the natureof flow rate of the watercourse with the object of determining what precautions are necessary to be taken care during period of execution.

6.4 In the case of crossings of watercourses for which no special methods of laying are required, crossing spool piece shall be assembled and subsequently laid. Bends shall be of cold field type.

6.5 Whenever required by Owner/Consultant, Contractor shall, before start of construction, execute a soil investigation. Based on such soil investigation he shall prepare construction drawings, work method, Equipment and Manpower deployment and time schedule for approval by Owner/Consultant.

6.6 The depth of the existing bottom of a minor watercourse crossing shall be determined in relation to the adjacent ground level by taking the average of four measurements.

6.7 Contractor shall take special care to check with the concerned authorities for special conditions applying to working on, over, under or through minor water crossing and Contractorshall comply with all such conditions. Written arrangements with authorities shall be drawn up in co-operation with Owner/Consultant.

6.8 The minimum cover over the pipe shall be as specified in the relevant approved drawings and specifications.

6.9 For crossings beneath the bed of watercourses, the pipe section shall be made in such a way that it conforms to the existing or future bed as indicated in the approved drawings. In crossings for which an individual drawing has not been prepared, the minimum cover of the pipeline shall not be less than that indicated in the standard drawings for a similar type of crossing.

6.10 Whenever the crossing requires a straight section of pipe between the lower bends coinciding with the riverbed, this section shall be laid at a single horizontal level.

6.11 For crossing of ditches, canals, banked channels, etc., by boring, the pipe section shall be prepared, laid and tested in accordance with the applicable provisions of Section 3.0 of this specification.

6.12 The Contractor shall arrange temporary installation on diversion as may be necessary; to ensure the effective functioning of watercourses to be crossed, to the entire satisfaction of the concerned local authorities as well as the Owner.

6.13 Banks and trenches of minor water crossings shall be backfilled with soil which is to be approved by Owner/Consultant and shall be thoroughly compacted to prevent soil and bank erosion as per the drawings and standards to the satisfaction of authorities having jurisdiction thereof and Owner/Consultant.

6.14 Whenever boulders, rock, gravel and other hard objects are encountered, they shall not be placed directly on the pipe. Sufficient earth, sand or other selected and approved backfill material shall be placed initially around and over the pipe to provide a protective padding or cushion extending to a minimum thickness of 30 centimeters around the pipe before backfilling remainder of the trench with excavated or other

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material as per approved drawings and standards.

6.15 After the trench has been backfilled and during the clean-up works, the minor water crossing shall be cleaned at least across the whole width of the ROW.

6.16 When specified in the Contract, Contractor shall repair the ditch/ river/ stream bank with materials to be supplied by him. The excavation shall be backfilled with well compacted soil, followed by a minimum 0.25m thick layer of properly shaped boulders (75mm to 150mm) encased in a net of galvanized iron wire of dia 3mm spaced at a maximum distance of 50mm to be laid over the backfilled, compacted and graded banks.

6.17 The crossing of any embankments shall be carried out strictly in accordance with approved drawings.

6.18 No drilling work on embankments shall be permitted without prior written approval from the relevant Authorities.

7.0 CASED CROSSING

7.1 Jacking of line pipe for crossing are not allowed at any circumstances. Whenever boring is to be carried out, casing pipe shall be used.

Before start of the boring/jacking, Contractor shall carry out a soil investigation and determine the ground water table. Based on such investigations, Contractor shall prepare construction drawing, methodology, equipment and manpower deployment details and submit the same to Owner/Consultant for approval which shall also include work schedule and soil investigation report.

During the execution of the boring the ground water table over the length of the boring shall belowered up to at least 0.50m below bottom of the pipeline. This water table is to be regularly inspected and maintained by Contractor and reported to Owner/Consultant.

To safeguard the stability of the bore pit, Contractor shall, if necessary in Owner/Consultant's opinion, use a closed sheet piling, which shall extend at least over 50% of the length in undisturbed soil. The length of casing pipe shall extend to the crossing (road, railroad, etc.), minimum 0.6m extra on either side of the crossing (Road, railroad, etc.).

In approaches to the crossing, Contractor shall eliminate unnecessary bending of pipe by conforming to the contour of the ground by gradually deepening the ditch at such approaches.

7.2 The bottom of the trench and/or the pit for at least twelve (12) meters at the approach to each end of a casing shall be graded and if necessary backfilled with clean sand and compacted upto at least 95% Proctor density to an elevation that will provide sufficient and continuous support to the pipeline so that the pipeline remains correctly aligned at the casing ends during and after backfilling.

7.3 The diameter of the hole for a bored section shall have diameter as close as practicable to theoutside diameter of the carrier or casing pipe.

Equipment proper operation shall be demonstrated before the work is commenced to the satisfaction of Owner/Consultant.
Removal of soil from the pipeline during jacking shall be done mechanically by means of a standard, locked augur, which has to be safeguarded against jacking, ahead of the pipe. If, in the opinion of the Owner/Consultant, fluid sand may arise, an inner pipe with funnel shall be used.

7.4 During boring/jacking the progress of the pipe to be jacked and the cutting capacity of the auger shall be mutually adjusted, by regulating the speed of the augur, to prevent the road from bulging (rpm too low) or cave-ins (rpm too high). In any case no more soil shall be removed than the volume of the pipe. Augur drive shall be provided with a clutch.

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7.5 During the progress of the work, readings of the gauge pipes, jacking pressure observed etc. shall be recorded in a logbook which should be presented to Owner/Consultant upon request. All information shall be supplied to Owner/Consultant on completion of the work.

7.6 Owner/Consultant reserves the right to inspect certain lengths of pipes to assess damages, if any, to the corrosion coating of the carrier pipe used for boring. Contractor shall weld additional lengths of pipe and pull the required extra lengths for Owner's inspection. If during inspection any defects are noticed, Contractor, in consultation with Owner/Consultant, shall carry out the remedial measures required.

7.7 All the execution of the work, loading/unloading of material shall be carried out within the proximity of the crossing as allotted by Owner/Authorities. Casing must be laid with a single gradient in order to allow for an easy insertion and, if necessary at a future date, to allow for the removal or replacement of the pipeline, leaving the casing undisturbed.

7.8 Welding of casing and vent/drain pipes need not be radiographed, however, only normal visual inspection shall be carried out. Before welding, the single length of pipe shall be inspected in order to check that there is no out of roundness and dents. If these defects cannot be repaired, the defective section shall be cut out.

7.9 The assembly of vent pipe units as approved by Owner/Consultant shall be carried out by direct insertion and welding to the ends of the casing pipe before introducing the carrier pipe. The operation of assembling and extending the vent pipe shall be carried out in such a way that there is no contact with the carrier pipe. The painting/coating on the vent pipes shall be applied before backfilling as per relevant specifications/approved procedures.

7.10 The casing pipe shall be considered ready for installation of the carrier pipe, after careful inspection and internal cleaning with the removal of soil, mud, stones and all other foreign materials.

7.11 Insulators, as approved by Owner/Consultant, shall be securely fastened to the carrier pipe with all bolts and fixtures firmly tightened. The number of insulators and spacing shall be as shown in the project drawings or at 2.5 meters whichever is more stringent. At the end of both sides of the casing, a double set of insulators shall be installed. Casing insulators and end materials are to be conformed as per Section 8.0 & 9.0 of this specification.

7.12 Care must be taken in pushing or pulling carrier pipe into the casing so that the pipe is alignedcorrectly in the casing and that the pushing or pulling force is evenly and constantly applied to avoid damages to the insulators. A nose piece having a diameter equal to that of the pipeshall be welded on the front and back end of the carrier pipe to facilitate installation of the carrier pipe properly in the casing and to keep it dry and clean.

7.13 After installation of the carrier pipe section, but prior to making tie-in welds and backfilling, an electrical test shall be conducted by the Contractor in the presence of the Owner/Consultant, to determine the resistance between the casing and the carrier pipe or the carrier and the soil. These tests shall show at least a resistance of 100000-ohm/m^2 after backfilling and compaction. Additional tests shall be conducted to determine, if the casing is electrically shorted to the pipe. If the installation is found to be shorted, Contractor shall make the necessary corrections and repairs, until a test to the satisfaction of the Owner is obtained.

8.0 CASING INSULATORS

Pipeline insulators shall be used to support the carrier pipe inside the casing pipe andelectrically isolate the carrier pipe from the casing pipe at the cased crossings.
Manufacturer shall obtain prior approval from Owner/ Consultant on drawing/design of casinginsulators.

8.1 It shall be made in segments duly held together with cadmium plates. Bolts and nuts are to be supplied

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with casing insulators.

The number of segments shall be two for pipe diameters up to 12" (generally). For larger diameters, the number of segments may be more than two, but their number shall be kept minimum.

Casing insulators shall be made of injection moulded high density polyethylene or other material equivalent or superior as approved by Owner/Consultant and shall meet the requirements given in Table-1.

TABLE – 1: MATERIAL PROPERTIES FOR CASING INSULATORS

PROPERTY	VALUE	ASTM TEST METHOD
Dielectric Strength	450-500 Volts/Mil	D-149
Compressive Strength	3200 psi	D-695
Tensile Strength	3100-5000 psi	D-638, D-651
Impact Strength	4 ft.lb./inch of notch	D-256
Water Absorption	0.01%	D-570

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9.0 CASING END-SEALS

Casing end seals are intended to be used for sealing the annular space between casing pipeand carrier pipe at casing ends so as to prevent ingress of moisture and water.

Manufacturer shall obtain approval from Owner/Consultant on design/ drawing of end seals.

The seals shall be suitable for the casing and carrier pipe diameter as applicable for each case.

The casing end-seal shall be flexible to cater for the expansion and contraction of carrier andcasing pipes and shall be able to tolerate both angular and concentric misalignment of casing pipe without loss of sealing efficiency.

The casing end-seals shall be made of heat shrink high density radiation cross linked polyethylene with an adhesive having a melt point suitable for the pipeline service temperature and ambient temperature foreseen during construction. End-seals material shallbe resistant to heat, cold, vibration, impact, abrasion, corrosive fluids, disbanding, organic and bio-deterioration.

Material for casing end seals shall meet the requirements given in Table-2.

TABLE – 2: MATERIAL PROPERTIES FOR CASING END SEALS

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PROPERTY	VALUE	ASTM TEST METHOD
Backing (Sleeve and closure patch) Tensile Strength Ultimate Elongation Heat Shock	 2200 psi 400% No visual cracks, flow or drips (at 250°C, 4 hours)	 ASTM D-638 ASTM D-638 ASTM D-2671
Adhesive Ring and Ball softening point Lap Shear	 90°C 60°C – 25 psi 23°C – 250 psi (2 inch/min.)	 ASTM E-28 ASTM D 1002
System Peel strength (to casing and carrier pipe and closure patch)	 5 psi (10 inch/min.)	 ASTM D-1000

9.1 Inspection And Testing For Insulator & End Sealings:

Manufacturer/ contractor shall furnish material test certificates of the components used in theassembly of casing insulators and end seal.

The manufacturer / contractor shall replace, at no extra cost, any material not conforming to the material and performance requirements of this specification.

Manufacturer / contractor shall submit detailed specification of the materials used in the assemblies, along with instructions for handling, use and installation of the material for OWNER approval prior to procurement.

9.2 Documentation

Manufacturer shall submit documentation for Casing insulators and End seals, which shallinclude the following as minimum:

a. General Arrangement Drawings
b. Test and material certificates of all components used in the assembly of casing insulatorsand end seals.
c. Application Procedures / Manuals

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR FIELD JOINT COATING

ENG-STD-PL-DOC-TS-005

BGL/632/2024-25

1	22.01.16	Issued for client approval				
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1.0 SCOPE

This specification establishes the minimum requirements of materials, equipment and installation of field joint anti-corrosion coating of buried onshore pipelines factory coated with three layer polyethylene or three layer polypropylene by heat shrink wraparound sleevesconforming to DIN EN 12068 class C– "Cathodic Protection – External Organic Coatings for theCorrosion Protection of Buried Steel Pipelines". Unless modified / replaced by this specification, all requirements of DIN EN 12068 shall remain fully applicable and complied with.

This specification shall be read in conjunction with the conditions of all specifications and contract documents between Owner/ Consultant and Contractor.

2.0 CODES AND STANDARDS

Reference has also been made to the latest edition (edition enforce at the time of floating the enquiry) of the following standards, codes and specifications:

a)	ISO 8502 – 3	:	Preparation of Steel Substrates before Application of Paints and Related Products – Part 3 - Assessment of Dust on Steel Surfaces Prepared for Painting (Pressure Sensitive Tape Method)
b)	ISO 8503 – 1	:	Part 1: Specification and definitions for ISO surface profile comparator for the assessment of abrasive blast cleaned surfaces.
c)	ISO 8503 – 4	:	Part 4: Methods for calibration of ISO surface profile comparator and for the determination of surface profile – Stylusinstrument procedure.
d)	SIS-055900	:	Pictorial Surface Preparation Standard for Painting Steel Surfaces
e)	SSPC-SP1	:	Steel Structure Painting Council.
f)	DIN EN12068	:	Cathodic Protection – External Organic Coatings for the Corrosion Protection of Buried Steel Pipelines
g)	DIN 30672	:	Coating of corrosion protection tapes and heat shrinking products for pipelines
h)	ASTM D-638	:	Standard method of test for tensile properties of plastics.
i)	ASTM D-149	:	Standard Test Methods of Dielectric Breakdown voltage and Dielectric strength of solid electrical insulating materials at commercial frequencies.

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j) ASTM D-257 : Standard Test Methods for D-C Resistance or conductance of insulating materials.

k) ASTM D-570 : Standard Method of Test for Water Absorption of Plastics.

In case of conflict between the requirements of this specification and that of above referred documents, the most stringent requirements shall be followed.

3.0 MATERIALS AND EQUIPMENT

Contractor shall supply joint coating materials, all equipment and manpower required for a skillful and adequate application of coating in the field in accordance with the specifications.

Contractor shall submit and demonstrate to Company proposed materials and works procedures for applying field coating and repair procedures for same. These proposed procedures and all materials, equipment and tools used in the work shall be subject to Owner's approval.

3.1 Field Joint Corrosion Coating Material

Field joint anti-corrosion coating material shall be either heat shrinkable wraparound sleeve orcold applied tape suitable for a maximum operating temperature of (+) 65°C (T_{max}) and shall conform to designation EN 12068 – C HT 60 UV. In addition the field joint anti-corrosion coating shall comply the requirements specified in para 3.3 of this specification. Also suitable coating material shall be applied for 3LPP coated pipes (if any) subject to the owner's approvals,other than Dirax sleeve for HDD crossings.

3.2 Heat Shrinkable Wraparound Sleeves

Heat shrinkable wraparound sleeve shall consist of radiation cross-linked, thermally stabilized,ultraviolet resistant semi-rigid polyolefin backing with a uniform thickness of high shear strengththermoplastic/ co-polymer hot melt adhesive. The joint coating system shall consist of a solventfree epoxy primer applied to the pipe surface prior to sleeve application. The backing shall beprovided with suitable means (thermo-chrome paint, dimple, or other means) to indicate the desired heat during shrinking in field is attained. The sleeve shall be supplied in pre-cut sizes tosuit the pipe diameter and the requirements of overlap.

The total thickness of heat shrinkable wraparound sleeve in the as applied condition shall be asfollows:

Pipe Size (Specified Outside Diameter)	Thickness (mm)	
	On Pipe Body (Min.)	On Weld Bead (Min.)
4" (114.3 mm) to 10" (273.0 mm)	2.5 mm	2.0 mm
12" (323.9 mm) to 18" (457.2 mm)	2.5 mm	2.0 mm
20" (508.0 mm) to 30" (762.0 mm)	3.0 mm	2.5 mm
≥ 32" (812.8 mm)	3.0 mm	2.5 mm

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The heat shrink wraparound sleeve shall have the required adhesive properties when appliedon various commercial pipe-coating materials. The pre-heat and application temperatures required for the application of the shrink sleeve shall not cause loss of functional properties ofthe pipe coating.

The Contractor shall propose the specific grade of field joint coating system meeting the requirements of this specification from manufacturers. In case the Contractor proposes to supply heat shrinkable wraparound sleeve then the Contractor shall propose only those coatingsystems that have been previously used in pipelines of same or higher than the size indicated intender and above in a single project for similar operating conditions.

3.3 Functional Requirements of Field Joint Coating

3.3.1 Properties of the PE backing shall be as follows:

Sl. No.	Properties	Unit	Requirement	Test Method
a.	Tensile Strength @+25ºC	N/mm^2	> 12	DIN EN 12068
b.	Ultimate Elongation @+25ºC	%	> 250	DIN EN 12068
c.	Dielectric withstand with 1000 Volts/ sec	KV	> 30	ASTM D 149
d.	Water absorption, @+25ºC for 24 hours	%	<0.05	ASTM D 570
e.	Volume Resistivity @+25ºC	Ohm-cm	> 10 15	ASTM D 257

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NOTE: Thermal Ageing Resistance is as per DIN EN 12068.

3.3.2 Functional Properties of Joint Coating System (As applied) As applied field joint coating systemshall comply the requirements of DIN EN 12068, Table 1 and 2 corresponding to designation DIN EN 12068

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– C HT 60 UV, except as modified below :

Cathodic Disbondment Resistance at T_{max} i.e. (+) 60°C shall be 20 mm when tested as perAnnexure K of DIN EN 12068. Test shall be carried out at (+) 60°C

Peel Strength shall be as follows:

Peel Strength	Temp	Unit	Requirement for Mech. Resistance Class C (minimum)	Test Method as per DIN EN 12068
Inner to Inner + Outer to Inner	@ 23ºC	N/mm	1.5	Annexure B
	@T max	N/mm	0.3	
Outer to Outer	@ 23ºC	N/mm	1.5	
	@T max	N/mm	0.3	
To Pipe Surface	@23ºC	N/mm	3.5	Annexure C
	@T max	N/mm	0.5	
To Factory Coating	@23ºC	N/mm	3.5	
	@T max	N/mm	0.5	

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Contractor shall obtain prior approval from Owner/Consultant regarding the Manufacturer of thejoint coating material and the specific grade of the joint coating system. Complete technical details along with test certificates complying with the requirements of clause
3.2.1 and 3.2.2 shall be submitted to Owner/ Consultant for this purpose. The Contractor shallfurnish test certificates from an independent DIN recognized/approved laboratory for all the properties required for the specified EN designation of field joint coating and the requirements ofthis specification.

3.4 The materials shall not be older than their period of validity at the time of application by Contractor. Deteriorated/decomposed material shall be disposed off and replaced by Contractorat his own expense.

Contractor shall ensure that the coating materials supplied by him are properly packed andclearly marked with the following:

Manufacturer's name

Material qualification

Batch number

Date of manufacturing and date of expiry

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CONTRACTOR shall be responsible for arranging all equipment and manpower required for application, testing and inspection of coating and all required materials for field joint coating inaccordance with this specification.

3.5 Contractor shall ensure that the Manufacturer has carried out all quality control tests on each batch and manufacturer shall provide test certificates to certify that the supplied materials meetthe manufacturer's specifications as indicated in the purchase order and as approved byOwner/Consultant. Certificates and data sheets certifying the qualities of the coating materialsshall be submitted by Contractor to Owner/Consultant prior to application. Owner/Consultantreserves the right to have the materials tested by an independent laboratory.

3.6 Materials shall be stored in sheltered storage in the manufacturer's original packing and awayfrom direct sunlight and in accordance with manufacturer's instructions.

3.7 Contractor shall provide and maintain mobile facilities which contain all necessary equipmentand its spares for cleaning, coating, repairs, inspection and tests.

3.7 Contractor shall furnish sufficient number of the following equipment and the required spares as a minimum for inspection and test purposes for each crew:

a) Fully automatic full circle adjustable holiday detector with a visible and audible signal systemfor inspection of coatings.

b) Thickness gauge for measuring thickness.

c) Contact type temperature recording thermometer.

d) Roughness profile measuring (Stylus) instrument

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4.0 APPLICATION PROCEDURE

4.1 General

4.1.1 The application procedure shall be in accordance with manufacturer's instructions and the minimum requirements specified below, whichever are the most stringent and shall bedemonstrated to and approved by the Owner/Consultant. Manufacturer's expert shall supervisethe application and shall be available at site upon request during qualification of application procedure and during construction at Contractor's cost.

4.1.2 Operators for coating application shall be given necessary instructions and training before startof work, by the Contractor. To verify and qualify the application procedures, all coating applied during the qualification test shall be removed for destructive testing as detailed subsequently inthis specification. Contractor shall only utilize those operators who have been approved/pre- qualified by the field joint coating manufacturer.

4.1.3 Oil, grease and salt shall be removed from steel surface by wiping with rags soaked with suitable solvents such as naphtha or benzene. Kerosene shall not be used for this purpose.

4.1.4 Each field joint shall be blast cleaned using a closed cycle blasting unit. Steel or chilled shot andiron grit shall be used and Garnet material with the second one. During blast cleaning the pipe surface temperature shall be simultaneously more than 5°C or more than 3°C above ambientDew Point, while the ambient Relative Humidity shall not be greater than 85%. Prior to surfacecleaning the surfaces shall be completely dry. The surface shall be cleaned to a grade Sa 2½in accordance with Swedish Standard SIS-055900 with a roughness profile of 50 – 70 microns. Surface roughness profile shall be measured using an approved profile comparatorin accordance with ISO 8503-1 and shall be calibrated prior to the start of the work in accordance with ISO 8503-3 or ISO 8503-4. The blast cleanliness shall be checked on every joint and the roughness profile shall be checked for 1 out of every 10 joints.

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Dust, girt or foreign matter shall be removed from the cleaned surface by a suitable industrial cleaner. The dust contamination allowed shall be of a rating max 2 as per ISO 8502 -3. The frequency of checking for dust contamination shall be 1 out of every 10 joints.

Blast cleaned field joint shall be coated within 2 – 4 hours according to the conditions below :

- Relative Humidity (RH) > 80 % - 2 hours
- Relative Humidity (RH) 70 - 80 % - 3 hours
- Relative Humidity (RH) < 70 % - 4 hours

Pipes delayed beyond this point or pipes showing any visible rust stain, shall be blast cleanedagain.

4.1.5 The field joint surface shall be inspected immediately after blast cleaning and any feature of the steel surface such as weld spatter, scabs, laminations or other imperfectionsconsidered injurious to the coating integrity made visible during blast cleaning shall be reportedto the Owner/Consultant and on permission from Owner/Consultant, such defects shall be removed by filing or grinding. Pipes affected in this manner shall be then re-blasted cleaned ifthe defective area is larger than 50 mm in diameter.

4.1.6 The ends of existing pipe protective coating shall be inspected and chamfered. Unbounded portions of the coating shall be removed and then suitably trimmed. Portions where parent coating is removed shall be thoroughly cleaned as specified. The adjacent chamfered areasof the line pipe coating shall be cleaned and abraded, to expose a clean uniform fresh surface of uncontaminated factory applied coating.

4.1.7 All steel joint surfaces shall be thoroughly examined before the application of the coating in order to ensure the surfaces are free of oil, grease, rust, mud, earth or any other foreign matter.All these substances shall be removed before coating, to the procedures herein described.

4.1.8 Protection coating shall be applied on the joints immediately after the completion of cleaning operation.

4.2 Application Procedure for Heat Shrink Wraparound/Sleeves

In addition to the requirements stated above, following shall be complied with:

4.2.1 The wrap around sleeve shall be of a size such that a minimum overlap of 50 mm is ensured (after shrinking) on both sides of the yard applied corrosion coating of pipes.

In the cases where carrier pipe is installed by direct boring/jacking, the overlap on the mill coating for the leading edges of the joints shall be minimum 200 mm. When this extra overlapis achieved by providing an additional patch of heat shrink tape/wraparound, it shall be applied in such a manner that the square edge of the patch on the joint coating is in the direction opposite to the direction of boring / jacking.

4.2.2 Before centring the wraparound sleeve, the bare steel surface shall be preheated either with atorch moved back and forth over the surface or by induction heating. The minimum pre-heat temperature shall be as recommended by manufacturer and shall be checked by means of contact type temperature-recording thermometer. Temperature indicating crayons shall not beused. Pre-heat temperature shall be checked on every joint. Care shall be taken to ensure thatthe entire circumference of the pipe is heated evenly. Temperature measuring instruments shallbe calibrated immediately before the start of the works and thereafter at intervals recommendedby the manufacturer of the instrument.

4.2.3 Upon pre-heating, the pipe surface shall be applied with two pack epoxy primer of wet film thickness 200 microns or as per manufacturer's recommendation whichever is higher, to coverthe exposed bare metal of the welded field joint and 10 mm min. onto the adjacent pipe coatingif recommended by the manufacturer. The wet film thickness of the primer shall be checked onevery joint with a wet film thickness gauge prior to installation of sleeve. Thickness gauge shallbe calibrated once per shift.

4.2.4 Immediately after application of epoxy primer, the wraparound sleeve shall be entirely wrapped around the pipe within the stipulated time recommended by the manufacturer. Sleeve shall be positioned such

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that the closure patch is located to one side of the pipe in 10 or2 O'clock position, with the edge of the undergoing layer facing upward and an overlap of min.50 mm. Gently heat by appropriate torch the backing and the adhesive of the closure and pressit firmly into place.

4.2.5 A heat shrinking procedure shall be applied to shrink the sleeve in such a manner to start shrinkage of the sleeve beginning from the centre of the sleeve and heat circumferentially around the pipe. Continue heating from the centre towards one end of the sleeve until recoveryis completed. In a similar manner, heat and shrink the remaining side. Shrinking has been completed when the adhesive begins to ooze at the sleeve edges all around the circumference.

Visual appearance and void after installation on the body, area adjoining the weld and area adjoining the factory applied coating. (To establish voids adjoining the weld and factory coating, a strip of 50 mm wide and 200 mm long shall be stripped and examined.)

Owner/Consultant shall witness the tests and inspection. Regular application of field joint coating shall commence only upon successful completion of the pre-qualification testing.

After successful completion of the pre-qualification testing as above, the entire field joint coatingshall be removed, the pipe surface re-blasted and field joint coating re- applied as per the requirements of this specification.

4.3 Pre-Qualification of Field Joint Coating System

The field joint coating system materials and the procedures proposed by the Contractor shall bepre-qualified during the sleeve installation start-up phase. Five joints (5) shall be coated with therequirements of this specification and then inspected and tested in accordance with the requirements of this specification with respect to the following:

- Surface preparation, cleanliness, roughness profile and dust contamination
- Pre-heat temperature (as applicable)
- Primer thickness
- As applied coating thickness
- Holiday detection

Peel test at (+) 23°C & (+) 80°C on pipe surface & factory applied coating and at over laps (asapplicable). If required to achieve the temperature of (+) 80°C, suitable thermal blanket may beused.

Visual appearance and void after installation on the body, area adjoining the weld and area adjoining the factory applied coating. (To establish voids adjoining the weld and factory coating,a strip of 50 mm wide and 200 mm long shall be stripped and examined.)

Owner/ owner's representative shall witness the tests and inspection. Regular application of field joint coating shall commence only upon successful completion of the prequalification testing.

After successful completion of the pre-qualification testing as above, the entire field joint coatingshall be removed, the pipe surface re-blasted and field joint coating reapplied as per the requirements of this specification.

4.4 Application Procedure for Cold Applied Tapes

4.4.1 Cold applied joint protection tape shall be of the type, which can be applied by spiral wrappingon the pipe.

4.4.2 Immediately after the completion of surface preparation, the approved primer of wet film thickness 150 microns or as per manufacturer's recommendation whichever is higher, to coverthe exposed bare metal

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of the welded field joint and 10 mm min. onto the adjacent pipe coating if recommended by the manufacturer. Any dirt on the primed surface shall be removed. If the primer is damaged, the damaged area shall be cleaned and re-primed.

4.4.3 Approximately 100 mm of inner wrap interleaving paper shall be peeled back and inner wrap shall be applied with the thicker adhesive side to the pipe. Whilst continuously removing the interleaving paper, the tape shall be spirally applied through a machine to provide a minimum of55% overlap. Sufficient tension shall be applied to ensure good conformity, avoiding air pocketsand also continuously smooth out as the wrapping proceeds. The wrapping shall start and finish to give a minimum 50 mm overlap on to the adjoining yard applied coating. Outer wrap shall also be applied in similar method.

5.0 INSPECTION AND TESTING

5.1 Visual Inspection

Visual inspection of the as applied coating shall be carried out on every joint, for the following:

- Mastic extrusion on either ends of the sleeve shall be examined
- There shall be no sign of punctures or pinholes or bend failure. The external appearance ofthe sleeve shall be smooth, free of dimples, air entrapment or void formation. All sleeves shall be tested for the presence of voids by knocking on the sleeves. A hollow sound compared to the remainder of the sleeve may indicate the presence of voids under the sleeve.Such sleeve shall be tested for adhesion at the discretion of the Owner/ Consultant.
- Weld bead profile shall be visible through the sleeve
- Visual indicator provided on the backing and the closure patch showing desired heat is achieved.

5.2 Holiday Inspection

The entire surface of each joint shall be inspected by means of a full circle holiday detector approved by Owner/Consultant set to a DC voltage applicable as per the requirementsof factory applied mainline coating specification of Owner/ Consultant. Inspection of the sleeves shall be conducted only after the joint has cooled below 50°C. The holiday detector used shall be checked and calibrated daily with an accurate DC voltmeter. The detector electrode shall be in direct contact with the surface of coating to be inspected.

No field joint shall be covered or lowered in the trench until it has been approved by the Owner/Consultant.

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5.3 As-applied Coating Thickness

Coating thickness shall be checked by non-destructive methods for each field joint. Average thickness of the as-applied coating on pipe body shall be established based on measurementsat min. eight locations i.e. four measurements on either side of the girth weld at 3, 6, 9 & 12 O'clock positions. To establish the minimum thickness on the girth weld, four measurements shall be taken on apex on the weld at 3, 6, 9 & 12 O'clock positions. All such measurements shall be recorded. Owner/ Consultant reserves the right to ask for additional measurements atany location on the field joint coating, whenever doubt arises.

5.4 Peel Strength Testing

5.4.1 One out of every 50 joint coatings or one joint coating out of every day's production, whicheveris stringent, shall be tested to establish the peel strength on steel and factory applied coating.Contractor shall carry out such testing in the presence of Owner/Consultant.

5.4.2 From each test sleeve selected as above, one or more strips of size 25 mm x 200 mm shall becut perpendicular to the pipe axis and slowly peeled off.

The required peel strength shall meet the requirements of this specification as applicable for (+) 23°C or (+) 80°C whichever is feasible. This test shall be conducted between wrapping & metal and mill coating & between layers at overlap with joint coating (wherever applicable).After removal of strip, the

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bulk of adhesive shall remain adhered to the pipe showing no bare metal, otherwise, test shall be considered failed. The adhesive layer that remains on the pipe surface shall generally be free of voids resulting from air or gas inclusion. In case the peel strength test at a different temperature than that specified is warranted due to the ambientsite conditions, then the peel strength shall comply the recommendation of the manufacturer. Manufacturer shall be asked to furnish peel strength values corresponding to various expectedtemperatures, prior to start of the works.

5.4.3 If the sleeve does not meet the requirements of above clause 5.4.2, the adjacent two sleevesshall also be tested. If the adjacent two sleeves are acceptable the test rate shall be increasedto one sleeve every twenty five until Owner/Consultant's is satisfied. The test rate can then bereduced as per clause 5.4.1. If either or both of the adjacent two sleeves do not meet the requirements of clause the field coating shall be stopped.

5.4.4 Owner/Consultant reserves the right of 100% removal of sleeves if he is not convinced that the requirements of clause 5.4.2 are achieved.

6.0 REPAIRS

6.1 If a field joint is detected to be unacceptable after testing as per section 6.0 of this specificationthe Contractor shall, at his own cost:

- determine the cause of the faulty results of the field coating.
- mobilise the expert of manufacturer, if required.
- Test to the complete satisfaction of the Owner/Consultant, already completed field coatings
- stop field coating until remedial measures are taken against the causes of such faults, to theentire satisfaction of the Owner/Consultant.

6.2 Contractor shall replace all joint coating found or expected to be unacceptable as per section 6.0 of this specification.

6.3 Contractor shall, at his own cost repair all areas where the coating has been removed for testingby the Owner/Consultant.

6.4 After the coating work on welded joints and repairs to the coating have been completedthe coating as a whole shall be tested with a spark-tester before lowering or jacking the pipeline.

6.5 Owner/Consultant shall be entitled to check the coating on buried pipelines or parts of pipelineswith equipment such as the "Pearson Meter" and the resistance meter. If coating defects are established, the Contractor shall be responsible for excavation at such points, repairing the coating, spark testing and backfilling the excavations without extra charge.

7.0 DOCUMENTATION

7.1 Prior to procurement of coating materials, Contractor shall furnish the following information for qualification of the Manufacturer and material:

a. Complete information as per clause 3.1, DIN EN 12068 along with descriptive technical catalogues.
b. Test certificates and results of previously conducted tests, for all properties listed in clause 3.2of this specification.
c. Reference list of previous supplies, in last 5 years, of the similar material indicating the projectdetails such as diameter, quantity, operating temperature, year of supply, project name, contactperson and feedback on performance.
d. Once the Owner/Consultant's approval has been given, any change in material or Manufacturer shall be notified to Owner/Consultant, whose approval in writing of all changes shall be obtained before the materials are manufactured.

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7.2 Prior to shipment of materials from the Manufacturer's Works, Contractor shall furnish thefollowing documents:

a. Test certificates/results as per Manufacturer's Quality Control Procedure for each batch of materials.

b. Specific application instructions with pictorial illustrations.

c. Specific storage and handling instructions.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR CASING INSULATORS & CASING END SEALS

ENG-STD-PL-DOC-TS-006

BGL/632/2024-25

Rev	Date	Purpose	Prepared By	Checked By	Approved By
1	22.01.16	Issued for client approval			
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1.0 SCOPE

This specification covers the minimum requirements of design, material, manufacture and supply of casing insulators and end seals intended to be used for cased pipeline crossings.

2.0 CODES AND STANDARDS

The related, standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry:

a) ASME B 31.8 : Gas Transmission and Distribution Piping System

b) API 1102 : Steel Pipeline Crossing Railroads and Highways

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3.0 FUNCTIONAL REQUIREMENTS

3.1 Casing Insulators

Pipeline insulators shall be used to support the carrier pipe inside the casing pipe andelectrically isolate the carrier pipe from the casing pipe at the cased crossings.

The Casing insulators shall have the following properties:

- Resist cold flow and will not soften at design temperature.
- Resist mechanical damage while being pulled into the casing
- Resist corrosion.
- Have high electrical insulating value and low water absorption, thus preventing leakageand maintain electrical isolation between carrier and casing pipes.
- Have high compressive strength in order to ensure a permanent support to the carrierpipe.

Manufacturer shall obtain prior approval from OWNER on drawing/design of casinginsulators.

3.2 Casing end-seals

Casing end seals are intended to be used for sealing the annular space between casingpipe and carrier pipe at casing ends so as to prevent ingress of moisture and water.

Manufacturer shall obtain approval from OWNER on design/drawing of end seals.

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4.0 DESIGN REQUIREMENTS

4.1 Casing Insulators

It shall be made in segments duly held together with cadmium/ xylan plated bolts and nuts,to be supplied with casing insulators.

The number of segments shall be two for pipe diameters up to 12" (generally). For largerdiameters, the number of segments may be more than two but shall be kept to minimum.

The skid height shall be obtained by the following formula & shall be ≥2 inch (min):-

$$\frac{\text{Casing Internal Dia - Carrier Outer Dia}}{2}$$

Manufacturer shall obtain prior approval from COMPANY on casing insulators drawings/ designs.

Double insulators shall be installed at ends and shall be located at 300 mm from the end of the casing. Another insulator shall be placed at a distance of approx. 1250 mm (max) from the double insulators. The remaining insulators shall be installed at an equal spacing of approx. 2500mm (max.) each (Refer Fig. 2 attached at the end for installation details). The support point of successive collars shall be regularly staggered.

Material:

Casing insulators shall be made of injection moulded high density polyethylene or other material equivalent or superior as approved by Owner and shall meet the requirements given in Table-1.

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Table 1 : Material Properties for Casing Insulators

Property	Value	ASTM Test Method
Dielectric Strength	450-500 Volts/Mil	D-149
Compressive Strength	3200 psi	D-695
Tensile Strength	3100-5000 psi	D-638, D-651
Impact Strength	4.0 ft.lb./inch of notch	D-256
Water Absorption	0.01%	D-570

4.2 Casing end seals

The seals shall be suitable for the casing and carrier pipe diameter as applicable for eachcase. The casing end-seal shall be flexible to cater for the expansion and contraction of

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carrier and casing pipes and shall be able to tolerate both angular and concentric misalignment of casing pipe without loss of sealing efficiency.

The design of the casing end seal shall permit easy installation of the seal to the cased pipeline crossing. It shall provide moisture-proof seals when installed for the entire anticipated life of the buried pipeline

Material:

The casing end-seals shall be made of heat shrink high density radiation cross linked polyethylene with an adhesive having a melt point suitable for the pipeline service temperature and ambient temperature foreseen during construction. End-seals material shall be resistant to heat, cold, vibration, impact, abrasion, corrosive fluids, disbonding, organic and bio-deterioration. The manufacturer shall confirm compatibility of end seals with carrier pipe coating.

Material for casing end seals shall meet the requirements given in Table-2.

Table 2 : Material Properties for Casing end Seals

Property	Value	Test Method
Backing (Sleeve and closure patch) Tensile Strength Ultimate Elongation Heat Shock	 2200 psi 400% No visual cracks, flowor drips (at 250 °C, 4 hours)	 ASTM D-638 ASTM D-638 ASTM D-2671
Adhesive Ring and Ball softening point Lap Shear	 90 °C 60 °C - 25 psi 23 °C - 250 psi (2 inch/min.)	 ASTM E-28 ASTM D 1002
System (as applied) Peel strength (To casing and carrier pipe and closure patch)	 5 pli (10 inch/min.)	 ASTM D-1000

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5.0 DOCUMENTATION

Manufacturer shall submit documentation for Casing insulators and End seals, which shall include the following as minimum.

i) General Arrangement Drawings

ii) Test and material certificates of all components used in the assembly of casing insulators and end seals as per section 4.0 of this specification.

iii) Application Procedures / Manuals

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6.0 SUPPLEMENTARY REQUIREMENTS

6.1 The manufacturer shall replace, at no extra cost, any material not conforming to thematerial and performance requirements of this specification.

6.2 Manufacturer shall submit all the documents, test reports, records and other informationto the OWNER for record after approval.

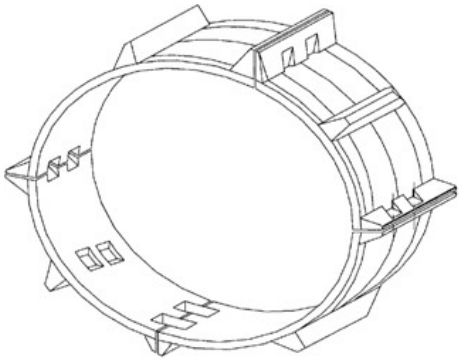
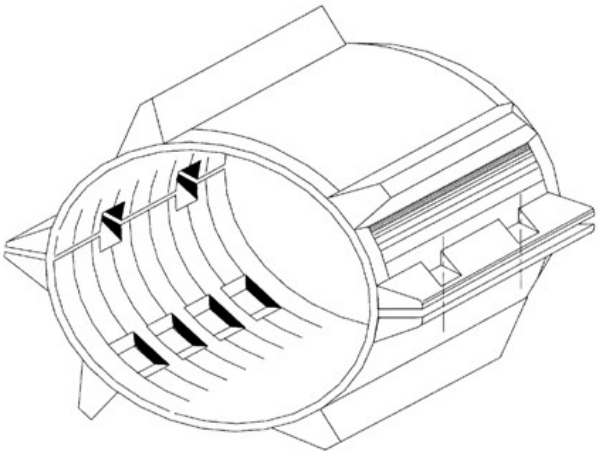


Fig 1: Casing Insulators



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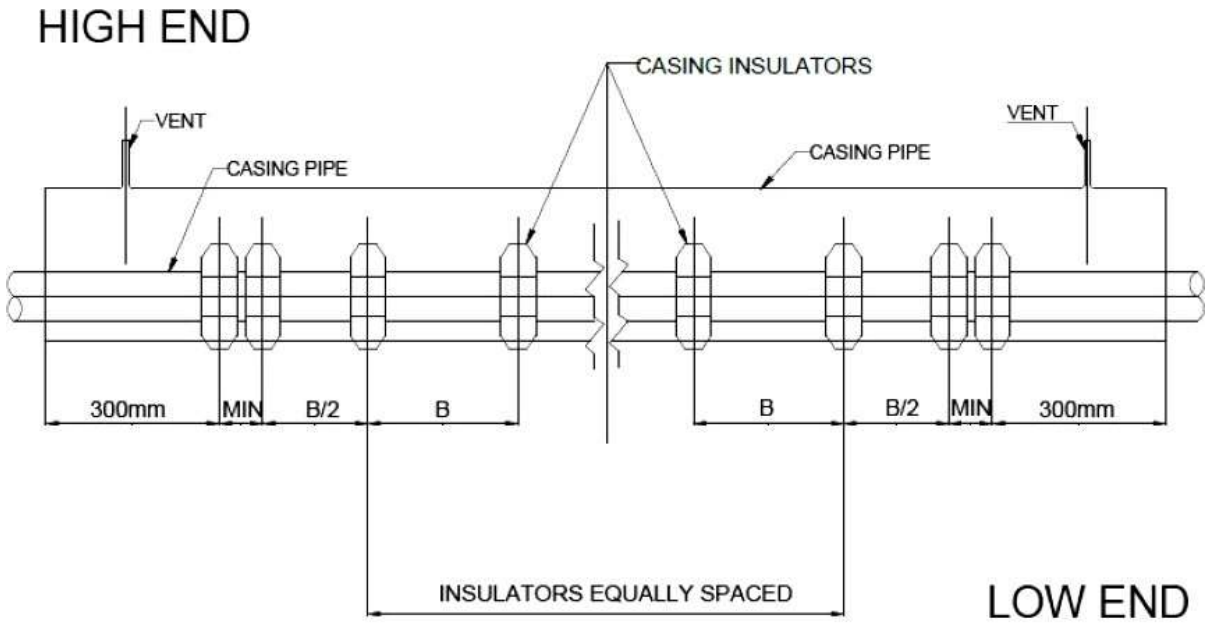

DISTANCE 'B' = MAXIMUM 2500mm

Fig.2 Typical Installation Diagram

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR LONG RADIUS BENDS

ENG-STD-PL-DOC-TS-007

BGL/632/2024-25

1	22.01.16	Issued for client approval				
0	25.11.15	First Issue				
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1.0 SCOPE

This Specification defines the minimum requirements for design, manufacture, inspection, testing, transportation and supply of Long Radius Bends made from carbon steel line pipes for use in onshore gas pipeline systems.

2.0 CODES AND STANDARDS

The manufacturer shall perform work in accordance with the latest edition of the following codes, standards and specifications:

a)	ASME Sec. V	:	Method for non-destructive examination
b)	BS EN 10204	:	Metallic Products- Types of inspection documents
c)	ASME B 31.8	:	Gas Transmissions and Distribution Piping System
d)	BS EN ISO 6507-1	:	Methods for Vickers Hardness Test – Testing of Metals
e)	MSS-SP-75	:	Specification for High Test Wrought Weld Fitting
f)	API-5L	:	Specification for Line Pipe
g)	API RP 5L1	:	Recommended Practice for Rail Road Transportation of Line Pipes
h)	ASME Sec. II Part A	:	Ferrous Material Specification
i)	ASME Sec VIII Div 1 & 2	:	Boiler and Pressure Vessel Code.

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j)	ASME B 16.49	:	Factory made wrought steel Butt-welding Induction Bends for Transportation and Distribution Systems
k)	ASTM A370	:	Standard Test Methods and Definitions for Mechanical Testing ofSteel Products.
l)	ISO 15590-1	:	Petroleum and natural gas industries- induction bends, fittings, and flanges for pipeline transportation system- Part 1: Induction Bends

In case of conflict between the requirements of this specification and the referencedocuments, the requirement whichever is more stringent shall prevail.

3.0 MATERIALS

Bend shall be fabricated from bare steel line pipe of heaviest thickness available. Pipes withpositive wall thickness shall be used for fabrication of bends. The type of pipe to be used in fabrication of bends shall be seamless API 5L Gr. X-52 or as indicated in the purchase order.

Unless specified otherwise in Purchase Order, the Line pipes for fabrication of bend shall be provided by the CONTRACTOR. Only pipes with positive wall thickness shall be used for fabrication of bends.

All mechanical properties of the bends after finishing shall be same as pipe specification.

One additional bend for each heat, nominal diameter and wall thickness shall be made by the manufacturer for test purposes. Each test bend shall be bent to an angle of 90º. All examination and test shall be performed on the test bends after final stress relieving. The result of all tests shall be in accordance with the requirements of this Specification. The following tests shall be conducted:

a) The bend shall be non-destructively tested in accordance with 6.2 of this specification.
b) The dimensions of the bends shall meet the requirements of section 7.0 of this specification.

c) The bend shall be hydrostatically tested in accordance with Section 6.1 of this specification.

d) Tensile tests shall be performed in accordance with API-5L on transverse and longitudinal specimens one each taken from the inner and outer radius and from the stop and start transition areas of the bend. Tensile properties shall be in accordance with the Specification.

e) One transverse weld tensile test shall be performed by the Manufacturer to determine the yield and tensile strengths. Such test shall be performed as per API-5L.

f) One set of three Charpy V-notch impact test specimens shall be taken from each of the innerand outer radii and from the stop and start transition areas of the bend. Impact test shall be carried out as per ASTM 370 at -20 & 0 °C and impact energy shall be in accordance withthe specification / approved QAP.

g) One set of three Charpy V-notch impact test specimens shall be taken from each of the following locations for Welded Pipe Bend (for seamless Pipe, bend as per coupon):

Centre of the weld
Fusion line
2mm from fusion line
5mm from fusion line

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Min. impact energy value at -20 °C shall be 35 J Avg. and 28 J Ind. and 100 J Avg & 80 JInd. for testing at 0 °C

h) One full wall macro section taken parallel to the longitudinal axis of the bend shall be removed from the inner and outer radii and from the stop and start transition areas in the body of the bend. The macro sections shall be polished and Vickers hardness tested in accordance with BS EN ISO 6507-1 shall be performed.

i) Guided bend test shall be conducted in accordance with the requirements of API-5L as specified in specification.

j) The fracture toughness test shall be determined by manufacturer at 0º C & -20 ºC.

k) Hardness test shall be carried out for each heat of steel. Hardness shall not exceed 248 HV10.

l) Metallographic examination (X200 & X400) shall be carried out as per material / manufacturing specification. The grain size shall be 8 or finer as per ASTM E 112. Optical microphotograph shall be provided along with final documentations.

4.0 PROCESS OF MANUFACTURE

4.1 Manufacturing Procedure Specification

The Manufacturer shall submit a manufacturing procedure specification (MPS) which shall meet all the requirements of these specifications. The MPS shall include but not limited to a complete and detailed procedure for the manufacture of high frequency induction bends and shall include all proposed operations, in the correct sequence, together with all appropriate parameters and methods by which the manufacturer proposes to monitor the parameters as listed below:

a. Sequence of operations;
b. Description of equipment and instrumentation;
c. Bending speed (mm/min);
d. Bending load;
e. Bending temperature;
f. Dimensional Control Procedure;
g. Hydrostatic Testing Procedure;
h. Quench variables (including flow rate);
i. Stress Relieving procedure;
j. Mechanical testing and inspection procedures;
k. Marking details;
l. Handling, transport and storage

Bidder has to submit work procedure with QA/QC plan for approval. Work shall commence after approval from Owner/Consultant.

Failure of any of the qualification tests listed above shall cause rejection of the MPS and all induction bends. Owner / Consultant reserve the right to demand re-qualifications in the caseof any changes to the Owner / Consultant approved MPS or interruptions in the production ofinduction bends.

4.2 Manufacturing Procedure Qualification

Manufacturer shall perform the Manufacturing Procedure Qualification to demonstrate that the procedure will produce bends with the requirements set forth in this specification. Test bends shall be

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provided by Manufacturer for qualification of the MPS. Owner / owner representative reserves the right to select the test bends.

Once the bending operation has commenced any stoppage of the activity shall not be permitted until the entire bending process is completed.

Post bend stress relieving shall be applied over the entire bend and tangent lengths.

5.0 MANUFACTURE OF PRODUCTION BENDS

5.1 Bends shall be manufactured in accordance with the Owner / Consultant approved MPS.Any deviations from the MPS or any changes in the bend forming parameters used for the Manufacturing Procedure "Qualification Test Bend shall be cause of rejection of MPS" or the performance of additional test bends for re-qualification of the MPS at Manufacturer's expense.

5.2 All bends shall be manufactured by hot bending of the pipe by using high frequencyinduction heating and forming.

5.3 All bends manufactured by induction welding shall be subject to post bend stress relieving bytempering. Post bend heat treatment procedure including temperature and time shall be included in the bend manufacturing procedure.

5.4 All bends shall be manufactured by using a type of bending equipment approved by the Owner/ Consultant.

5.5 The longitudinal weld seam shall be located at approximately 10º from the neutral zone, measured from the outside of the bend made with welded pipe. Manufacturer shall provide a drawing which shows the orientation of weld seam.

5.6 The Manufacturer shall, at no additional expense to the Owner / Consultant, furnish and use an internal bending mandrel to achieve smooth and undistorted bends.

5.7 All bends having a difference between the maximum and minimum outside diameters in excess of 2.0% of the nominal outside diameter of the pipe, or having buckles, shall be rejected.

5.8 The minimum wall thickness of the pipe after bending shall not be less than the required nominal design wall thickness of the pipeline.

5.9 Bends shall not have any circumferential joints.

5.10 All bends shall be provided with tangent length at both ends. Tangent length shall be 500mm or pipe OD whichever is more.

5.11 The Manufacturer shall supply all the bends with machined bevel at both ends in accordancewith API-5L. Bend angle and bend radius shall be as indicated in the Material/Purchase requisition. All bends shall be non-destructively examined in accordance with the requirements of Section 6.2 of this specification.

5.12 Each bend shall be tested using a gauging pig consisting of 2 gauging plates. The diameter of the gauging plates shall be 95% of the nominal internal diameter. The gauge plates shall be mounted 2D or 300 mm (whichever is more) apart on each end of the gauging pig. Detailsof the gauging pig shall be submitted to the Owner / Consultant for approval.

5.13 No repair by welding shall be allowed on any part of the bends.

5.14 Maximum allowable ripple in any section of the bend shall not exceed 1.0% of the outside diameter of the pipe.

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5.14 Any bend that is buckled or gouged by the bending operation shall be rejected.

5.15 Spiral / HSAW pipes shall not be used for fabrication of bends. LSAW pipes or seamlesspipes shall be used for bend formation as indicated by owner.

6.0 INSPECTION AND TESTING

The Manufacturer shall perform all inspection prior to shipment and tests as per the requirement of this specification at his works prior to shipment. Inspection/ Material certificate shall confirm to EN 10204 3.2 certification.

6.1 Hydrostatic testing

All induction bends shall be hydrostatically tested at the Manufacturer's works in accordance with the requirements of API-5L. The test pressure shall be 100% SMYS with a hold time of 30 min.

The Manufacturer shall submit hydrostatic test pressure calculations to the Owner / Consultant for approval.

All gauges used for measurement of pressure during hydrostatic testing of bends shall be calibrated against a dead weight tester to the satisfaction of the Owner / Consultant before and after the test. All pressure gauges used shall have an upper range of 1.5 to 2 times the minimum test pressure.

All hydrostatic pressure tests shall be chart recorded. The identification number of the induction bends being tested shall be clearly recorded on the hydrostatic pressure charts.

Orientation of the weld seam of the pipe bends fabricated from welded pipes shall be such that any pin hole leak in the seam area shall be clearly visible to hydrostatic testing operators and inspection personnel.

6.2 Non-destructive examination

6.2.1 Manufacturer shall submit a detailed procedure for all non-destructive Tests to be performedon the bend. The NDT procedure shall, as a minimum, include the following:

a) Equipment Details and Calibration Techniques
b) Qualification of NDT operators (shall be minimum ASNT-TC-1A level 2)
c) Scanning Techniques (100% coverage)
d) Examination Techniques
e) Testing evaluation method
f) Preparation of Reports

6.2.2 All bends shall be subjected to non-destructive testing in accordance with the requirementsof specification.

6.2.3 Non destructive examination shall be performed on all bends that have passed the hydrostatictesting.

6.2.4 The surface of the bends to be examined shall be clean and smooth, free from dirt, paint or any other foreign matter which would affect/influence the results of testing.

6.2.5 The entire outer surface of each bend and bevels shall be inspected for laminations and cracks by Magnetic Particle Inspection in accordance with ASME Section V, article 7.

6.2.6 The Manufacturer shall ultrasonically examine the weld areas of all induction bends for defects. Also full body surface shall be examined ultrasonically for bends made by SMLS / welded pipes.

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6.2.7 All seam welds of bends fabricated from welded pipes shall be fully radiographed.

6.2.8 The full circumference of both ends of each bend after beveling shall be ultrasonically testedfor laminations over a length of 100 mm add lamination is not acceptable.

6.2.9 Acceptance levels for MPI, UT and RT inspections shall be in accordance with specification.

6.2.10 The entire outer surface included extrados surface of each bend and bevel ends shall be inspected for lamination by MPI in accordance with ASME Sec V.

6.3 Residual Magnetism

Manufacturer shall use a digital or analogue gauss meter with directional probe with an accuracy of 0.1 Gauss to determine the residual magnetism of the induction bend.

No residual magnetism in either longitudinal or transverse direction to the pipe axis shall be greater than 15 Gauss.

Demagnetization shall be applied if the magnetic measurement shows values greater than theacceptable limit of 15 Gauss.

The Manufacturer shall include the procedure for degaussing in the Manufacturing Procedure Specification.

6.4 Surface Finish

Any irregularities in the surface contour of the bend caused by the bending operation shall be rejected. Manufacturer shall include a description of how surface irregularities shall be avoided and themethods proposed to inspect such irregularities in the MPS.

6.5 Inspection by Owner/ Consultant

Owner/ Consultant's representative reserves the right to perform stage wise inspection and witness tests on all bends as indicated in 6.1 and 6.2 at manufacturer's work, prior to shipment.

Manufacturer shall give reasonable notice of time and shall provide without charge reasonableaccess and facilities required for inspection to the Owner / Consultant.

7.0 DIMENSIONAL REQUIREMENTS

All induction bends shall be of a minimum radius as specified in Purchase Order.

All bends shall be supplied to the dimensional tolerance specified in this specification and relevant data sheets.

Tolerances

The finished bends shall conform to the following dimensional tolerances in addition to MSS- SP-75 requirements. However the ends of the tangent length of the finished pipe bend shall meet the dimensional tolerances of the relevant line pipe specification referred in Section 2.0.

7.1 Bend Angle : (±) 0.5º
Bend Radius : (±) 0.5% of nominal bend radius.

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7.2 The manufacturer shall check the wall thickness of the pipe ultrasonically before bending a 6Dbend both the inside and outside rail, at approximately 15 degree intervals or 300mm whichever is less. The wall thickness shall be measured ultrasonically after bending at the same locations measured before bending. These measurements shall be taken at four equallyspaced locations around the pipe circumference at both welding ends of the bend. The measured wall thickness shall be at least equal to the pipeline nominal wall thickness specified in the purchase requisition.

7.3 Ovality in any plane in the finished bend shall not exceed 2% at body and 1% at the ends. Ovality shall be calculated using the following formula:

$$\text{Ovality} = \frac{2(OD_{max} - OD_{min})}{OD_{nom}}$$

Where
OD max- Maximum Outside Diameter
OD min - Minimum Outside Diameter OD
nom- Nominal Outside Diameter

The measurements shall be made over the circumference of the bend either at distances approximately equal to pipe diameter or 300mm whichever is less. Minimum three measurements shall be taken for each bend.

7.4 Off Plane

Off plane of bends shall not exceed (θ/90) x 10mm, where θ is the bend angle in degree or the tolerance limit specified in MSS-SP-75, whichever is less. The measurement shall be inaccordance with MSS-SP-75.

7.5 Any type of repair and sizing is not acceptable until unless approved by owner/ owner's representative.

8.0 MARKING, PACKING AND SHIPMENT

8.1 All bends shall be marked as per MSS-SP-75

8.2 The original pipe number and bend suffix shall be marked by die stamping at both ends on thebevel of all bends. No die stamping shall be permitted on any other part of the bend.

8.3 As a minimum, for each bend, following markings are stenciled at both ends internally with indelible paint.

8.4 Pipe original individual identification number and bend suffix heat number and original pipe number

a) Purchase order/Item number
b) Bend angle
c) Heat number
d) Owner/Consultant name
e) API-5L material grade
f) Specified wall thickness, outside diameter, bend angle, bend radius
g) Heat treatment
h) Measured weight
i) Any other information required by API-5L.

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8.5 All loose and foreign material such as rust, grease etc. shall be removed from inside and outside of the bend.

8.6 All bends except bevelled ends shall be coated internally and externally with a thin film of zinc chromate red oxide paint for protection against corrosion during transit and storage. The coating shall be easily removable in the field. Manufacturer shall furnish the details for the same

8.7 Both ends of the bends shall be suitably protected to avoid any damage to the bevel during transit by means of metallic or high impact plastic bevel protectors.

8.8 Package shall be marked legibly with indelible marking ink to indicate the following:

a) Order Number
b) Tag Number
c) Manufacturer's Name
d) Size (Inches) and wall thickness (mm)
e) Radius of bend (mm) and bend angle

9.0 DOCUMENTATION

Documentation relating to the supply of goods shall be provided by the Manufacturer. All documents shall be reviewed and approved by the Owner / consultant.

Full certification of the procedure and results of bending, inspection and testing shall be provided by the Manufacturer.

Certification shall cover all results required by this specification. All certificates shall be marked with sufficient information to enable full traceability to the items it represents and the relevant specifications and procedures.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR INSPECTION & TESTING OF PRODUCTION WELD

ENG-STD-PL-DOC-TS-008

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1	22.01.16	Issue for client approval				
0	25.11.15	First Issue				
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1.0 SCOPE

This Specification defines the minimum technical requirements for the various activities to be carried out by Contractor for Inspection & Testing of Production Weld.

2.0 GENERAL

Except otherwise stated by the Owner / Consultant for the number of field butt weldsselected for non-destructive examination, the provisions of ASME B 31.8 shall govern.

The Owner/ Consultant shall determine the non-destructive examination method applicableand their specific field application.

The Owner/ Consultant shall supervise and inspect the welding activities in accordancewith the provisions laid down in the Codes.

The Owner/ Consultant are also exclusively responsible for its personal interventions and decisions as supervisor and inspector of the welding activities.

Except otherwise stated by the Owner and the Consultant. The inspection and testing of production welds will be carried out in accordance with the provisions of the ASME B 31.8 code and the standard mentioned in this chapter.

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3.0 TESTING OF WELDED JOINTS AND ACCEPTANCE CRITERIA

The welded joints shall be tested prior to painting or coating.

3.1 Non – Destructive testing

3.1.1 Visual Inspection

Inspection of all welds shall be carried out by owner/ consultant as per the latest editions of the applicable codes and specifications. All finished welds shall be visually inspected for parallel and axial alignment of the work, excessive reinforcement, concavity of welds, shrinkage, cracks, under-cuts, dimensions of the weld, surface porosity and other surface defects. Undercutting adjacent to the completed weld shall not exceed the limits specified in the applicable standard/ code.

The visual inspection shall be interpreted in accordance with API 1104 with the following additional requirements:

- Arc ignition Points
  - ≤ 0.5 mm: acceptable if ground out
  - > 0.5 mm: unacceptable and cut out
- Clamp Crates
  - ≤ 0.5 mm: acceptable if ground out
  - > 0.5 mm: unacceptable and cut out

3.1.2 Radiographic Testing

3.1.2.1 Test method and acceptance criteria

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Radiographic testing with X rays or gamma rays shall be carried out in accordance with theprovisions of API 1104. All butt welded joints of mainline as well as of station piping shallbe 100% radiographic tested irrespective of the class location.

3.1.3 Ultrasonic Testing

3.1.3.1 Test Method and Acceptance criteria

The ultrasonic testing shall be carried out in accordance with ASME V-Art. 5 and API 1104.

The number of field joints welds selected for ultrasonic examination is specified by the Owner / Consultant.

3.1.3.2 Scope of the Test

a) Minimum test planned

- For the stations and valves stations all welds shall be inspected by ultrasonictesting.
- Welded joints, which are welded using external clamps (e.g. tie-in welds) shall be100% ultrasonically tested.
- If any pipe end is cut by more than 50 mm, the re-bevelled end shall beultrasonically tested for any lamination.

b) Supplementary Tests

Further to a decision by the Owner / Consultant (for example in the event of cracks)all the welds carried out in the course of that day may be tested with ultrasonic testing and if necessary this inspection may be extended to all welds. If these tests bring to light any defective welds, the Contractor shall carry out the repairs at his own expense.

3.2 Other test method

As well as the non-destructive tests describe above, the Owner / Consultant, decide to carry out additional destructive or non-destructive tests, such as:

- Magnetic Particle Test
  - All tie-in weld & Fillet weld shall be 100% Magnetic particle tested.
  - All re-bevelled pipe end shall be magnetic particle tested.
  - All repair areas shall be verified by either LPT / MPT as directed by site in-charge
- Liquid Penetrant test
  - All repair areas shall be verified by either LPT / MPT as directed by site in-charge
- Weld Sampling
- Any other destructive or non – destructive test methods

The acceptance criteria for the magnetic partial test and liquid penetrant test are defined onthe basis of the following standards:

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- Magnetic particle test
  - Method: ASME V-Art 7
  - Acceptance criteria ASME VIII Div II – App. 6 and API 1104.
- Liquid penetrant test
  - Method: ASME V-Art 6
  - Acceptance criteria ASMEVIII – Div II – App. 8 and API 1104

The acceptance criteria for the weld samples shall be the same as for the weldingprocedure qualification.

3.3 Destructive test

At least one production weld (to be checked by Owner / Consultant) will be cut out during the first week of welding production and sent for destructive testing. Other production welds(Cut-out) to be sent for destructive testing shall be chosen by Owner / Consultant. The frequency of other production weld shall be one joint / 10 km with a minimum of 50 cm of material on either side of the weld.

Contractor will not be entitled for any type of compensation for any destructive test deemednecessary by Owner/ Consultant.

The destructive testing shall be carried out in accordance with section 5.6 of API 1104. Alltests shall be carried out in Owner /Consultant approved laboratory.

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4.0 IMPLEMENTATION OF THE NON-DESTRUCTIVE TESTS

Radiographic tests will be carried out daily after the completion of the welding on the day'swelding pipeline stretch.

No tests shall be carried out on strings, which are still being welded even if the usualdeadlines are compromised as a result.

Ultrasonic tests shall in principle be carried out 24 hours after welding.

5.0 ANNOUNCEMENT OF TEST RESULTS

The NDT results shall be sent to contractor by Owner / Consultant / TPI during normal working hour in the following day as agreed with Owner.

5.1 Welding of tie-ins and repairs

5.1.1 Radiographic Testing

Subject to the approval of the Owner / Consultant, in urgent cases, TPI shall inform the Contractor verbally of the provisional test results within the hour following the photograph by interpreting the wet film.

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The results shall not be definitive until the dry firm has been examined.

The deadline for verbal communication of the definitive results shall be twelve hours following the announcement of the results when they have been interpreted from the wet film.

5.1.2 Visual and ultrasonic Testing

The results of these tests shall be given verbally at the time of the test.

Written communication of the results shall be by means of inspection test report.

6.0 INSPECTION OF FILMS BY CONTRACTOR

Before carrying out any repairs, the Contractor may inspect the relevant film himself. Thefilm remains the property of the Owner.

7.0 LOCAL REPAIRS AND CUT OUT DEFECTIVE WELDS

7.1 General

The Contractor shall be obliged to repair welds or re-weld or cut out welds which are deemed defective by the owner/ consultant/ TPI. This shall be carried out within normal working hours.

Each repair of defective weld, whether local or total, shall be carried out within two workingdays following the announcement of the results by owner/ consultant/ TPI.

Section 10 of API 1104 is applicable with the following requirements.

- All cracks other than carter cracks or star cracks (ref 9.3.10 of API 1104) shall not be repaired by welding. The cracks must be removed by cutting out the weld.
- All other defects except superficial defects detected by NDT can only be repaired by welding after approval by owner/ consultant/ TPI on site.
- Superficial defects can be removed by grinding provided min. thickness of pipe is respected. After grinding, the ground area will be inspected by liquid penetrant test or magnetic particle test.
- The weld repairs shall be tested by X-rays, UT and / or MT as required by owner/ consultant/ TPI at site.
- A second repair on weld is not acceptable and weld must be cut out if defects are detected in repair.
- In case of cut out of weld, & zone of at least 5 cm of the pipe material shall be removed on both side of the weld. The new bevel should be checked by penetrant test in the absence of defect.
- The cut out welds shall be preserved in the weld number for further investigation.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR DRYING AND CLEANING OF PIPELINE

ENG-STD-PL-DOC-TS-009

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1.0 SCOPE

This specification covers the minimum requirements to be followed by the contractor incarrying out cleaning, dewatering, swabbing and drying operation of pipeline after testing.

2.0 CODES AND STANDARDS

The related, standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry:

ASME B 31.8	:	Gas Transmission and Distribution Piping System
OISD 226	:	Natural Gas Transmission Pipelines and City Gas Distribution Networks

3.0 DRYING ACTIVITIES

The contractor shall perform the following for drying the pipeline:

DEWATERING - Removal of hydrotest water from pipelines

SWABBING - Reducing the amount of remaining water in the pipeline, left after dewatering operations, and spreading it as a thin film on the inside wall on the pipeline

DRYING - Drying the gas pipeline to the required degree of dryness

PURGING - Purging or filling the pipeline with nitrogen (as applicable) and keeping it under positive pressure if commissioning is delayed

Contractor shall develop procedure accordingly and carry out applicable activities after obtaining owner's approval for the same.

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4.0 DEWATERING

Dewatering shall be performed to remove major amount of test water from the pipeline using apropellant and a pig train.

The dewatering operation shall consist of at least two dewatering runs when air is used as propellant for pig trains. In case the propellant is the product that the pipeline will ultimately carry, only one dewatering run is required.

CONTRACTOR shall ensure that continuous operation can be performed without the pigs getting stuck. Necessary calculations shall be submitted by CONTRACTOR in this regard. CONTRACTOR shall also submit a contingency plan for retrieval of stuck pigs if any.

The pig velocities during the first and second dewatering runs shall not exceed 1.5 km/hr and 3.5 km/hr respectively. The pigs shall be removed immediately by the CONTRACTOR in the presence of OWNER Representative upon arrival at the receiving end. CONTRACTOR shall ensure that the bulk of the water has been removed from the pipeline before taking up thenext stage of the drying operations. CONTRACTOR shall specify when the dewatering phase

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is to be considered complete and shall take approval of the OWNER before proceeding further.

As a minimum the CONTRACTOR shall continue the dewatering operation till majority of water is removed from the pipeline.

5.0 SWABBING

The swabbing operation consists of running several pig trains through the pipeline. During the swabbing operation, the remaining water in the pipeline shall be reduced and spread out inthe form of a thin water film over the pipeline wall to obtain a more efficient drying operation.

The CONTRACTOR shall submit the detailed procedure and the duration of the swabbing operation and obtain OWNER approval before starting the operation.

CONTRACTOR shall weigh and measure the pigs prior to launching and on arrival of the pigs at the receiving end.

The pig velocities during the complete swabbing operations shall not exceed 7.0km/hr.

Swabbing shall be considered as completed only when the difference in final and initial weight of the pig does not exceed 25%.

6.0 DRYING

The CONTRACTOR may choose any of the following methods of drying as applicable:

6.1 Vacuum Drying

The residual water in the pipeline left after the swabbing operation shall be removed by meansof boiling the water below the vapor pressure in the pipeline. The vapor shall be drawn from the pipeline until the specific dryness has been achieved.

The vacuum drying operation shall commence as soon as possible after the swabbing is completed but not later than 30 hours after the swabbing operation has been completed. The vacuum drying operation shall consist of four stages i.e., evacuation stage, boiling stage, air purge dryness test and the final reduction of line pressure.

During air purge dryness test the dew point measured at the suction end shall not deviate by more than 1 °C from the dew point measured at the inlet end during the 24 hour test period. Ifit is more than 1 °C it is implied that the pipeline still contains free water.

The pipeline shall be dried up to a dew point of at least (-) 8 °C at atmospheric pressure.

The dew point at the input and output ends shall be measured to ensure that required dew point is achieved. As a final acceptance the dew point stated above shall be maintained for a period of 48 hours.

Upon completion of the drying operation CONTRACTOR shall submit evidence to substantiatethat the pipeline has been dried to the required dryness level. This evidence shall consist of data related to the following stages of the operation.

- A rapid decrease of pressure at the end of the boiling stage
- A conclusive result of the air purge dryness test
- A steep pressure drop rate during the final draw down, which shall correspond with a calculated rate.

If any of the aforementioned criteria do not give a conclusive result that the pipeline has been dried to the required level, CONTRACTOR shall repeat the vacuum drying operation by continuing the boiling stage followed by the air purge test and the final draw down, until a conclusive result of the required dryness of the pipeline has been established and proven to the satisfaction of OWNER.

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6.2 Super Dry Air Method

The residual water in the pipeline left behind after the swabbing shall be removed by means ofabsorption of the water into dry air blown through the pipeline.

Contractor shall specify the procedure and duration of the air drying method, which shall be approved by owner.

The air drying operation shall commence as soon as possible but not later than 24 hours afterthe swabbing is completed.

The air drying operation consists of two stages namely, the pigging stage and the air purgedryness test. Oil free and dry air shall be used.

The air shall have dew point below the required dew point in the pipeline. The pipeline shall bedried up to a dew point of (-) 8 °C at atmospheric pressure.

The dew point at the inlet and outlet ends shall be monitored to ensure that the required dewpoint is achieved.
As a final acceptance, the dew point stated above shall be maintained for a minimum period of48 hours.

7.0 PURGING

During the purging operation the air left in the pipeline shall be replaced by dry nitrogen beforeadmitting the hydrocarbon that the pipeline will ultimately carry.

The purging operation shall start as soon as possible after the drying operation has been completed and approved by the owner. If nitrogen purging is carried out after the 24 hours of completion of drying CONTRACTOR to re-perform the air dryness test prior to commencement of the purging operation.

Nitrogen with dryness corresponding to a water dew point of (-)50 °C or better shall be used. The maximum allowable oxygen content shall be 1% by volume.

The carbon dioxide content shall not exceed 5% by volume.

The purging operation procedure may vary as per the drying procedure. CONTRACTOR shallsubmit the detailed purging procedure for approval of the OWNER prior to its implementation.

8.0 ACCEPTANCE OF WORK

Upon completion of the dewatering, swabbing, drying and purging operations written approvalshall be obtained from the OWNER to terminate the operations.

Approval for such termination shall be given only after completion of the following conditions:

- The required accuracy of measuring equipment and records has been demonstrated.
- All data, records, calculations and duly completed forms have been submitted.

- The drying criteria as specified and detailed in the approved procedures in terms of residual water, required dew point and/or other requirements established have been satisfactorily attained.

The work shall only be considered to be completed after receipt and approval of the final report.

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The CONTRACTOR shall repeat part or the whole of the dewatering, swabbing, dryingoperations under any of the following circumstances as determined by the OWNER.

- The accuracy of the measurements is considered to be insufficient.

- The submission of data, records, calculations, and other documentation is considered to be insufficient or inconclusive.

-The acceptance criteria established for the drying and purging operations have not been met to the satisfaction of the OWNER.

9.0 DOCUMENTATION

Final report shall be submitted to the OWNER not later than 30 days after acceptance of the work.

CONTRACTOR shall submit to the OWNER for approval the complete description, detailed procedure and time schedule of all the dewatering, swabbing drying and purging operations.
CONTRACTOR shall ensure that the documents are related to the as-built conditions of the pipeline.

All documents, procedures, calculations, schedules and details of the equipment shall be in SIunits. Documents shall also contain all safety plans procedures to be followed while carrying out the activities.

Upon successful completion of the work CONTRACTOR shall prepare a final report of the work which shall include necessary charts, diagrams, graphs, calculations, recordings/daily logs, measurements and details of the operation etc. Report shall also include all certificates of calibration of instruments required together with records of calibration performed at site just prior to the start of operation.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR MAJOR CROSSING BY HDD

ENG-STD-PL-DOC-TS-010

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1.0 SCOPE

1.1 This specification defines the minimum technical requirements for the various activities to be performed by the Contractor for the engineering, design and construction of pipeline at major crossings using horizontal directional drilling technique.

1.2 This specification shall be read in conjunction with the requirements of specification and other documents included in the CONTRACT between owner and Contractor.

1.3 Contractor shall, execute the work in compliance with laws, by laws, ordinance and regulations.Contractor shall provide all services, labour, inclusive of supervision thereof, supply of all materials (excluding "Owner supplied Material), equipment, appliances etc.

1.4 Contractor shall take full responsibility for the stability and safety of all operation and methodsinvolved in the work.

1.5 Contractor shall be deemed to have inspected and examined the work area and its surroundings and to have satisfied himself as far as practicable with the surface conditions, hydrological and climatic conditions, the extent and nature of the work and materials necessary for the completion of the work, and the means of access to the work area.

1.6 Contractor shall be deemed to have obtained all necessary information with regard to risks, contingencies and all other circumstances, which may influence the work.

1.7 Contractor shall, in connection with the work, provide and maintain at his own costs all lights,guards, fencing, as necessary or directed by Owner or their representative.

2.0 CODES AND STANDARDS

Reference has been made in this specification to the latest edition/ revision of the following codes, standards and specification.

a) ASME B 31.8 - Gas Transmission and Distribution Piping System.

b) API RP 1102 - Steel pipeline crossing railroads and highways

c) OISD 226 - Natural Gas Transmission Pipelines and City Gas Distribution Networks

3.0 DESIGN & ENGINEERING

3.1 The limits of each crossing shall be determined by the Contractor on the basis of crossing profile based on survey drawings, design, equipment, installation technique and site condition.Contractor shall furnish all engineering design calculation and crossing drawings etc. to ownerfor their approval prior to execution of the work.

3.2 Within the entire limits of crossing, the minimum cover to top of coated pipe shall be asspecified in the Special Conditions of Contract (SCC).

However, wherever the drilled length for a crossing includes the crossings of obstacles such as roads, railroads, canals, streams, etc. The following minimum requirements of cover to the pipe shall be satisfied unless specified otherwise in the scope of work in SCC.

For Road Crossing : 1.5 m from top of road to top of pipe.

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For canal crossing : 1.5 m from lowest bed level to top of pipe.

For river crossing : a) 2.5 m below scour level in case of normal soil
b) 1.5 m below scour level in case of rocky strata

In case the pipeline crosses other utilities, viz., other pipelines, sewers, drain pipes, water mains, telephone conduits and other underground structures, the pipeline shall be installed with at least 500 mm free clearance from the obstacle or as specified in the drawing or such greater minimum distance as may be required by authorities having jurisdiction. Also in all cases, the minimum covers specified above shall be maintained within the entire limits of crossing.

3.3 The entry and exit points of the pipeline at ground level shall not come within the limits of crossing as defined in the crossing drawings.

3.4 Level of the pipeline considering the Geo-technical hydrological data provided by the ownerfor basic route detail. However, detailed survey data shall be collected by the Contractor before execution of work.

3.5 Contractor shall carry out calculations for determining the maximum permissible overburden onpipe, to check that the empty pipeline is safe from collapse at any point along the drilled crossing section. Contractor shall submit these calculations to Owner for approval.

The minimum requirements of limits of each river crossing shall be as defined in the preliminary drawings furnished by Owner/Consultant. Contractor may change the limits slightlyto suit his requirement and installation technique, with prior written approval from Owner/Consultant and authorities having jurisdiction.

3.6 Following survey/ test shall be performed by the contractor before detail engineering:

3.6.1 Detailed soil investigations and hydro-geological data collection in the proposed crossing locations so as to obtain site specific soil data.

3.6.2 Boring/ coring into all types of soil/ rock shall be done in each of the river crossing location.

3.6.3 Conducting standard penetration tests and collecting disturbed and undisturbed soil samples from boreholes.

3.6.4 Collection of soil and ground water samples for chemical testing

3.6.5 Record water tables in boreholes

3.6.6 Laboratory tests on soil/ water samples collected from boreholes.

3.7 Pipeline Axis

The plane containing the pipeline route axis shall be perpendicular to the horizontal plane. There shall be no bending of the pipeline route axis at depths shall lower than 2 meters below ground level.

3.8 Back-reamed hole and Pipeline Interface

3.8.1 Contractor shall derive combination of:

- Back-reamed hole diameter

- Bentonite density

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- Pipeline submerged weight in bentonite (and means to achieve that weight) to optimise thecrossing design in terms of pipeline stresses and power requirement

3.8.2 Contractor shall indicated what maximum shear stress in the pipeline coating will result from his choice of above parameters and other characteristics described in this section.

3.8.3 Contractor shall furnish all calculations for Owner's approval. If shear stress in pipe coating is, in the opinion of Owner, beyond the permissible limits, Contractor shall revise his choice of parameters to reduce shear stress on pipe coating to permissible value.

3.9 Contractor shall determine in the minimum allowable elastic bend radius for pipe from the following consideration:

3.9.1 Maximum Longitudinal Stress During Installation

Total maximum longitudinal stress in the pipeline due to tension and bending at any locationshall not exceed 90% of the SMYS of the pipe material.

Contractor shall, in order to check this requirement, evaluate the maximum tensile forces towhich the pipeline is subjected to at any phase of its installation during the pulling operation.

Contractor shall, evaluate the maximum tension forces to which the pipeline is subjected forfollowing phase of its installation during the pulling operation

a) Stress in the pipe at the beginning of the pull

b) Stress in the pipe upon finish of the pull-in

c) Stress in the pipe due to over-bend

3.9.2 Maximum Equivalent Stress during Final Hydrostatic Test

After installation, the pipeline shall be hydrostatically tested to a minimum test pressure equal to 1.5 times the design pressure or at a pressure stipulated in the Special Conditions of Contract whichever is higher. However, during hydrostatic testing, the combined equivalent stress in the pipeline due to bending and test pressure shall not exceed 90% of the SMYS of pipe material.

3.9.3 Maximum Equivalent Stress during Service

Permissible values of maximum equivalent stress during services shall be governed by the requirements of ASME B 31.8. The details of pipeline operating parameters are provided inthe Special Conditions of Contract.

3.9.4 The minimum allowable radius of curvature for the pipeline shall be the highest value of the minimum pipeline elastic radius as computed from the considerations outlined above after correction for drilling inaccuracies or multiplication by the factor 1.85, whichever results in the highest permissible value of minimum elastic bend radius.

3.9.5 Contractor shall submit all calculations for Company's approval along with procedure.

3.10 Pipeline Configuration along the Support String before Entry Point

3.10.1 Contractor shall determine the required pipeline configuration in order to allow smooth pull in the crossing entry point and admissible stress in the supported pipeline string.

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Pipeline combined stress shall not exceed 90% of the specified minimum yield strength forline pipe material.

3.10.2 Contractor shall furnish all calculation and specify the number of required supports,description of the supports, their co-ordinates and capacity in metric tons.

3.10.3 Contractor shall also furnish a drawing of the launching ramp indicating the pipelineconfiguration.

3.10.4 The distance between each roller shall also be specified and justified.

3.11 Contractor shall, based on result of design and engineering carried out by him, prepare construction drawings for the crossing and shall submit the same for Owner's approval.

Construction drawings shall indicate the pipeline profile with levels furnished at sufficient intervals for proper control during construction. Other relevant details viz., entry & exit point co-ordinations details, Bore hole location as wells as survey details to be included in the Drawings.

Contractor shall also submit the following details:

a. Plan drawings showing drill axis, co-ordinates of entry/ exit point, north direction, existing utilities close to the drilled hole, obstacles, shortest distance between the drill axis and obstacles, minimum radius of curvature, planned work area for rig site and pipe string site, and markers and signage.

b. Profile drawing showing entry/ exit angle, horizontal and effective length of drilling, elevations of drill profile at sufficient intervals, scour profile where applicable, cover, minimum radius of curvature, obstacles and pipe data.

c. Work area preparation drawing on the rig and pipe side showing location of variousdrill rig components (rig, cabin, pump, etc.), method of anchoring the rig, location and size of the drill fluid storage pit and access roads shall also be provided.

d. Pipe roller supports/ trench line drawing showing the number of rollers/ supports, location of rollers in plan and elevation, pipe string configuration on launch ramp and detailed drawing of the roller support.

e. Bundle drawing showing cross section of the bundle, diameters of individual pipes, method of securing the bundle.

f. Pipe break-over entering into the hole.

g. Arrangement of accessibility to rig and pipe side.

Contractor shall also calculate the total length of pipeline required as well as the maximum tension required on the pull head of the rig.

3.12 All construction works shall be carried out in accordance with the construction drawingsapproved by Owner.

3.13 Before commencement of any field work, Contractor shall furnish for Owner's approval alldesign calculations and construction drawings as stipulated in the above clauses.

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4.0 CONSTRUCTION

The method of Construction shall comply with all the conditions and requirement issued by Authorities having jurisdiction in the area where the work is to be performed.

If no public road exists, Contractor shall arrange for access to his work area at no extra cost to Owner/consultant.

Contractor shall carry out geo-technical and hydrographical survey and the same shall besubmitted to Owner/ consultant for review and approval.

CONTRACTOR shall use three layer Polypropylene coated pipes (3LPP) for execution of HDD. 3LPE coated line pipes may also be used in case of emergency and for that required HDD hole with its soft bedding has to be ensured with prior approval from owner. Spiral SAW line pipes shall not be used for HDD crossings.

4.1 Installation Procedure

HDD shall be done by approved / registered HDD contractor in BGL vendor list. Contractorshall take approval from PMC / Owner in case of an unapproved HDD contractor.

HDD contractor shall submit Site organogram to PMC / Client before starting the work at site.The

installation procedure as a minimum shall include the following:

a. Project Manpower deployment at site and co-ordination office.

b. Time schedule for construction.

c. Details of equipment: Contractor shall furnish the complete list of all equipment to be deployed for preparation of pipe string and installation of crossing including technical characteristics and capacity of each equipment including instrumentation, monitoring and control equipment.

d. Preparation of fabrication yard and launching areas.

e. Pipeline string preparation (hauling, stringing, welding, etc.).

f. Pre & Post hydrostatic test procedure.

g. Method of installation covering all stages of construction, viz. Rig up, Pilot Hole, Back- reaming, Pulling Rig Down, Back filling, etc.

h. Calculations for maximum pulling force on the rig.

The time schedule shall be in accordance with overall time schedule for the project.

Approval by Owner/Consultant of the methods used by Contractor shall in no way relieveContractor from the sole responsibility for safe and satisfactory installation of the crossing.

4.2 R.O.W. Preparation

Contractor shall arrange additional land required for pipeline string preparation, rig set-up and launching operations. Contractor shall clear and grade the length of ROW required for

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installation of the land portion and drilled river-crossing portion. Contractor shall do such grading on ROW as is necessary and properly to perform the pipeline construction operations,to provide access to the pipeline construction and to ensure safe construction of pipeline.

Contractor shall ensure that his construction activities shall not cause inconvenience to public nor shall there be any undue interference with the normal use of the land and watercourses.

4.3 Handling, Hauling, Storing and Stringing Of Pipes and Other Materials

Contractor shall be fully responsible for arranging and paying for storage areas. Contractor shall load, unload, transport and stock-pile the coated pipes using approved suitable means and in a manner to avoid damage to the pipe and coating. Transportation and handling of coated pipes shall also comply with requirements of API RP 5L-1 & 5LT.

4.4 Pipe String

Complete pipe string shall be prepared as a single string for pulling.

4.5 Installation

4.5.1 Installation shall be taken in accordance with approved installation procedures.

4.5.2 The lateral offset of the actual exit point of the pilot hole from the calculated and theoretical exit point shall not exceed +/- 0.5% of the length of the crossing, however the actual exit point shall not come outside the ROU limits of the pipeline.

The length tolerance shall not exceed +/- 0.5% of the crossing length, subject to the condition that the actual exit point shall be within the limits of crossing as defined in the approved drawings.

4.5.3 Back reaming shall be done separately from the pipeline pulling operation. The size of the back-reamed hole shall be adequate (approximately 1.5 times the pipeline diameter) to allow enough clearance for smooth pull-back of the pipeline.

4.5.4 Contractor shall be responsible for maintaining the drilled hole till such time the pipeline is pulled in.

4.5.5 During pulling operation, the buoyancy of the pipeline shall be controlled by suitable approved methods so as to maintain the buoyancy as close as possible to zero during pull-back in order to reduce friction forces of the pipeline in the hole.

Bentonite slurry of specified viscosity shall be pumped into the hole, preventing the wall from collapsing and protecting the pipeline coating.

4.5.6 Contractor shall provide suitable facilities to Owner/consultant's personnel to witness all stages of construction.

4.5.7 Contractor shall be responsible for the integrity of the corrosion coating and shall apply necessary approved protective coatings.

Coating inspection of the pipeline after completion of pulling operation shall be made by:

a. Pulling the pipe to the extent possible with normal rig set tip at the exit point;

b. Excavating the adjacent portion tip to and including the first held joint.

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The pipeline and joint coating shall be examined visually and with holiday detectors for defect. The length to be inspected shall, as a minimum, be one pipe length and one joint coating. In case damages/holidays are detected in the first pipe length/ joint, the subsequent pipe length /joint shall be exposed and coating integrity checks shall be made. If found acceptable by Owner/consultant, the first pipe length/ joint shall be repaired and/or replaced as directed by Owner/consultant. If the coating of second pipe length/ joint is also found damaged, Contractor shall propose further course of action and Owner/consultant's instructions shall be followed. All such works shall be done at no extra cost to Owner/consultant.

4.5.8 Before final hydrostatic testing, Contractor shall prove the diameter of the pipeline by passing a gauging (calliper) pig through the pipeline. The gauging pig shall have a diameter equal to 95% of the nominal internal diameter of the pipe. Contractor shall supply and install all temporary scraper launchers/ receivers and other equipment, piping and materials and consumables for the purpose.

4.5.9 Contractor shall obtain plans and full details of all existing and planned underground services from the relevant Local Authorities and shall be responsible for location and protection of the same. Contractor shall execute the work at the crossings as per guidelines of the authorities having jurisdiction and to the satisfaction of the Owner/consultant.

4.5.10 After pulling the pipeline across the drilled crossing, Contractor shall cut the extended portionof the pipeline at the entry and exit points. Thereafter, the drilled portion of the pipeline shall be cut at suitable location/depth and extended on either bank by installing a cold field bend with minimum bend radius as specified in the relevant specification and a straight pipe length of 12m, such that at the ends the top of the pipeline is minimum 1.2 m below the natural ground level.

4.6 Hydrostatic Testing

4.6.1 Pre- testing

Contractor shall hydrostatically pre-test the complete pipe string of each river crossing before installation as per approved procedure.

The section of the pipeline corresponding to the crossing shall, before installation, be subjected to a minimum hydrostatic test pressure not less than 90 % SMYS and test pressure shall be maintained in between 90 to 95 % SMYS of minimum wall thickness of HDD string forsix (06) hours. At any cost highest pressure shall not be exceeding the maximum mill test pressure and recorded by manothermograph. During the test, Contractor shall check all welds for leakage. Failure, if any, during the test shall be rectified by the Contractor to the satisfaction of Owner/consultant at no extra cost. The method adopted for pre-hydrotesting shall be in accordance with Specification.

4.6.2 Post-testing

Post hydro test shall be carried out for HDD portion of the pipeline at a pressure not less than 1.5 times the design pressure. After the temperature has been stabilized, the pressure shallbe maintained for at least 6 hours and shall be recorded.

4.6.3 De-watering, Cleaning, Drying

Once the tests have been declared satisfactory, the pipeline shall be de watered and properly cleaned and dried as per Specification No. ENG-STD-PL-DOC-TS-009.

The disposal of the water shall be performed such that no harm is done to the environment and the dewatering procedure, to be submitted by the pipeline contractor for Company/Company's representative's approval, should indicate this safe disposal methodology.

4.7 Fencing

Contractor shall supply all materials and install G.I. Wire Chain link security fencing at HDDsite.

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4.8 Idle Time Preservation of Pipeline

If directed by Owner/consultant, Contractor shall supply all materials and consumables including water, corrosion inhibitor and shall install all piping connections, valves, instrumentation, etc., perform all works for preservation of pipeline by pressurization with inhibitor added water. Contractor shall use approved inhibitors and shall determine the required dosages of inhibitors and pressure for idle time preservation of the pipeline for a period of maximum six months from the date of completion of construction.

Corrosion inhibitors and dosages shall be subjected to Owner/ consultant's approval prior touse.

4.9 Final Clean Up

After completion of construction, Contractor shall clear the sites of all balance material and debris to the satisfaction of owner/consultant and authorities having jurisdiction.

The ground occupied during the work shall be reinstated to its original condition as quickly as possible after the completion of work.

Contractor shall take due care in disposing off inhibitor added water so that it doesn't cause any adverse affect on the surrounding environment.

4.10 Markings

The location of the pipe shall be clearly marked by suitable means: conventional yellowmarkers, overhead markers, sign etc.

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5.0 DOCUMENTATION

5.1 In addition to the documents specified elsewhere in this specification, Contractor shall submit to the Owner/consultant six copies each of the following documents/records.

5.2 During the course of execution of the crossing contractor shall generate/compile the following data. It shall be obligatory on part of the Contractor to furnish this data to Owner/consultant forthe event it is required for.

Detailed drilling log and down hole data, including but not limited to, the following:

a) Torque and pulling/pushing force

b) Data on drilling fluid consisting of the following:

i) Density

ii) Type of mud and additive employed

iii) Mixing, pumping & cleaning.

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Wash and drill pipe data, viz.

a) Dimension and material properties,

b) Data on APT classification,

c) Type of inspection previously carried out on these pipes.

d) Topics of the permits obtained from authorities having jurisdiction for the various works.

e) Detail profile of the drilled hole along with the water level variations.

f) Records of hydrostatic pre-testing and final testing

g) Record of Non Destructive Testing of welds.

h) Clearance certificates from the land Owner/consultant, authorities having jurisdictionregarding satisfactory clean-up and restoration of pipeline ROU and work areas.

5.3 After completion of construction, contractor shall prepare and furnish six sets of copies and two sets of reproducible of As-Built drawings for the crossings. As built drawings shall, as a minimum include the following information:

- True profile of the river bed and banks along the pipeline;
- True profile of the pipeline as installed;
- Depth of cover to top of-pipe at regular intervals;
- Location of entry and exit points and angles of entry and exit, along with lateral offset ofexit point from the original pipeline alignment;
- Location and angle of field bends;
- Location of pipeline markers.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR PIPELINE MARKERS

ENG-STD-PL-DOC-TS-011

BGL/632/2024-25

Rev	Date	Purpose	Prepared By	Checked By	Approved By
0	25.11.15	First Issue			

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1.0 SCOPE

This specification covers the minimum requirements for supply, fabrication and erection of pipeline markers to be installed by Contractor at various locations along the route of cross- country pipeline.

2.0 REFERENCE CODES

Reference has been made in this specification to the latest revision of the following code:

API RP 1109 : Recommended practice for marking liquid petroleum pipeline facilities OISD 226: Natural Gas Transmission Pipelines and City Gas Distribution Networks

3.0 GENERAL

3.1 Contractor shall supply, fabricate and install the pipeline markers along the pipeline route. The locations of markers as indicated in the approved drawings shall be treated forguidance purposes only and the exact location of the markers shall be based on AS- BUILTdrawing and as directed by the Owner.

3.2 The pipeline markers shall be fabricated, painted (painting shall be done as per standard specification) and installed in accordance with the standard drawings included herein. Before start of fabrication of the markers, Contractor shall prepare and submit for Owner's approval the detailed scheme for the marker plates as applicable for the project.

3.3 The pipeline markers shall be installed, as far as possible, at locations such that they do not cause any hindrance to the regular use of the land or to the traffic.

4.0 AERIAL MARKERS

Aerial markers shall in general be installed along the pipeline at every five (5) kilometers intervals and at places specified by Owner. Refer standard drawing no. **ENG-STD- PL-DWG-TP-008** for more details.

5.0 KILOMETER MARKERS

Kilometer markers shall in general be installed along the pipeline between the aerial markers at every one (1) kilometer interval. Markers shall indicate cumulative chainage in kilometers from the reference station, as directed by OWNER. A kilometer marker is not required if the relative length between its location and any pipeline warning sign is less than
200 meters. Refer standard drawing no. **ENG-STD-PL-DWG-TP-010** for more details.

6.0 PIPELINE WARNING SIGN

Pipeline Warning Sign shall in general be installed at

•National, State Highway & Other Road Crossings (above 15m width) : 2 Nos.

•Other Road Crossings (less than 15m width) : 1No.

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- Railway Crossings : 2 Nos.
- Water Crossings (less than 15m width) : 1No.
- Water Crossings (above 15m width) : 2No.
- SV Stations & TOP Station : 1No.
- And at any other location of importance as observed by Owner /Owner's Representativeduring construction.

Pipeline Warning Sign shall identify the existence of the pipeline and display the name of the Company, with an emergency telephone number, as shown in standard drawing no. **ENG-STD-PL-DOC-TS-011**.

7.0 ROW BOUNDARY MARKERS

Right-of-Way boundary markers shall be fabricated and installed as per the drawings at every 250 metres interval along the entire pipeline route. These shall be installed on either side of the pipeline route to define the ROW boundary limits. These shall also be installed at pipeline turning points to maintain the continuity of the ROW limits. Refer standard drawing No. **ENG-STD-PL-DOC-TS-012** for details.

8.0 DIRECTION MARKERS

Direction markers as shown in standard drawing no. **ENG-STD-PL-DOC-TS-009** shall be installed to identify the significant turning points of the pipeline during serial traverse. One direction marker shall be installed at each turning point along the pipeline alignment. Two more directional markers shall be installed along the Pipeline alignment on either side of the Turning Point at 200 m from Turning Point of the pipeline route.

9.0 SPECIAL MARKERS

As directed by Company, Special Marker shall be installed at Location where the followingchanges take place:

- Change in pipeline diameter and wall thickness.
- Change in type of pipe.
- Change in class locations for pipeline conveying gas.

The above data may be provided on other types of marker (except RoU boundary marker), ifthe relative distance between the two does not exceed 100 m.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR HYDRO TESTING OF PIPELINES

ENG-STD-PL-DOC-TS-012

BGL/632/2024-25

1	22.01.16	Issued for client approval				
0	25.11.15	First Issue				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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1.0 SCOPE

1.1 This specification defines the minimum technical requirements for supply, works and operations to be performed by Contractor for hydrostatic testing of cross country pipelines transporting hydrocarbons in gaseous phase.

2.0 CODES AND STANDARDS

a) ASME B31.8 : Gas transmission and distribution piping system

b) API RP1110 : Pressure testing of liquid petroleum pipelines

c) ASME Sect. VIII : Boiler & Pressure Vessel code Div. 1

3.0 GENERAL

3.1 Hydrostatic test shall be performed on the entire length of the pipeline. Hydrostatic test shall be performed in accordance with approved test diagrams for each test section. The maximum length of each test section shall not exceed 50 kilometers. The hydrostatic testing shall exclude all the facilities that are installed as a part of the scrapper station. For hydrostatic testing, temporary test headers shall be provided and the pipeline section between the headers shall be tested as per approved procedure. The test shall not commence until the pipeline has been cleaned, gauged and flooded as per this specification.

Wherever pipeline is installed through casing or by HDD, the pipe strings/sections, shall be pre-tested and post-tested. Hydrostatic test shall include all those sections, which have beenpreviously tested i.e. rail, road and water crossings.

3.2 In addition to the above, for pipeline sections, which in Owner's/Consultant's opinion, once installed would require an inordinate amount of effort for repair in case of a leak, a provisional pre-test shall be conducted in consultation with the Owner/consultant. However, after installation, all such pre-tested sections shall be tested again along with the entire pipeline.

3.3 Hydrostatic testing of the mainline shall be done only after completion of all mechanical and civil works i.e., all welds have been accepted and the pipeline has been laid and backfilled according to the specifications. Further, the test shall commence only after the pipeline has been cleaned, pigged, gauged and flooded as per this specification. Contractor shall performall works required for testing after obtaining written approval from the Owner/consultant. All pipe work in test sections shall be adequately supported to hold loads imposed by weight of water.

3.4 Corrosion Inhibitor

If considered necessary by Owner/Consultant the Contractor shall provide corrosion inhibitorto the water to be used for hydrotesting.

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Contractor (not the inhibitor manufacturer) shall get the inhibitor tested for corrosion inhibition and microbiological control efficiency from competent Govt./ PSU Laboratory. The test report shall be submitted to company for approval prior to undertaking hydrotesting works.

The dosage as recommended by inhibitor supplier shall only be adopted.

Contractor is to ensure that the numbers of golden welds that remain untested are a minimum. The hydrotest for the total pipeline system indicating the estimated number of subsections, which will hydrotested, shall be part of the procedure. The consecutive test sections shall be constructed with adequate overlap and planning so that tie-in can be carried out with a single weld. If tie-in cannot be carried out with a single weld, then that length of pipe shall be pre-tested at the specified test pressure for duration not less than six hours. All golden tie-in welds shall be welded and subjected to radiographical and ultrasonic inspection. Further in case of golden tie-ins, DPT or MPT shall be performed after completing root/ hot pass.

3.5 The maximum variation in altitude within the test sections shall be restricted as far as possible within 60 meters. However, contractor shall ensure that the test pressure shall not exceed 100% of SMYS at the lowest portion of the test section due to altitude difference.

3.6 Contractor shall prepare a detailed test procedure and submit for Owner/Consultant's approval at least one month before the scheduled commencement of tests. The procedure shall strictly comply with the requirements of this specification. The procedure shall include all temporary materials and equipment, but not limited to the following items:

a) A test diagram indicating all fittings, test ends, vents, valves test headers, temporary connections, instruments, thermocouples, relevant elevations and ratings. The diagram shall also indicate injection location and intake and discharge lines. The P&ID and pipeline drawings shall be marked up showing the battery limit of the test section.

b) The hydrostatic test diagram shall also indicate pipeline wall thickness, length of testsections, Specified minimum test pressure, points of maximum and minimum elevations and theirrelationship to the pressure at the test point.

c) Estimated amount of test water, water sources, results of test sample, including required concentration of corrosion inhibitors and additives, procedure for inhibitor injection andcontrol of concentration.

d) Cleaning, gauging, filling and flushing procedures, including a complete description of allproposed equipment and instruments (including spares), their location and set-up.

e) The type and sequence of pigs and the pig tracking system for cleaning and removal of air pockets. Drawings of pigs, pig inspection procedures, including procedures to be followed.

f) Pressure testing procedure including a complete description of all proposed equipment and instruments (including spares), their location and set-up, and proposed system for observation and recording of data during the pressure test.

g) Procedure for filling, pressurization and residual air volume determination.

h) Procedure for thermal stabilization and pressure and temperature monitoring during stabilization and hold period.

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i) Theoretical pressure volume and pressure temperature curves including calculatingsteps.

j) Procedure for detection and location of leaks.

k) Procedure for depressurization, dewatering the pipeline section after testing, including a complete description of all proposed equipment and instruments (including spares), their location and set-up, the type and sequence of pigs and the pig tracking system ifrequired along with the pig specification.

l) Formats for recording the test data, calculation sheets etc.

m) HSE requirements during filling, hydro testing, water disposal, use of chemicals, etc.

n) An emergency procedure in the event of a test failure through rupture.

o) Contingency procedure for removal of stuck pig/ blocked pigs in pipeline.

3.7 Equipment and Instrumentation

The Contractor shall furnish all necessary equipment for performing the work as stated incleaning, flushing, filling, leveling, stabilizing, testing and dewatering procedures.

This shall include, but not be limited to the following equipment and instruments.

1) Pigs for filling, cleaning and gauging of the pipeline include:
   - Cleaning pigs with spring loaded steel wire brushes except for internal coated pipes. In this case pigs to be provided with nylon / polyurethane brushes.
   - Four cup batching pigs
   - Calliper pigs with gauge plate diameter equal to 95% of the heavy wall pipe in the pipe sections. Gauging pig fitted with gauge plate.

2) Air compressors for cleaning, gauging & dewatering of minimum 3000 Nm^3/h capacity0-100 bar.

3) Calibration of all measuring instruments in Owner/ Consultant approved laboratory.

4) Fill pumps: The Contractor shall determine the type and number of fill pumps in orderto guarantee the following:

a) Differential head 20% greater than the maximum required.

Flow rate - Minimum 400 m^3/h

Maximum 1000 m^3/h

If a single pump is used, a standby unit must be available. The stuffing boxes of thepumps must be sealed to prevent air from entering the internals of the pump.

5) Variable speed positive displacement pumps equipped with a stroke counter to pressurize the line with a known volume per stroke and capable of exceeding the maximum test pressure by at least 20 bar.

6) Breakwater tanks with filters for water filling and chemical dosing.

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7) Two positive displacement meters and/or turbine flow meters with flow straightners to measure the volume of water used for filling the line. These meters shall be providedwith a calibration certificate not older than six months. However all instruments used for measurement of volume of water added for pressurization shall have calibration certificates not older than one month.

8) Pressure recording instruments with pressure sensors and 24-hour charts. These shall be calibrated against dead weight tester.

9) Dead weight testers with an accuracy of 0.01 bar measuring in increments and sensitivityof 0.05 bar shall be provided with a calibration certificate no older than one month. The pressure range of the dead weight tester shall be 1.5 times the hydrotest pressure.

10) Large diameter (6" Minimum) Bourdon Pressure gauges of suitable pressure range (1.5x test pressure to be measured) and accuracy of ± 0.1% of the full-scale value. These shall be calibrated at site with dead weight tester. Its calibration shall be checked at the beginning, end and during the hydrotest period. The pressure gauges shall be installed at both ends of the test section.

11) Two temperature recorders for fill water with an accuracy of ± 1% of full-scale range. Thescale range shall be 0º to 60ºC and the sensitivity shall be 0.1ºC. The temperature shall be recorded throughout filling stage.

12) Thermocouples for measuring the pipe wall temperature with an accuracy of ± 0.2ºC.

13) Ambient/Environmental temperature shall be recorded throughout hydrotest duration from the beginning of pressurization. The recorder shall have a range of 0ºC to 60ºC andshall have an accuracy of ± 1% of full-scale range. Two recorders one at each end shall be used.

14) A barograph with an accuracy of ± 0.8 millibar and measuring increments of 1 mbar.

Two laboratory thermometers (thermocouples based) of 0ºC to 60ºC range, with an accuracy of ± 0.1ºC to be used in thermowells. The temperature measuring instruments shall be provided with NPL calibration certificate not older than one month. These shallbe used for calibration of the temperature recorders.

15) Portable tanks of sufficient size to provide a continuous supply of water to the pump during pressurizing.

16) Means to measure the volume of water necessary to drop the line pressure by 0.5 bar (container on scales or graduated cylinder). Resolution shall be 0.0005% of fill volume of the pipeline.

17) Injection facilities to inject additives for anti-corrosion, oxygen scavenger and bactericides into the test medium in the required proportions.

18) The temporary test headers shall be installed according to the testing sections fixed inthe test procedure manual. Proper piping and valve arrangements shall be available to allow launching and receiving of each pig independently. The test heads, manifolds etc., shall be pre-tested for four hours at a pressure equal to 110% of maximum test pressure.The manifolds, test heads, end closures and other temporary testing equipment shall be designed as per recognized codes and shall be either flange/bolted or welded to the pipeline section.

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19) A good and well laid out test cabin shall be located at a safe distance and shall have sufficient space to house all instruments and record of data.

20) Communication equipment suitable for a continuous connection between the beginning and the end of the test section and with the inspection team along the line, in accordancewith the requirements of Local Authorities.

21) Thermocouples for measuring the temperature of the pipe wall shall be installed on the pipeline to be tested:

- 1 thermocouple at about 500 m distance from the pumping head.
- 1 thermocouple every 2500 m of the pipe. The spacing may be increased to 5000m depending upon the terrain and nature of sub-soil
- 1 thermocouple at about 500 m distance from the terminal head.

These instruments shall be installed at least 2 days before the commencement of test sothat the ground temperature trend is well established.

22) All instruments used for measurement shall be certified for accuracy, repeatability and sensitivity.

23) The temperature along the pipeline section shall be measured prior to start of water filling, during filling, during thermal stabilization, and during hydrotest. The recording frequency shall be in terms of every four hours or lesser based on site condition or as directed by the Owner.

In addition to above, Owner/Consultant reserves the right to demand installing more thermocouples as per site conditions.

Thermocouples shall be attached on the external surface of the pipe after removal of external coating and shall be adequately protected. Owner/Consultant coating instruction shall be followed.

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4.0 TEST DURATION AND PRESSURE

4.1 The duration of hydrostatic test shall be minimum 24 hours after stabilization and the test pressure shall be as indicated in approved hydrostatic test diagram.

4.2 Unless otherwise specified in the Contract, natural gas pipelines shall be tested at a minimum test pressure of 1.5 times the design pressure irrespective of the class location. However, the maximum test pressure at the lowest point of the test section or at the section with the least wall thickness shall be limited to hoop stress resulting in 100% of SMYS.

4.3 Pre-testing:

Pre-testing of pipe shall be carried out of carrier pipes in case of cased crossings, pipe strings in case of HDD, pipe before concrete coating and as specified elsewhere in the tender document at a test pressure limited to hoop stress resulting in 100% of SMYS.

The test duration shall be 6 hours and shall be properly recorded.

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5.0 PROCEDURES

The test medium shall be soft non-aggressive water. The water to be used shall be filtered, potable and free from sand or silt. The water shall be free of dissolved substances, harmful chemicals, bacteria etc., which could be harmful to the pipe or which could form internal deposits in the pipeline. The water quality shall correspond to filtration through a 50 micron filter and the average content of suspended matter shall not exceed 20g/m^3. Contractor shallsubmit laboratory test reports of water used for testing.

Contractor shall provide Owner/ Consultant approved corrosion inhibitors, oxygen scavengers and bactericides to be added to the test water as required. The Contractor shall furnish and install all temporary piping which may be necessary to connect from source of water to its pumps and manifolds/tankages. All temporary piping shall be adequately supported during the pressure test. Pressure hoses used shall be properly armoured and shall have a safe working pressure at least equal to twice the hydrostatic test pressure. The hoses shall be anchored to prevent pipe whip and shall not be used inside the test cabin. All hoses shall be pre-tested at least for one hour at their rated working pressure.

5.1 Cleaning & Calliper Pigging

Before filling operation the Contractor shall clean the pipeline by air driven pigs to remove all mill scale, rust/sand, weld debris and other metallic particles from the internal of pipe sections. The finishing touch shall be executed with pigs provided with air jet holes or nozzles to keep the internal dust in turbulence ahead of the pigs. Contractor to ensure that the cleaning pigs does not damage pipeline components and facilities. The number of pig runs shall depend upon the cleaning results and shall be determined by the Owner/ Consultant Representative at site. In case of stuck/ blocked pigs, contractor to submit detail action plan at site for Owner's approval before proceeding with any remedial measures. Pig train speed shall be maintained between 0.5 m/sec to 1 m/sec. Progress of pig train shall be monitored. Contractor has to furnish detailed procedure including placement of pig locators on the line.

During filling the pigs used shall be capable of providing positive air/water interface and minimize air entertainment. All spaces in which air could be entrapped such as valve bodies; bypass pipe work etc. should be vented and sealed. The cleaning fluids shall remove chemical particles and organisms. The cleaning and gauging train design, number of pigs, train velocity etc., shall be based on pipeline size and gradient along pipeline route. Care should be taken in downhill pipe sections where air pressure shall be maintained to ensure that pigs do not move ahead of line fill resulting in air pockets being trapped at the uphill.The pressure produced by downhill point of water column on the pig shall be balanced by sufficient back pressure.

After cleaning, pipeline will be flushed with minimum 1 km of pipeline volume and water shallbe filled with corrosion inhibitor by propelling minimum 2 pigs with water column of 100 meters.

5.2 Thermal Stabilization

After a check has been made to confirm whether the pressure has attained at least 1 bar (g) on the highest section, the thermal stabilization can be started.

Thermal equilibrium between the pipeline and environment shall be checked through the thermocouples installed on the pipeline.

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Temperature readings shall be taken at every 2 hour intervals. Thermal stabilization shall be done for 24 hours and shall be considered to have been achieved when a difference not higher than 1ºC is attained between the average values of the last two readings. Owner/Consultant shall approve thermal stabilization completion before pressurization.

5.3 Pressurization

The pressurization rate shall not be more than 2 bar/ min. Pressure shall be recorded byusing a dead weight tester and confirmation shall be done with pressure gauge on the same header. Water volume shall also be recorded with respect to pressure.

- Each 5 bar increments upto 80% of test pressure as recorded by the dead weight tester.
- Each 2 bar increment between 80% of test pressure as recorded by the dead weighttester.
- Each 0.2 bar increments between 90% of the test pressure up to full test pressure asrecorded by dead weight tester.

Pressure cycling and Air volume ratio calculations requirements:

i) Pressurise to 33% of test pressure, hold pressure for 1 hour, and collect water for airvolume calculations. Check for any leaks.

ii) Drop pressure to static head of test section at test head.

iii) Re-pressurise to 75% of test pressure, hold pressure for 1 hour and check for anyleakage

iv) Drop pressure to static head of test section at the test head.

v) Re-pressurise to test pressure and hold for stabilization.

5.4 Air Volume Calculation

In order to check the presence of air in the pipeline, two separate consecutive pressure lowering of 0.5 bar shall be carried out.

For calculation of air in the pipeline the second pressure lowering shall be used, and the relevant drained water shall be accurately measured (V_1). This amount measured shall be compared to the

theoretical amount (V_2) corresponding to the pressure lowering that has been carried out, by using the procedure outlined in the specification.

If no air is present in the length under test:

$$\frac{V_1}{V_2} = 1$$

The above ratio is acceptable, provided it shall not differ from '1' by more than 0.2% (i.e. 1.002).

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If ratio is found to be above within limits, then pressurization can proceed. If not, water refilling shall be carried out by another run of batching pigs after depressurizing the pipeline.

Simultaneously contractor shall also construct a plot of pressure volume from the initial stage of pressurization until a definite linear relationship is obtained. The theoretical P/V plot shall also be plotted on the same graph. Once 33% of test pressure is reached, the linear curve shall be extrapolated backwards to cut the volume axis. The measured air volume and its percentage of pipeline test section volume shall be calculated. On completion of the air inclusion P/V plot, a separate P/V plot should commence and continue until the test pressureis reached. The slopes of the actual P/V plot and theoretical P/V plot shall be compared and all calculations and graphs shall be submitted to Owner/Consultant for information.

Percentage of air = (volume of air / volume of line) X 100

Air content shall not exceed 0.2 % of the line volume. In case, air content exceeds the limit, testing shall be terminated. The test section should be emptied and refilled at the discretion of the Owner/ Consultant.

5.5 Testing (pressure holding test)

After the section has been pressurized and the air column test has given acceptable results the test pressure shall be held for a minimum of 48 hours (24 hours for strength test and 24 hours for leak test) after stabilization for 24 hours. After temperature and pressure are stabilized, (for the 24 hours leak test) the injection pump shall be disconnected and all connections at the test heads shall be checked for leakage. The pressure and temperature recorders shall then be started once again with the charts in a real time orientation for continuous recording throughout the test duration. No further pumping is permitted duringthe test period.

During the testing period the following measurements shall be recorded/ reported:

- Every one-hour pressure measurements from dead weight testers.
- Every two hours the ambient temperature and the pipe temperature at the thermocouplesand fill water temperature.
- Barometric pressure for every one hour.

All data shall be recorded on appropriate formats attached to the hydrostatic test proceduremanual. Care shall be taken that the maximum test pressures are not exceeded.

6.0 ACCEPTANCE

The hydrostatic test shall be considered as positive if pressure has kept a constant value throughout the test duration, except for change due to temperature effects. Such changes shall be evaluated as described below.

The pressure change value as a function of temperature change shall be algebraically added to the pressure value as read on the meters. The methodology for calculation of pressure change due to temperature shall be as per section 8.0 of this specification. The pressure value thus adjusted shall be compared with the test and shall be considered as acceptable if the difference is less than or equal to 0.3 bar of test pressure. In case of doubt or if for any reason the test pressure has been reduced other than for bleed-off excess pressure, the test duration shall be extended by 24 hours.

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If test section doesn't meet the above requirement, Contractor shall determine by search the location of leakage or failure. All leaks and failures within the pipe wall or weld seam shall berepaired by replacement of entire pipe or pipes in which leakage or failure occurs. In those cases, where leaks occur in circumferential welds the Owner/ Consultant shall determine themethod of repair. Contractor shall comply with instructions of the Owner/ Consultant's representative whether to replace a section of the line pipe that includes the line leak or whether to repair the circumferential weld. The repair shall be carried out as per specifications. Where failures occur in pipeline field bends, bends shall be replaced with same degree bends. After completion of repairs, the hydrostatic test shall be repeated as a complete cycle, as per this specification. All repairs and retesting shall be carried out at the expense of the Contractor. All work of reinstalling line pipes to replace failed pipes shall be carried out as per specifications. For Owner/Consultant verification, all failed pipes shall be stored, marked, and tagged indicating date and location of failure and pressure at which failure occurred. The failed areas shall be greased to prevent corrosive action.

7.0 TERMINATION

After the positive results of testing and all the data have been gathered, the test shall be terminated upon written approval given by Owner/Consultant.

The pipeline shall be slowly depressurized at a moderate and constant rate as instructed by Owner/Consultant.

Contractor shall dispose of test water in a responsible manner to the satisfaction of the local authorities, client and contiguous property owners. There shall be minimum damage to environment and shall not result in any ground water contamination.

All thermocouples installed on the line shall be removed and coating repaired to satisfaction of the client. All piping and instrument connections shall be blanked, plugged or capped as per requirements.

8.0 CALCULATIONS

The theoretical water amount that is necessary for filling the section to be tested shall be obtained from the geometrical volume of the section considering the pipe tolerances.

The theoretical water amount that is necessary for pressurizing the section shall be calculated by means of the following formula:

$$Vp = (0.884\ r_1/t+A) \times 10^{-6} \times V_t \times \Delta P \times K$$

Where:

Vp = Computed water amount required to raise the pressure by 'ΔP' in the section to be tested (m^3)

Vt = Geometrical volume of the section (m^3)

ΔP = Pressure rise (bar)

r_1 = Nominal inner radius of the pipe (mm)

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t = nominal pipe thickness (mm)

A = isothermal compressibility value for water at the pressurization temperature in the P range (bar^{-1}).

K = a dimensionless coefficient that is equal to a value of 1.02 for Longitudinally welded pipe, and 1.0 for seamless pipe.

The pressure change due to a water temperature change shall be calculated through thefollowing formula:

$$\Delta P = B * \Delta T / \{ (0.884 r1 / t)+ A \}$$

Where;

ΔP = Pressure change resulting from a temperature change (bar).

ΔT = Algebraic difference between water temperature at the beginning of the test and water temperature as measured at the end of the test (ºC).

B = Value of the difference between the thermal expansion of water at the pressure and temperature as measured at the end of the test and that of Steel (ºC). Refer Table-1.

A = Isothermal compressibility value of water as estimated at the pressure and temperature values obtained at the end of test (bar^{-1}). Refer Fig-1.

r_1 = Nominal inner radius of the pipe (mm).t =

Nominal pipe thickness (mm).

9.0 TEST REPORT / DOCUMENTATION

A complete report signed by Contractor and the Owner/ consultant Representative shall besubmitted upon completion of the hydrostatic testing operations for each test section.

The report shall contain as minimum:

- Cleaning, flushing, filling and testing procedure used
- Schematic layout of cleaning, filling and testing facilities
- All Instruments calibration certificates
- A profile of the pipeline that shows the test sites, all instrument and injectionconnections.
- Pipe filing logs and records.
- Hydrotest chemicals specification, dosage, injection records specifications andcertificates.
- Pig specifications

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- Pigging records including details of pig runs.
- Pressurization and stabilization records and charts with all information specified.
- Pressure and temperature recording charts with appropriate information inscribedthereon.
- Dead weight tester logs and recordings
- Air volume calculations and plots
- Pressure – temperature change calculations
- Profiles of pipelines with elevations
- Environmental data, barometric data
- Depressurisation logs and records
- Disposal method of test water
- Records and photograph of all leaks/failure, location of failure and method of repair
- Schematic isometric drawing of test header with all auxiliaries.
- Daily log of events.

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10.0 PRECAUTIONS DURING THE TEST

In addition to all that has been expressly described in the procedures for carrying out thetest, the following requirements shall also be complied with.

10.1 During the hydrotest, no other activities shall be performed on or near pipeline being tested. Further, the test sections shall be kept under continuous surveillance by regular patrols during test and with continuous communication.

10.2 Signs stating "PIPE UNDER TEST – KEEP OFF" shall be placed where the test ends are located. Such areas shall be suitably guarded throughout the duration of the test. In case pressurizing is done from the shore end, the entire operational area shall suitably be fenced to prevent entry of unauthorized personnel. The warning sign shall also be in Local Language.

10.3 All personnel working on the hydrotest spread shall be instructed on the possible dangers connected with the high-pressure test operations. During the testing, operations, unauthorized personnel shall not be allowed near by the test head location. Test cabin shall be at least 10 m away from the pipeline so that it is not affected by any pipeline failure.

10.4 All precautions pertaining to handling and disposal of chemicals shall be as per manufacturer's standards.

10.5 All pumps shall have overprotection devices set @ 5 bar above test pressure.

10.6 The pressure shall be reduced to a safe level of 1 bar before any work is permitted on the pipeline section.

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10.7 All crossing areas and areas of public access should be patrolled during test.

10.8 Contractor to ensure that all safety precautions comply with statutory and other national/state and local regulations and shall give notice to the concerned authorities regarding the intention to carry out the test.

10.9 Contractor to ensure that a hydrotest organization chart is made and all personnel are fully aware of their responsibilities and scope of work.

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Table 1

Difference between the water thermal expansion factor and the steel thermal expansionfactor ($^oC^{-1}$).

°C / Bar	1	2	3	4	5	6	7	8
0.98	-98.62	-79.89	-61.81	-44.34	-27.47	-11.14	4.66	19.98
10	-95.55	-76.94	-58.99	-41.65	-24.89	-8.67	7.02	22.23
20	-92.15	-73.68	-55.86	-38.64	-22.01	-5.92	9.65	24.74
30	-88.74	-70.4	-52.72	-35.63	-19.14	-3.16	12.29	27.26
40	-85.32	-67.12	-49.58	-32.62	-16.24	-0.41	14.93	29.78
50	-81.9	-63.84	-46.43	-29.6	-13.36	2.36	17.57	32.31
60	-78.47	-60.55	-43.27	-26.58	-10.46	5.15	20.23	34.85
70	-75.03	-57.25	-40.1	-23.54	-7.56	7.92	22.89	37.39
80	-71.6	-53.96	-36.94	-20.51	-4.65	10.7	25.55	39.94
90	-68.16	-50.66	-33.77	-17.47	-1.73	13.5	28.23	42.5
100	-64.72	-47.35	-30.6	-14.43	1.18	16.29	30.9	45.05
110	-61.28	-44.05	-27.43	-11.38	4.1	19.08	33.58	47.61
120	-57.84	-40.74	-24.26	-8.34	7.02	21.88	36.26	50.18
130	-54.4	-37.44	-21.08	-5.29	9.95	24.68	38.94	52.75
140	-50.96	-34.13	-17.9	-2.25	12.87	27.49	41.63	55.32
150	-47.53	-30.83	-14.73	0.8	15.79	30.29	44.31	57.89
160	-44.1	-27.53	-11.56	3.85	18.72	33.1	47	60.46
170	-40.67	-24.23	-8.4	6.89	21.64	35.9	49.69	63.04
180	-37.24	-20.94	-5.23	9.94	24.56	38.7	52.37	65.62
190	-33.83	-17.65	-2.06	12.98	27.48	41.51	55.06	68.19
200	-30.42	-14.37	1.09	16.01	30.4	44.3	57.75	70.77
210	-27.02	-11.09	4.25	19.04	33.31	47.1	60.43	73.34
220	-23.63	-7.82	7.4	22.06	36.22	49.9	63.12	75.9
230	-20.24	-4.56	10.54	25.08	39.13	52.69	65.8	78.48
240	-16.87	-1.3	13.67	28.1	42.03	55.48	68.48	81.05
250	-13.58	1.94	16.79	31.11	44.92	58.26	71.15	83.61
260	-10.14	5.17	19.9	34.12	47.81	61.04	73.81	86.81
270	-6.8	8.39	23	37.11	50.69	63.8	76.48	88.73
280	-3.48	11.6	26.11	40.09	53.56	66.57	79.14	91.29
290	-0.17	14.8	29.19	43.07	56.43	69.33	81.78	93.83
300	3.13	17.98	32.27	46.03	59.29	72.06	84.83	96.38

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Table 1

Difference between the water thermal expansion factor and the steel thermal expansionfactor ($^oC^{-1}$).

°C Bar	9	10	11	12	13	14	15
0.981	34.82	49.22	63.2	76.78	89.99	102.83	115.34
10	36.97	51.26	65.15	78.64	91.75	104.51	116.93
20	39.36	53.55	67.33	80.71	93.72	106.39	118.71
30	41.76	55.84	69.51	82.79	95.7	108.26	120.49
40	44.18	58.14	71.7	84.87	97.68	110.14	122.28
50	46.6	60.45	73.9	86.96	99.68	112.04	124.07
60	49.02	62.76	76.1	89.07	102.67	113.93	125.88
70	51.44	65.08	78.32	91.17	103.68	115.84	127.69
80	53.88	67.4	80.53	93.29	105.69	117.76	129.5
90	56.32	69.73	82.75	95.41	107.7	119.67	131.32
100	58.77	72.07	84.98	97.53	109.73	121.59	133.15
110	61.21	74.41	87.22	99.66	111.75	123.52	134.98
120	63.67	76.74	89.45	101.79	113.79	125.46	136.82
130	66.12	79.09	91.69	103.93	115.83	127.39	138.67
140	68.58	81.45	93.93	106.07	117.67	129.34	140.51
70	71.05	83.8	96.18	108.21	119.9	131.2	142.37
160	73.51	86.15	98.43	110.36	121.96	133.74	144.22
170	75.97	88.51	100.68	112.51	124.01	135.19	146.08
180	78.44	90.87	102.94	114.66	126.06	137.15	147.94
190	80.91	93.23	105.19	116.82	128.12	139.11	149.81
200	83.37	95.59	107.45	118.97	130.17	141.07	151.68
210	85.84	97.95	109.71	121.13	132.24	143.03	153.55
220	88.3	100.31	111.97	123.29	134.29	144.99	155.42
230	90.67	102.67	114.23	125.45	136.36	146.96	157.3
240	93.22	105.03	116.48	127.6	138.42	148.93	159.18
250	95.69	107.39	118.74	129.76	140.48	150.9	161.05
260	98.14	109.74	121	131.92	142.54	152.87	162.93
270	100.6	112.1	123.25	134.08	144.61	154.84	164.81
280	103.05	114.44	125.5	136.24	146.67	156.84	166.69
290	105.5	116.79	127.75	138.39	148.73	158.78	168.57
300	107.94	119.13	130	140.54	150.79	160.75	170.45

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Table 1

Difference between the water thermal expansion factor and the steel thermal expansionfactor ($^oC^{-1}$).

°C Bar	16	17	18	19	20	21	22	23
0.981	127.52	139.41	151	162.31	173.37	184.18	194.75	205.08
10	129.02	140.83	152.36	163.58	174.56	185.3	195.79	206.07
20	130.71	142.42	153.85	165	175.9	186.55	196.96	207.16
30	132.4	144.02	155.35	166.42	177.23	187.8	198.14	208.26
40	134.1	145.62	156.87	167.85	178.58	189.07	199.33	209.37
50	135.8	147.24	158.39	169.85	179.93	190.34	200.52	210.49
60	137.51	148.86	159.92	170.73	181.29	191.62	201.72	211.61
70	139.22	150.49	161.46	172.18	182.66	192.91	202.93	212.74
80	140.95	152.11	163	173.64	184.03	194.2	204.14	213.88
90	142.67	153.75	164.56	175.1	185.41	195.5	205.36	215.03
100	144.42	155.4	166.11	176.58	186.8	196.8	206.59	216.17
110	146.15	157.04	167.66	178.05	188.2	198.12	207.82	217.33
120	147.9	158.7	169.24	179.54	189.59	199.44	209.06	218.49
130	149.65	160.36	170.81	181.02	191	200.75	210.31	219.66
140	151.4	162.03	172.39	182.51	192.41	202.09	211.56	220.84
70	153.16	163.7	173.98	184	193.82	203.42	212.81	222.02
160	154.93	165.37	175.56	185.51	195.24	204.76	214.08	223.2
170	156.69	167.05	177.15	187.02	196.66	206.1	215.34	224.39
180	158.47	168.73	178.75	188.53	198.09	207.45	216.61	225.55
190	160.24	170.42	180.35	190.05	199.52	208.8	217.89	226.79
200	162.01	172.1	181.95	191.57	200.97	210.16	219.17	227.99
210	163.8	173.8	183.55	193.09	202.4	211.53	220.46	229.2
220	165.58	175.43	185.16	194.62	203.85	212.89	221.74	230.41
230	167.36	177.19	186.78	196.14	205.3	214.26	223.04	231.63
240	169.16	178.89	188.39	197.68	206.75	215.63	224.33	232.85
250	170.94	180.59	190.01	199.21	208.2	217	225.63	234.08
260	172.73	182.3	191.63	200.75	209.66	218.4	226.93	235.31
270	174.53	184	193.25	202.29	211.12	219.77	228.24	236.54
280	176.32	185.7	194.88	203.83	212.59	221.16	229.55	237.77
290	178.11	187.42	196.5	205.37	214.05	222.54	230.86	239.01
300	179.9	189.13	198.13	206.92	215.51	223.93	232.18	240.26

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Table 1

Difference between the water thermal expansion factor and the steel thermal expansionfactor ($^oC^{-1}$).

°C Bar	24	25	26	27	28	29	30
0.981	215.22	215.14	234.88	244.41	253.79	263	272.03
10	216.13	225.99	235.66	245.13	254.44	264.27	272.57
20	217.15	226.94	236.53	245.94	255.18	264.59	273.18
30	218.18	227.88	237.41	246.75	255.93	264.95	273.8
40	219.21	228.85	238.3	247.58	256.69	265.64	274.42
50	220.25	229.82	239.2	248.4	257.45	266.33	275.07
60	221.3	230.79	240.11	249.24	258.22	267.04	275.7
70	222.35	231.78	241.02	250.08	258.99	267.75	276.35
80	223.42	232.77	241.94	250.93	259.78	268.47	277.01
90	224.48	233.76	242.87	251.79	260.57	269.19	277.66
100	225.56	234.76	243.79	252.66	261.36	269.92	278.33
110	226.64	235.78	244.73	253.53	262.17	270.77	279.01
120	227.73	236.79	245.68	254.4	262.98	271.41	279.69
130	228.82	237.81	246.63	255.28	263.69	272.16	280.38
140	229.92	238.84	247.59	256.18	264.62	272.92	281.08
150	231.03	239.87	248.55	257.07	265.44	273.69	281.78
160	232.14	240.91	249.52	257.97	266.28	274.46	282.49
170	233.26	241.96	250.49	258.88	267.12	275.23	283.2
180	234.38	243.01	251.47	259.79	267.97	276.01	283.92
190	235.51	244.06	252.46	260.71	268.82	276.8	284.64
200	236.64	245.12	253.45	261.63	269.67	277.59	285.37
210	237.77	246.18	254.45	262.5	270.54	278.39	286.11
220	238.91	247.26	255.45	263.49	271.4	279.19	286.85
230	240.06	248.33	256.46	264.43	272.28	280	287.59
240	241.21	249.41	257.46	265.37	273.16	280.82	288.35
250	242.36	250.49	258.48	266.31	274.04	281.63	289.11
260	243.52	251.58	259.49	267.27	274.92	282.46	289.86
270	244.68	252.66	260.52	268.23	275.82	283.29	290.64
280	245.84	253.76	261.54	269.18	276.71	284.12	291.4
290	247.01	254.86	262.57	270.15	277.61	284.95	292.18
300	248.18	255.96	263.6	271.11	278.51	285.79	292.95

BGL/632/2024-25

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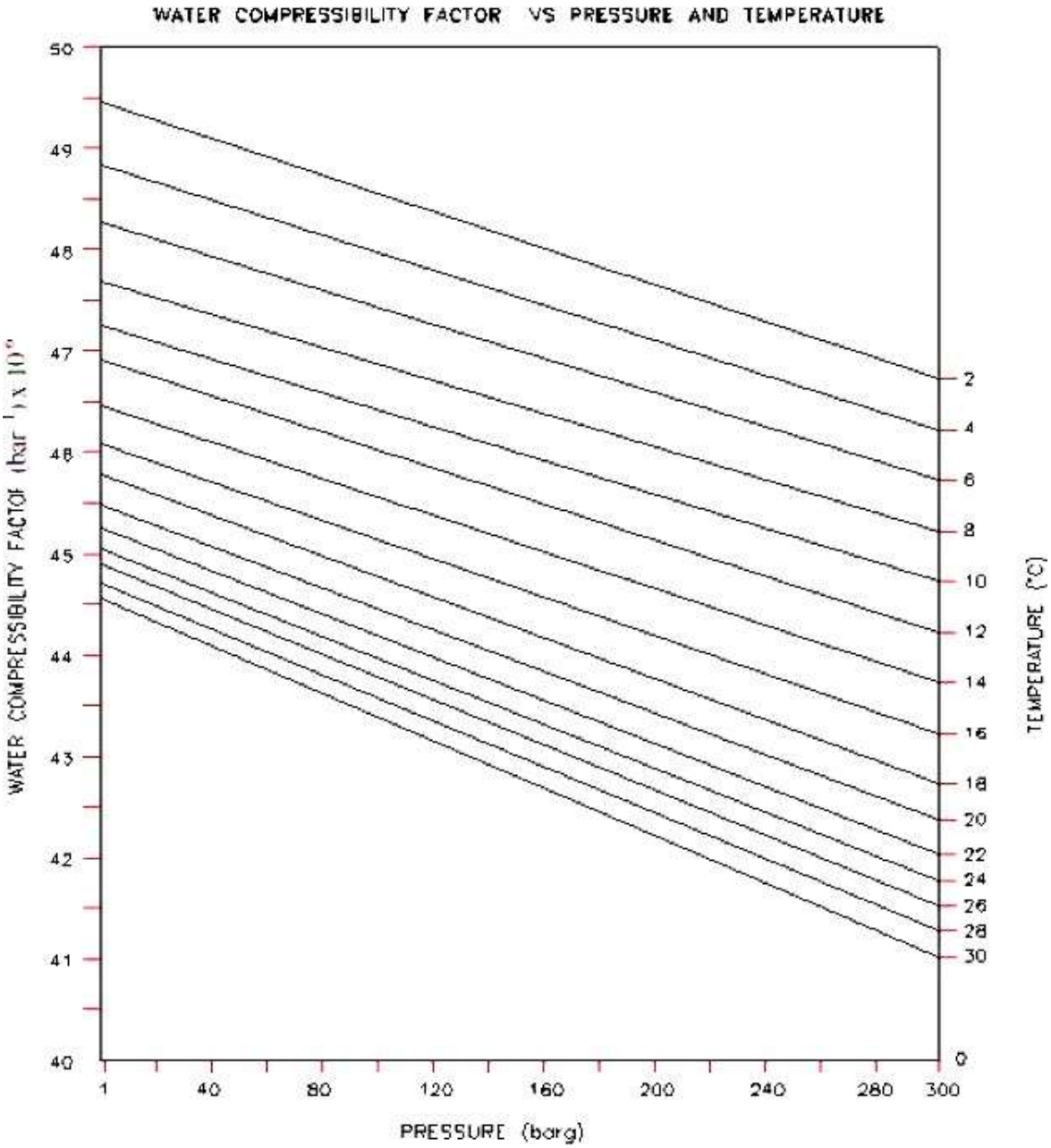

Fig.1 Water Compressibility Factor

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR CALIPER PIGGING

ENG-STD-PL-DOC-TS-015

BGL/632/2024-25

1	22.01.16	Issued for client approval				
0	25.11.15	First Issue				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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1.0 SCOPE

The intent of this specification is to set forth the requirements of the caliper pigging. The specification is not intended to be all-inclusive and the use of this specification will not absolve the contractor of his responsibility of generating valid, interpretable and physically verifiable data.

2.0 OBJECTIVE

The objective of the present pigging programme is to access the internal geometry of the following pipelines and detect significant geometry defects if any, which may affect safe operation of the pipeline.

3.0 SCOPE OF WORK

To achieve the above objective, contractors SCOPE OF WORK includes running of adequate numbers of foam pigs, cleaning pigs (magnet, brush, combination of brush and magnet, scraper, pin wheel etc.), gauge pig and caliper pig.

Further the scope of work comprises supply of skilled personnel, all equipment e.g. foam pigs cleaning pigs, gauging pig, caliper pigs, pig locating and pig tracking devices, spares consumables, communication and transportation including their mobilisation and demobilisation. It is expressly understood that this do not limit the scope of work of the CONTRACTOR in any way. The quantities to be mobilized for different equipment (differenttypes of pigs pig tracking device, marker device) accessories, spare and consumables need to be carefully evaluate by the CONTRACTOR taking in to the consideration that caliper pigging of various pipelines in the scope of work should be carried out without any constraint and turn around time.

The contractor shall submit the details of each type of pig including foam, gauge and caliper for approval of OWNER / CONSULTANT, which he proposes to use. Pigs shall be launched in the pipeline only after their design and size has been approved by OWNER / CONSULTANT. Due care shall be taken not to damage internal coating by the contractor, while proposing the pigs for internally coated pipeline.

The detailed scope of work shall be, but not limited to under

- Supply of all equipment, personnel and consumables.
- Running of foam, Gauge, Cleaning and Caliper pigs and Tracking to generate valid data.
- Placement of marker devices along the Row over the pipeline.
- Identification of defects in the field as found
- Preparation of work reports.

4.0 VELOCITY OF DIFFERENT PIGS

Contractor shall be required to maintain velocities of propelling medium in such a way that the objective of each pig run shall be achieved.

5.0 FOAM PIG RUN

Contractor to carry out adequate number of foam pigs runs in each pipeline covered under Scope of Work prior to running of cleaning pigs to make a final assessment of the line pig-

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ability to the satisfaction of the Contractor and provide detailed daily site report for each runin the approved format before commencing the subsequent run. Contractor to select size ofthe foam pigs in such a way that the objective shall be achieved.

6.0 GAUGE PIG RUN

Contractor to carry out adequate number of gauging pig runs in each pipeline covered under Scope of work including pig tracking for pipeline to assess any internal restriction in the pipeline that may restrict the passage of cleaning and caliper pig. Contractor to provide detailed daily site report for each run in the approved format before commencing the subsequent run Gauge pig shall be equipped with a gauge plate made of Aluminium havingits diameters 95% of minimum pipeline Internal Diameter (I.D.). The gauge pig should be able to pass over or negotiate lateral tees or bends on the pipeline.

7.0 CLEANING PIG RUN

7.1 Pipelines with Internal Coating

Contractor to carry out adequate number of cleaning pig runs by running suitable cleaning pigs in the pipelines including pig tracking till the time owner/ owner's representative is satisfied about the degree of cleanliness of pipeline. The contractor shall provide detailed daily site report for each run in the approved format before commencing the subsequent run. Choice of the type of cleaning pig has been left to the contractor. The contractor shall assure that the pigs, which are proposed to be used, are adequately soft and they do not damage internal coating under any circumstances. The brushes and scrappers used shall be of non-metallic/ plastic material. However, the details of these pigs including their construction details of brushes, scrappers etc. (if applicable) shall be submitted to OWNER / CONSULTANT for approval before their usage.

7.2 Pipelines without Internal Coating

CONTRACTOR to carry out adequate numbers of cleaning pig runs by running suitable cleaning pigs in pipeline including pig tracking till such time CONTRACTOR is satisfied withhimself about the degree of cleanliness of pipeline and provide detailed daily site report for each run in the approved format before commencing the subsequent run. Choice of the type of cleaning pig has been left to the contractor. Contractor may deploy brush cleaning pig, magnetic cleaning pig, combination of brush and magnet, scrapper pig etc. the cleaning pigs should be able to pass over negotiate lateral tees or bends on the pipeline.

8.0 CALIPER PIG RUN

CONTRACTOR to carry out adequate number of electronic geometry (caliper) pig runs each pipeline including pig tracking for each pipeline decided after findings of gauging pig run to generate valid and interpretable geometry data of the pipeline and analysis of data ofthe caliper survey to detect the nature, extent and location of geometry defect. Contractorto provide detailed daily site report for each run in the approved format before commencingthe subsequent run. The caliper should be capable of inspecting entire length of the pipeline i.e. from launcher to receiver in single run. Battery life should be adequate to commensurate with the run time required to travel the pipeline length. The electronic recorder system should have requisite data storage capacity. The drive cups should have requisite resistance to wear and tear to maintain effective seal throughout the entire run time.

The measurement shall cover the entire 360° of internal pipe wall circumference using properly oriented and sufficient quantity of sensors. For internally coated pipelines adequate care shall be taken by using soft cups so that no damage takes place to the

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internal coating of pipe. The tool shall be capable to identify and locate the followingfeatures as minimum.

- Individual Girth weld
- Dent, ovality, buckles, or any other out of roundness, change in pipeline I.D. anddifference of thickness.
- Bend with bend radius and degree of bend.
- Valves or any partially closed valves.
- Tees/ off-takes.

The caliper pig should have minimum capability to identify and detect the defects offollowing threshold.

Dent	:	3% of outer diameter (O. D.)
Ovality	:	5% of outer Diameter (O. D.)
Location accuracy	:	Axial ± 2.0m
		Circumferential ± 10°

(For dents, ovalities and pipeline feature as detailed above).

Caliper Pig shall be calibrated on predetermined dent on same size and thickness of thepipeline to be examined and witnessed by Owner/ Consultant

9.0 PIG TRACKING

The movement of any type of pig (Except, foam pig) put into the line during caliper pigging shall be required to be monitored along the pipeline length. The Contractor shall detail out the complete methodology of pig tracking proposed to be deployed by him including complete technical details of the equipment and device proposed to be used for this purpose.

It is proposed that pig tracking would be done in a discrete manner at regular intervals(Max 5 km) on each pipeline. The exact KM chainage of these locations shall be decided atsite in consultation with the Contractor and Owner / Consultant.

10.0 MARKER DEVICES

The contractor shall submit the details of marker devices, which he proposes to place for relocating the defect accurately in the field, when the same has been identified as a resultof Caliper survey.

The contractor shall be responsible for placing these devices (Marker Magnets or Locator coils or any other device) at suitable interval so that the defect can be easily located in the field with minimum above ground measurement. It may be noted that placement of marker devices, their retrieval and locating the identified defect in the field shall be the responsibility of the contractor. The liquidation of defects, if any, is however, not included inthe scope of work of the contract.

11.0 DEFECT VERIFICATION

At the discretion of the Owner/ Consultant identify at least two verification dig sites for eachpipeline jointly with Owner and Consultant from the recorded data and provide Owner / Consultant with their distance from the nearest pipeline feature or reference marker to facilitate location of defect in the field.

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The contractor shall depute his representative to observe the verification at verificationsites for proving that filed log detected anomalies conform to sizing including linear and circumferential positions.

12.0 ABNORMAL SITUATIONS

The objective of this section is to write down foreseeable abnormal circumstances for taking appropriate measures, should such a condition arise during implementation of project.

The following abnormal condition has been foreseen by the Owner. However, if the Contractor foresees any other abnormal condition, he is free to make a mention of thesame in his technical BID offer.

12.1 Tool Failure

Contractor is required to get valid interpretable and verifiable data for pipeline. In case Contractor's equipment fails to perform electronic geometry inspection to generate valid data for any of the pipeline, Contractor will make extra runs of pigs to get valid and physically verifiable data.

12.2 Stuck-Up Tool

The Contractor shall details out a contingency plan as proposed by him in case any of the pigs get stuck up. The plan shall identify procedure for exactly locating the stuck up pig, detail procedure for retrieval of pig, equipment, including support facilities required to retrieve the pig.

If pig does not move from stuck up location, by any measure, then the pipeline section shallhave to be cut for retrieval of Pig. Necessary erection, fabrication and modification of pipe with new pipe piece after retrieval of pig shall be done by Contractor. The cost for this works shall be borne by Contractor on actual. After fabrication & erection, pigging contractor shall run Gauge pig to check internal restriction, if any. Locating the stuck up pig and its retrieval shall be the responsibility of the Contractor.

13.0 WORK REPORT

The work report shall be prepared and submitted in hard copy (4 sets) and Soft Copy.The work report shall consist of following as a minimum.

- All field activities.
- Equipment description
- List of installations
- List of significance with feature information and installation reference.
- Survey log and enlargement areas of special interest to suitable scale.

14.0 DOCUMENTATION

- Specification of foam pigs, cleaning pigs, gauge pig and caliper pig for pipelines with andwithout internal coating respectively.

- Details of caliper pig in following respects:
  Max. % of Nominal pipeline ID tool can pass (% of ID)

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Minimum deformation level reported (as % of ID)

Accuracy of measurement (% of ID)

Bend radius tool able to negotiate

- Details of pig tracking equipment and pig tracking procedure.
- Pig contingency plan.
- Proposed methodology for execution of pipeline pigging.
- Sample reporting format.

-Minimum velocity of various pigs acceptable to bidder for generation of valid data.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR DOCUMENTATION OF PIPELINE CONSTRUCTION

ENG-STD-PL-DOC-TS-017

BGL/632/2024-25

0	25.11.15	First Issue				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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1.0 SCOPE

1.1 This specification covers the minimum requirements of the various records, reports and drawings for all aspects of pipeline construction to be prepared by Contractor and submitted to the Owner at intervals as described in this specification and as directed by Owner.

1.2 All documents required to be prepared and submitted by Contractor as per this specification shall be in addition to the various reports, records, methodology statements, calculations, drawings etc. to be submitted by the Contractor for Owner's record, review or approval as per the requirements of all other specifications included in the Contract between the Owner and the Contractor.

1.3 This specification shall be read in conjunction with the condition of all specifications and documents included in the Contract between Owner and Contractor.

2.0 RECORDS

Contractor shall submit daily, weekly, monthly and after completion to the Owner various records and reports, for Owner's documentation purposes during and immediately after the construction. This shall as a minimum include, but not limited to the following:

2.1 Daily

- Planning Sheet
- Separate progress reports of all crews
- Daily welding results and repairs
- Actual weather conditions
- Application for variations, if any
- Accidents
- Damages
- Activities required from OWNER at short notice.
- Materials Receipts
- Urgently required materials etc

2.2 Weekly

- Up-to-date list of confirmed site instructions issued by OWNER
- Materials procured

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- Material defects and repairs
- Outstanding activities of Owner
- List of installed markers, chainage
- Required approvals from Owner
- Progress planned
- Report of manning of all crews, equipment and plant
- Report of equipment and plant
- Report of accidents
- Report of damages
- Report of acquired releases, permits
- Priced variations
- Required materials for next month etc.

2.3 Monthly

- Progress report for payment, safety report, report of accidents, security report, health and environment report, material balance, approved variations.

2.4 Further Contractor shall supply (for approval, if required, to the Owner with documents such as but not limited to:

- Organogram for the construction of the work.
- Bio-data of key personnel (including foremen).
- List of addresses of personnel in particular of medical staff, safety and security officers.
- List of approved codes.
- List of approved sub-contractors.
- Time schedule.
- Acquired permits and/or approvals from authorities, endowments, if any.
- Minutes of meeting with Owner with comments, if any.
- Material certificates, material receipts, etc.
- Guarantees from Vendors and Sub-contractors
- Calculations, temporary works, buoyancy, blasting, etc.
- Drawing issued by Contractor
- Vendor drawings

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- As-built drawings of route maps, profile drawings, detail drawings and isometric drawings.
- Procedures such as surveying, staking, fencing etc.
- Welder procedure qualification record, radiographic procedure qualification, Welder qualification.
- Coating procedure.
- Installation of crossings.
- Hydrostatic testing procedure,
- Blasting procedure.
- Radiographic report along with original radiographs.
- Pipe and welding book
- Material records and accounting book
- **Reports:**
  - Materials tests (coating, welding, painting, etc.)
  - Computerized Potential Logging Test
  - Water samples
  - Cleaning, pigging report before hydrostatic test
  - Hydrostatic test
  - Calibration test
  - Rock blasting trials
  - Equipment certificates (dead weight tester, instruments, vessels, equipment, etc.)
  - Manuals
  - Major water crossings
  - Releases.

2.5 Contractor shall submit to Owner color photographs of various construction activities/ operations at regular intervals. Size, number and frequency of the photographs shall be mutually agreed upon ata later stage. Also Contractor shall make video recordings of all operations right from the start of construction till the completion of works, covering to the extent as instructed by Owner and submit to the Owner.

3.0 "AS-BUILT" DRAWINGS AND PIPE BOOK

3.1 General

Contractor shall prepare "as-built" drawings of all by or on behalf of Owner issued drawings and of all Contractor work drawings including Vendor drawings, such as but not limited to:

For pipeline section:

- Route maps
- Profile maps
- Alignment Sheets
- Detail drawings (road, railway, minor water crossings, major water crossings, etc.)
- Isometric drawings of installations
- Special installations, etc.

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Further Contractor shall prepare a pipe and weld book.

3.2 "As-Built" Drawings

Contractor shall prepare a complete set of "as-built" drawings. From the start of construction, Contractor shall daily process any changes into two sets of drawings. Deleted parts shall be indicated in red, new parts in blue, remarks in green and unchanged parts in yellow. Said drawings shall be kept in site and be available to Owner at all times. Contractor shall prepare "as-built" drawings based on these data and as laid down hereafter. One set of these drawings with data shall be sent to Owner before taking over of the work, while the other set shall be handed to Owner at the same time. On completion of the work, one revised film transparency of all drawings made "as-built" by Contractor containing the "as-built" information shall be handed to Owner as well as onecomplete set of microfilms of same as will be specified by Owner. Contractor shall prepare and submit a specimen of the layout of the drawings for Owner approval.

The required measurements for "as-built" drawings shall be executed by Contractor by experienced, qualified surveyors.

The surveyors shall daily take care of all measurements required such as but not limited to:

- Horizontal location of the pipeline with regard to deviations and permanent grid pillars.
- Vertical levels with regard to Mean Sea Level of pipeline and grade.
- Location and type of bends, fittings etc. and grades, points of intersections, etc.
- Changes of wall thickness, materials.
- Location and details of valves, insulating flanges, fencing etc.
- Location and details of buried services.
- Location and details of road, railway, water crossing etc.
- Location and details of casing pipes, vents etc.
- Location and type of coating
- Location and type of weighting, anchoring
- Location and type of markers.
- Location of further appurtenances (pig – signallers, etc.)
- Location of ROW and of pipeline with respect to ROW.
- Type of soil
- Type of rock.
- Type of blasting or ripping
- Sand padding.
- Type of road pavement
- Details of bank protection, number of insulators, seals etc.

Contractor shall also prepare isometric drawings of all installations (facilities) etc. for which the data as mentioned in or required for the pipe and welding book can be identified as such and which drawings can also be used for material accounting.

3.3 Nameplates of equipment

All permanent equipment supplied and installed by CONTRACTOR shall be provided with nameplates by CONTRACTOR. All texts size of the plate shall be submitted to OWNER for approvalbefore plates may be manufactured.

3.4 Pipe Book

Every page of the pipe and welding book shall mention.

- Data relevant to the project and section thereof.

- Sequential number

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- Length brought forward (for pipes and other materials)
- Length to bring forward (for pipes and other materials).

Alignment sheet number and at least the location thereon of two welds on every page of the pipe book.

Further,

- Diameter of pipeline
- Length of each pipe
- Wall thickness
- Pipe number
- Heat number, certificate number
- Cut and re-numbered pipe ends
- Coating
- Date of stringing
- Data of welding
- Direction of working
- Weld number
- Welder number
- Type of welding, electrode, diameter
- Weld treatment
- Used equipment for radiography
- Limits of valve stations, water crossings, etc
- Test pressure, data and test (hydrostatic)
- Length of section per page in line separated in the pipes including field bends and factory bends and/or other inline fittings.
- Length to bring forward (pipes and other materials)
- Length brought forward (pipes and other materials)

In order to achieve this CONTRACTOR shall identify all pipe elements. Sample format of pipe book shall be submitted for Owner/ Consultant approval.

3.5 As-Built Documents

Contractor shall prepare all documents in the prescribed format as indicated below. In

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addition to the hard copies, softcopies of final documents shall also be submitted inelectronic media i.e. CD / DVD format.
Software used for the preparation of these documents shall be as follows:

Type document		**Software**
a) Reports/ Documents	-	MS Office
b) Drawings	-	Auto CAD

For the purpose of preparation of as-built drawings, Contractor shall update the "Issued for construction" drawings issued by the Company. It shall be the Contractor's responsibility to covert the drawings furnished by the Company in hard copy into CAD drawings including scanning, digitising and converting the drawings into a suitable format compatible with the AutoCAD and above. As-built drawings shall be prepared only on AutoCAD drawings.

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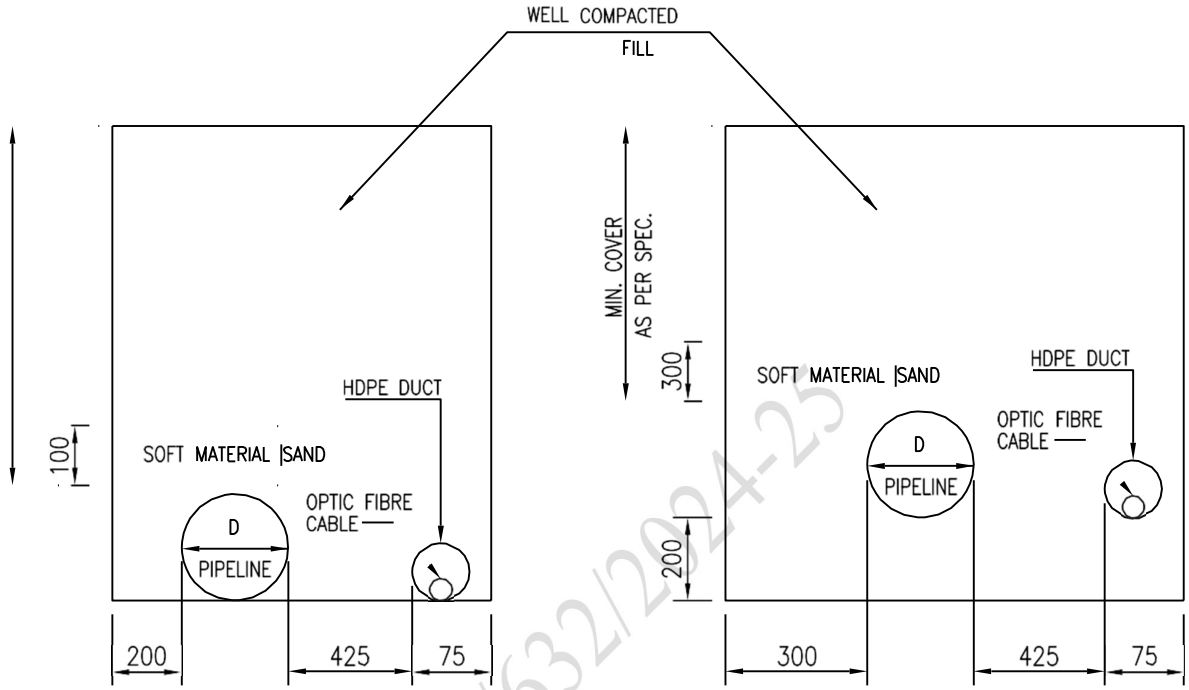

TRENCH IN NORMAL SOIL (IN ROCK)

TYPICAL SECTON

BGL/632/2024-25

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. MINIMUM COVER SHALL BE AS PER SPECIFICATION AND REQUIREMENT OF CONCERNED.
3. THIS SKETCH IS INDICATIVE ONLY.

REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
0	25-11-15	ISSUED FOR STANDARD			

TYPICAL TRENCH LAYOUT

SCALE: NTS (SHEET 1 OF 1) REV

ENG-STD-PL-DWG-TP-001 0

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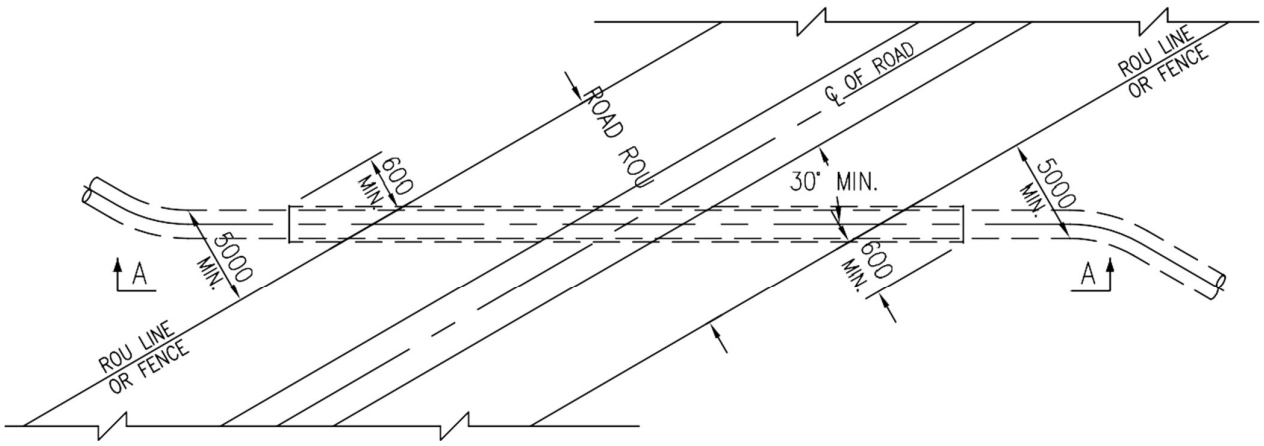
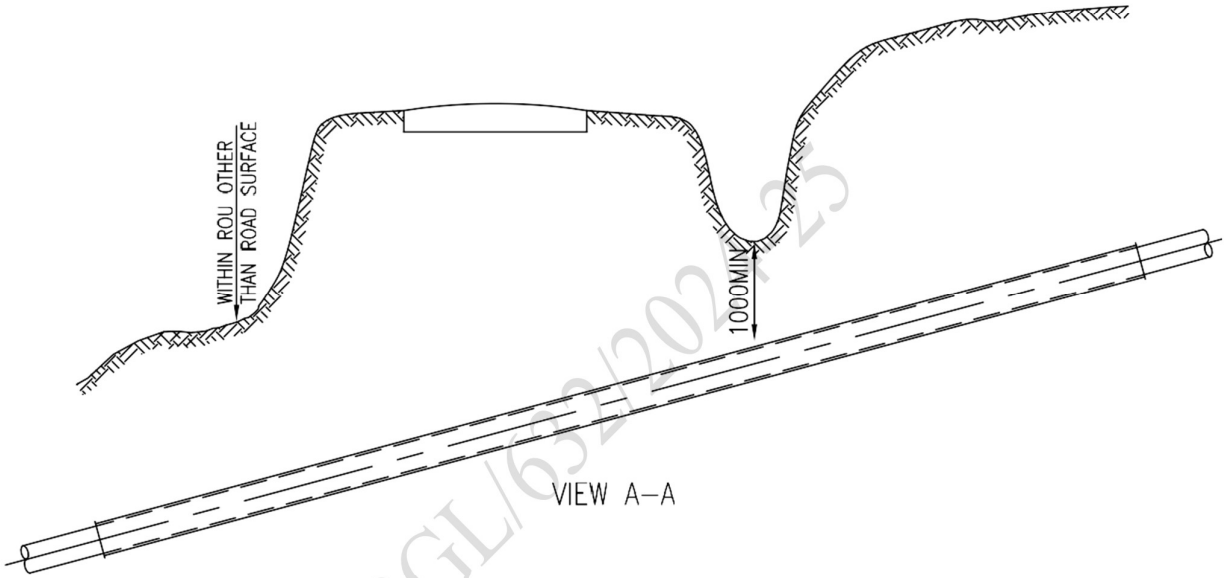


PLAN



VIEW A–A

BGL/62/2024 25

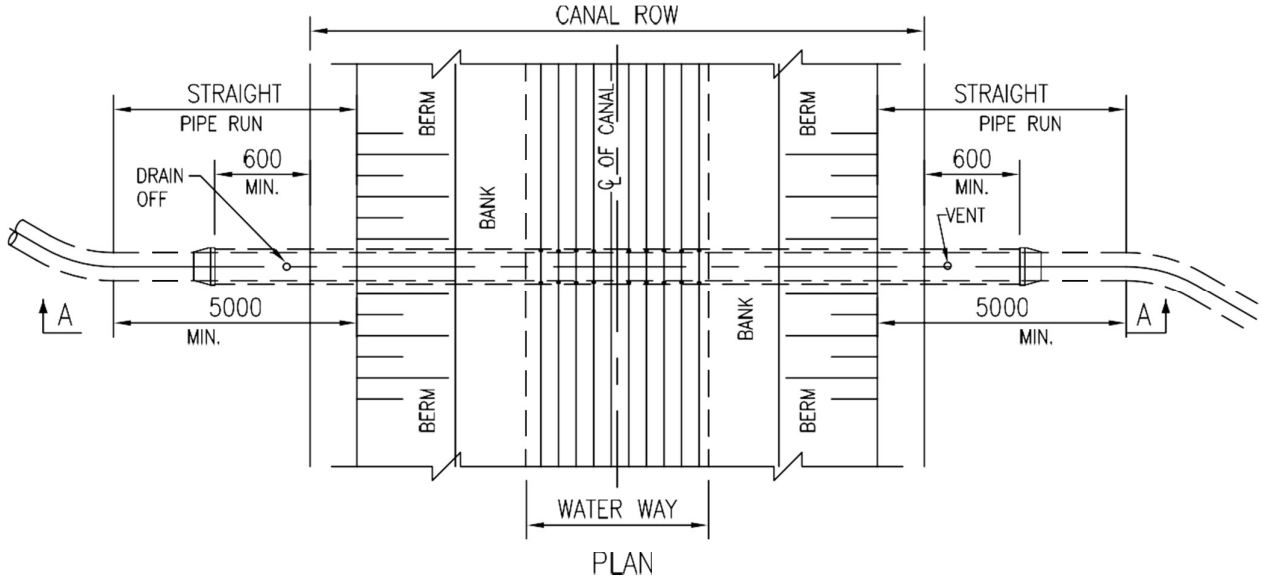
NOTES:–

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SPECIFIED.
2. ROAD/HIGHWAY SHALL BE RESTORED TO ORIGINAL CONDITION TO THE ENTIRE SATISFACTION OF COMPANY AND CONCERNED AUTHORITES HAVING JURISDICTION.
3. REFER API RP 1102 FOR OTHER DESIGN INSTALLATION REQUIREMENTS.
   INTERSECTION THE ROAD/HIGHWAY SHALL IN <
   AT WARNING SIGN SHALL BE INSTALLED THE
   BE MOUNTED ON THE VENT/DRAIN OFF PIPE.
6. CONTRACTOR SHALL VERIFY THE ACTUAL DIMENSIONS WITH RESPECT TO SURVEY DETAILS OF EACH CROSSING AND PREPARE DETAILED DRAWINGS FOR INDIVIDUAL CROSSING FOR COMPANY/CONCERNED AUTHORITIES' APPROVAL BEFORE COMMENCEMENT OF CONSTRUCTION.
7. CATHODIC PROTECTION TEST LEAD TERMINAL BOX MAY BE MOUNTED ON VENT PIPE. FOR CP LEAD TERMINAL BOX DETAILS REFER STANDARD/SPECIFICATION.
8. ALL PIPELINE JOINTS SHALL BE RADIOGRAPHED.
9. ELECTRICAL INSULATION BETWEEN CASING AND CARRIER PIPES SHALL BE CHECKED WITH SUITABLE MEGGER.
10. AFTER INSTALLATION OF CASING AND CARRIER PIPES THE ROAD SHALL BE RESTORED TO THE SATISFACTION OF ROAD AUTHORITIES/ COMPANY.
11. PIPELINE SECTION SHALL BE PRETESTED HYDROSTATICALLY SEPARATELY FROM THE MAIN LINE TESTING WHEN REQUIRED BY CONCERNED AUTHORITIES/OR AS DIRECTED BY COMPANY.

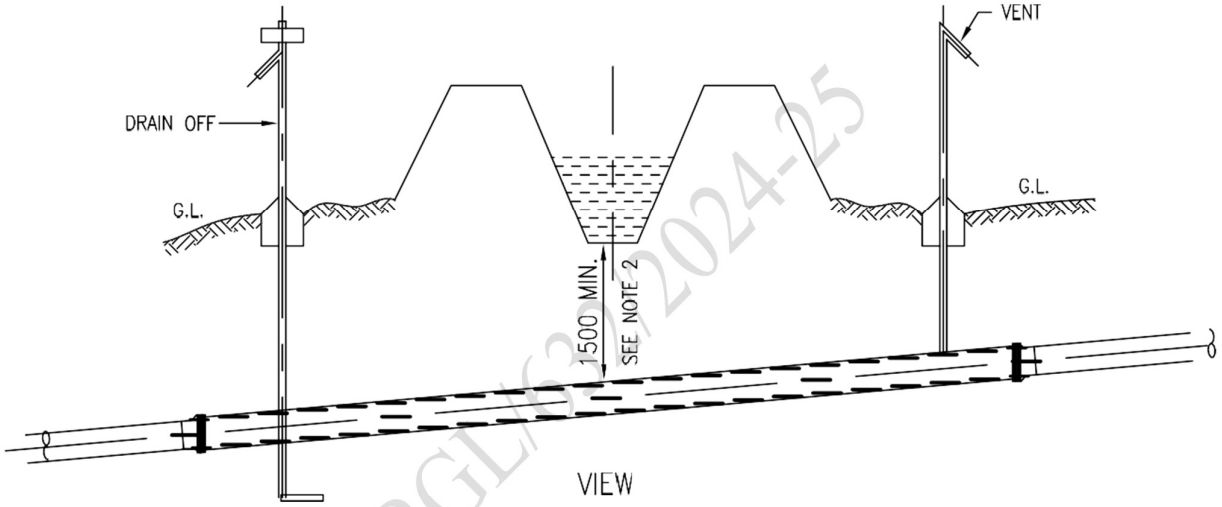
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
0	25–11–15	ISSUED FOR STANDARD			

CASED CROSSING PIPELINE–ROAD/HIGHWAY	SCALE: NTS	(SHEET 1 OF 1)	REV
	ENG–STD–PL–DWG–TP–002		0

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST



PLAN



VIEW

BGL/C3/2024-25

NOTES:–

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SPECIFIED.
2. THE MINIMUM 1.5M COVERAGE SHALL BE MAINTAINED BETWEEN UPPER GENERATRIX OF CASING PIPE AND LOWER LEVEL OF CANAL EXCEPT OTHERWISE STATED IN PTS OR REQUESTED BY CANAL AUTHORITES.
3. REFER API RP 1102 FOR OTHER DESIGN AND INSTALLATION REQUIREMENTS.
4. ANGLE OF INTERSECTION BETWEEN PIPELINE AND THE CANAL SHALL BE AS CLOSE TO 90° AS POSSIBLE BUT IN NO CASE < 30°.
5. AT EACH CROSSING, PIPELINE CROSSING WARNING SIGN SHALL BE INSTALLED ON EITHER SIDE OF CROSSING. THE WARNING PLATE MAY BE MOUNTED ON THE VENT/DRAIN OFF PIPE.
6. CONTRACTOR VERIFY THE ACTUAL DRAWINGS FOR INDIVIDUAL COMPANY/CONCERNED AUTHORITIES' BEFORE COMMENCEMENT OF CONSTRUCTION.
7. TERMINAL BOX MAY BE MOUNTED ON VENT PIPE. STANDARD/SPECIFICATION.
8. ALL PIPELINE JOINTS SHALL BE RADIOGRAPHED.
9. ELECTRICAL INSULATION BETWEEN CASING AND CARRIER PIPES SHALL BE CHECKED WITH SUITABLE MEGGER.
10. AFTER INSTALLATION OF CASING AND CARRIER PIPES THE RESTORATION SHALL BE CARRIED OUT TO THE SATISFACTION OF CANAL AUTHORITIES.
11. PIPELINE SECTION SHALL BE PRETESTED HYDROSTATICALLY SEPARATELY FROM THE MAIN LINE TESTING WHEN REQUIRED BY CONCERNED AUTHORITIES/OR AS DIRECTED BY COMPANY.

REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
0	25-11-15	ISSUED FOR STANDARD			

	CASED CROSSING PIPELINE–CANAL	SCALE: NTS (SHEET 1 OF 1)	REV
		ENG-STD-PL-DWG-TP-003	0

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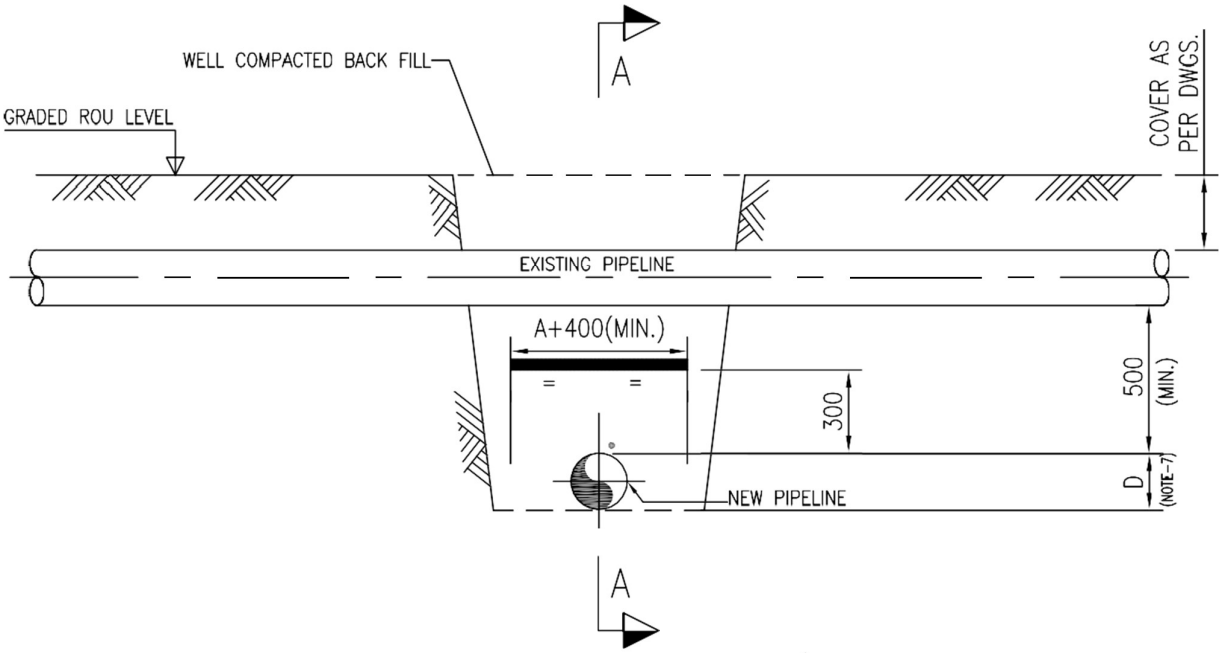
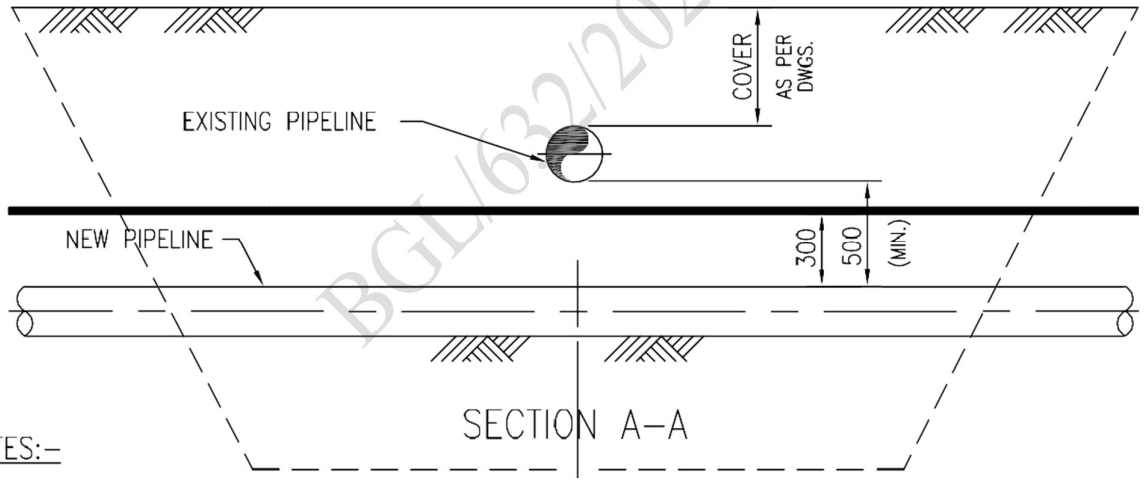




BGL/632/2024-25

NOTES:–

1. A MODIFIED PIPELINE WARNING SIGN SHALL BE INSTALLED WHERE THE PIPELINE CROSSES AN EXISTING PIPELINE CARRYING HAZARDOUS FLUID.
2. SUITABLE CATHODIC PROTECTION BONDING SHALL BE PROVIDED BETWEEN CROSSING PIPELINES. IN SOME CASES THE NEW PIPELINE MAY REQUIRE ELECTRICAL ISOLATION. C.P. DETAILS ARE COVERED SEPARATELY.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
4. DIMENSION 'A' SHALL BE CALCULATED USING A=(D1+D2+....Dn) + (n−1) x D1, D2,.... Dn ARE THE DIAMETERS. IN mm IN THE IS NO. OF PIPELINES IN SAME TRENCH.
5. DIMENSIONS 'D' SHALL BE THE LARGEST DIAMETER OF THE PIPELINES LAID IN SAME TRENCH.
6. TRENCH DIMENSIONS SHALL BE IN ACCORDANCE WITH STANDARDS/SPECIFICATIONS. THE CONCERNED AUTHORITIES.

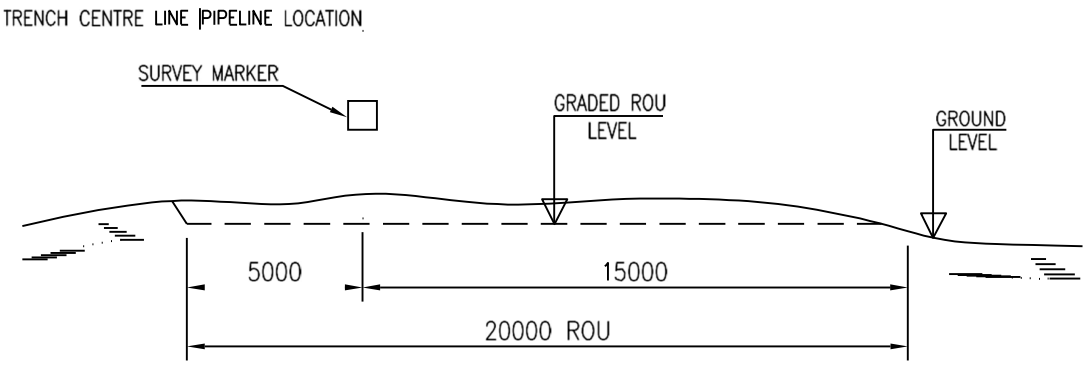
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
1	01-02-16	ISSUED FOR APPROVAL			
0	25-11-15	ISSUED FOR STANDARD			

EXISTING UNDERGROUND PIPE CROSSING

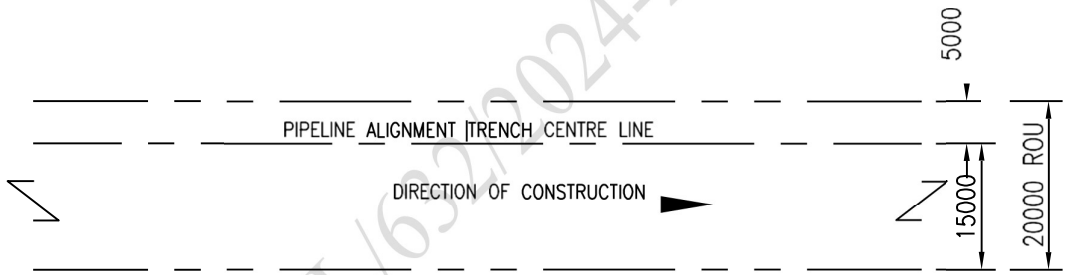
SCALE: NTS (SHEET 1 OF 1) REV

ENG-STD-PL-DWG-TP-004 1

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST



RIGHT OF USE DURING CONSTRUCTION



LOCATION OF PIPELINE IN ROU
WITH RESPECT TO DIRECTION OF CONSTRUCTION

BGL/632/2024-25

NOTES:-

1. ALL DIMENSIONS ARE IN mm.
2. DIFFERENT ROU DIMENSIONS MAY BE ADOPTED BASED ON SITE CONDITION, CONSTRUCTION METHOD.
3. THE LOCATION OF PIPELINE IN ROU MAY BE CHANGED TO SUIT SITE CONDITIONS, AFTER OBTAINING WRITTEN APPROVAL FROM OWNER.

REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
0	25-11-15	ISSUED FOR STANDARD			

	TYPICAL ROU FOR PIPELINES	SCALE: NTS (SHEET 1 OF 1)	REV
		ENG-STD-PL-DWG-TP-005	0

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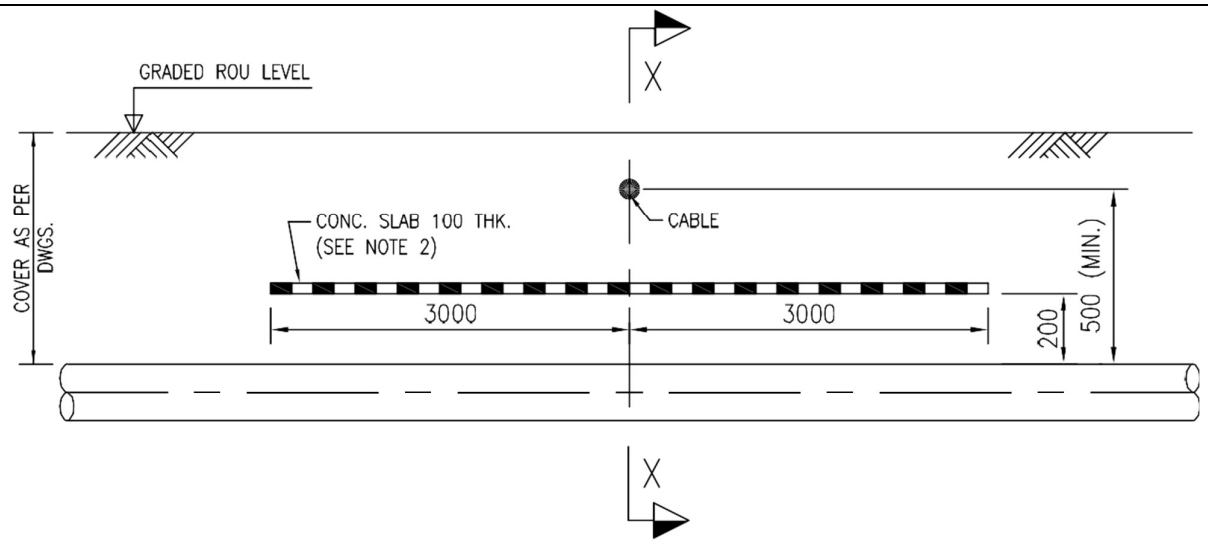

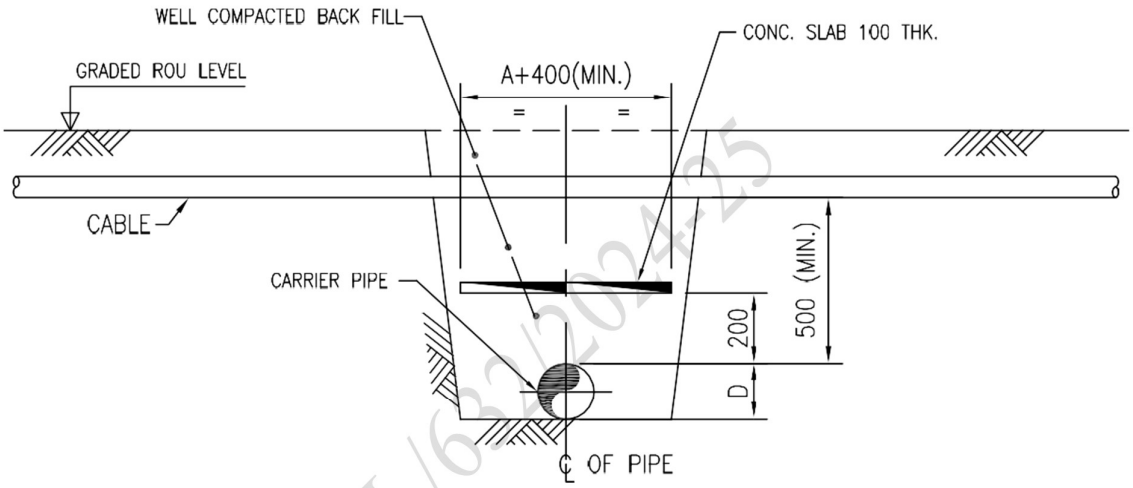

SECTION X–X

BGL/63/2024-25

NOTES:–

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. CONCRETE SLAB SHALL BE PCC M15 AS PER IS 456, 100THK.
3. A MODIFIED PIPELINE WARNING SIGN SHALL BE INSTALLED CLOSE TO THE CROSSING.
4. IN CASE OF ARMOURED AC CABLE, C.P. BONDING IS TO BE PROVIDED BETWEEN PIPELINE AND CABLE ARMOUR. IN CASE OF UNARMOURED CABLE, ARRANGEMENT FOR (BY CASING ON EITHER SIDE OF THE PIPELINE CABLE) BE CONSIDERED.
5. CALCULATED USING A=(D1+D2+....Dn) + (n–1) x D1, D2,.... THE IN mm IN THE IS NO. OF PIPELINES IN SAME TRENCH.
6. DIMENSIONS 'D' SHALL BE THE LARGEST DIAMETER OF THE PIPELINES LAID IN SAME TRENCH.
7. TRENCH DIMENSIONS SHALL BE IN ACCORDANCE WITH STANDARDS/SPECIFICATIONS. THE CONCERNED AUTHORITIES.

REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
0	25–11–15	ISSUED FOR STANDARD			

TYPICAL UNDERGROUND CABLE CROSSING	SCALE: NTS	(SHEET 1 OF 1)	REV
	ENG–STD–PL–DWG–TP–006		0

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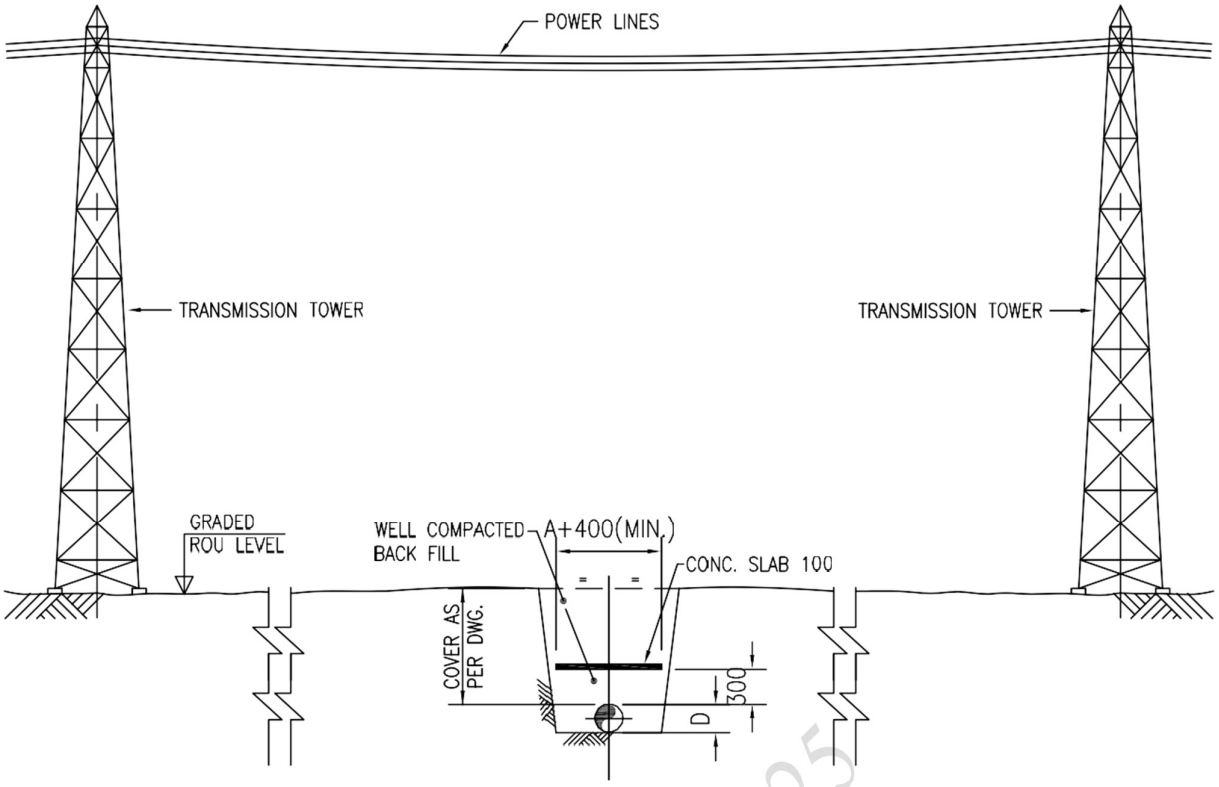
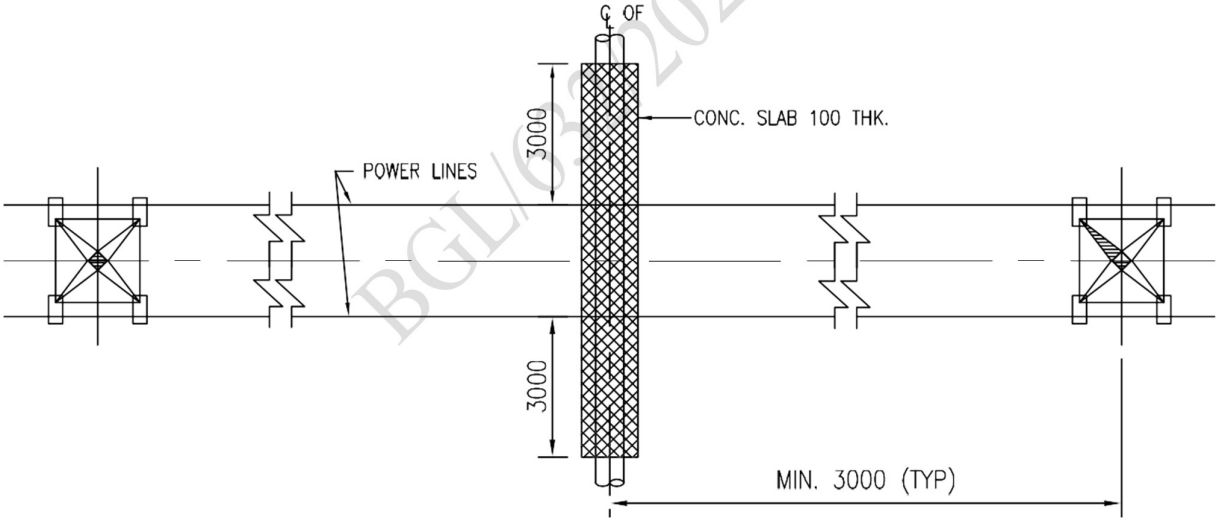
Date: 2024.09.16 18:15:02 IST



SECTION



PLAN

BGL/03/2024-25

NOTES:–

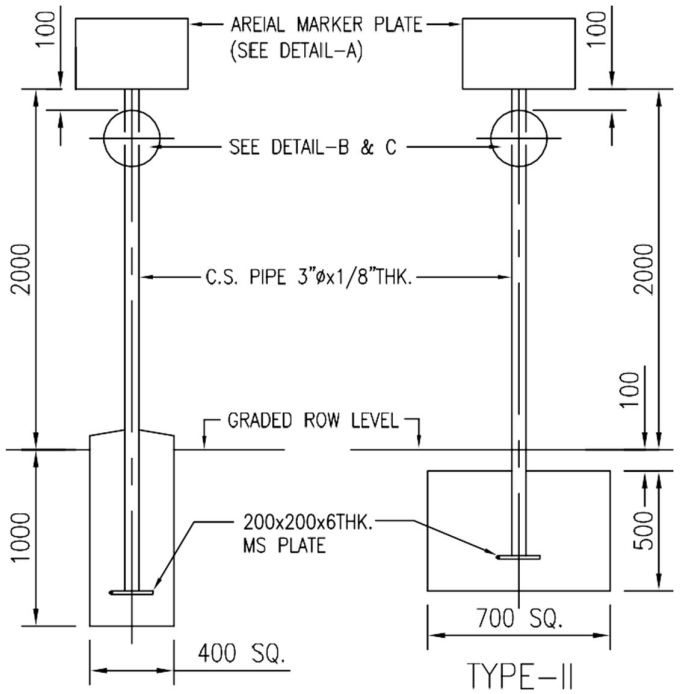
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. CONCRETE SLAB SHALL BE PCC M15 AS PER IS 456, 100THK.
3. SUITABLE MEASURES SHALL BE TAKEN FOR THE PROTECTION OF THE LINE AND SECURITY OF PERSONNEL WHEREVER FOUND NECESSARY.
4. DIMENSION 'A' SHALL BE CALCULATED USING A=(D1+D2+....Dn) + (n-1) x D1, D2,.... Dn ARE THE DIAMETERS. IN mm IN THE IS NO. OF PIPELINES IN SAME TRENCH.
5. DIMENSIONS 'D' SHALL BE THE LARGEST DIAMETER OF THE PIPELINES LAID IN SAME TRENCH.
6. APPROVAL OF THE CROSSING SHALL BE OBTAINED FROM CONCERNED AUTHORITIES.

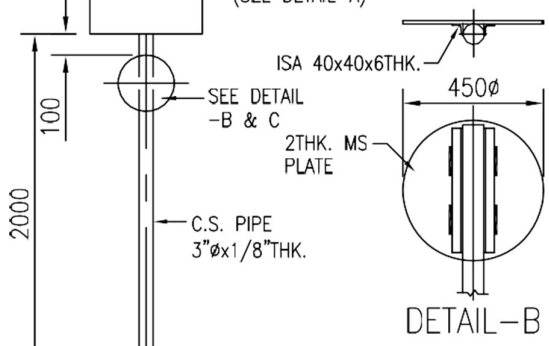
0	25-11-15	ISSUED FOR STANDARD	SC	SM	AKG
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD

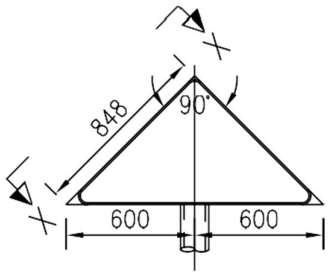
TYPICAL OVERHEAD POWER LINE CROSSING

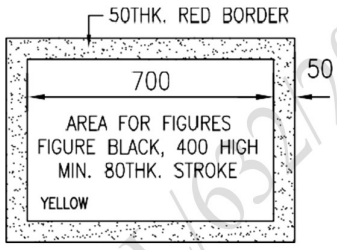
SCALE: NTS	(SHEET 1 OF 1)	REV
ENG-STD-PL-DWG-TP-007		0

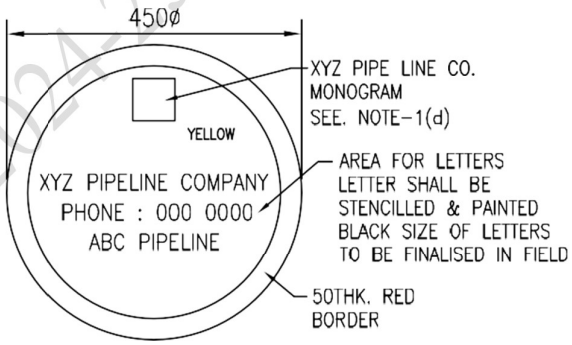
Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST











BGL/632/2024-25

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. SCHEME OF PAINTING & COLOURING
(a) UNDERGROUND STEEL STRUCTURE (EXCEPT EMBEDDED IN CONCRETE)
(b) OVERGROUND : ONE COAT & TWO COATS SPECIFIED
(c) THE IN
(d)
(e)
(f) ABOVEGROUND
3.
(a) AERIAL MARKER SHALL BE INSTALLED AT EVERY 5 KM. AS PER REQUIREMENTS OF CONTRACT AND AS DIRECTED BY OWNER.
(b) THE
(c) THE LEFT THE THE
INDICATED IN LOCATION SKETCH.
4. THE FOUNDATION SHALL BE MADE OF CONCRETE M20.
5. SIGN PLATE IN REGIONAL LANGUAGE SHALL BE PREPARED BY CONRACTOR ON SIMILAR LINES AND APPROVED BY THE OWNER.

REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
0	25-11-15	ISSUED FOR STANDARD			

	TYPICAL AERIAL MARKER	SCALE: NTS (SHEET 1 OF 1)	REV
		ENG-STD-PL-DWG-TP-008	0

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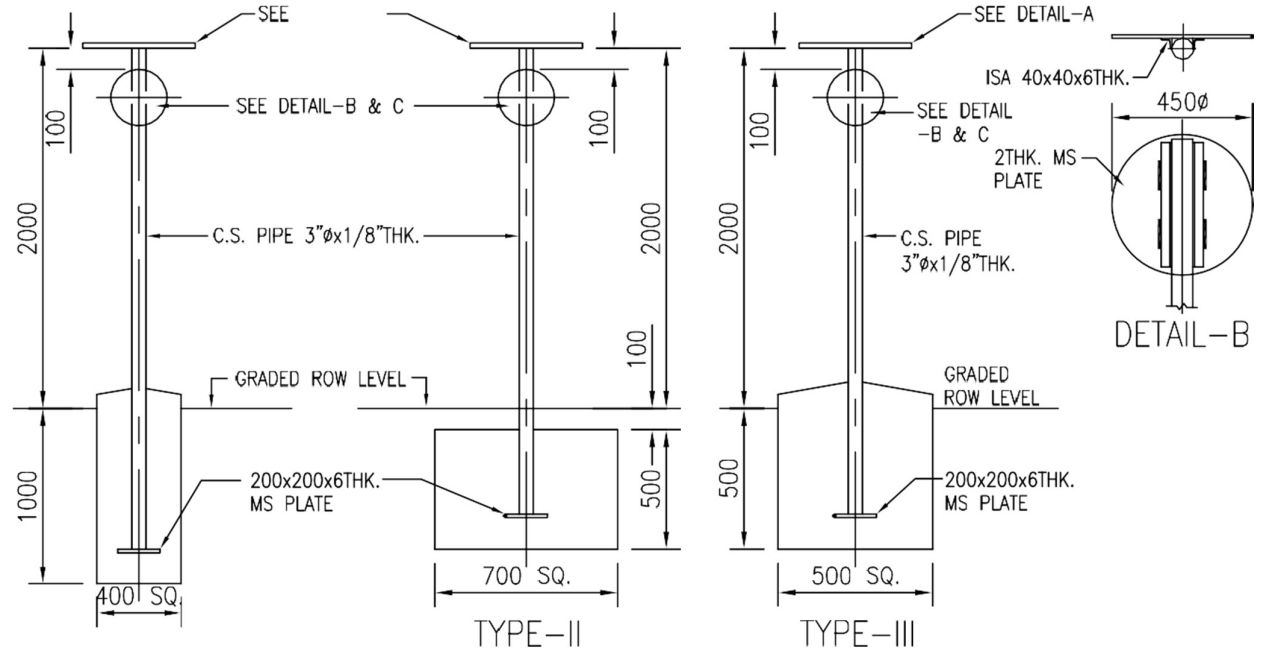
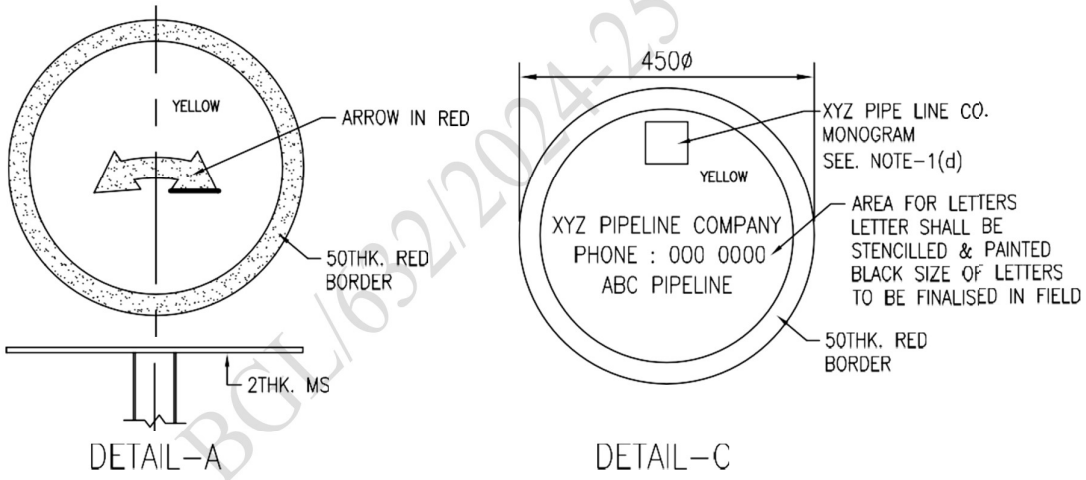
Date: 2024.09.16 18:15:02 IST





BGL/632/2024-25

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. SCHEME OF PAINTING & COLOURING
(a) UNDERGROUND STEEL STRUCTURE (EXCEPT EMBEDDED IN CONCRETE) EPOXY MIN. 300 MICRON THK.
(b) OVERGROUND : ONE COAT & TWO COATS SPECIFIED
(c) THE IN
(d)
(e)
(f) ABOVEGROUND
3.
(a) DIRECTION MARKER SHALL BE INSTALLED AS PER SPECIFICATIONS AS DIRECTED IN APPROVED DRAWINGS AND AS DIRECTED BY OWNER.
(b) THE
(c) 1000MM LEFT THE LINE/VIEWING THE
AS INDICATED IN LOCATION SKETCH.
4. THE FOUNDATION SHALL BE MADE OF CONCRETE M20.
5. SIGN PLATE IN REGIONAL LANGUAGE SHALL BE PREPARED BY CONRACTOR ON SIMILAR LINES AND APPROVED BY THE OWNER.

0	25-11-15	ISSUED FOR STANDARD	SC	SM	AKG
REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD

TYPICAL DIRECTION MARKER

SCALE: NTS (SHEET 1 OF 1)	REV
ENG-STD-PL-DWG-TP-009	0

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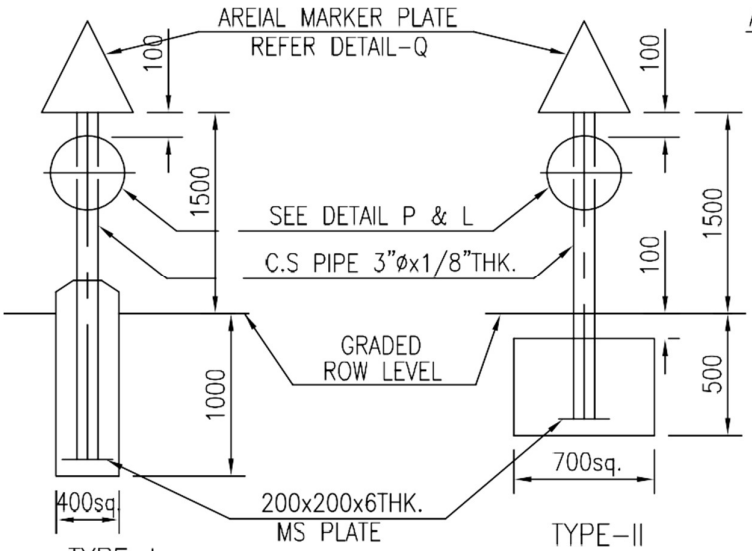
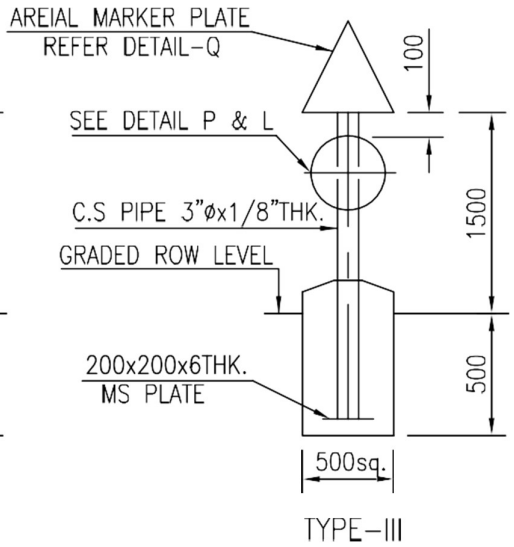
Date: 2024.09.16 18:15:02 IST



TYPE-I
FOR NORMAL SOIL

TYPE-II
FOR DRIFTING SAND SOIL



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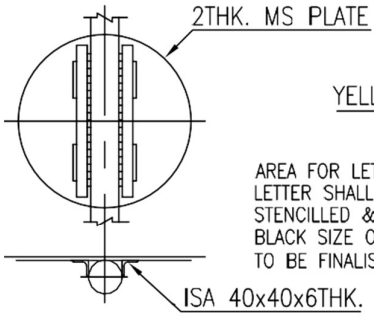
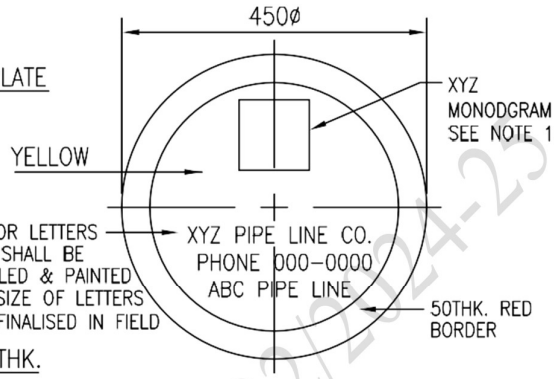
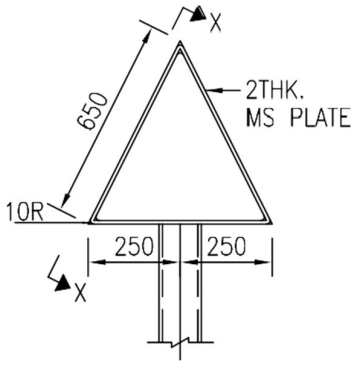


DETAIL-P



DETAIL-L



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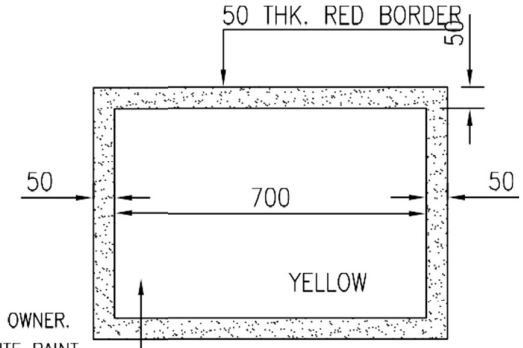

VIEW-XX

NOTES:-

1. SCHEME OF PAINTING & COLOURING
(a) UNDERGROUND STEEL STRUCTURE (EXCEPT THAT EMBEDDED IN CONCRETE) COAL TER EXPOXY MIN.300 MICRON THIK.)
(b) OVERGROUND STEEL STRUCTURE : ONE COAT OF PRIMER & TWO COATS SPECIFIED COLOUR PAINT.
(c) FIGURES SHALL BE STENCILED THE POSTS IN BLACK.
(d) COLOUR SCHEME FOR XYZ SHALL BE AS DIRECTED BY OWNER.
(e) POST SHALL BE PAINTED WITH ALTERNATE BANDS OF BLACK AND WHITE PAINT.
(f) ALL OTHER ABOVEGROUND STEEL BE PAINTED YELLOW.
2. LOCATION
(a) K.M. POST SHALL BE INSTALLED AT EVERY KILOMETERS AS PER REQUIREMENTS OF CONTRACT AND AS DIRECTED BY OWNER.
(b) OWNER NAME PLATE SHALL FACE THE PIPELINE.
(c) K.M. POST SHALL BE 100MM TO THE LEFT OF THE PIPE CENTRE LINE VIEWING TOWARDS THE DIRECTION OF FLOW AND AS INDICATED IN SKETCH.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.
4. THE FOUNDATION SHALL BE MADE OF CONRETE M20.
5. THE HEIGHT OF THE K.M. POST MAY BE VARIED TO SUIT FIELD REQUIREMENTS.

BGL/632/2024-25

REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
0	25-11-15	ISSUED FOR STANDARD	SC	SM	AKG

	TYPICAL KM POST MARKER	SCALE: NTS (SHEET 1 OF 1)	REV
		ENG-STD-PL-DWG-TP-010	0

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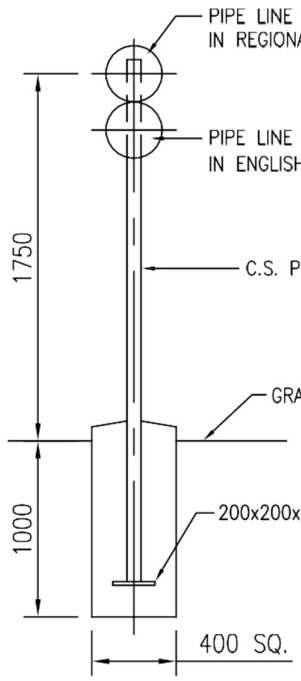
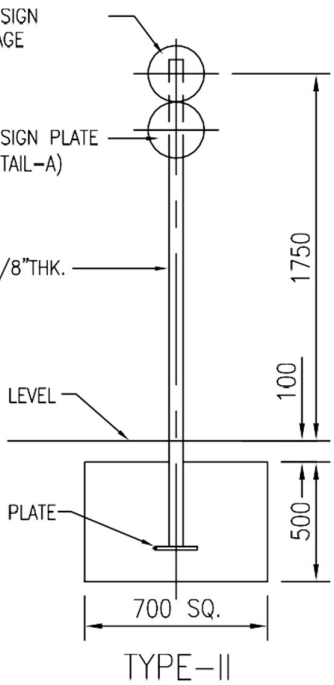
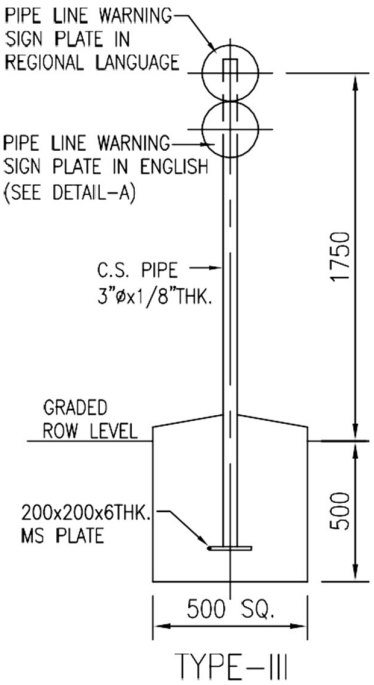
Date: 2024.09.16 18:15:02 IST



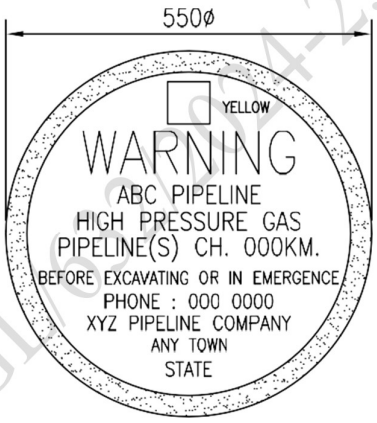
TYPE-I
FOR NORMAL SOIL



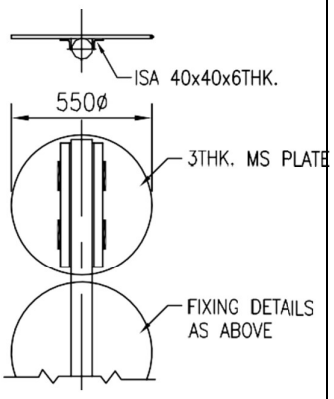
TYPE-II
FOR DRIFTING SAND SOIL



TYPE-III
FOR ROCKY AREAS



DETAIL-A



WARNING SIGN PLATE
FIXING DETAILS

BGI/G/2024-25

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
   SCHEME OF PAINTING & COLOURING
(a) UNDERGROUND STEEL STRUCTURE (EXCEPT THAT EMBEDDED IN CONCRETE), : COAL TAR EPOXY MIN. THK.
(b) OVERGROUND STEEL STRUCTURE : ONE COAT OF PRIMER & TWO COATS SPECIFIED COLOUR PAINT.
(c) COLOUR SCHEME FOR XYZ PIPELINE CO. MONOGRAM SHALL BE AS DIRECTED BY OWNER.
(d) ALL LETTERS EXCEPT WARNING SHALL BE PAINTED BLACK.
(e)
(f) ABOVEGROUND
3.
(a) THE PIPE LINE WARNING SIGN SHALL BE INSTALLED IN ACCORDANCE WITH CONTRACT REQUIREMENTS AND AS DIRECTED BY OWNER IT SHALL BE INSTALLED TO THE LEFT OF THE PIPE CENTER LINE, VIEWING IN THE DIRECTION OF FLOW AT 300MM FROM PIPELINE O.D. AND THE WARNING SIGN PLATE SHALL FACE THE UTILITY BEING CROSSED.
(b) THE WARNING SIGN PLATE MAY BE MOUNTED ON VENT PIPES OR KM POST WHERE EVER POSSIBLE.
4. THE FOUNDATION SHALL BE MADE OF CONCRETE M20.
5. SIGN PLATE IN REGIONAL LANGUAGE SHALL BE PREPARED BY CONRACTOR ON SIMILAR LINES AND APPROVED BY THE OWNER.

REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
0	25-11-15	ISSUED FOR STANDARD	SC	SM	AKG

TYPICAL PIPELINE WARNING SIGN

SCALE: NTS (SHEET 1 OF 1) REV

ENG-STD-PL-DWG-TP-011 0

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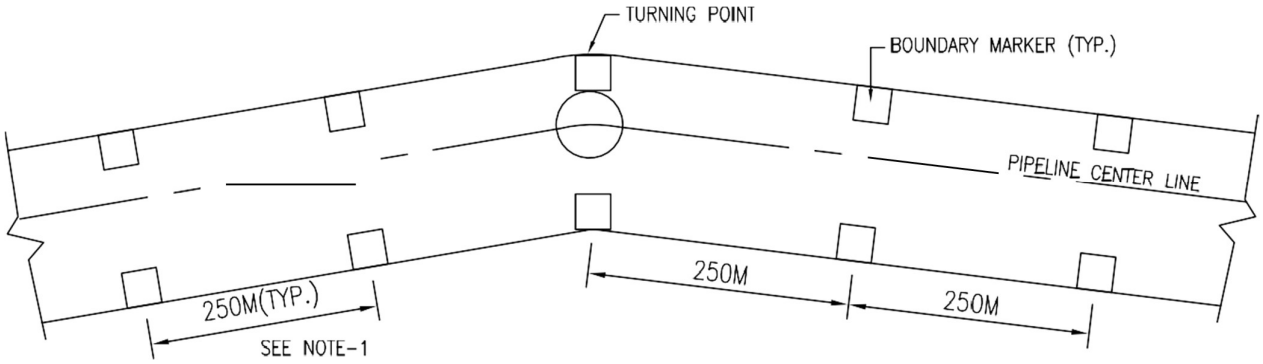
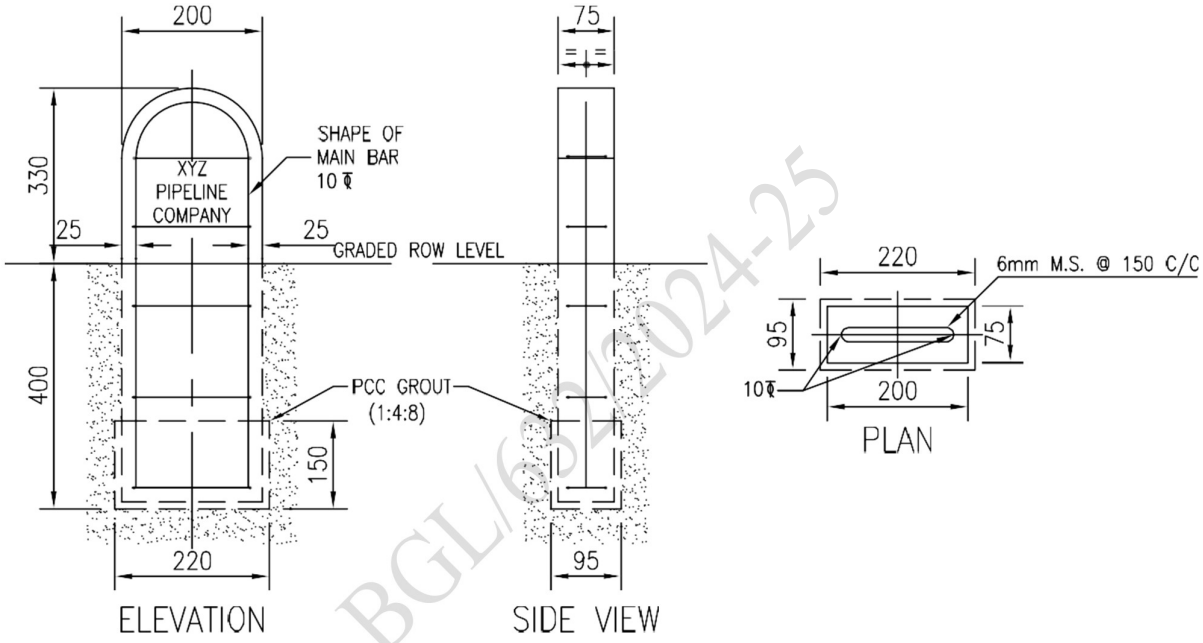


LOCATION PLAN OF BOUNDARY MARKER



BGL/652/2024-25

NOTES:–

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. BOUNDARY MARKERS SHALL BE INSTALLED AT THE ROW LIMITS ON EITHER SIDE AT 250M CENTERS AND ALSO AT ALL TURNING POINTS AS PER SPECIFICATIONS AND AS DIRECTED BY OWNER. BOUNDARY MARKERS SHALL PREFERABLY BE PLACED ON FIELD BUNDS/ UNCULTIVABLE AREAS.
3. ALL BOUNDARY MARKERS SHALL BE PRECAST AND INSCRIPTIONS SHALL BE ENGRAVED CENTRALLY IN THE MOULD ON THE FACE.
4. LETTERS SHALL BE 60 HIGH AND 5 DEEP.
5. INSCRIPTIONS SHALL FACE THE PIPE LINE.
6. CONCRETE FOR BOUNDARY MARKERS SHALL BE M20.
7. ABOVE GROUND PART OF BOUNDARY MARKERS SHALL BE PAINTED YELLOW WITH MIN. THREE COATS OF APPROVED QUALITY PAINT INSCRIPTIONS SHALL BE PAINTED BLACK.

REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
0	25-11-15	ISSUED FOR STANDARD	SC	SM	AKG

TYPICAL ROU BOUNDARY MARKER

SCALE: NTS (SHEET 1 OF 1) REV

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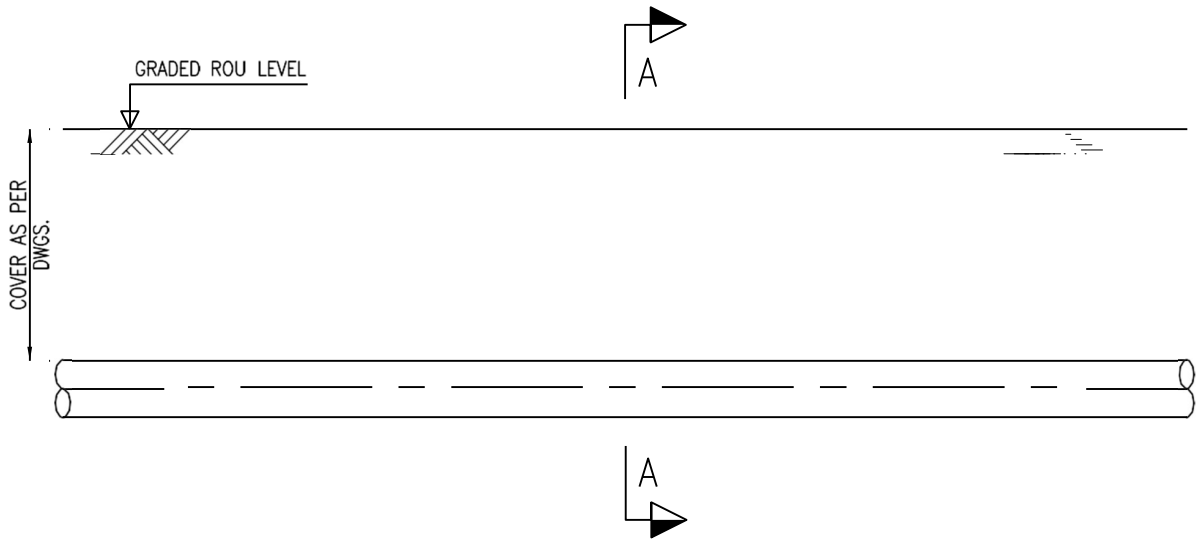

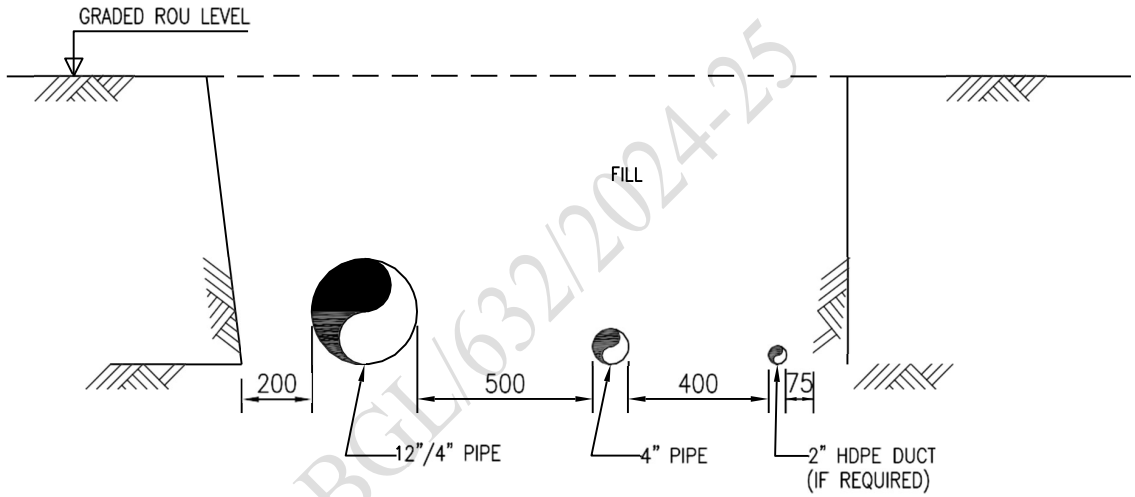

SECTION A–A

BGL/632/2024-25

NOTES:–

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. TRENCH DIMENSIONS SHALL BE IN ACCORDANCE WITH RELEVENT STANDARDS SPECIFICATIONS.
   THE FROM OWNER'S OPERATION DEPARTMENT.

REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
0	25–11–15	ISSUED FOR STANDARD	SC	SM	AKG

TYPICAL PARALLEL PIPELINE IN SAME TRENCH

SCALE: NTS (SHEET 1 OF 1) REV

ENG–STD–PL–DWG–TP–013 0

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3. PIPING

BGL/632/2024-25

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Date: 2024.09.16 18:15:02 IST

PMC:	Index - Mechanical - Piping		CLIENT:
Sr. No.	**Description**	**Document / Drawing No.**	**Rev. No.**
3.0	**Mechanical / Piping**		
1	Piping Design Basis	BGL-HYD-PI-DOC-DB-001	0
2	Piping Material Specification	ENG-STD-PI-DOC-TS-001	1
3	Technical Specification for Gaskets Bolts and Nuts	ENG-STD-PI-DOC-TS-005	1
4	Technical Specification for Seamless Fittings & Flange	ENG-STD-PI-DOC-TS-006	1
5	Technical Specification for Painting	ENG-STD-PI-DOC-TS-008	1
6	Technical Specification for Welding of Station Piping	ENG-STD-PI-DOC-TS-009	1
7	Technical Specification for Fabrication and Installation	ENG-STD-PI-DOC-TS-010	1
8	Technical Specification for NDT	ENG-STD-PI-DOC-TS-011	1
9	Technical Specification for Inspection,Flusing and Testing	ENG-STD-PI-DOC-TS-012	1
10	Technical Data Sheet of Flanges, Fittings	/ DS/ MECH/ 009,010,011	0
11	QAP for Fastners, Gaskets, Fittings, & Flanges	4 QAPs	0
12	Typical Support Drawings	ENG-STD-PI-DWG-TP-002,003,004,005	0

BGL/632/2024-25

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BHAGYANAGAR GAS LIMITED

PIPELINE LAYING AT HYDERABAD GA

PIPING DESIGN BASIS

BGL-HYD-PI-DOC-DB-001

BGL/632/2024-25

0	24.03.2024	Issued for Approval				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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Date: 2024.09.16 18:15:02 IST

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BGL/632/2024-25

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1.0 INTRODUCTION

Green Gas Ltd. a joint venture of GAIL (India) Ltd. & Indian Oil Corporation Ltd. proposes to implementCity Gas Distribution network in Lucknow & Agra city. GGL is inviting tenders on Competitive Bidding basis for laying of steel pipeline network and associated activities at Lucknow city.

The scope of work for these tender covers construction of steel pipeline in three sections of LucknowCity Section-I and Section-II. The total pipeline network of two sections consists of: -
Section-I -6"- 12 Km,
Section-II 4"- 2.0 Km respectively, approximately

2.0 SCOPE OF WORK

2.1 This specification covers the basis for the overall design of piping system. The requirements given in this specification are bare minimum. Construction contractor shall be responsible for ensuring that thedesign of piping system conforms to codes and accepted practices, fulfill all design requirements of theP&IDs, maintenance and access requirements listed in various project engineering specifications to achieve successful, trouble free commissioning and operation of the pipeline.

This project envisages the following main facilities:

a) Laying of new pipeline
b) Construction of Valve Pit Chamber
c) Hook-up at CNG Station Compressor / DRS
d) Provision of future tap-off.
e) Installation of metering skid
f) Development of customer premises up to battery limit including process area paving, meteringskid foundation, RCC road etc.

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3.0 DESIGN CODES, STANDARDS & SPECIFICATION

Design, engineering, fabrication, testing etc. shall be as per the latest edition indicated below for thefollowing codes & standards.

ASME B 31.3	: Process Piping.
ASME B 31.8	: Gas Transmission and Distribution Pipeline System.
ASME Section - II, Div-1	: Boilers and Pressure Vessel Code- Materials
ASME V	: Boiler and Pressure Vessel Code - Non Destructive Testing.
ASME VIII	: Boiler and Pressure Vessel Code - Div 1- Pressure Vessels.
ASME IX	: Boiler and Pressure Vessel Code - Welding & Brazing qualifications
ASME B1.20.1	: Pipe Threads, General Purpose (Inch)

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ASME B 16.5	: Steel Pipe Flanges and Flanged Fittings.
ASME B 16.9	: Factory-made Wrought Steel Butt Welding Fittings.
ASME B 16.11	: Forges Steel Fittings, Socket Welding and Threaded.
ASME B 16.25	: Butt Welded Ends.
ASME B 16.47	: Large Diameter Steel Flanges: NPS 26 through NPS 60.
ASME B 36.10	: Welded and Seamless Wrought Steel Pipe.
ASME B 16.20	: Metallic Gaskets for Pipe Flanges.
ASTM A182	: Specification for Forged or rolled alloy & stainless steel Pipe, flanges,forged fittings and valves & parts for high temperature service.
ASTM A 106	: Carbon steel seamless pipe for high temperature service.
ASTM A 105	: Forging, Carbon Steel for Piping Components.
ASTM A 181	: Forging, Carbon Steel for General-Purpose Piping.
ASTM A 234	: Piping Fitting of Wrought Carbon Steel and Alloy Steel for moderated and Elevated Temperatures.
ASTM A 370	: Mechanical Testing of Steel products.
ASTM A 216	: Carbon Steel Castings suitable for Fusion Welding for High temperature Service.
ASTM A 20	: General requirements for steel plate for pressure vessels.
ASTM A 516	: Carbon steel pressure vessel plates for moderate and low
ASTM A 193	: Alloy steel and stainless steel bolting materials for high temperature.
ASTM A 194	: Carbon and alloy steel nuts for bolts for high pressure or temperature.
ASTM A320	: Specification for Alloy steel & SS bolting materials for lowtemperature service.
ASTM A 420	: Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service.
ASTM A 860	: Standard Specification for Wrought High Strength Low Alloy Steel Butt Welding Fittings
ASTM A 350	: Forged Carbon and Low Alloy Steel requiring Notch Toughness Testing for Piping Components.
ASTM A352	: Specification for Steel casting, ferritic & martensitic for pressure containing parts suitable for low Temperature.
ASTM A 694	: Forging, Carbon and Alloy Steel, for Pipe Flanges, Fitting, Valves and Parts for High Pressure Transmission Service.
ASTM A 333	: Low temperature service seamless pipe.
ASTM A403	: Specification for Wrought Austenitic SS piping fittings

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API 5L	: Specification for Line Pipe
API 6D	: Pipeline Valves
API 590	: Steel Line Blank
API 600	: Steel Gate Valves Flanges and Butt welding Ends
API 602	: Compact Steel Gate Valves
MSS-SP-6	: Standard Finishes for Contact Faces of Pipe Flanges and Connecting –End Flanges of Valves and Fittings.
MSS-SP-44	: Steel pipeline flanges.
MSS-SP-75	: High test wrought butt-welded fittings.
MSS SP 97	: Integrally Reinforced Forged Branch Outlet Fitting – Socket Welding, Threaded and Butt welding Ends.
PNGRB	: Petroleum & Natural Gas Regulatory Board
OISD 226	: Natural gas transmission pipelines and City Gas Distributionnetworks

4.0 PIPING DESIGN BASIS

4.1 General

4.1.1 The design basis gives the minimum basic requirement for piping design to be carried out. This shall be read in conjunction with the specifications and other attached elsewhere in the bid.

4.1.2 All design calculation for pressure requirements, vibrations, thermal expansions/ flexibility consideringseismic factors (if applicable) etc. shall be made in accordance with code requirements and submitted to the OWNER for approval.

4.1.3 All piping systems shall be designed as per the requirements of ASME B 31.3/ ASME B 31.8/ PNGRB T4S.

4.1.4 All piping material shall be tested as prescribed in the piping specifications and standard codes andpractices and certificates of conformance shall be furnished for review and approval by OWNER.

4.1.5 All piping material and components i.e. pipes, fittings, valves, flanges, gaskets and bolting etc. shall beas per the piping specifications.

4.1.6 Piping general arrangement drawing / Isometric / Support drawings etc. shall be prepared using good engineering practice as per the guidelines furnished in the piping specifications.

4.1.7 Thermal insulation and insulation for Personnel protection shall be provided wherever required as perthe P&ID and general specifications attached with the bid.

4.1.8 All pipe threads shall conform to American Standard taper as per ANSI 1.20.1 NPT, unless otherwisespecified.

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4.1.9 Pipe wall thickness shall be calculated against each size of each piping class as per relevant codes.

4.1.10 Transition piece shall be provided between different grades of pipeline welding as shown in P&ID's and as per standard engineering practice.

4.1.11 In the event of any conflict between specifications, related standards and codes, any other document, the following order of priority shall govern:

a) PNGRB Regulation
b) Statutory Requirements
c) Design Basis
d) Data Sheet/QAP
e) P&ID
f) Drawings
g) Technical specification of particular item
h) Code and Standards.

4.1.12 All pipe, valves and fittings shall be new and unused and shall have legible mill code as to type and grade of material.

4.1.13 The venting arrangement in station should have ball and globe combination. Primary valve shall be butt weld and secondary valves are flange end.

4.1.14 Overall design of piping system shall be in line with applicable statutory guidelines in force time to time and in compliance to PNGRB requirements. Safety/ quality compliance shall be as per PNGRB, over & above the EC standards and other local statutory compliances.

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4.2 Piping Specifications

4.2.1 The piping material specification shall be governed by the design conditions of pressure, temperature, corrosion allowance and compatibility with contained media. Piping material specification for this project has been attached elsewhere in the bid document.

4.2.2 When two lines that operates at different pressure – temperature conditions are connected; the valve segregating the two lines shall be rated for more severe service condition.

a) Pipe wall thickness shall be calculated in accordance with ASME B 31.8. Corrosion allowance shallbe as indicated in piping material specification.

4.2.3 Pipes

- Piping shall be designed to meet the design code of ASME 31.8, latest edition.
- The main piping system parameters to be considered is as follows:

Sl.No	Parameter	Value
1	Design Pressure	49 Kg / cm^2
2	Operating Pressure	17 -19 Kg / cm^2
2	Design Temperature	-29 to 65 ◦ C.

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3	Pipeline size (NPS)	8"/6"/4" NB
4	Service	NG / R-LNG (Non-Sour)
5	Pressure Class Rating	300#
6	Material Grade of Mainline	API 5L Gr. B PSL-2
7	SMYS, psig (Mpa)	360
8	Codes Applicable	ASME B 31.8

- If the pipeline passes through fault location, suitable allowance for occasional loads like seismic effect on the piping to be considered while calculating the wall thickness as per the relevant code applicable.

- No negative tolerance on thickness shall be considered.
- Corrosion allowance shall be considered based on the gas specification.
- Branch line shall be carbon steel seamless pipes of equivalent grade to match with 300#/ 150# pressure and temperature rating.
- Transition piece has to be maintained between two different grade and thickness of line pipes.
- The minimum diameter used shall be ½". The pipes having nominal diameters ¼", 3/8", 1 ¼", 2 ½", 5", 7" shall not be used. If vessel has connections at these diameters the piping from thevessels shall be increased to the next largest diameter.
- Minimum 1.5 D bends shall be used at stations.
- Minimum 3D bends shall be used in mainline.
- All pipes 2" and below shall be Sch. 80.

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4.2.4 Fittings

Fittings up to 1 ½" diameter

- Generally the fittings up to 1 ½" diameter shall be socket welding type made of forged steel.
- Malleable cast iron fittings are not allowed.

Fittings of 2" or more in diameter

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- Generally the fittings used for piping 2" or larger in diameter shall be made of the BUTT WELDINGends.
- Elbow shall have long radius (R = 1.5d).
- Fittings shall be seamless.

Branch connections (GENERAL)

- Branch connections shall be as per PMS (Piping Material Specification) attached elsewhere in thebid document.

  All fittings 2" and below size shall be Sch. 80.

.

4.2.5 Flanges

- The dimensions of flanges shall comply with ANSI B 16.5.
- Welding neck flanges shall be generally used for sizes 2" and more.
- Socket welding shall be used for sizes less than or equal to 1 ½" as per piping class.
- The type of flange facing and its finish shall be as per piping material specification.

4.2.6 Gasket And Bolts

The types to be used shall be as per piping material specification.

4.2.7 Valves

- All main line valves shall be double block and bleed type, double piston effect for low temperature application.
- For underground services, fully welded valves shall be used and for above ground services flangedtype valves shall be used.
- Stem extensions where specified in the requisition shall be to the proven vendor standard. The stem extensions height to be decided by the engineering consultant which shall be normal operating height up to chest level from the finished ground level.
- The first isolation valves from the mainline shall be welded types of ball valve.
- All isolation valves shall be equipped with spectacle blind at downstream of the valve.
- Valves shall be Top entry or Side entry.
- All valves shall be Full Bore type only, irrespective of their location.

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- The face-to-face dimensions of valves shall be based on ANSI 16.10.
- Hand wheel made of aluminum alloy are not allowed.
- All soft-seated valves shall be fire safe as per API 607(latest edition) or API 6FA (latest edition).
- Ball valves shall be floating ball type / trunnion mounted type as per following:

RATING	SIZE	TYPE
800#	1.5" and below	Floating Ball
150#	2" and above	Trunion mounted
800#	1.5" and below	Floating Ball
300	2" and above	Trunion mounted

- Generally valves up to 1 ½" diameter shall have socket welding ends.

4.2.8 Branch connection details: Branch connections shall be in accordance with piping materialspecification attached elsewhere in the bid.

4.2.9 Installation and mounting of instruments shall be as per fabrication and installation specification.

4.2.10 Underground valves shall be coated with high build coal tar epoxy with minimum 500 micronsDFT.

4.2.11 Underground valves shall be provided with pup piece, which will be as per pipeline design criteria.

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4.3 Vents And Drains

- The venting arrangements in station should be ball and globe combination.
- Hydrostatic test vent connections shall be in accordance with piping material specification. Vents are not required on lines, which are pneumatically tested and may be omitted on alloy piping and on lines handling corrosive commodities. Vent size shall be less than ¾".
- Piping and equipment shall be sufficiently drained at all low points to remove all liquid from the system. Drain shall be valved and shall not be smaller than ¾".
- Branch connections shall be in accordance with piping material specification attached elsewhere in the bid.

4.4 Site and Environmental Data

The site and environmental data attached elsewhere in the bid shall be referred for this purpose.

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4.5 Battery Limits

Battery limits for the stations shall be as per the drawings attached in the bid.

4.6 Colour Coding

- Ball Valve (Above Ground) : Off- White – RAL 9010
- Globe Valve (Above Ground) : Oxford Blue – RAL 5005
- Check valve (Above Ground) : Oxford Blue – RAL 5005
- All Underground Valves: Grey Epoxy
- Pipelines & Station pipes (A/G): Yellow Golden
- Cross Over: Gray epoxy with white stripes (white color shall have radiant property) or as directedby engineer In-charge.
- Structural Supports: Zebra Stripes or as directed by engineer In-charge.

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5.0 PIPING LAYOUT DESIGN GUIDES

5.1 Layout

5.1.1 All piping shall be routed in an orderly manner and grouped in banks wherever possible to provide an economical layout and have the minimum number of fittings consistent with ease of support and with the proper provision for expansion and flexibility and ease of maintenance.

5.1.2 Where possible piping shall be grouped and run on sleepers for ease of supporting.

5.1.3 Piping to be arranged for ease of inspection and servicing. Maintenance areas are to be kept clearof piping as far as possible. Piping shall be designed so that vessel connections and other pertinent components can be isolated for safe maintenance.

5.1.4 Piping or equipment requiring occasional cleaning or maintenance shall be provided with break flanges for dismantling.

5.1.5 All components requiring operation or maintenance, where practical shall be located where they can be operated or serviced conveniently. Access shall be provided to such components if they are located out of reach from platform.

5.1.6 The piping arrangement shall provide for isolation by operation of valves or other components to accomplish safe isolation.

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5.1.7 Small instrument tubing and piping shall be adequately supported and protected from damage by impact.

5.1.8 Bypass spools in piping shall be designed to permit the removal of the components bypassed without removing isolating block valves. A drain valve shall be provided to drain liquids between isolating valves.

5.1.9 Connections from the header for air, nitrogen, fuel gas will be from the top and liquids to be either from the side or bottom.

5.1.10 Control valves, relief valves shall be accessible from equipment or ground levels and grouped at main operating levels if possible. Valve stems should not be positioned below a horizontal centerline.

5.1.11 Bracing and supports for pressure relief valve risers shall be designed to prevent vibrations duringoperation and to permit independent removal of pressure relief valve from piping systems.

5.1.12 Pockets in lines including dead legs shall be avoided at all times.

5.1.13 In the event this is not possible, all gas traps shall have accessible plugged vents and liquid traps shall have accessible plugged valve drains.

5.1.14 Circumferential butt welds shall be separated by the maximum possible distance. Piping of sizes4" and above shall be no less that 100 mm apart or 5x W.T., whichever is greater. For piping 3" and below, minimum spacing shall be one pipe diameter.

5.1.15 Bolt-holes on fabricated piping items shall straddle the vertical and North / South center lines unless otherwise specified on the piping drawing.

5.1.16 Changes in pressure rating in piping system shall be made at valves, a valve separating two different pressure rated systems shall carry the rating of higher-pressure system.

5.1.17 Branching for instrument gas or air systems shall have block valves at the primary header.

5.1.18 Control Valves shall be installed with the actuator in a vertical upward position. Manifold arrangements shall consider access, clearance, maintenance and removal of control valve withoutremoving of stop valves. Control valve manifold shall preferably be located within view of associated instruments.

5.1.19 The clearance between two pipes shall be the minimum of flanges to pipe distance plus 25 mm, or insulated flange to pipe insulation plus 25mm, in case where the two pipes are insulated, with the flanges staggered. Consideration shall be given to the expansion / contraction in spacing of pipes.

5.1.20 The minimum clearance between hand wheels on valve manifolds shall be 75mm.

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5.1.21 Minimum clearance for personnel access ways shall be as follows:
Overhead clearance : 2.2 m
Horizontal clearance : 0.750 m

5.1.22 All allocated areas for safety access, service, maintenance and operation shall be kept clear ofpiping or any other obstructions.

5.1.23 Block valves in pipe work connected to equipment shall be installed as close to the equipment aspractical.

5.1.24 Locked open (or closed) valves should have a stainless steel tag shall be attached to the stem,bearing the following:
"THIS VALVE MUST NOT BE CLOSED (OR OPENED) WITHOUT WRITTEN PERMISSION FROMRESPONSIBLE AUTHORITY".

5.2 Spectacle Blinds

5.2.1 Spectacle blinds shall be provided as per the requirements shown in P&IDs.

5.2.2 Spectacle blinds assembly shall be provided with jackscrews. All heavy flanges 12" NPS and aboveshall be provided with jackscrew holes for easy removal of flanges.

5.3 Vents And Drains

5.3.1 Valve vents and drains (bleeds) shall be in accordance with process requirements as shown on thepiping and instrument diagrams. They shall generally be provided at control valve sets, level controller and gauge glass hook-ups and where liquid / gas can be trapped between isolating valves.

5.3.2 For pressure testing, all piping low points shall be drained by a valves connection and in general, all high points shall be vented by plugged, capped or flanged connection in accordance with the piping specification.

5.4 Valves (Manual)

5.4.1 All valves requiring attention during normal or emergency operation shall be accessible fromeither ground or elevated platform.

5.4.2 For optimum operation, hand wheel elevations shall be between 900mm and 1375mm above ground level. For normal operation, maximum elevation of the centerline of the hand wheel shall not be above a height of 1800mm from the operational level.

5.4.3 Valves shall not be installed with the spindles below the horizontal plane.

5.4.4 For buried valves the stem shall extend above the ground and the same shall be added in the requisition.

5.5 Clearance and Accessibility

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All equipment, structure, platform, piping and its support shall be arranged to provide thefollowing minimum clearance:

5.5.1 Overhead Clearance (Vertical)

- Maintenance passageways and walkways : 2200mm
- Clearance between bottom of pipe and top of grade level : 300mm

5.5.2 Horizontal Clearance : 750 mm

5.6 Exits

5.6.1 The piping arrangement shall be such that, so as to facilitate easy exit in case of emergency.

5.7 Platforms. Ladders And Stairways

5.7.1 Platforms, ladders and stairways shall be minimized consistent with access and safetyrequirements.

5.7.2 Elevated stations requiring attention for operation and / or maintenance shall be supplied with a permanently fixed ladder and/ or platform. Maintenance platforms shall be provided for allpressure vessels and other relief valves over 2000 mm above ground level. Access is not required to equipment nozzles where flanges are provided only for initial assembly of the piping.

5.7.3 Gauges, instrumentation, cable trays and small-bore piping shall not interfere with access to area.

5.7.4 Access and permanent maintenance facilities shall be provided for all plant and equipment subject to regular maintenance.

5.7.5 On racks and pipe ways, consideration shall be given to space allocation for future piping.

5.8 Equipment

5.8.1 Equipment Fixing (General)

Permanently fixed equipment shall be supported on the ground / civil structure as applicable.

5.8.2 Platforms and Access

Elevation of platform to be established for access to instruments and valves as per good engineeringpractices.

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5.8.3 Run piping at a common BOP elevation for ease of supporting.

5.8.4 Minimum dimension from grade level to be 300 mm BOP.

5.9 Instruments

5.9.1 Control Valves

- Control valves shall generally be installed in a horizontal line and the actuator in a verticalposition. Variations shall be approved by the design Engineer.
- Control valves shall be easily accessible from the grade or permanent platform and beconveniently located for ease of operation, maintenance and removal.

5.9.2 Safety valves

Safety relief valves shall be installed vertically and as close as possible to the equipment or piping to be protected. If for installation reasons (e.g. accessibility) the inlet connection length of safety valves has to be larger than usual, the pressure drop in the related section of pipe must be checked. Inlet and outlet lines to relief valves shall have full bore lock open ball valves.

6.0 GUIDELINES-PREPARATION OF PIPING DRAWINGS

6.1 Title Blocks

6.1.1 At least following information shall be reflected in the TITLE BLOCK:

a. The title of document, including the contract name.
b. The document serial number included the contract number.
c. The date and revision number of document.
d. The purpose of issue of document with the signature / initials of the persons, who drafted,checked and approved the document.
e. Name of Owner, Detail engineering consultant, TPIA (if applicable), EPC/ Laying Contractor,Project Name & No. and Area code (if applicable)

6.2 Revisions

6.2.1 Revisions shall be clearly identified on all documents / drawings and modified portions shall be clouded in case of drawings and outlined (• shown with Revision) in case of documents.

6.3 List Of Drawings

6.3.1 All documents shall be listed. From the list it should be possible to keep track of various issues and revisions of the documents. The list shall be regularly updated to reflect the latest revisions based on project requirements.

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6.4 Scales

6.4.1 Equipment Layouts - 1:50, 1:75

6.4.2 Piping plans / Support plans - 1:50

6.4.3 The metric system shall be used for all drawings.

6.4.4 True north and plant north to be shown. Nozzles with size, rating and orientation are to be marked on equipment layout for installation of equipment.

6.4.5 The piping plan shall provide all information required for installation of piping. Sectional views and details to be drafted. Line marking shall be as per P&ID.

6.4.6 Pipe support shall be marked on piping plans and support drawings shall be furnished separatelyfor OWNER's review / information.

6.4.7 Piping arrangement inside Vendor's skid not required to be shown on piping GAD's.

6.4.8 Piping up to 12" NB diameter shall be shown by single lines. All piping lines shall be identified as shown in P&ID. The direction of flow and any insulation and tracing shall be indicated.

6.5 Guarantee Test

6.5.1 In addition to the routine tests and guarantees by the manufacturers for the items beingprocured and installed, the EPC/ Laying contractor to demonstrate as called for by the OWNER / OWNER'S representative by carrying out additional tests viz. Hydrotesting, NDT etc. at pressure and temperatures as specified.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR PIPINGMATERIALSPECIFICATION ENG-STD-PI-DOC-TS-001

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REV	Date	Purpose	Prepared by	Checked by	Approved by
1	30.12.2016	Issued for Bid			
0	31.10.16	First Issue			

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1.0 SCOPE

This specification covers the requirements of various piping materials used in piping/ pipeline system handling Natural Gas/ Re-gasified Liquid Natural Gas (RLG)N and associated utilities in the pipeline. This specification describes the minimum requirements for the design, furnishing of materials, fabrication, inspection, testing of pipes & fittings and valves.

2.0 CODES AND STANDNRDS

All materials shall conform to AST,MAPI or BS Standards.

Pipeline and terminal facilities envisaged as a part of this project shall be designed and engineered primarily in accordance with the provisions of ASEM B 31.8 – " Gas Transmission & Distribution Piping System", ASEM B 31.3 Pressure Piping, "Chemical Plant and petroleum Refinery Piping" and IOSD Standard 226-"Natural Gas Transmission Pipeline and City Gas Distribution Networks".

All codes standards and specifications referred herein shall be the latest edition of such documents.

The latest revision of the following shall be considered as part of this specification.

- ASEM B 16.5 - Steel Pipe Flanges and Flanged Fittings
- ASEM B 16.9 - Factory made Wrought Steel Butt welding Fittings
- ASEM B 16.10 - Face to Face/ End to End dimension of valves.
- ASEM B 16.11 - Forged Steel Fittings, Socket Welding and Threaded
- ASEM B 16.20 - Metallic Gaskets for Pipe Flanges.
- ASEM B 16.21 - Non-Metallic Flat Gasket for Pipe Flanges
- ASEM B 16.25 - Butt welding ends
- ASEM B 16.34 - Valves- Flanged, Threaded and welding ends
- ASEM B 31.3 - Process Piping
- ASME B 31.4 - Pipeline Transportation system for Liquid hydrocarbons & other liquids
- ASEM B 31.8 - Gas Transmissions and Distribution Piping System
- ASEM B 36.10 - Welded and Seamless Wrought Steel Pipe
- ASEM B 46.1 - Surface Texture
- API 5L - Line Pipe
- API 6D - Pipeline Valves
- API 590 - Steel Line Blank
- API 600 - Steel Gate Valves Flanges and Butt welding Ends

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- API 602 - Steel Gate, Globe, and Check Valves for Sizes NPS 4 (ND 100) and Smaller for the Petroleum and Natural Gas Industries
- SMS SP 44 - Steel Pipe line Flanges.
- SMS SP 97 - Integrally Reinforced Forged Branch Outlet Fitting – Socket Welding, Threaded and Butt welding Ends
- ASTMA 105 - Forging, Carbon Steel for Piping Components
- ASTMA 193 - Alloy Steel and Stainless-Steel bolting Materials for High temp Service
- ASTMA 194 - Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
- ASTMA 320 - Standard Specification for Alloy Steel and Stainless Steel Bolting Materials
- ASTMA 216 - Steel Casting, Carbon, Suitable for Fusion Welding, for High Temperature Service
- ASTMA 234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperature
- ASTMA 285 - Pressure vessel plates, carbon steel, low and intermediate Tensile strength
- ASTMA 694 - Forging, Carbon and Alloy Steel, for Pipe Flanges, Fitting, Valves and Parts for High Pressure Transmission Service.
- ASTMA 333 - Low temperature service seamless pipe
- ASTMA 350 - Forged Carbon and Low Alloy Steel requiring Notch Toughness Testing for Piping Components
- ASTMA 420 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service
- ASTMA 860 - Standard Specification for Wrought High Strength Low Alloy Steel Butt Welding Fittings
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3.0 PIPING

3.1 Carbon steel pipe shall be made by open hearth, electric furnace or basic oxygen process only. The steel used shall be fully killed and made with fine grain structure. The grade and wall thickness of various sizes of pipes shall be as specified in the P & ID or other bid documents.

3.2 Pipe dimensions shall be in accordance with ANSI B 36.10 or API 5L for carbon steel pipes.

3.3 For butt weld end, bevel shall be in accordance to ANSI B 16.25/ API 5L as applicable.

3.4 Test reports shall be supplied for all mandatory tests as per the applicable material specifications.

3.5 Material test certificates (physical property, chemical composition and heat treatment report) shall also be furnished for the pipes supplied.

3.6 Pipes shall not have any circumferential seam joint in a random length.

3.7 All pipes shall be hydrostatically tested and the test pressure shall be as per QAP or as specified.

3.8 All pipe threads shall conform to American Standard taper as per ANSI 1.20.1 NPT, unless otherwise specified.

3.9 All pipe and their dimensions, tolerances, chemical compositions, physical properties, heat treatment, hydro test and other testing and marking shall confirm to the codes and standards.

3.10 Marking and Despatch

3.10.1 All Pipes shall be marked in accordance with the applicable codes, standards and specifications.

3.10.2 Pipes shall be dry, clean and free from **m**oisture, dirt and loose foreign materials of any kind.

3.10.3 Pipes shall be protected from rust, corrosion and mechanical damage during transportation, shipment and storage.

3.10.4 Steel end protectors to be used on galvanized pipes shall be galvanized.

3.10.5 Both ends of the pipe shall be protected with the following material:
a) Plain end: Plastic cap,
b) Bevel end: Wood, metal or plastic cover.

3.10.6 End protectors to be used on beveled ends shall be securely and tightly attached with belt or wire.

4.0 BENDS

Unless otherwise specified for terminal piping, the elbow of radius R= 1.5D shall only

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be used.

5.0 FITTINGS

5.1 Fully killed carbon steel shall be used in the manufacture of fittings.

5.2 Dimension of socket weld/ screwed fittings shall conform to ASEM B 16.11

5.3 Fittings thickness tolerances shall match pipe thickness tolerance.

5.4 Bore of socket welded fittings shall suit O. D. of pipe and its thickness.

5.5 For reducing butt weld fittings having different wall thickness at each end, the greater wall thickness of the fittings shall be employed and inside bore at each end shall be matched with the specified inside diameter of connecting pipe.

5.6 Chemical composition, physical properties, tests; dimensions and tolerance, heat treatment and marking shall conform to the applicable codes / standards / specifications as specified.

5.7 All unequal tees are reducing in branch only.

5.8 No repair welding is permitted.

5.9 All fittings shall be seamless in construction unless otherwise specified and as directed by Owner.

5.10 Dimensions of butt welded carbon steel fittings shall be as per ASME B 16.9 / SMS-SP- 75, as applicable.

5.11 Butt welding ends shall conform to ANSI B 16.25/ API 5L. In case of difference in thickness of matching ends, requirements of ASEM B 31.8 shall apply.

5.12 Integrally reinforced forged branch fittings such as sockolet, threadolet, weldolet, nippolet etc. shall be as per MSS-SP-97. Fittings not covered in ASME B 16.9 and SMS- SP-97 shall conform to manufacturer's standard.

5.13 Marking And Despatch

5.13.1 Each fitting shall be legibly and conspicuously marked in accordance with the requirements of applicable standards.

5.13.2 Steel die marking shall not be permitted on body of butt weld fittings, except for low stress round nose die stamping.

5.13.3 Fittings shall be dry, clean and free of moisture, dirt and loose foreign materials of any kind.

5.13.4 Fittings shall be protected from rust, corrosion and mechanical damage during transportation, shipment and storage.

5.13.5 Rust preventive used on machined surfaces to be welded shall be easily removable

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with petroleum solvent of the same shall not be harmful to welding.

5.13.6 Each end of fitting shall be protected with a wood, metal or plastic cover.

5.13.7 Each size of fitting shall be supplied in separate packaging marked with the purchase order no., item code no., material specification, size and schedule / thickness / rating, etc.

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6.0 FLANGES

6.1 Flange rating shall be same as ANSI B 16.5/ MSS-SP-44/ B 16.47 Series A as specified.

6.2 Dimensions of flanges shall be in accordance with ASNI B 16.5/ B 16.47 Series A, as applicable.

6.3 Neck of Weld Neck (WN) flanges to suit pipe bore and thickness.

6.4 Bore of Socket Welded (SW) flanges shall suit pipe O.D. and its thickness.

6.5 Sizes for blind flanges shall be indicated by nominal pipe sizes.

6.6 Carbon steel flanges faces shall have smooth finish as indicated in the material specification. Flanges faces shall have smooth finish to 125-250 micro inches AARH as per MSS-SP-6.

6.7 Wherever face finish is not mentioned, it shall be serrated spiral / concentric.

6.8 All flanges of size 2" NB & above shall have Butt Weld ends unless otherwise specified.

6.9 Flanges of size 1.5" NB and below shall have socket weld ends unless otherwise specified.

6.10 Butt welding ends of WN flanges shall conform to ANSI B 16.25.

6.11 Spectacle blind/ spacer & blinds shall be in accordance with ASME B 16.48/ Manufacturer's Standard. Spectacle blind shall be used for sizes up to 8" NB and spacer & blind for 10" & above shall be used.

6.12 Tow jack screws 180° apart shall be provided for all spectacle blind assemblies. The jack screws shall be as per CNOSULTANT/ WONER's standard.

6.13 No repair welding is permitted.

6.14 Material test certificate (physical property, chemical composition & heat treatment report, etc.) shall also be furnished for flanges supplied.

6.15 Marking &Despatch

All flanges shall be properly marked with item code no. and size and shall be securely placed in wooden boxes for dispatch

7.0 SGAEKTS

Spiral wound metallic gaskets (SS 316 – Pure Graphite, Spiral Wound) shall conform to B 16.20. All spiral wound gaskets shall be provided With inner and outer (centering) ring.

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8.0 BOLTING

8.1 Nuts for stud bolts shall be American Standard Hexagonal Heavy series and double chamfered.

8.2 Flange bolting shall be fully threaded alloy steel stud bolts with two heavy hex nuts as per the relevant material standard. All C.S. stud bolts and nuts shall be hot dip galvanized.

8.3 Dimension and tolerances for stud bolts and nuts shall be as per ANSI B 18.2.1 and 18.2.2 with full threading to ANSI B 1.1 Class 2A thread for bolts and Class 2B for nuts. Diameter and length of stud bolts shall be as per ANSI B 16.5/ ASEM B 16.47 with full threading.

8.4 Threads for nuts shall be as per ASNI B 1.1, as follows:

Nuts for stud dia ¼" to 1" : NC-U2B
Nuts for stud bolts dia $1^{1/8}$" to 3¼" : 8UN2B

Threads for stud bolts shall be as per ANSI B 1.1, as

follows. Studs bolts dia ¼" to 1" : UNC-2A

Stud bolts dia $1^{1/8}$" to 3¼" :8UN-2A

8.5 Heads of jack screws shall be heavy hexagonal type. Jack screw end shall be rounded Stud bolts shall be fully threaded with tow hexagonal nuts.

9.0 THREAD SEALANT

Threaded joints shall be made with 1" wide PTFE Jointing tape.

10.0 VALVES

Unless specified otherwise, valves shall conform to the latest edition of following standards:

Screwed / Socket welded / Flanged end valves (1 ½" and below)

Ball Valves	-	ISO17292
Plug Valves	-	BS 5353
Globe Valves	-	ISO15761

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Gate Valves	-	API 602

Flanged / Butt weld end Valves (2" and above)

Ball Valves	-	API 6D
Plug Valves	-	API 6D
Check Valves	-	API 6D
Globe Valves	-	BS 1873
Gate Valves	-	API 6D

All valves with non-metallic seats and seals shall be fire safe type. Fire safe test shall be as per API-607 (latest) or API-6FA (latest). Fire safe test certificates duly certified by a recognized Third Party Inspection Agency shall be furnished to the Owner for approval.

The face to face dimensions of flange valves shall be as per ANSI B16.10 and flanges on the steel flange valves shall conform to ASEM B16.5 and ASME B 16.47 as applicable

Butt welding ends of Butt Welded valves shall conform to ANSI B 16.25.

Face-to-face and end-to-end dimensions shall conform to applicable standards.

Buried valves on mainline shall be provided with stem extension, sealant, vent/drain & shall have butt welded ends.

By pass requirement for Ball valves shall be provided for sizes 4" NB and above. The basic design of bypass shall be of tow valve configuration. One Ball valve (Butt weld type) and one Globe Valve (Flanged type) on by pass line.

The size of bypass line/ valve (wherever applicable) shall be as under
On main valve =<4" NB = 2"

The by-pass piping arrangement shall be such that clearance between main valve body and by-pass assembly shall be the minimum possible for the layout reasons.

Casting of valves shall be radiographically examined as per the procedure and acceptance criteria specified in ANSI B 16.34 Annexure - B. All valves of ANSI 300# and 150# rating shall be 100% tested by radiography irrespective of the valve size.

Valve castings not requiring radiography shall be of radiographic quality as per ANSI B16.34 Annexure 'B', Radiography for these valve castings shall be carried out by the manufacturer as per his standard quality control procedure.

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Valve body thickness, wherever not specified in the standard, shall be as per ANSI B16.34.

Flange shall be integral with valve body, valves with flanges welded to the body shall not be accepted.

Socket weld end ball valves with non-metallic seats or seals shall be provided with 100m long nipples having material and thickness equivalent to that specified in the piping material class. These nipples shall be welded to the valve by the supplier on both ends before fitting packing seats and seals.

Ball position indicator shall be provided.

Ball shall be solid in construction.

Ball valves shall be provided with antistatic device.

Ball valves shall be field serviceable.

Ball valves shall meet the Quality Specification Level-3 as per API 6D.

Valves of trunion mounted type shall be double block and bleed type and shall be equipped with a device through which sealant can be injected into the sealant area.

Gear operator shall be as under, with position indicators for open/close positions, with limit stops (limit stops are not applicable for gate and globe valves)

For Globe valves - Totally enclosed bevel gear in grease case with grease nipples/plugs

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For Ball / Plug valves - Totally enclosed helical worm or combination of helical worm and spur gear in grease case with grease nipples/plugs

Material selection for soft seats/seals for Ball valves shall be suitable for maximum differential pressure, corresponding to pressure/temperature rating and service fluid handled on a continuous basis. The seat/ seal material in valve data sheets for Ball valves is indicative only. Vendor can propose an alternative seat provided he furnishes the pressure/temperature rating of the proposed seat material which shall cover the class temperature pressure rating of the valve and is superior to the seat/seal material specified in the valve datasheets.

10.1 Gate and Globe Valves

Globe valve shall be of type BS 1873, bolted bonnet, hard faced stellited conical sheet, taper disc with either flanged ends according to ASEM B 16.5/ ASME B 16.47 (as applicable), or welded ends.

Gate valve shall conform to API 6Dwith either flanged ends according to ASME B 16.5 / ASEM B 16.47 (as applicable) or Welded ends.

The Valve shall be design for maximum pressure of 49 bar (g)/ 19 bar (g) (as specified by owner) and a temperature of –29C ^{0} to + 65 ^{0} C.

The Material of construction of body will be ASTMA 216 Gr. WCB and the same should be certified according to the DINEN10204 3.2.

All underground valves shall be of extended stem type and Height of the stem shall be decided during detail engineering. Also, refer AQP and Data sheet attached elsewhere in the bid document.

10.2 Ball &Plug Valves

Ball of class 300#/ 150# shall be used with full bore, fully welded design / bolted Side entry design, anti-static tested as per clause B.5 of annexure-B of API 6D, Double block & Bleed having drain & vent device fire safety, gear operated with wheel, local position hand

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indicator, ex-switch for opening and closing suitable for either butt weld ends or flanged connections according to ASME B 16.34, ASEM B 16.5 or ASME B 16.47 as applicable.

The ball shall be design for maximum pressure of 49 bar(g)/ 19 bar(g) (as specified by owner) and a temperature of –29 ^{0}C to + 65 ^{0}C.

The material of construction of body will be ASTMA 216 Gr. W/CA 234 Gr. WPC and the same should be certified according to the DINEN10204 3.2.

All underground valves shall be of extended stem type and Height of the stem shall be decided during detail engineering.

Also refer QAP and data sheet.

manual Valve operation shall be as indicated below, unless specified otherwise in the P&ID.

For ANSI class 150#, 300#– hand wheel operated for size <4"BN.
Gear operated for size >6_"NB.

10.3 Check Valves Description

Material of construction of body will be A 216 Gr. WCB, swing check valve, 13% chrome trim, bolted cap, renewable seat, satellite faced seat and disc. (Size 2" thru 16").

The Valve shall be design for maximum pressure of 49 bar (g)/ 19 bar (g) (as specified by owner) and a temperature of –29 ^{0}C to + 65 ^{0}C.

The material of construction will be carbon steel – ASTMA 216 Gr. WBC and the same should be certified according to the DINEN10204 3.2.

Also, refer AQP attached elsewhere in the bid.

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12.0 HYODRTESTING VENTS AND DRAINS

High point vents and low point drains required for the purpose of hydro testing shall be of mi n size 1" and consist of sockolet, globe & ball valve for vent, Globe & Ball Valve for drain, flange & blind flange.

13.0 INSULTAING FLANGE

Insulating flange, type IF, complete with insulating washers, O-ring seals weld ends for pipe of suitable dimensions.

The Insulating flange shall be design for maximum pressure of 49 bar (g)/ 19 bar (g) (as specified by owner) and a temperature of –29 °C to + 65 °C.

The material of construction will be ASTMA105 (charpy) and the same should be certified according to the DINEN10204 3.2.

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14.0 INSULTAING JOINT

14.1 According to ASME – Code section VIII/D1, with Ex-proof spark gap butt-weld ends for suitable pipe connection, as applicable.

14.2 The Insulating Joint shall be design for maximum pressure of 49/ 19 bar (as specified by the owner) and a temperature of –29^{0}Cto + 65 ^{0}C.

14.3 Material for the pressure containing parts of the insulating joints shall be as indicated in the monolithic insulating joint data sheets. Material for pups shall be equivalent or superior to the material of connecting pipeline, which is indicated in the data sheets. Pup piece material shall be such as to limit the thickness of pup piece to be welded with pipeline. In the present case the material of the mainline is API 5L X-42 and that of station piping is ASTMA106 Gr. B (Charpy). All materials used in IJ should be certified according to the DINEN10204 3.2.

14.4 Refer QAP/data sheet for more details.

PIPINGMATERIALSPECIFICATION							**PRESSURERATING:150#** **DESIGPNRESSUER:19B GAR** **LOCATION LASS :Class IV**
OCDE:ASMEB31.8 SERVICE:			**NATURAL GAS**				**CORROSION ALL :1.5MM**
ITEM	**SHORT CODE**	**SIZE FRM-OTRHU**	**DESCRIPTION**	**RATING/SCH/WT**	**DIMENSION STADNRD**	**MATERIAL STANADRD**	**REMAKRS**
PIPELINE	PL	4”-12”	BE	64. MM(Min.)	API 5L	API5LGr.B(PSL2)	
STATIONPIPING	SP	2”	BE,SEAMLESS	S80	ASMEB36.10	ASTMA 106Gr.B(Charpy)	U/G- PRIMARILY ELECTRIC RESISTANCEWELDED ./AG-PRIMRAILY
		3”		S40	ASMEB36.10	ASTMA106GrB.(Charpy)	
		4”to12”	BE,SEAMLESS	6.4MM(Min).	ASME B36.10	ASTMA 106GrB.(Charpy)	
VENTPIPE	VP	1/2"–1½"	PE, SEAMLESS	S80	ASME B36.10	ASTMA 106Gr.B(Charpy)	
		2”	BE,SEAMLESS	S80	ASME EB36.10	ASTMA 106Gr.B(Charpy)	
		3”	BE, SEAMLESS	S40	ASME	ASTMA 106Gr.B(Charpy)	
		4”	BE,SEAMLESS	6.4MM(Min.)	ASME B36.10	ASTMA106GrB.(Charpy)	
BALLVALVE	BLV	1/2"–1½"	SW or THREADED	800#	BS17292	BODY: ASTMA 105	FLOATINGBALLVALVESCOEKTWELD- ASME B161. 1 THREADED- ASME B12. 01.

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		2”-3”	BW or FLGDRF 125-250 AARH	150#	API6D	BODY: ASTM A 216 Gr. WCC/ A234 Gr. WPC	FLOATINGBALALLVVE BTUTEWLD-ASMEB16.25 FLGEANDED-NASMEB16.5
		4”-12”	BOWRFLGDR F125-250 AARH	150#	API6D	BODY: ASTM A 216 Gr. WCC/ A234 Gr. WPC	TRUNINMO NUOTED BTUTEWLD-ASMEB16.25FLANGED END-ASME B16.5
GLOBE VALVE	GLV	1/2"–1½"	SW O R THREADED	800#	BS157 61	BODY: ASTM A 105	SCOEKTWELD-ASME B161. 1 THREDED- ASME B12. 01. .
		2”–12”	BOWRFLGDR F125-250 AARH	150#	BS187 3/ API 602	BODY: ASTM A 216 Gr. WCB	BTUTEWLD-ASMEB16.25 FLANGED END-ASME B 16.5
LIFTCHECK VALVE	NRV	1/2"–1½"	SW	800#	BS15761	BODY: ASTM A 105	HORIZONTAL ISNTALLATIONSOCKET WELD-ASMEB16.11

SIWNG CHECK VALVE		2”–12”	BOWRFLGDRF 125-250 AARH	150#	API 6D OR BS1868	BODY ASTM A 216 Gr. WCB	HORIZONTAL INSTALLATION OR VERTICAL INSTALLATION WITH UPWARD FLOW DIRECTION BUTT WELD - ASME B 16.25
PLUG VALVE	PLV	2”–12”	BOWRFLGDRF	150#	API 6D	BODY: ASTM A 216 Gr. WCB	BUTT WELD - ASME B 16.25 FLANGED END - ASME B 16.5
ELBOWS LR/ LRBENDS (30°to90°)	EL	1/2"–1½"	S,1W.5D	M	ASME B 16.11	ASTM A 105 Gr. B.	SOCKET WELD - ASME B 16.11
		2”-3”	BW1, 5. D	M	ASME 16.9.	ASTM A 234 Gr.WPB (Charpy)	BUTT WELD - ASME B 16.25
		4”-12”	B15RDO3D	M	ASMEB16.9	MSSP75WPHY42 (For pipeline)/ SATMA234P WB (Charpy) (For Station Piping)	BUTT WELD - ASME B 16.25
		2”-3”	BW	MXM	ASME B16.9	ASTM A 234 WPB (Charpy)	BUTTWELD -ASME B 16.25

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REDCUERS CONCENTRIC	RC	4”-12”	BW	MXM	ASMEB16.9	MSSP75WPHY42 (For pipeline)/ ASTM A 234 PWB (Charpy) (For Station Piping)	BUTTWELD- ASME B 16.25
TEE EQUAL AND REDUCING	T	1/2"–1½"	SW	3000#	ASME B16.11	ASTM A10 5	SCOEKTWELD- ASME B 16.11
		2”-3”	BW	MMX	ASME B16.9	ASTM A 234 Gr.WPB (Charpy)	BUTTWELD- ASME B 162. 5
		4”-12”	BW	MXM	ASMEB16.9	MSSP75WP4HY2 (Forpipeline)/ SATMA234PW B (Charpy) (ForStationPiping)	BUTTWELD- ASME B 16.25
SOCKLOET /THREADOLET	S	1/2”to11/2”	SW OR TRHED AED	3000#	MSS-SP97	ASTM A 105	SCOEKTWELD- ASME B 16.11 TRHEADED - ASMEB12. 01.
WELDOLET	W	2”– 12”	BW	MMX	S-SP 97	ASTM A105 (Charpy)	BUTTWELD- ASME B 16.25
END CAP	C	1/2"–1½"	SW	3000#	ASME B16.11	ASTM A10 5	SCOEKTWELD- ASME B 161. 1
		2”– 12”	BW	M	ASM B16.9 E	ASTM A 234 Gr. WPB (Charpy)	BUTTWELD- ASME B 162. 5
PIPENIPPLE	NIPL	1/2"–1½"	PE, SEAMLESS	M	ASME B36.10	ASTM A 106 Gr.B (Charpy)	-
COUPLING (FULLor HALF)	COUP	1/2"–1½"	SW OR TRHED AED	3000#	ASME B16.11	ASTM A 105	SCOEKTWELD- ASME B 16.11 TRHEDEAD-ASMEB12. 0.1
FLANGE	FW	1/2”to11/2”	SORF,125-250 AARH	150#	ASMEB16.5	ASTM A 105	-
		2”-3”	WNRF,125-250 AARH	150# Bevel End TW Sch.80	ASMEB16.5	ASTM A 105 (Charpy)	-
		4”–12”	WNRF,125-250 AARH	150# BevelEndTW 6.4m	ASMEB16.	MSS SP 44 GR F42 (For pipeline)/ ASTM1A05(Charpy)	-
BLIND FLANGE	FB	1/2”to11/2”	RF,125-250AARH	150#	ASMEB16.5	ASTM A 105	-
BLIND FLANGE		2”-3”	RF1, 25-250ARAH	150#	ASMEB16.5	ASTM A 105 (Charpy)	-
		4”–12”	RF,125-250RAH	150#	ASMEB16.	MSSSP44rG.F42 (For pipeline)/ ASTM1A05(Charpy)	-
SPECTCALE BLIDN	FSB	2”-12”	RF,125-250ARAH	150#	ASME B 16.48	ASTM A 105 (Charpy)	-
STUD&NTU /BLOT	B	1/2”–12”	-	-	ASMEB18.2	STUD:ASTM A 193 B7 NUT: ASTM A 194 Gr.2H	HOTDIPGALVENIZED

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GASKET SPIRAL WOUND	G	1/2"–12"	-	0.175 „ THICNE KSS	ASME B 16.20	SPIRAL WOUND CNAF FILLER + INNER & OUTER RING SS316 + CAF	COMPATIBLE WITH ASME B16.5 FLANGES

NOTE:

1. M=TIHCKNESS TO MATCPHIPEWALLTHICKNESS
2. THISSPECIFICATIONS SHALL BE READ IN CONJUCTION WITH GENERAL NOTES AND DATA SHEETS &TECHNICAL SPECIFICATIONS OF AN INDIVIDUAL ITEM

BRANCH TABLE

BRANCH SIZE

HEADER SIZE

	1/2"	3/4"	1"	1 ½"	2"	3"	4"	6"	8"	12"	14"	16"
1/2"	T											
3/4"	T	T										
1"	T	T	T									
1 ½"	T	T	T	T								
2"	S	T	T	T	T							
3"	S	S	T	T	T	T						
4"	S	S	S	S	T	T	T					
6"	S	S	S	S	W	T	T	T				
8"	S	S	S	S	W	W	T	T	T			
12"	S	S	S	S	W	W	W	T	T	T		
14"	S	S	S	S	W	W	W	T	T	T	T	
16"	S	S	S	S	W	W	W	T	T	T	T	T

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LEGEND

T : EQUAL/REDUCING TEE
S : SCOKOLET
W : WELDOLET

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PIPINGMATERIALSPECIFICATION							PERSSURETRAING:300# DESIGPNRESSUER:49BG AR TEMPERATURERANGE:-29 °Cto65°C LOCATION CASS:CLASSIV
CODE:ASME B31.8 SERVICE:			**NATURALGAS**				**CORROSION ALL.:1.5MM**
ITEM	**SHORT code**	**SIZE FRM-OTRHU**	description	**RATING/SCH/WT.**	**DIMENSION STANDARD**	**MATERIAL STADNRD**	**REMARKS**
PIPELIENE	PL	4”-12”	BE	64. MM(Min.)	API5L	API5LGr.4X2(PSL2)	U/G- PRIMARILY ELECTRIC RESISTANCE WELDED/AG-PRIMRAILY SEAMLESS
STATION PIPING	SP	2”	BE, SEAMLESS	S 80(Min).	ASME B 36.10	ASTM A 106rG.B(Charpy)	
		3”	BE ,SEAMLESS	S40(Min.)	ASME B 36.10	ASTM A 106rGB.(Charpy)	
		4” - 6”	BE ,SEAMLESS	6.4 MM (Min.)	ASME B 36.10	ASTM A 106rGB(Charpy).	
		8” - 12”	BE ,SEAMLESS	S40 (Min.)	ASME B 36.10	ASTM A 106rGB(Charpy).	
VENTPIPE	VP	1/2"–1½"	PE, SEAMLESS	S80	ASME B36.10	ASTM A 06rG.B(Charpy)	
		2”	BE, SEAMLESS	S80	ASME 36.10	ASTM A 06rG.B	
		3”	BE, SEAMLESS	S80	ASME 36.10	ASTM A 06rG.B(Charpy)	
		4”	BE, SEAMLESS	64MM(Min.)	ASME 36.10	ASTM A 06rG.B(Charpy)	
BALL VALVE	BLV	1/2"–1½"	SW orTHREADED	800#	BS17292	BODY: ASTM A 105	FLOATING BALL VALVE SOCEKTWELD-ASMEB161. 1 THREDED-ASME B12. 0.1.

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		2”-3”	BW OR FLGD RF125-250 AARH	300#	API6D	BODY: ASTM A 216 Gr. WCC / A 234 Gr. WPC	FLOATING BALL VALVE BUTT WELD - ASME B 16.25 FLANGED END - ASME B 16.5
GLOBE VALVE	GLV	4”-12”	BW OR FLGD RF125-250 AARH	300#	API6D		TRUNIONMUNOTED BUTTEWLD- ASME B16.25 FLANGED END - ASME B 16.5
		1/2"–1½"	SW orTHREADED	800#	BS15761	BODY: ASTM A 105	SOCEKTWELD-ASMEB 16.11 THREDED-ASME B12. 0.1.
		2”–12”	BW OR FLGD RF25-250 AARH	300#	BS1873/ API602	BODY ASTM A 216 Gr. WCB	BUTTEWLD- ASME B162. 5 FLGANEDED-N ASME B 16.5
LIFTCHECK VALVE	RNV	1/2"–1½"	SW	800#	BS15761	BODY: ASTM A 105	ORHIZNTOAL ISNTALLATINS OCOEKT WELD- ASME B16.11
SWING CHECK VALVE		2”–12”	BW OR FLGDRF 125-250 AARH	300#	API 6DRO BS1868	BODY: ASTM A 216 Gr. WCB	HORIZONTAL INSTALLATION OR VERTICAL INSTALLATION WITH UPWARD FLOW DIRECTION BUTT WELD - ASME B 16.25
PLUGVALVE	PLV	2”–12”	BW OR FLGD RF	300#	API 6D	BODY ASTM A 216 Gr. WCB	BUTT WELD - ASME B 16.25 FLANGED END - ASME B 16.5
ELBOWS LR/ LRBENDS (30°to90°)	EL	1/2"–1½"	SW, 1.5D	M	ASMEB16.11	ASTM1A05	SCOEKTWEL–DASME B 16.11
		2”-12”	BW, 1.5 D OR 3D	M	ASME B16.9	MSSP 75 WPHY 42 (For pipeline) / ASTM A 234 Gr. WPB (Charpy) (For Station Piping)	BUTTWELD-ASME B 16.25
REDCUERS CONCENTRIC	RC	2”-3”	BW	MXM	ASME B16.9	ASTM A 234 Gr. WPB (Charpy)	BUTTWELD-ASME B 16.25
		4”-12”	BW	MXM	ASME B16.9	MSSP 75 WPHY 42 (For pipeline) / ASTM A 234 Gr. WPB (Charpy) (For Station Piping)	BUTTWELD-ASME B 16.25
		1/2"–1½"	SW	3000#	ASME B16.11	ASTM1A05	SCOKETWELD–ASME B 16.11

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TEE EQUALAND REDCING	T						
		2”-3”	BW	MXM	ASME B16.9.	ASTM A 234 Gr. WPB (Charpy)	BUTTWELD-ASME B 162. 5
		4”-12”	BW	MXM	ASME B16.9	MSSP 75 WPHY 42 (For pipeline)/ ASTM A 234 Gr. WPB (Charpy) (For Station Piping)	BUTTWELD- ASME B 16.25
SOCKOLET/ TRHEDOLET	S	1/2”-11/2”	SW OR TRHEAEDD	3000#	MSS-SP 97	ASTM A 105	SOCEKTWELD-ASMEB 161. 1 TRHEDEAD - ASME B12. 0.1
WELODLET	W	2”– 12”	BW	MMX	MSS-SP 97	ASTM1A05(Charpy)	BUTTWELD-ASME B 162. 5
ENDCAP	C	1/2"–1½"	SW	3000#	ASME B16.11	ASTM1A05	SCOEKTWELD-ASME B 16.11
		2”–3 ”	BW	M	ASME B16.9	ASTM A 234 Gr. WPB (Charpy)	BUTT EWLD-ASME B 162. 5
		4”to12”	BW	M	ASMEB16.9.	MSSP75PW4HY2 (For pipeline)/ ASTM A 234 Gr. WPB (Charpy) (For Station Piping)	BUTTWELD-ASME B 16.25
PIPE NIPPLE	NIPL	1/2"–1½"	PE -SEAMLESS	M	ASME B36.10 A10	ASTM A 106 Gr B -	
COUPLING (FULL or HALF)	COUP	1/2"–1½"	SW or TRHEAEDD	3000#	ASME B16.11	ASTM A105	SOCEKTWELD-ASMEB 161. 1 THREADED-ASME B12. 0.1
FLANGE	FW	1/2”to1 1/2”	SORF,125-250 AARH	300#	ASME B16.5.	ASTM A105	-
		2”-3”	WNRF,125-250 AARH	300# BevelEnd WT Sch8. 0	ASME B16.5.	ASTM A105(Charpy)	-
		4”to12”	WNRF,125-250 AARH	300# BevelEndWTM	ASME B16.5.	MSSSP44GRF42 (For pipeline)/ ASTM A 105(Charpy) (For station piping)	-
BLIND FLANGE	FB	1/2”to11/2”	RF,125 -250 AARH	300#	ASME B16.5.	ASTMA105	-
		2”-3”	RF,125 -250 AARH	300#	ASME B16.5.	ASTMA105 (Charpy)	-
		4”-12””	RF,125-250 AARH	300#	ASME B16.5.	MSSSP44Gr.F42 (For pipeline)/ ASTMA105 (Charpy) (For station piping)	-
SPECTACLE BLIND	FSB	2-12”	RF,125-250 AARH	300#	ASME B16.48	MSSSP44GrF. 42 (For pipeline)/ ASTMA 350rG.LF2 (For station piping)	-

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STUD&NUT/ BOLT	B	1/2" –12"	-	-	ASME B18.2	STUD:ASTM A 193Gr.7 NUT: ASTM A 194Gr.2H	HOT DIP GALVENIZED
GASKET SPIRAL WOUND	G	1/2" –12"	-	0.175 " THICKNESS	ASME B16.20	SPIRAL WOUND CNAF FILLER+INNER &OUTER RING SS316+CAF	COMPATIBLE WITH ASME B 16.5 FLANGES

NOTE:

1. M = THICKNESS TO MATCH PIPE WALL THICKNESS
2. THIS SPECIFICATIONS SHALL BE READ IN CONJUCTION WITH GENERAL NOTES AND DATA SHEETS & TECHNICAL SPECIFICATIONS OF AN INDIVIDUAL ITEM

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3"	S	S	T	T	T	T						
4"	S	S	S	S	T	T	T					
6"	S	S	S	S	W	T	T	T				
8"	S	S	S	S	W	W	T	T	T			
12"	S	S	S	S	W	W	W	T	T	T		
14"	S	S	S	S	W	W	W	T	T	T	T	
16"	S	S	S	S	W	W	W	T	T	T	T	T

LEGEND

T : EQUAL/REDUCING TEE
S : SOCKOLET
W : WWELDOLET

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ENGINEERING STANDARD

TECHNICAL NOTES FOR GASKETS, BOLTS & NUTS

ENG-STD-PI-DOC-TS-005

BGL/632/2024-25

0	31.10.16	First Issue				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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I. TECHNICAL NOTES FOR GASKETS

1.0 All gaskets shall conform to the codes/standards and specifications given in the requisition.Vendor shall strictly comply with MR / PR stipulations and no deviations shall be permitted.

2.0 Process of manufacture, dimensions and tolerances not specified in requisition shall be inaccordance with the requirements of the manufacturer's standards.

3.0 Test reports shall be supplied for all mandatory tests for gaskets as per the standards specified in the requisition.

4.0 Chemical composition and hardness of RTJ gaskets shall also be furnished in the form of test reportson samples.

5.0 For Spiral wound material following shall be furnished:

a. Manufacturer's test certificate for filler material and spiral material as per the relevant material specifications.

b. Manufacturer's test certificate for raw materials and tests for compressibility / seal- ability &recovery as per the relevant material specifications.

6.0 Filler material for spiral wound gaskets shall not have any color or dye.

7.0 All spiral wound gaskets shall be supplied with Outer ring. Material of the outer ring shall be CSunless otherwise specified in the MR.

8.0 Irrespective of size & rating, all spiral wound gaskets shall be supplied with inner ring.

9.0 Hardness of metallic RTJ gaskets shall not exceed the values specified below unless otherwise specified in MR:

Ring Gasket Material	**Maximum Hardness (BHN)**
Soft Iron	90
Carbon steel	120
5 Cr. ½ Mo	130
Type 304, 316, 321, 347	140
Type 304L, 316L	120

10.0 Face finish of metallic RTJ gaskets shall be 32 to 63 AARH.

11.0 Gaskets of different types and sizes shall be placed in separate shipping containers and eachcontainer clearly marked with the size, rating, material specification and item code.

12.0 All items shall be inspected and approved by OWNER/OWNER representative Inspector or any otheragency authorized by OWNER/ OWNER representative.

13.0 Any additional requirements specified in the requisition, shall be fully complied with.

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14.0 Non-metallic ring gaskets as per ASME B16.21 shall match flanges to ASME B16.5 up to 24"(except 22" size) and to ASME B16.47A above 24" unless specified otherwise. For 22" size, the matching flange standard shall be MSS-SP44 unless specified otherwise.

15.0 Spiral wound gasket as per ASME B16.20 shall match flanges to ASME B16.5 up to 24" (except 22" size) and to ASME B16.47A above 24" unless specifically mentioned otherwise. For 22" size, the matching flange standard shall be MSS-SP44 unless specified otherwise.

The following abbreviations have been used in the Material Requisition for Spiral WoundGaskets :

(I)	:	Inner Ring
(O)	:	Outer Ring
GRAFIL	:	Grafoil Filler

16.0 Gaskets for Raised Face flanges shall be spiral wound, RPTFE or non-asbestos filled with SS 316 spiral in accordance with ASME B16.20.

17.0 TESTING

17.1 Test report shall be supplied for all mandatory tests for gaskets as per codes and standards.

17.2 For spiral wound material following shall be furnished:

a) Manufacturer's test certificate for raw material and spiral material as per the relevant material specification.
b) Manufacturer's test certificate for raw material and tests for compressibility / seal ability & recoveryas per the relevant material specification.

Note: The certificates shall be valid only when approved / certified by **OWNER / TPI.** Only those fittings, which have been certified by **OWNER / TPI,** shall be dispatched from **Manufacturer's** works. All documents shall be in English language only.

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II. TECHNICAL NOTES FOR BOLTS & NUTS

1.0 The process of manufacture, heat treatment, chemical & mechanical requirements and marking forall stud bolts, m/c bolts, jack screws & nuts shall be in accordance with the codes/ standards andspecification given in the requisition. The applicable identification symbol in accordance with the material specification shall be stamped on each bolt and nut. Vendor shall strictly comply with MR/PR stipulations and no deviations shall be permitted.

2.0 Test reports shall be supplied for all mandatory tests as per the relevant material specifications.

3.0 Material test certificate shall also be furnished. (Heat Analysis, Product Analysis andMechanical Requirement)

4.0 All bolting shall be as per ANSI B 18.2.1 for studs. Machine bolts and jackscrews and ANSI B 18.2.2 for nuts.

5.0 Stud bolts shall be threaded full length with two heavy hexagonal nuts. Length tolerance shall bein accordance with the requirement as per ANSI B 16.5.

6.0 The nuts shall be double chamfered, semi-finished, heavy hexagonal type and shall be made by the hot forged process and stamped as per respective material specification.

7.0 Heads of jackscrews and m/c bolts shall be heavy hexagonal type. Jackscrew end shall be rounded.

8.0 Each size of studs & m/c bolts with nuts and jackscrews shall be supplied in separate containers marked with size and material specifications. 'CRYO' shall be marked additionally in case 'CRYO' is specified in the requisition.

9.0 All items shall be inspected and approved (stagewise) by OWNER'S REPRESENTATIVE/OWNER inspector or any other agency authorized by OWNER'S REPRESENTATIVE/ OWNER.

10.0 The heat treatment for stud bolts & nuts shall be as per code unless mentioned otherwise.

11.0 All austenitic stainless steel bolts, nuts, screws shall be supplied in solution annealed condition unless specified otherwise in the material specification.

12.0 Any additional requirements specified in the requisition shall be fully complied with.

13.0 Stud bolts, nuts & jackscrews shall be impact tested wherever specified in the material specification and also where the material specification is indicated as "CRYO". For" S.S. nutsand bolts minimum impact energy absorption shall be 27 Joules and test temperature shall be - 196°C unless mentioned otherwise. For other materials impact energy and test shall be as per respective code.

14.0 Bolts / nuts of material of construction A193 Gr B7 and A194 Gr. 2H shall be 100% hardness tested. Refer QAP attached elsewhere in the bid document for more details.

15.0 When specified as galvanized, the studs, m/c bolts and nuts shall be 'hot dip zinc coated' in accordance with requirements of 'class C' of 'ASTM A 153'. As an alternative, electro- galvanizingas per IS 1573, 'Service Grade Number 2' is also acceptable.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR SEAMLESS FITTINGS & FLANGES

ENG-STD-PI-DOC-TS-006

BGL/632/2024-25

0	31.10.16	First Issue				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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1.0 SCOPE

This specification covers the minimum requirements for the design, manufacture and supply of following carbon steel flanges and fittings of size up to DN 250 mm (10" NB)to be installed in onshore pipeline systems handling non-sour hydrocarbons in gaseous phase.

- Flanges such as welding neck flanges, blind flanges, spectacle blinds,spacers and blinds etc.

- Seamless fittings such as tees, elbows, reducers, caps, outlets etc.

This specification does not cover the above-mentioned items, which are to be installed inpipeline handling sour hydrocarbon (liquid/gas) service as defined in NACE standard MR-0175-98.

2.0 CODES AND STANDARDS

Reference has been made in this specification to the latest edition (edition enforce at the time of issue of enquiry) of the following Codes, Standards and Specifications:

ASME B31.8	-	Gas Transmission and Distribution Piping Systems
ASME B 31.3	-	Process Piping
ASME B16.5	-	Pipe Flanges and Flanged Fittings
ASME B16.9	-	Factory Made Wrought Steel Butt Welding Fittings ASME
B 16.11	-	Forged Steel Fittings, Socket Welding and Threaded
ASME B 16.48	-	Steel Line Blanks
ASME Sec VIII	-	Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels
ASME Sec IX	-	Boiler and Pressure Vessel Code - Welding and Brazing Qualifications
ASTM A 370	-	Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
MSS-SP-25	-	Standard Marking System for Valves, Fittings, Flanges and Unions

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MSS-SP-44	-	Steel Pipeline Flanges
MSS-SP-75	-	Specification for High Test Wrought Welding Fittings MSS-
SP-97	-	Forged Carbon Steel Branch Outlet Fittings - Socket Welding, Threaded and Butt-welding Ends.
ASTM A 105	-	Carbon Steel Forgings for Piping Applications
ASTM A 234	-	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 420	-	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-TemperatureService
PNGRB T4S	-	T4S for City or Local Natural Gas Distribution Networks

In case of conflict between the requirements of this specification and the requirements of above referred Codes and Standards, the most stringent requirement shall govern.

3.0 MANUFACTURER'S QUALIFICATION

Manufacturer who intends bidding for fittings must possess the records of a successful proof test, in accordance with the provisions of ASME B16.9 / ASME B16.11 MSS-SP-75 as applicable.

4.0 MATERIAL

The Carbon Steel used in the manufacture of flanges and fittings shall be fully killed. Material for flanges and fittings shall comply with the material standard indicated inthe Purchase Requisition. In addition, the material shall also meet the requirements specified hereinafter.

Fittings Material shall comply with ASTM A 105, ASTM A 234, ASTM A350 LF2, ASTM A 420 WPL 6, ASTM A 694 F42/52/65, MSS SP 75 & MSS SP 97.

Each heat of steel used for the manufacture of flanges and fittings shall have Carbon Equivalent (CE) not greater than 0.45 calculated from check analysis in accordance with the following formula:

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$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

Carbon contents on check analysis shall not exceed 0.22%.

For flanges and fittings specified to be used for Gas service, Charpy V-notch test shall be conducted on each heat of steel. Unless specified otherwise, the Charpy V-notch test shall be conducted at -20° and -46 °C in accordance with the impact test provisions of ASTM A 370 for flanges and fittings.

The average absorbed impact energy values of three full-sized specimens shall be avg. 35 J and individual value shall not be less than 27J at -29° or as per the requirements of relevant material standard.

For flanges and fittings specified to be used for Gas service, Hardness test shall be carried out in accordance with ASTM A 370. Hardness test shall be performed as per quality assurance plan (QAP) enclosed elsewhere in the bid document. A full thickness cross section shall be taken for this purpose and the maximum hardness shall not exceed 248 HV_{10}.

Hardness testing shall be carried out by Manufacturer in accordance with applicable ASTMcode:

MOC	Max. Hardness
A105	187 BHN
A234, A 350 Gr. LF2, ASTM A420 WPL6/ASTM A694 F52	197HBW
MSS SP 75	MSS SP 75 - 235 BHN max

If hardness is not specified in standard with which MOC comply then hardness shall notexceed 248 HV10 based on minimum 4 measurements.

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5.0 DESIGN AND MANUFACTURE

Flanges such as weld neck flanges and blind flanges shall conform to the requirements of ASME B16.5 up to sizes NPS 24" excluding NPS 22".

Flanges manufactured from bar stock are not acceptable.

All welds shall be made by welders and welding procedures qualified in accordance with provisions of ASME Sec. IX. The procedure qualification shall include Charpy V-notch testfor weld/heat affected zone and hardness test.

Repair by welding on flanges and parent metal of Flanges is not permitted. Repair of weld seam by welding shall be carried out by welders and welding procedures duly qualified as per ASME Section IX and records for each repair shall be maintained.

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Repair welding procedure qualification shall include all tests, which are applicable for regular production welding procedure qualification.

All flanges shall be furnished in the heat treated condition. Hot formed flanges shall becooled below the lower critical temperature prior to heat treatment.

Fittings shall be made by forging, hammering, pressing, piercing, rolling, extruding, upsetting, welding, or by a combination of these operations. The forming procedure shall be so applied that it will not produce injurious defects.

Fittings not covered in ASME B16.5, 16.9 and 16.11 like weld-o-lets, sock-o-lets etc. shall be manufactured in accordance with MSS SP 97 and in accordance with Manufacturer's recommendation

Fittings such as tees, elbows, reducers, etc. shall be seamless type and shall conformto ASME B16.9 for sizes DN 50 mm (2") and above ASME B16.11 for sizes below NPS 2".

Spectacle blind and spacer & blind shall conform to the requirements of ASME B16.48.

Fittings such as weldolets, sockolets, nippolets, etc. shall be manufactured inaccordance with MSS-SP-97.

All butt weld ends shall be bevelled as per ASME B 16.5 / ASME B 16.9 / MSS-SP- 97as applicable.

Type, face and face finish of flanges shall be as specified.

Flanges and fittings manufactured from bar stock are not acceptable.

Repair by welding on flanges and fittings are not permitted.

Stub-in or pipe to pipe connection shall not be used in the manufacture of tees.

Tees shall be manufactured by forging or extrusion methods. Fittings shall not haveany circumferential joint.

6.0 INSPECTION AND TESTS

6.1 The Manufacturer shall perform all inspections and tests as per the requirement of quality assurance plan (enclosed elsewhere in the bid document), this specificationand the relevant codes, prior to shipment at his works. Such inspections and tests shall be, not but limited to the following :

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a) All flanges and fittings shall be visually inspected. The internal and external surfacesof the flanges and fittings shall be free from any strikes, gauges and other detrimental defects.

b) Dimensional checks shall be carried out on finished products as per ASME B16.5 for flanges, ASME B16.48 for spacers and blinds and ASME B16.9 / MSS-SP-97 as applicable for fittings and as per this specification.

c) Chemical composition and mechanical properties shall be checked as per relevant material standards and this specification, for each heat of steel used.

d) All finished wrought weld ends subject to welding in field, shall be 100% tested for lamination type defects by ultrasonic test. Any lamination shall not be acceptable irrespective of their size and length at bevel areas.

e) All other inspection shall be carried out as per quality assurance plan attached elsewhere in the bid as minimum.

6.2 Purchaser's Inspector reserves the right to perform stage wise inspection and witness tests, as indicated in clause 6.1 of this specification at Manufacturer's Works prior to shipment. Manufacturer shall give reasonable notice' of time and shall provide, without charge, reasonable access and facilities required for inspection, to the Purchaser's Inspector.

Note: NDE inspector & procedures shall be qualified in accordance with ASME Sec. VArticle 5. The evidence of such records shall be furnished by Manufacturer to OWNER TPI on request. Minimum qualification of NDE Inspector shall be ASNT Level-Icertification.

Inspection and tests performed / witnessed by Purchaser's Inspector shall in no wayrelieve the Manufacturer's obligation to perform the required inspection and tests.

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7.0 TEST CERTIFICATES

Manufacturer shall furnish the following certificates:

a) Test certificates relevant to the chemical analysis and mechanical properties of the materials used for manufacture of flanges and fittings as per relevant standards and this specification.

b) Test Reports on non destructive testing.

c) Certificates for each fitting stating that it is capable of withstanding without leakage a test pressure, which results in a hoop stress equivalent to 100 % of thespecified minimum yield strength for the pipe with which the fitting is to be attached without impairment of serviceability.

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8.0 PAINTING, MARKING AND SHIPMENT

After all inspection and tests required have been carried out; all external surfaces shall be thoroughly cleaned to remove grease, dust and rust and shall be applied with standard mill coating for protection against corrosion during transit and storage. The coating shall be easily removable in the field.

Ends of all fittings and weld neck flanges shall be suitably protected to avoid any damage during transit. Metallic or high impact plastic bevel protectors shall be provided for fittings and flanges. Flange face shall be suitably protected to avoid any damage during transit.

All flanges and fittings shall be marked as per applicable dimension / manufacturing standard.

Ends of all fittings shall be suitably protected to avoid any damage during transit. Metallic bevel protectors shall be used for fittings and each item shall be marked with indelible paint with the following data:

1) Manufacturer name / trademark
2) Material specification
3) Size and schedule/wall thickness
4) Heat Number

Package shall be marked legibly with suitable marking ink to indicate the following:

1) Order Number
2) Package number
3) Manufacturer's Name/trademark
4) Type of fitting
5) Size and wall Thickness/schedule

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9.0 DOCUMENTATION

Documentation to be submitted by Manufacturer to Company is summarized below. Number of Copies (Hard copies / soft copies etc.) shall be as indicated in CONTRACT document / Material Requisition.

At the time of bidding, Manufacturer shall submit the following documents:

a) Reference list of previous supplies of similar fittings of similar specification.
b) Clause wise list of deviations from this specification, if any.
c) Brief description of the manufacturing and quality control facilities at Manufacturer's works.
d) Manufacturer's qualification requirement as per clause 3.0 of this specification.

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e) Quality Assurance Plan (QAP) enclosed with this tender duly signed, stamped and accepted.

Prior to shipment, the Manufacturer shall submit test certificates as listed in clause 7.0 ofthis specification.

All documents shall be in English Language only.

10.0 WARRANTY

10.1 Warranty Type

Manufacturer shall give warranty stating that the fittings comply with the requirements stated in this specification and the other relevant standard & codes. Manufacturer is bound to replace or repair all fittings, which are found defective due to inadequate engineering or to the quality of materials and machining or any other reasons at no extra cost to OWNER.

If fittings defects cannot be eliminated, Manufacturer shall replace the same without any delay.

Manufacturer will reimburse OWNER for any fitting furnished on the order that fails under field hydrostatic test if such failure is caused by a defect in the fitting, which is outside the acceptance limits of this specification. The reimbursement cost shall include fitting, labor and equipment rental for finding, excavation, cutting out, and installation of replaced fitting in position. The field hydrostatic pressure will not exceed that value which will cause a calculated hoop stress equivalent to 100% of SMYS for the pipe with which the fitting is to be attached without impairing its serviceability.

10.2 Warranty validity

The above warranty shall be valid for any defect occurring during the first year of operation, butnot later than 24 months from the date of shipment from Manufacturer's works. All expenses shall be to Manufacturer's account.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR PAINTING

ENG-STD-PI-DOC-TS-008

BGL/632/2024-25

0	31.10.16	First Issue				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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1.0 SCOPE

1.1 This specification defines the requirements for surface preparation, selection and application of primers and paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, etc. The items listed in the heading of tables of paint systems is indicative only, however, the contractor is fully responsible for carrying out all the necessary painting, coating as per the tender requirement.

1.2 Extent of Work

1.2.1 The following surfaces and materials shall require shop, pre-erection and field painting:

a. All uninsulated C.S. & A.S. equipment like columns, vessels, drums, storage tanks(both external & internal surfaces), heat exchangers, pumps, compressors, electrical panels and motors etc.

b. All uninsulated carbon and low alloy piping, fittings and valves (including painting ofidentification marks), furnace ducts and stacks.

c. All items contained in a package unit as necessary.

d. All structural steel work, pipe, structural steel supports, walkways, handrails, ladders,platforms etc.

e. Flare lines, external surfaces of MS chimney with or without refractory lining and internalsurfaces of MS chimney without refractory lining.

f. Identification colour bands on all piping as required including insulated aluminum clad, galvanized, SS and nonferrous piping.

g. Identification lettering/numbering on all painted surfaces of equipment/piping insulated aluminum clad, galvanized, SS and non-ferrous piping.

h. Marking / identification signs on painted surfaces of equipment/piping includinghazardous service.

i. Supply of all primers, paints and all other materials required for painting

j. Over insulation surface of equipment's and pipes wherever required.

k. Painting under insulation for carbon steel, alloy steel and stainless steel as specified.

l. Painting of pre-erection/fabrication and Shop primer.

m. Repair work of damaged pre-erection/fabrication and shop primer and weld joints in the field/site before and after erection as required.

n. All CS Piping, equipment's , storage tanks and internal surfaces of RCC tanks in ETP plant.

1.2.2 The following surfaces and materials shall not require painting in general. However, if there is any specific requirement by the owner, the same shall be painted as per the relevant specifications:

a. Un insulated austenitic stainless steel.

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b. Plastic and/or plastic coated materials
c. Non-ferrous materials like aluminum.

1.2.3 Documents

1.2.3.1 The contractor shall perform the work in accordance with the following documents issued to him for execution of work.

a. Bill of quantities for piping, equipment, machinery and structures etc.
b. Piping Line List.
e. Painting specifications including special civil defence requirements.

1.2.4 Unless otherwise instructed, final painting on pre-erection/ shop primed pipes and equipment's shall be painted in the field, only after the mechanical completion, testing on systems are completed as well as after completion of steam purging wherever required.

1.2.5 Changes and deviations required for any specific job due to clients requirement or otherwiseshall be referred to Consultant/ Owner for deviation permit.

2.0 CODES & STANDARDS

Without prejudice to the specifications of the contract, the following codes and standardsshall be followed for the work covered by this contract.

IS: 5	Colors for ready mixed paints and enamels.
IS: 101	Methods of test for ready mixed paints and enamels,IS:
161	Heat resistant paints.
IS: 2074	Specifications for ready mixed paint, red oxide zinc chrome priming.IS:
2339	Aluminum paint for general purposes in dual container.
IS: 2379	Color code for identification of pipelines.
IS: 2932	Specification for enamel, synthetic, exterior (a) undercoating. (b) Finishing.

3.0 CONDITIONS OF DELIVERY

Packaging
Every recipient will be fitted with a hermetically-sealed lid with an opening that is sufficientlylarge to allow the contents to be stirred: the outside and inside are protected against oxidation, and,the lid, are marked with a strip of color identical to the contents.

4.0 COMPOSITION OF THE PAINT PRODUCTS USED

a) Quality

The composition and quality of the products may not differ from batch to batch. A batch is all of the products of a specified manufacture. If the analyses of products bring to light that the composition does not conform to the specifications of the paint manufacturer, the OWNER may refuse to use this batch of products. The paint products must comply with the following

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conditions

- They must have the viscosity necessary for the described use and the established condition: use of the brush - paint roller (spray gun only for special cases and in the workshop)

b) Quality control - Sampling

While the works are in progress on the construction site, the OWNER may carry out sampling on the paint being used for the purpose of checking conformity. The paint products must be made available free of charge to the laboratory or the approved supervisory body in sufficient quantities so that all the tests can be carried out on thesame batch.

If analyses reveal a non-conformity in the composition of the products used, the OWNER may refuse application of the product under consideration, halt the work and have the nonconforming product already applied removed.

Before proceeding with the work, a product data sheet with its test certificates & batch certificate stating that products offered conform to the required specification, are to be submitted for owner/ consultant's approval. The only Purpose of the analysis is to find out any non-conformity of the composition of the products. Their purpose is therefore not to assess the quality of the different components. The analysis concerned are not acceptance tests of the products supplied and in no way affect the obligations of the Contractor towards the OWNER.

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5.0 IDENTIFICATION

Every recipient will bear the following information:

- Name of the manufacturer
- Date and number of manufacture
- Name of the product type
- Batch no
- Net weight of the produced or the contents of the recipient
- Date of the expiry.

At the time of delivery, packaging must bear labels in conformity with the legal stipulations inforce.

Leaving the site after work

After completion of a job, a general clean-up shall be carried out by the Contractor to remove all debris, materials or irregularities that his work has brought to the site so that it is left tidy.

The restoration work includes:

- the removal of abrasives.

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- the removal of the different protective coverings.
- the Contractor will make the required repairs to any damage after refitting thesupports.
- the removal of paint and cleaning of the stains on the floor.

6.0 SURFACE PREPARATION STANDARDS

Following standards shall be followed for surface preparations:

1 Swedish Standard Institution- SIS-05 5900-1967

2 Steel Structures Painting Council, U.S.A. (Surface Preparation Specifications(SSPC-SP)

3 British Standards Institution (Surface Finish of Blast-cleaned for Painting) BS-4232.

4 IS-1477-1971 (Part-1) - Code of Practice for Painting of Ferrous metals in Buildings.(Part 1, Pre-treatment)

a) The contractor shall arrange, at his own cost to keep a set of latest editionof above standards and codes at site.

b). The paint manufacturer's instruction shall be followed as far as practicableat all times. Particular attention shall be paid to the following:

- Proper storage to avoid exposure as well as extremes of temperature.
- Surface preparation prior to painting.
- Mixing and thinning.
- Application of paints and the recommended limit on time intervals between coats.

Any painting work (including surface preparation) on piping or equipment shall be commenced only after the system tests have been completed and clearance for taking up painting work is given by the OWNER, who may, however, at his discretion authorize in writing, the taking up of surface preparation or painting work in any specific location, even prior to completion of system test.

7.0 PREPARATION OF THE SURFACES

7.1 General Specifications

The cases that occur in practice on building sites, with regard to painted surfaces, can be broken down as follows:

- Material of which the oxide content disappears by natural oxidation.
- Material that has already been covered with a layer of paint in the workshop.
- Material that is covered with old paint layers that show different degrees ofweathering.

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Good surface preparation is the best guarantee for good anti-corrosion protection.

Paintwork may never begin until the surface to be treated is dry and is independent of the base coat and cleared of dirt, dust, rust, scale, grease, salt attack, cement powder, cement mud-scale, sand, oil, etc.

Based on the environmental conditions of coastal and saline nature, the Painting specification for station pipes defines the complete requirements like:

- Surface preparation standards like NACE etc.
- Sand blasting process
- Color Codes for piping
- Paint materials types and their DFT measurement.
- Selection and application of paints on external surfaces.

The pipeline passes through the coastal and marine environment, the **Table-4** of this specification to be followed for the painting works.

The method of preparation of the surface will be implemented in accordance with the preparation methods described below:

- Cleaning (bright blast-cleaning);
- Mechanical cleaning;
- Manual derusting.

The Contractor should have the required material at his disposal to clean the surfaces to be coated thoroughly in accordance with the preparation methods regardless of the form or the condition of such surfaces. The cleaning devices that might be damaged during the surface preparation shall be screened off by the Contractor.

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7.2 Sandblasting

Before beginning cleaning by blasting, the person carrying out the work will take the following measures:

- Clear the steel surface of oil and/or grease;
- Ensure that each flange collar (section where the sealing is applied) is properly screened off against the blasting and the subsequent works;
- Check that no blasting grains can act into the pipes during this process. Any openings not sealed off must be screened off;
- Where there are valves, regulators and other devices, the manufacturer's identification plate will be dismantled so that all surfaces can be treated. The plate will then be put back again.
- Screen off all non-metal structures such as rubber where there is a filter;
- With valves, operators and other devices, care should be taken to ensure that no metal filings or paint get into the apparatus:
- The OWNER reserves the right to carry out part or all of these works himself.

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To prevent rust forming quickly as the result of humidity on the blasted surface, cleaning by blasting may only be carried out when the temperature of the steel surface is at least 3°C higher than the dew-point of the ambient air.

Blasting may not be carried out if the relative degree of humidity exceeds 80%. The choiceof the type of blasting medium used depends on local circumstances such as the possible presence of gas and the material to be blasted.

The abrasive to be used must conform to the local low i.e. it may contain no carbon and lessthan 1% free silicon dioxide. The surface preparation must conform to the minimum standard set by SA 2½ before start of the any paintwork. The degree of cleanliness to be obtained will be inspected in accordance with the Swedish standard ISO 8501-1:2007

- SA 2½: blasted very carefully. Scale, rust and foreign bodies must be removed insuch a way that near white surface is achieved.

The blast-cleaning will be carried out by means of compressed air free of water and oil.

After the blasting and before painting, the surface should be completely cleaned of blasting material and so forth with a soft brush, a dry cloth or dry compressed air.

7.3 Mechanical cleaning

If sandblasting is not permitted or if the metal structures are not easily accessible for blasting or blasting for one reason or another is technically unfeasible, mechanical derustingcan be used instead, by prior approval from Owner / Consultant. With mechanical cleaning by means of chipping, rotating steel brushes and sanding discs, a degree of cleanliness St. 3 should be reached.

St 3 : removal of the old paint layers of which the adhesion leaves something to be desired and/or of which the paint layer no longer fulfils the requirements.

If parts are present that are so corroded that St 3 is difficult to achieve, this should be notified to the OWNER representative prior to the start of the works.

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N.B:

St. 3 : means removal of every old paint layer. Retouching means local polishing with St. 3or Sa 3 followed by application of the desired painting system.

After mechanical cleaning, the surface should be made dust-free with a cloth or a soft brush,washed with an organic solvent and thoroughly dried off with a dry cloth (e.g. with 1.1.1.) Trichoroethane such as Solvethane, Chloromethane).

7.4 Manual Derusting

Manual de-rusting with the aid of scrapers, steel brushes, sandpaper etc. shall only be permitted in exceptional cases for local repairs. Any deviation must be requested from the OWNER/ OWNER 's Representative.

With manual derusting, a surface preparation degree St 3 must be obtained. The length of the handles of the equipment used may not exceed 50 cm.

7.5 Preparation of a surface covered with a layer of paint in the workshop.

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This layer is in general applied by the manufacturer, for example, on valves, regulators etc. Layers of this kind will be checked for their proper adhesion in accordance with ASTM D 3359, method A (Standard Test Method for measuring adhesion by tape test). The adhesionshould be at least 4A.

If the paint layer shows less adhesion or is incompatible with the rest of the system it should be completely removed. If the paint layer is not removed, the Contractor accepts it in the state in which the coating is found and the guarantee remains in force. The adhesion does not have to be examined if system 63 has already been applied in the workshop on behalf ofthe OWNER.

The Contractor, who must provide for the protection on the construction site, must therefore obtain the information regarding the treatment of the surface and the quality of the paint that was used and must, moreover, examine the adhesion of the layer on the construction site, the percentage of damage and weathering as well as the value of the preparation of the surface in the workshop together with the thickness thereof that must be supplemented if necessary.

a) Galvanized surface

Galvanized surfaces, both old and new will be carefully roughened up. Every foreign body (concrete splatters, chalk marks, grease and oil stains, etc.) will be removed. Thereafter, rub the surfaces with abundant water and, if necessary, with cleaningproducts.

To this end, nylon brushes will be used for every kind of dirt as well as for removing zincsalt residue. Thereafter, the surfaces will be treated in accordance with system 21. Where the zinc layer is lacking, it will be derusted manually to a degree of cleanliness St3, after which a primer coat will be applied in accordance with system 22.

b) Metallised surfaces treated with an impregnation layer

- degrease with the desired degreasing product:
- clean under high pressure or with a product prescribed by the paint supplier.

If the paint layer adheres well and is applied on a clean base, the painting system described may be continued. If the percentage of damage and weathering does not exceed 5 % per m.retouching may be considered. These partial repairs will be carried out.

If on the other hand, the percentage of damage does exceed 5 % per m or if the layer applied in the workshop comes loose the Contractor must draw the attention of the OWNER to this and carry out the complete application system.

7.6 Preparation of surfaces covered with earlier paint layers that show different degrees of weathering.

If the surfaces do not show deep weathering limited to the spread of rust by small pitted areas or non-penetrative rust in spots, it will very often be sufficient to clean the surfaces with abrasives or with an abrasive disc, then to rub them down with steel wool, remove the dust and wash off. If thick rust appears, in spots, scale rust and active rust canker, this should be removed with needle hammers or stripped away directly by blasting, removing thedust and washing oft.

7.7 Preparation of concrete or cement plaster surfaces

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Remove unsound paint layers and loose components with scrapers, blades or rotating steel brushes. Thoroughly clean the entire surface with water containing ammonia. Thoroughly remove moss, algae and fungal growths. Where these growths have been removed, treatthe area with a fungicide in accordance with the instructions for use.

Once the entire area is completely dry, brush off the dead residue of moss, algae and fungus with a hard brush. In the case of reinforcement steel that has been laid bare, removeas rust, dust and grease as possible and treat with a printer coat. When painting concrete surfaces, they must first be checked for cracks. Cracks larger than 0.3 mm must be repairedwith an appropriate system in accordance with the type and extent of the repairs (e.g. injection with epoxy mortar). Repair damage such as cracks and bursts to concrete parts with a two-component mortar or preferably with micro-mortars. Finally check the alkalinity of the surface with the aid of litmus paper and neutralize it if necessary.

7.8 Use of solvents

It is sometimes necessary to use solvents when the surfaces to be painted are streaked withgrease or oil. In this case a suitable organic solvent should be applied. The operation shouldbe carried out with the aid of clean brushes or rags and clean solvent.

All the legal specifications in connection with solvents etc. must be adhered to. The OWNER/OWNER's Representative will be informed in advance of any toxicity or flammability. All measures must be taken to prevent any risk of fire and to nick out any possibility of poisoning (ventilation). The Contractor will provide drip collectors to keep the environment free of pollution.

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7.9 Condition of the metal after stripping

The Contractor must call in a representative of the OWNER/OWNER's representative or of the Approved supervisory Body responsible for checking the condition of the metal during stripping and informing the OWNER/OWNER's representative immediately of any damage that he might have noticed.

- Deep corrosion of the plates - rivets - bolts
- Faulty welding
- Fittings that appear to be dangerous because of their age.

7.10 Removing coating from surface pipelines

The Contractor must have the equipment necessary for the removal of asphalt from the pipewithout damaging the latter (scratching, impact, etc,). The Contractor undertakes to carryout the work in accordance with an approved procedure.

8.0 CARRYING OUT THE PAINTWORK

8.1 Conditions for carrying out paintwork

Painting may not be carried out in unsuitable conditions.

All preparatory work and painting may only he carried out in dry weather and at a minimum temperature of 10□C, except for special cases requested by the OWNER's Representative.

Unless otherwise stipulated in the specifications of the paint supplier, application of the paintis forbidden if it is forecast that the temperature will fall to below 0□C before the paint is dry.

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The temperature of-the surface to be painted must be at least 3°C higher than the dew pointof the ambient air. Application of the paint is also not permitted if there is a danger that the coat of paint will not be dry before dew or condensation sets in.

The work must be stopped:

- If the temperature of the surface to be painted is higher than that described by thesupplier.
- In rain, snow, mist or fog or when the relative humidity is higher than 80 %.

Coats that have not yet dried and have been exposed to frost, mist, snow or rain and might thereby be damaged must be removed after drying and the surfaces must be repainted at the expense of the Contractor.

Working in direct sunlight or in hot weather must be avoided,

The first coat of paint must be applied maximum 3 hours after the preparation of the surface of the relative humidity of the air is between 50% and 80%. This time span may be increased to 6 hours if the relative humidity is less than 50%. In all cases, the preparation of the surface must exhibit degree Sa 3 and at the very least the appearance of degree Sa 2 ½at the time of painting.

The coats of paint may only be applied on carefully cleaned surfaces that must be dry and free of grease and dust.

8.2 Special conditions

Painting may be carried out when the Contractor can be sure that the instructions of the paint supplier have been scrupulously followed with regard to the parameters in the following (non-exhaustive) list:

- Ambient temperature.
- Surface temperature.
- Relative humidity.
- Dew point.
- Drying times.

The Contractor must in this respect be able to produce the instructions for the paint on the site. The OWNER/CONSULTANT will guarantee 100% supervision in this regard during the execution of the work.

In addition, the paintwork may only be carried out to a minimum ambient temperature of 5°Cand/or to a maximum relative degree of humidity of 80 %. Application of the paint is also not permitted if there is a danger that the coat of paint will not be dry before dew or condensation sets in.

8.3 Paint Materials

Manufacturers shall furnish the characteristics of all paints indicating the suitability for the required service conditions. Primer and finish coats shall be of class-I quality and shall conform to the following:

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a) Primer (P-1)

Red oxide Zinc Chromate Primer

Type and Composition	Single pack, Modified phenolic alkyd medium pigmented with red oxide and zinc chromate.
Volume solids	30 - 35%
DFT	25 microns/coat (min)
Covering capacity	12-13 m²/Lit/coat

b) Primer (P-2)

High build chlorinated rubber zinc phosphate primer

Type and Composition	Single pack, Chlorinated rubber medium Plasticised with unsaponifiable plasticiser pigmented with zincphosphate
Volume solids	35- 40%
DFT	50 MICRONS/COAT (MIT)
Covering capacity	7-8 m²/Lit/Coat

c) Primer (P-3)

High build zinc phosphate primer

Type and Composition	Single Pack, Synthetic medium, pigmented with zinc phosphate.
Volume solids	40-45%
DFT	35-50 microns/coat
Covering capacity	10-12 m²/Lit/coat
Heat resistance	Upto 100º C (dry)

d) Primer (P-4)

Etch Primer / Wash Primer

Type and Composition	Two pack Poly vinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxychromate.
Volume solids	7-8%
DFT	8-10 microns/coat
Covering capacity	7-8 m²/lit/coat

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e) Primer (P-5)

Epoxy Zinc Chromate Primer

Type and Composition	Two pack, Polyamide cured epoxy resin medium pigmented with zinc chromate.
Volume solids	40%(min)
DFT	35 microns/coat (min)
Covering capacity	11-12 m^2/lit/Coat

f) Primer (P-6)

Epoxy Zinc Phosphate Primer

Type and Composition	Two pack, Polyamide cured Epoxy resin medium pigmented with zinc phosphate.
Volume solids	40% 35 microns / coat (min)
Covering capacity	11-12 m^2/lit/coat

g) Primer (P-7)

Epoxy high build M10 Paint (Intermediate Coat)

Type and composition	Two pack Poly Polyamide cured epoxy resin medium pigmented with micaceous iron oxide. Volume solids7-8%
Volume Solids	50%
DFT	100 microns/coat (min)
Covering capacity	5.0 m^2/lit/coat

h) Primer (P-8)

Epoxy Red Oxide zinc phosphate primer

Type and Composition	Two pack. Polyamine cured epoxy resin pigmented with Red oxide and Zinc phosphate.
Volume solids	42%
DFT	30 microns/coat (min)
Covering capacity	13-14 m^2/lit/coat

i) Primer (P-9)

Epoxy based tie coat (suitable for conventional alkyd based coating prior toapplication of

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acrylic polyurethane epoxy finishing coat)

Type and Composition	Two pack, Polyamide cured epoxy resin medium suitably pigmented.
Volume solids	50-60%
DFT	50 microns/coat (min)
Covering capacity	10-12 m²/Lit/Coat

j) Finish Coats (F-1)

Synthetic Enamel

Type and Composition	Single pack, Alkyd medium pigmented with superior quality water and weather resistant pigments
Volume solids	30-40%
DFT	20-25 microns/coat
Covering capacity	16-18 m²/lit/Coat

k) Finish coat (F-2)

Acrylic Polyurethane paint

Type and Composition	Two pack, Acrylic resin and iso-cyanate hardener suitably pigmented.
Volume Solids	40% (min)
DFT	30-40 microns / coat
Covering Capacity	10-12 m²/lit/ coat

l) Finish Coat (F-3)

Chlorinated Rubber Paint

Type and Composition	Single pack, Plasticised chlorinated rubber medium with chemical & weather resistant pigments.
Volume solids	30%
DFT	30 microns/coat (min)
Covering capacity	1 0.0 m² / lit /coat

m) Finish Coat (F-4)

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High build chlorinated rubber M10 paint.

Type and Composition	Single pack Chlorinated rubber based high build pigmented with micaceous iron oxide.
Volume solids	40-50%
DFT	65-75 microns/coat
Covering capacity	6.0-7.0 m² / lit / coat

n) Finish coat (F-5)

Chemical Resistant Phenolic based Enamel

Type and Composition	Single pack phenolic medium suitably pigmented.
Volume solids	35-40%
DFT	25 microns/ coat
Covering capacity	15.0 m² /lit/ coat

o) Finish Coat (F-6)

Epoxy High Building Coating

Type and Composition	Two pack. Polyamide cured epoxy resin medium suitably pigmented.
Volume solids	60-65%
DFT	100 microns/coat (min)
Covering capacity	6.0-6.5 m² / lit / coat

p) Finish Coat (F-7)

High build Coal Tar Epoxy

Type and Composition	Two pack, Polyamine cured epoxy resin blended with Coal Tar.
Volume solids	65% (min)
DFT	100-125 microns/coat
Covering capacity	6.0-6.5 m² / lit / coat

q) Finish Coat (F-8)

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Self-priming epoxy high build coating (complete rust control coating)

Type and Composition	Two packs. Polyamide-amine cured epoxy resin suitably pigmented. Capable of adhering to manuallyprepared surface and old coatings.
Volume solids	65-80%
DFT	125-150 microns/coat
Covering capacity	4-5 M² / lit / coat

r) Finish Coat (F-9)

Inorganic Zinc Silicate coating

Type and Composition	Two pack , Self cured Ethyl silicate solvent based Inorganic Zinc coating.
Volume solids	60% (min)
DFT	65-75 microns/coat
Covering capacity	8-9 M² / lit / coat

s) Finish coat (F-10)

High build Black

Type and Composition	Single pack. Reinforced bituminous composition phenol based resin.
Volume solids	55-60%
DFT	100 microns/coat (min)
Covering capacity	5.50-6.0 M ²/ lit / coat

t) Finish Coat (F-11)

Heat Resistant Aluminium Paint Suitable up to 250°C.

Type and Composition	Duel container (paste & medium). Heat resistant spec varnish medium combined with aluminium flakes.
Volume solids	20-25%
DFT	20 microns/coat (min)
Covering capacity	10-12 M² / lit/ coat

u) Finish Coat (F-12)

Heat Resistant Silicon Paint suitable up to 400º C.

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Type and Composition	Single pack Silicone resin based with aluminium flakes.
Volume solids	20-25%
DFT	20 microns/coat (min)
Covering capacity	10-12 M²/lit/coat

v) Finish Coat (F-13)

Synthetic Rubber Based Aluminium Paint Suitable up to 150□C.

Type and Composition	Single Pack, Synthetic medium rubber medium combined with leafing Aluminium,
DFT	25 microns/coat
Covering capacity	9.5 M² /lit/ coat

Notes

1 Covering capacity and DFT depends on method of application Covering capacity specified above is theoretical. Allowing the losses during application, min specified DFT should be maintained.

2. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation quality and workmanship should be ensured.

3. Selected chlorinated rubber paint should have resistance to corrosive atmosphere and suitable for marine environment,

4 All primers and finish coats should be cold cured and air-drying unless otherwise specified.

5. Technical data sheets for all paints shall be supplied at the time of submission of quotations.

6. In case of use of epoxy tie coat, manufacturer should demonstrate satisfactory testfor inter coat adhesion. In case of limited availability of epoxy tie coat (P-9) alternate system may be used taking into the service requirement of the system.

7. In case of F-6, F-9, F-1 1 & F-1 2 Finish Coats, No Primer are required.

MANUFACTURERS

The paints shall conform to the specifications given above and Class-I quality in theirproducts range of any of the-following manufacturers:

i) Asian Paints (India) Ltd,
ii) Bombay Paints
iii) Berger Paints India ltd.
iv) Gaodlass Nerolac Paints Ltd.

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v) Jenson & Nicholson
vi) Shalimar Paints

STORAGE

All paints and painting material shall be stored only in rooms to be provided by contractor and approved by OWNER/ OWNER 's Representative for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent, building.

A signboard bearing the words given below shall be clearly displayed outside:PAINT STORAGE No NAKED LIGHT highly -inflammable

COLOR CODE FOR PIPING:

i) For identification of pipelines, the color code as per Table -1 shall be used.
ii) The color code scheme is intended for identification of the individual group of the pipeline. The system of color coding consists of a ground color and color bands superimposed on it.
iii) Colors (Ground) as given in Table-2 shall be applied throughout the entire length of uninsulated pipes, on the metal cladding & on surfaces. Ground color coating of minimum 2m length or of adequate length not to he mistaken as color band shall be applied at places requiring color bands. Color bands shall be applied as per approved procedure.
V) Line coating shall meet DIN 30670 standard for external coating and API 5L RP – 2for internal coating.
VI) The thickness for the epoxy should be 180 microns, adhesive 200 microns andbalance should be PE
VII) The minimum coating thickness on weld seam shall be 3.2 mm and minimum coating thickness on body should be 3.2.
VIII) Minimum thickness for liquid epoxy for internal coating should be 100 ± 20 microns.Max design temperature for coating should be considered +80 ºC

COLOR CODE:

a) Ball Valve (Above Ground) : Off White
b) Globe Valve (Above Ground) : Oxford Blue-RAL 5005, IS-519941005
c) Check Valve(Above Ground) : Oxford Blue-RAL 5005, IS-519941005
d) Launcher / Receiver : Yellow Golden
e) Jib Crane / Trolley : Yellow Golden
f) All underground valves shall have epoxy base coating after surface finish of SA 2.5
g) Valves and above ground pipes need to be properly blasted to achieve surface finishof Sa 2.5 before the application of paints.

IDENTIFICATION SIGN

i) Colors of arrows shall be black or white and in contrast to the color on which they are superimposed.

ii) Product names shall be marked at pump inlet, outlet and battery limit in a suitablesize as approved by OWNER.

iii) Size of arrow shall be either of the following:

a) Color Bands

Minimum width of color band shall be as per approved procedure.

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b) Whenever it is required by the OWNER to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal stripes of black and golden, yellowas per IS:2379 shall be painted on the ground color.

IDENTIFICATION OF EQUIPMENT

All equipment shall be stenciled in black or white on each vessels, column, equipment, painting as per approved procedure.

INSPECTION AND TESTING

1. All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates Paintformulations without certificates are not acceptable.

2. The painting work shall be subject to inspection by OWNER/ OWNER's Representative at all times. In particular, following stage wise inspection will be performed and contractor shall offer the work for inspection and approval at every stage before proceeding with the next stage.

In addition to above record should include type of shop primer already applied on equipment e.g. Red oxide zinc chromate or zinc chromate or Red lead primer etc.

Any defect noticed during the various stages of inspection shall be rectified by the contractorto the entire satisfaction of OWNER/ OWNER's Representative before proceeding further. Contractor shall be responsible for making good any defects found during finalinspection/guarantee period/defect liability period as defined in general condition of contract.Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to OWNER.

PRIMER APPLICATION

i. The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting, holiday detectors and pinhole detector and protector whenever required for checking in case of immerse conditions.

ii. At the discretion of OWNER/ OWNER's Representative, contractor has to providethe paint manufacturers expert technical service at site as and when required. For this service, there should not be any extra cost to the OWNER.

iii. Final Inspection shall include measurement of paint dry film thickness, check of finishand workmanship. The thickness should be measured at as many points/ locationsas decided by OWNER/ OWNER's Representative and shall be within +10% of the dry film thickness.

iv. The contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The OWNER shall have the right to test wet samples of paint at random for quality of same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.

PAINT SYSTEMS

The paint system should vary, with type of environment envisaged in and around the plants. The types of environment as given below are considered for selection of paint system. The paint system is also given for specific requirements.

a) Normal Industrial Environment, Table 2.

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b) Corrosive industrial Environment, Table3
c) Coastal & Marine Environment, Table 4

Notes 1. Primers and finish coats for any particular paint systems shall be from same manufacturer in order to ensure compatibility.

Table – 1

Colour Coding Scheme for Pipes and Equipment

Sl. No.	Content	Ground Color	First Color Band	Second Color Band
1	**COMPRESSED AIR**			
a)	Plant Air	Sky Blue	Silver Grey	-
b)	Instrument Air	Sky Blue	French Blue	-
2	*GASES*			
a)	Charge Gas	Canary Yellow	Signal Red	Smoke Grey
b)	Regeneration Gas	Canary Yellow	White	Dark Violet
c)	Residue Gas	Canary Yellow	White	French Blue
d)	LPG	Canary Yellow	Brilliant Green	White
e)	Acetylene	Canary Yellow	Dark violet	-
3	*ALL EQUIPMENT*			
a)	Such as vessels. columns, exchangers, etc. containing non-hazardous fluids.	Light Grey		
b)	All equipment containing hazardous fluids	Canary Yellow		
c)	Pipe carrying hazardous fluids	Bar is to be replaced by Hazardous Marking as per IS: 2379 Clause 7.1C		

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Table 2

Normal Industrial Environment (Above Ground)

Sl. No.	Description	Temp. Range	Surface Preparation	Primer	Finish Coat	Total DFT	Remarks
1.0	**External surface of equipment's and piping.**						
1.1	-Do-	-10 to 20	SSPC-SP-3	One coat P-250 microns / coat (min)	One coat F-4 65 microns/ coat (min) Two coats F-3, 30 Microns/coat (min)	175	Primer and Finish coat can be applied at ambient temp.
1.2	-Do-	21 to 60	SSPC-SP-6	Two coats P-1, 25 microns/ coat (min.)	Two coats of F-1, 20 microns/coat (min)	90	-
1.3	-Do-	61 to 80	SSPC-SP-6	Two coats P-3, 50 microns/ coat (min)	Two coats of F-13, 25 microns/coat (min)	150	-
1.4	-Do-	81 to 250	SSPC-SP-6	Covered in Finish coat	Three coatsof F-11, 20 microns/ coat (min)	60	Paint application at ambient temp. curing at elevated temp. during start-up.
1.5	-Do-	251 to 400	SSPC-SP-10	Covered in Finish coat.	Three coatsof F-12, 20 microns/ coat (min)	60	-do-

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Table- 3

Corrosive Industrial Environment (Above Ground)

Sl. No.	Description	Temp. Range	Surface preparation	Primer	Finish Coat	Total DFT	Remarks
1.0	**External surface of un-insulated and other equipment**						
I.1	- do -	-10 to 20	SSPC-SP-3	Two coat P-2, 50 microns) coat (min.)	Two coat F-3, 30 microns / coat (min.)	160	Primer and paint application at ambient temp.
1.2	- do -	21 to 80	SSPC-SP-10	Two coats P-5, 35 microns / coat (min.)	Two coats F-6, 100 microns coat (min.)	270	Paint application at ambient temp.
I.3	- do -	81 to 400	SSPC-SP-3	Covered in finish coat	Three coats F-12, 20 Microns / coat (min.)	60	Paint application. at ambient temp, and curing at 250'C for 4 hours,

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Table – 4

Coastal and Marine Environment (Above Ground)

Sl. No.	Description	Temp. Range	Surface Preparation	Primer	Finish Coat	Total DFT	Remarks
1.0	**External surface of equipment's and piping.**						
1.1	-do-	-10 to 60	SSPC-SP-3	Two coats P-2, 50 micron/ coat (min)	Two coats F-3, 30 Microns/coat (min.)	160	Primer and Finishcoat application at Ambient temp.
1.2	do -	61 to 80	SSPC-SP-10	Two coats P-5. 35 Microns. coat (Min.)	Two coats of F-6, 100 Microns/Coat (min.)	270	-do-
1.3	- do -	81 to 400	SSPC-SP-l0	One coat F-9, 83 Microns/ Coat(Min.)	-	85	Paint application at Ambient temp. Primer is acting as primer cum finish coat.
1.4	- do -	i) Upto 80	SSPC-SP-10	One coat F-9, 6.5 microns / coat (Min)	One coat of F-2. 30 Microns/coat (min.)	95	Paint application at ambient temp.
		ii) 8l to 400	SSPC-SP-10	-do-	-do-	85	Paint application at ambient temp. Primer is acting as primer cum finish coat.

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8.4 Precautions to be taken

Neither the environment of the site nor the marking labels of devices may be covered with paint and they must be kept free of paint splashes. To this end, it is advisable to use removable masking tape.

Paint splashes, leaks, etc. on any adjacent installations such as measuring apparatus, valves, pipes. sources of light, insulation, heat insulators, walls, concrete, etc, must immediately be wiped up and the damage repaired before the paint is dry.

Otherwise, the OWNER will be obliged to have the cleaning carried out at the expense of the Contractor. The paint recipient will only be opened at the time of use (unless otherwise specified by the manufacturer).

The product will be mixed in the recipient with the aid of suitable tools and thus homogenized.

8.5 Method of application

Normally, three methods of application will be used on the construction site for the paint products, i.e., with a brush, with a roller or with a spray gun.

- The brush method makes it possible to obtain good penetration of the paint over irregularities in the metal.
- Only this method will be used for application of the base coats, for retouching and for protrusions, welded areas, riveted joints or bolted joints:
- The roller method may be used on large flat surfaces for the intermediate and topcoats.
- The spray gun method must be used in accordance with the instructions of themanufacturer and carried out by qualified personnel.

The Contractor must guarantee that all safety measures have been taken for such work. The spray gun method may only he used on site for places that arc difficult to reach with the brush. In this case, a request must be made to the OWNER/ OWNER's Representative for adeviation.

All paintwork will be carried out with good brushes or rollers that are suitable for the type of paint being used and for the form of the material to be painted and fitted with short handles. The maximum length of the brush and roller handles will be 50 cm; longer handles may only be used for places that are absolutely inaccessible. The maximum width of a brush will be 13 cm.

8.6 Application of the coating

Application of the paint will be carried out in accordance with best practice in order to obtain a homogeneous and continuous layer. The OWNER or the Approved Supervisory body demands that painting of a layer will only be started after acceptance by them of the surface preparation or of the previous layer of paint.

The layers of paint must have a uniform thickness. They must he spread in such a way that all concave parts are dried out and that the surface is completely covered and has a glossy appearance without leaving brush marks and without exhibiting bubbles, foam, wrinkles, drips, craters, skins or gums that arise from weathered paint,

Each layer must have the color stipulated in the tables of the present specifications, which clearly differs from the previous layer, taking account of the Color of the top layer, all of which for the purpose of being able to identify the number of coats and their order of sequence. If the color of the coats is not mentioned in the tables the color difference in consecutive coats must, if possible, be at least 100 RAL.

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The color of the top layer is givenin the table.

The coating power should be such that the underlying layer is not visible. Only 1 layer per day may be applied, unless otherwise specified by the OWNER or the Approved Supervisory Body.

The drying times prescribed by the paint manufacturer must be strictly observed in relationto the environmental conditions before proceeding with the application of the next layer.

The dry coating thickness indicated in the description of the paint systems are minimum thickness. In this connection, the Contractor is obliged to contact the paint manufacturer and conform to his guidelines. The Contractor must respect the thickness specified by the supplier.

1.9.7 Transporting treated items

In the case of works being carried out in a workshop, the metal structures will be surroundedby ventilated contraction film that prevents damage during transportation. This film may only be applied after complete polymerization of the paint.

1.10 GROUND-LEVEL TRANSITION POINT

1.11 Polyester protection system

The Contractor will provide system 02 over the entire length of the pipes above ground and below ground and up to a height of 20 cm and a depth of 40 cm perpendicular to the ground level mark. In each case, he must ensure that the jointing below the asphalt is in good condition and assures' faultless adhesion. He will apply the following products over theentire surface area, prepared in accordance with is Sa 3:

1) The primer of system 01.

2) Reinforced polyester ± 20 cm above the ground level marker and ± 5 cm on the asphalt cleaned beforehand (application of reinforced polyester is carried out in accordance with the work method prescribed by the manufacturer). Moreover, in the case of PE, in contrast to asphalt, he will apply a polygon primer to PE immediately before applying the reinforced polyester.

3) He will then apply the other coats of system 01a to the surface section and thus cover the reinforced polyester with about 5 cm.

4) For new constructions, the polygon primer will be applied to PE and then subsequently processed as described under point 2.

1.11.1 USE OF SCAFFOLDING

Mounting, maintenance and dismantling of scaffolding for carrying out adaptation and/or paintwork to surface gas pipes or gas transport installations in use;

- The Contractor will specify the cost of scaffolding in the price list.
- The supplementary rental price for delays attributable to the Contractor will be chargedto him:
- In his price quotation the Contractor should present the OWNER with diagrams of the scaffolding that he intends to install for carrying out the works of the OWNER.

1.12 QUALITY CONTROLS AND GUARANTEE

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1.12.1 The Contractor is responsible for checking the weather conditions to ascertain whether the paintwork can be carried out within the technical specifications.

The Contractor should have the required calibrated monitoring apparatus for this purpose onsite (with calibration certificates). The personnel who will have to use this apparatus should have the training for this purpose.

The OWNER or his representative and possibly the approved supervisory body indicated by the OWNER will maintain supervision during the works and inspect the works with random checks. A daily report will be drawn up in relation to the department that maintains supervision of these works.

The supplementary inspection and the supervision by the OWNER or the approved supervisory body do not diminish in any way the liability of the Contractor. The proper execution of the work and the materials used may be checked at any time.

1.12.2 Reference Surfaces

At the start of the works. the OWNER or the approved supervisory body will indicate a few surfaces that the Contractor will prepare and cover in accordance with the recognized method of operation under the inspection and to the satisfaction of all parties ; the OWNER or his representative, the approved supervisory body. the contractor and possibly the paint manufacturer. These reference surfaces will serve as a point of comparison for the good adhesion of the paint on the installations as a whole. The parties will together work out a system for the identification of these surfaces in order to be able to monitor the conditions ofthe coatings over time. If the paintwork on a section of the installations is in a worse condition than the reference surfaces, the Contractor may be obliged to treat these parts again.

1.12.3 Measures to be taken in the event of a dispute

If on delivery of the works no agreement can be reached between the Contractor and the OWNER regarding the conformity of the works to the requirements of these specifications, an Approved Supervisory Body will he Called in. The Approved Supervisory Body will then carry out inspections' on site whereby the following assessment criteria wilt be used:

- The Swedish standards ISO 8501-1:2007 SS 05.5900 concerning the degree of cleanliness of the areas derusted by blasting, by machine or by hand.
- The wet film thickness of the paint will be measured in accordance with ISO 2808 orASTM DI 212;
- The dry layer thickness of the film will be measured electronically, will completestatistical information. in accordance will, ISO 2808 or ASTM D 1186.
- The thickness of each layer will he measured in accordance with ISO 2808. ASTM4138 or DIN 50986.
- Adhesion tests will be carried out in accordance with ISO 2409. ASTM 3359 or DIN53151.
- Traction tests will he carried out in conformity with ISO 4624 or ASTM D 4541.
- The rugosity will be measured electronically in accordance with DIN 4768;
- The non-porosity will be measured with a test tension depending on the type of coating, the layer thickness and after consultation with the Paint manufacturer.
- Any defects in the paint film may be inspected visually by means of a magnifying glass or

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microscope. If necessary a photographic report may be drawn up in accordance with ASTM Standard D 4121-82,

The final judgement of the Approved Supervisory Body is irrevocable and binding for the Contractor and the OWNER. In the event of non-conformity of the works with the criteria of these specifications, all costs arising from the inspection by the Approved Supervisory Body shall be borne by the Contractor.

1.12.4 Guarantee

a) General Principles

The Contractor declares that he is aware of:

- The maximum operating temperature of the surfaces to be covered.
- The maximum permitted degree of humidity of the bearing surface.
- The properties of the environment to which the surfaces to be covered are: subject.

b) Summary of the Guarantee.

The contractor fully guarantees the following without reservation:

- The observance of all stipulations of the specifications for paintwork regarding, among other things:
  - The preparation of the surfaces.
  - The thickness of each layer.
  - The total thickness of the covering.
- The uniformity of the materials used.
- The repair of all defects before delivery of the works.

The Contractor will carry out the requested repair work as promptly as possible.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR WELDING OF STATION PIPING

ENG-STD-PI-DOC-TS-009

BGL/632/2024-25

0	31.10.16	First Issue				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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1.0 SCOPE

This specification covers general requirements for welding of all types of station piping works. The specification covers the scope of work, basis of work, standards, specifications and normal practice to be followed by the contractor during execution of station piping works.

No supplier, vendor, manufacturer or fabricator shall subcontract the welding fabrication of any item without written approval from the OWNER.

The CONTRACTOR shall be fully responsible for works completed by him.
The welded pipe joints shall include the following and shall not relieve the contractor of his responsibilities and guarantee.

a) All pipe joints, longitudinal butt welds, circumferential butt welds and socket welds.

b) Attachments of forging, flanges and other supports to pipes.

c) Welded manifold headers and other sub assemblies.

d) Welded branch connections with or without reinforcing pads.

e) Joints in welded / fabricated piping components.

f) The attachments of smaller connection for vents drain drips and other instrument tapings.

2.0 CODES AND STANDARDS

The related standards referred to herein and mentioned below shall be of the latest editionsprior to the date of the purchaser's enquiry:

a) Indian codes and standards (OISD & PNGRB) augmented with the following:

1. AWS (American Welding Society).
   a. A2.4 (Symbols for Welding and Non destructive Testing).
   b. A3.0 (Standard Welding Terms and their Definitions).
   c. A5.1 (Specification for Mild Steel Covered Arc Welding Electrodes).
   d. A 5.17(Specification for Bare Carbon Steel Covered Electrodes).
   e. A 5.18 (Specification for Carbon Steel Filler Metals for Gas Shielded Arc Welding).
   f. A 5.20 (Specification for Mild Steel Electrodes for Flux Cored Arc Welding Electrodes).
2. Boilers and Pressure Vessels Act and Regulations.
3. ASME B 31.3 Chemical Plant and Petroleum Refinery and Process Piping.
4. ASME Sec. VIII Div. 1 - Pressure Vessels.
5. ASME Sec. IX – Welding and Brazing Specifications.

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6. ASME B31.8 - Gas Transmission and Distribution Systems.

7. ASME Sec V - Non-destructive examination.

8. API Std 1104 – Standard for Welding Pipelines and Related Facilities.

9. AWS D 1.1

10. PNGRB NOTIFICATION: Technical Standards and specifications including safety standardsfor city or local natural gas distribution Schedule-1 network

In case of conflict in the requirements of this specification and / or any of the above codes or standards, the requirement that is more stringent shall apply.

All welding procedures used by fabricators and CONTRACTORS shall have been established and qualified in accordance with the appropriate sections of one or more of the codes and standards listed above, and approved by the OWNER.

3.0 WELDING PROCEDURES

3.1 General

The CONTRACTOR shall submit welding procedures for review to the OWNER/ Owner's Representative.

The CONTRACTOR shall have a separate welding procedure for each method of welding heintends to employ during construction. A Procedure Qualification Record (PQR) shall be conducted and recorded for each WPS. The PQR shall be witnessed by the OWNER/ OWNER's representative, and shall be supported with destructive testing lab report from the testing laboratory.

All testing shall be performed and certified by OWNER approved testing laboratory, agency or equivalent. The written procedure must include the following details:

a. The scope of work performed under the procedures.

b. The base metals and applicable specifications.

c. The welding process.

d. Type, size, classification and composition of filler metals. (The specific brand name(s) of theflux-wire shall become an essential variable of the procedure qualification)

e. Type of current and voltage range Amperage

f. Width of electrode weave or oscillation

g. Joint preparation and cleaning procedures.

h. Tack welding procedures. Method of marking the location of tack welds to facilitate post weld inspection shall also be included

i. Electrode polarity.

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j. Applicable welding positions.

k. Preheat and inter pass temperatures. (Control method)

l. Welding travel speed.

m. Root preparation prior to welding from second side, (where applicable).

n. Removal methods for weld defects and stray arc strikes.

o. Inter pass-cleaning method.

p. Repair welding.

q. Post welding heat treatments (if required).

r. Shielding gas, and flow rates

s. Type of (GTAW) electrode, size and tip angle.

t. Welders qualified and deployed in production welds shall always bear an identity card in themanner so approved by OWNER/OWNER's representative.

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3.2 Consumables

The CONTRACTOR shall supply all the Owner/ Owner's Representative approved welding consumables necessary for the execution of the job such as electrodes, filler wires, argon etc. The cost of all such consumables shall be deemed to be inclusive in the rates of welding.

The welding electrodes and filler wires supplied by the contractor shall confirm to this specification and standard codes and shall be of the make approved by the OWNER/ OWNER's representative. The contractor shall submit all test certificates to the Engineer in Charge for review and approval.

The contractor shall submit batch test certificates from the electrodes manufacturers, giving details of physical and chemical tests carried out by them, for each batch of the electrodes tobe used.

The contractor shall conduct Electrode Qualification Tests (EQT) and record the parameters for each batch. The EQT shall be witnessed and the test reports shall be reviewed by the Owner/ OWNER's representative. No electrode shall be used without successful EQT of it's batch.

The electrodes, filler wires and flux used shall be free from rust, oil, grease, earth and other foreign matter, which affect the quality of the welding.

All coated metal arc-welding electrodes shall comply with the latest edition of AWS specification A 5.5 and A5.1 type unless approved otherwise by the OWNER.

All welding consumables, including fluxes shall be supplied in sealed containers and storedin a dry location at a minimum temperature of 68°F/ 20˚C and a maximum relative humidityof 60%. Low-hydrogen electrodes, after removal from factory sealed containers, shall be stored at a minimum temperature of 150°F/66˚C or as per manufacturer recommendations and suitably dried using a portable oven prior to every use.

The welding filler metals shall have a chemical composition as near as possible to the parent

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metals to be welded. The finished weld as deposited, or after post weld heat treatment (PWHT) when required, shall be at least equal to or greater than the parent metal in terms ofunit strength, ductility, and other physical properties and in resistance to corrosion, hydrogen attack, or other operating environment factors as required. Permission to change filler metalsto those other than the ones qualified in accordance with this specification must be obtained in writing, from the OWNER/ Owner's Representative.

Electrode and rod diameters shall conform to the parameters of the weld procedure specification.

The CONTRACTOR shall provide adequate drying ovens and take proper precautions in the storage and handling of low-hydrogen electrodes.

Electrodes and filler rods shall be protected from mechanical damage or deterioration. All unidentified damaged or deteriorated electrodes or filler wires shall be removed from the working area and rejected. Any low hydrogen type SMAW electrodes not contained in heated quivers shall be removed from the site. Electrodes shall not be exposed to wet or high humid conditions.

Care of welding consumables is the responsibility of the CONTRACTOR however, the following are minimum requirements:

Low-hydrogen SMAW electrodes shall be kept in commercial electrode ovens after the factory container has been opened. The electrode holding oven temperature shall be maintained between 175°F (79°C) and 250°F (121°C). Any low-hydrogen SMAW electrodes that have been exposed for more than 4 hours prior to restocking into the holding oven orany SMAW low-hydrogen electrodes that have become wet or have damaged coatings shall not be used and shall be immediately removed from site.

Other (non-low-hydrogen) SMAW electrodes shall be kept in a dry and dust-free enclosure after opening of the factory container. These non-low-hydrogen electrodes shall be held at a temperature below 150°F (66°C).

Bare wire and bare filler rod (GTAW) shall be stored in a dry and free from dust, grease etc.

3.3 Welding Process

Welding of various materials under this specification shall be carried out using one or more welding process as given below with the approval of the ENGINEER IN CHARGE.

- Shielded Metal Arc Welding Process (SMAW)
- Gas Tungsten Arc welding process (GTAW)

The CONTRACTOR shall have a separate welding procedure for each method of welding heintends to employ.

Automatic and semiautomatic welding processes shall be employed only with the express approval of the ENGINEER IN CHARGE. The welding procedure shall be adopted and consumables used shall be specifically approved.

A procedure qualification record (PQR) shall be included for each WPS. The PQT shall be witnessed by the OWNER/ OWNER's Representative or shall be supported with the lab report from the testing laboratory, if so previously agreed to by the OWNER.

A combination of different welding process could be employed for a particular joint only after duly qualifying the welding procedure to be adopted and obtaining the approval of ENGINEER IN CHARGE.
All testing shall be performed and certified by OWNER approved testing laboratory, agency or

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equivalent. The minimum acceptable written procedure shall detail information on the following parameters.

1. The scope of work performed under the procedures.
2. The base metals and applicable specifications.
3. The welding process.
4. Type, size, classification and composition of filler metals. (The specific brand name(s) ofthe flux-wire shall become an essential variable of the procedure qualification)
5. Type of current and voltage range As per range
6. Width of electrode weave or oscillation
7. Joint preparation and cleaning procedures.
8. Tack welding procedures. Method of marking the location of tack welds to facilitate postweld inspection shall also be included
9. Electrode polarity.
10. Applicable welding positions.
11. Preheat and inter pass temperatures. (Control method)
12. Welding travel speed.
13. Root preparation prior to welding from second side, (where applicable).
14. Removal methods for weld defects and stray arc strikes.
15. Inter pass-cleaning method.
16. Repair welding.
17. Post welding heat treatments (if required).
18. Shielding gas, and flow rates
19. Type of (GTAW) electrode, size and tip angle.
20. Welders qualified and deployed in production welds shall always bear an identity card inthe manner so approved by OWNER/OWNER's representative.

The CONTRACTOR shall only employ welders who have a valid welding certificate for the procedures being used.

The CONTRACTOR shall have all welders tested in accordance with the applicable code or standard. Testing shall be at the Contractor's expense including test pieces. Irrespective of pre qualification all welders proposed to be deployed in the work shall be tested and qualified afresh.

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No welder shall be allowed to make any weld for which he is not qualified.

Welding with larger-size electrodes for specific applications may be allowed only if each welder qualifies with the largest-size electrode to be used in production. This option is strictlyat the OWNER discretion. OWNER shall specify the details of the welder qualification tests.

For carbon steel, filler wire combinations shall be chosen such that the deposited hardnessof the cap pass shall not exceed 240 BHN. For low-temperature materials and other materials heat input shall be minimized and comply with the WIPS parameters.

The CONTRACTOR may propose alternate process in addition to those listed. Any proposed process shall require written OWNER approval and qualification prior to implementCONTRACTOR and OWNER shall agree on tests, results, and other criteria before OWNERapproval is granted.

All butt welds in pipe smaller than 60.3 mm O/D ("NPS 2" inch) Schedule 40 shall be made by GTAW, Root pass by gas metal arc is acceptable for pipe larger than 60.3 mm O/D (NP (2") inch).

Permanently installed backing rings shall not be used,

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All butt welds in pressure equipment shall have the same chemical and mechanical properties as the parent metal.

All welding procedures must be qualified for Charpy V impact testing when the Code requirements indicate that the parent material requires impact testing. When impact tests arerequired, tests shall be taken from the weld metal, fusion line, 2mm from fusion line, and 5mm from fusion line.

The electrodes shall be purchased from the list of approved manufacturer's and the same shall be supplied with proper certificates and batch certificates.

Extreme care shall be taken to ensure that electrode separation by classification is maintained in the CONTRACTOR's inventory. All storage bins and ovens for welding consumables shall be clearly labeled. In addition, all GTAW bare rod filler metals shall be tagged with the AWS designation of the filler metal. Any welding consumable that cannot be readily identified shall not be used for welding.

All pressure containing welds shall be of a minimum of two passes with overlap of starts and stops. This shall include socket welds and seal welds of threaded connections.

Weld stops and starts shall be staggered so that adjacent weld passes do not contain stops/ starts within 25mm (1 inch) of each other.

The width of weave during production welding shall be within the acceptable limit of the OWNER approved and qualified welding procedure, qualification certificates, and production welding operating sheets. As a norm this will be limited to a maximum of 3 times the core diameter of SMAW electrodes, whichever is less.

Each weld pass layer shall be completed in one full cycle/ circumference before proceeding with the next. Blocking out or segmental welding is not permitted.

All tools and equipment used in the welding operations shall be in first class operating condition and shall be of sufficient capacity to ensure welds of the specified quality are achieved throughout the work. It shall be the right of the OWNER to request at any times there-calibration of gauges and meters. etc. to ensure compliance with welding procedure- operating sheets/ WPS.

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3.4 Joint Preparation

The surface of the pipe at the weld area shall be free from dust, grease, scale, paint, grit or any other foreign material, which may adversely affect the final weld quality.

Bevels shall be 37½° and all field cuts shall be normal to the axis, of the pipe, Miter welds areprohibited.

All pipes shall be beveled for welding with an approved mechanical beveling machine.

Damage to bevels, which could possibly affect the quality of the weld, shall be repaired prior to welding. If repair cannot be done, the pipe shall be cut and the pipe end re-beveled. Lamination check by UT method shall be done prior to welding of gas cutting end pipe.

Where welding pipe both to a flange or another pipe or component, there must be a band of at least 25 mm (1 inch) wide around the internal / external joint weld preparation that is

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ground to bright metal, and is free of all foreign matter,

To assure proper spacing and alignment in accordance with the applicable Code, an approved lineup clamp shall be used.

All welds shall conform to the straightness and alignment specified herein. Correction of improperly fitted parts shall be accomplished by disassembly and refitting. Reworking by hammering or flame straightening shall not be permitted.

The ends of piping components to be joined shall be aligned as accurately as is practicable within existing commercial tolerance on diameters, wall thickness, and out of roundness. Maximum bore mismatch shall not exceed 1/16" inch (1.6 mm), Alignment shall be preserved during welding.

When joints of unequal thickness are joined, the joint preparation shall be as per ASME B 31.8.

Maximum bore mismatch shall not exceed 0.8mm (1/32 inch), Where ends are to be Joined and the internal misalignment due to difference in wall thickness, etc. exceeds 1.6 min (1/16 inch), the wall extending internally shall be internally trimmed. Internal machining shall be performed so that the inside diameters of the components coincide.

When cutting pipe to length, it should be cut by mechanical means. if practical. Ends that areto be connected to flanges, either in the shop or in the field, must be cut true and square.

3.5 Preheating

Preheat for pressure piping and furnace tubs shall be in accordance with ASME B31.3 and B31.8.

All pipe joints having a wall thickness greater than 9.5 mm (0.375") shall he preheated to 100°C prior to welding when the ambient temperature is less than 10°C (50 °F).

Preheating shall he carried out with an approved torch system or with electrical induction coils which will provide uniform heating.

The preheating area shall be at least 200 mm (8") wide centered about the weld and shall extend around the entire circumference of the pipe.

Preheat temperatures shall be checked with temperature sensitive crayons or by other approved methods.

If a joint requires preheating, the same temperature requirements shall be maintained for each succeeding pass,

3.6. Welding Details

3.6.1 All pressure welding shall be performed in accordance with approved and qualified welding procedures as required per code.

3.6.2 Each weld shall be uniform in width and size throughout its full length.

3.6.3 Each layer or welding shall be smooth and free of slag cracks, pinholes, undercuts (Internal and external), porosity and excessive bead shall be completely fused to the adjacent weld beads and base metal.

3.6.4 The cover pass shall be free of coarse ripples, irregular surface, non-uniform pattern, high

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crown, deep ridges or valleys undercut, arc strikes, porosity, undercut, slag, or shatter.

3.6.5 Butt welds shall be slightly convex, of uniform height, and have full penetration, unless otherwise approved.

3.6.6 For piping, limitations on weld reinforcement shall apply to the internal surfaces as well as to the external.

3.6.7 Fillet welds shall be of a specified size with full throat and the legs of uniform length.

3.6.8 Arcs shall only be struck in the weld groove. A controlled arc must be maintained while welding. Should an arc strike occur, it shall be removed by grinding and the area shall be etched (10% Nital) to confirm heat affected area removal, and MT examined to ensure absence of any surface cracking.

3.6.9 After each pass the layer of weld metal must be cleaned to remove all slag, scale dirt etc. wire brushes, grinder, or chipping hammer shall be used as needed to prepare proper surface for each succeeding weld pass.

3.6.10 Repair, chipping or grinding of welds shall be done in such a manner as not to gouge, groove or reduce the base metal thickness.

3.6.11 No welding shall be done if the temperature of the base metal is below 50°F. Nor shall there be any welding done if there is moisture, grease, or any foreign material on the joint to be welded.

3.6.12 A qualified welder shall make tack welds. Cracked lack welds shall be completely ground outand NDE by MT/PT prior to re-weld.

3.6.13 The CONTRACTORS shall make no substitution of materials or modifications to details without the prior written approval of the OWNER.

3.6.14 Welders and welding operators shall not be qualified on production welds.

3.6.15 The CONTRACTOR shall ensure that welders and welding operators are only employed onthose parts of the work for which they are qualified.

3.6.16 Each welder and welding operator shall possess an appropriate temperature-measuringdevice. All supervisors shall possess a copy of the approved welding procedures.

3.6.17 Alternatively, welding procedures may he clearly display at each welding location. Welders shall be familiar with the requirements of the appropriate approved welding procedures. Any welder found not complying with the approved welding procedures during production weldingshall be removed from the work and the non-conforming weld(s) may be completely rejected, at the discretion of the OWNER.

3.6.18 No welding should be undertaken without approved WPS.

3.6.19 The OWNER will not provide any WPS for the CONTRACTOR.

3.7 Welding Techniques

3.7.1 General

a) All welding shall be performed in accordance with an approved and qualified weldingprocedure.

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3.7.2 Cleaning

a) All weld impurities shall be removed between passes. Cleaning may be done with either handor power tools.

b) All rough irregularities in the cover pass and weld spatter shall be removed.

3.8 Weld Identification

Each finished weld shall be clearly marked to identify the portion made by each welder.

3.9 Defects and Repairs

Welds containing defects not exceeding an aggregate of five (5) percent of the length of the root bead may be removed by grinding, chipping or arc gouging and re-welded in accordance with an approved procedure. Welds containing defects exceeding that amount shall be cut out and replaced.

When defects are ground out the entire weld shall be preheated to a temperature of 150 °C(300 °F) prior to welding.

All repaired welds shall be radio graphed or by the same method of original defect detention.Repairing of Diameter Less than 2 inch is not allowed and the joint shall be cut and reweld.

3.10 Post Weld Heat Treatment (PWHT)

3.10.1 CONTRACTOR is responsible for all PWHT requirements. Which shall be performed as specified by the OWNER and in accordance with ANSI/ASME B31.3.
3.10.2 PWHT of pressure piping and furnace tubes shall be in accordance with ASME B31.3, B31.8 and the specification for Post Weld - Heat Treating.
3.10.3 Controlled atmosphere furnaces are preferred for heat treatment. Procedures using electric resistance, induction, or flame burner rings are acceptable for shop or field heat treatment. OWNER prior to heat treatment must approve these procedures.
3.10.4 CONTRACTOR must notify the OWNER prior to starting PWHT operations.
3.10.5 CONTRACTOR shall furnish a PWHT record chart. The chart must be dated, numbered and labeled with job identification. CONTRACTOR name and person Responsiblefor the PWHT. Heat-treated lane, welds and spool numbers shall be identified on the chart.
3.10.6 The completed PM/HT record chart shall be submitted for OWNER approval following completion of heat treatment.
3.10.7 Stress relieving of piping shall be performed as per ASME B31.3 ASME B31.8. as applicable.
3.10.8 Stress relieving may he performed by electrical induction or by electric resistance heating devices, or by furnace that has a large enough capacity to accommodate the entire piece being heat-treated.
3.10.9 The stress relieving temperature to be attained shall be
1100°F/˚5C9imn3ium.m 1150°F/621˚Camxium.mThe soak period of this temperature shall
be one hour per 25.0 m
(1 inch) of pipe wall thickness and in no case shall the soak period be less than one hour.
3.10.10 Rate of heating and cooling shall be in accordance with the requirements for thermal stress relief presented in Section VIII of the ASME Boiler and Pressure Vessel Code. In any event, the rate of heating above 600°F/315˚Camy not be more than 400°F/205˚Cper hour,
nor the rate of cooling more than 500°F/260 ˚C per hour when above 600°F/315˚.C
3.10.11 For field stress relieving, a continuous temperature record Log shall be furnished of the program from heating, soaking and cooling to 600°F. A minimum of two thermocouples shall be installed at each weld so that continuous readings can be assured in the event of thermocouple failure.

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3.10.12 Local heat treatment of welds shall consist of heating ID pipe length completely around the circumference of the pipe welds or pipes as required to eliminate thermally induced stresses. A continuous record of time.

3.11 WELDING PROCEDURE QUALIFICATION

Welding procedure qualification shall be in accordance with the relevant requirement of ASME Sec. IX latest edition or other applicable codes and the job requirements. The Contractor shall submit the welding procedure specification immediately after receiving the order. Owner's representative will review, check and approve the welding procedure submitted and shall release the procedure for qualification test. The complete set of test result as per ASME sec. IX shall be submitted to the OWNER/ OWNER's representative for approval immediately after completing the procedure qualification test and at least 2 weeks before the commencement of actual work. Standard test specified in the code shall be carried out in all cases. In addition to these test the following test shall be carried out.

a) Macro/ Micro Examination.

b) Hardness test.

c) Dye Penetrate examination.

d) Charpy V-notch Impact test at Weld and HAZ at (-) 20 °C for low temperature.

These tests shall be carried out on specimens depending upon the type of base material, operating conditions and requirements laid down in the detailed drawing and specification. It shall be the responsibility of the Contractor to carry out all the tests required to the satisfaction of the OWNER/ OWNER's representative.

3.12 Welder's Qualification

Welders shall be qualified in accordance with the ASME sec. IX or other applicable codes. It shall be the responsibility of the Contractor to carry out qualification tests of welders.

No welder shall be permitted to work without the possession of identity card.

If a welder is found to perform a type of welding or in a position for which he is not qualified, he shall be debarred from doing any further work. All welds performed by an unqualified welder shall be cut and redone by a qualified welder at the expenses of the contractor.

3.13 Destructive Testing

OWNER has the authority to order the cutting of up to 0.1% of the total numbers of welds completed for subjecting to destructive test at no extra cost to OWNER. The destructive testing of joints shall be as per ASME- Sec IX welding procedure qualification.

In addition, welds already cut out for defects for any reason may also be subjected to destructive testing. The sampling and the re-execution of welds shall be carried out by the contractor at his own expenses. If the results are unsatisfactory, welding operations shall be suspended and may not be restarted until the causes have been identified and the contractors have adopted measures which guarantee acceptable results.

If it is necessary in OWNER opinion the procedure shall be re-qualified. The weld joint represented by unsatisfactory welds shall stand rejected unless investigation proves otherwise.

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4.0 NON DESTRUCTIVE EXAMINATION

4.1 General

a) This specification shall govern the basic requirements for Non Destructive Examination (NDE) as it applies to the fabrication, testing and inspection of all Pressure Piping, and Transmission Piping.

b) No supplier, vendor, manufacturer or fabricator shall subcontract the non destructive examination of any such equipment without written approval from the OWNER, and the OWNER will not issue such an approval unless the proposed NDE SUB-CONTRACTOR hasreceived prior OWNER approval for the type of NDE work proposed.

4.2 NDE Company Certification

All Non Destructive Examination (NDE) CONTRACTORs contracted by the OWNER or working for fabricators or CONTRACTORs carrying out work on the OWNER behalf shall have in place an up-to-date Quality Control Manual and Code of Practice which shall cover the following:

i) All aspects of NDE for which the CONTRACTOR'S SUB-CONTRACTOR is qualified.

ii) Current resumes of all presently employed personnel including their certifications (PCN, ASNT, CGSB or equivalent).

iii) All proposed specific NDE procedure,

A registered copy of QC manual shall be made available to OWNER and shall be reviewed and approved by the OWNER quality assurance personnel prior to services being used.

The OWNER will review and approve element's i), ii) & iii) above: prior to start on any said company work. Any approval given by the OWNER does not relieve the CONTRACTOR of his obligations under governing, codes, rules and specifications.

All equipment shall be certified and current, to recognized calibration standard and in first class working condition.

All the government and regulatory HSE requirements shall be fully complied.

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4.3 Visual Inspection

a) Visual examination shall be carried out before, during and after fabrication in accordance with ASME Sec. V article 9 and ASME B31.3.

b) Cracks, (regardless of size and location) and under cutting or any evidence of poor workmanship, materials, etc., if not repairable shall be cause for rejection.

c) Welds shall be visually inspected wherever accessible in accordance with the following requirements:

1.	Internal misalignment	1.5 MM or Less
2.	Cracks or lack of fusion	None permitted.
3.	Incomplete penetration (for other than 100% Radiography butt-weld)	None permitted.

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4.	Surface porosity and exposed slag inclusions (4.7mm.Nom Wall thicknessand less)	Not permitted
5.	Concave root surface (SLICK UP)	For single sided welded joints concavity of the root surface shall not reduce the total thickness of joint including reinforcement to less than the thickness ofthe thinner of the components being joined.
6.	Weld ripples irregularities	2.5 MM or Less
7.	Lack of uniformity in bead width	2.5 MM or Less
8.	Lack of uniformity of leg length	2.5 MM or Less
9.	Unevenness of bead	2.0 MM or Less
10.	Weld undercutting	0.8 mm or 12.5% of pipe wall thickness, whichever is smaller and there shall not be more than 2 in. (50 mm) of undercutting in any continuous 12 in. (300 mm) length of weld
11.	Overlap	1.5 MM or Less
12.	Bead deflection	2.5 MM or Less
13.	External weld reinforcement and internal weld protrusion (when backing rings are not used) shall be fused with and shall merge smoothly into the componentsurfaces. The height of the lesser projection of external weld reinforcement or internal weld protrusion from the adjacent base material surface shall not exceed the following limits	
	Wall thickness of thinner component joined by butt weld (MM)	Weld reinforcement or internal weld protrusion (MM)Max
	6.4 and under	1.6
	Over 6.4 – 12.7	3.2
	Over 12.7 – 25.4	4.0
	Over 25.4	4.8
14.	Throat thickness of fillet welds: Nominal thickness x 0.7 or more.	
15.	FLATTENING Flattening of a bend, as measured by difference between the nominal outside diameter and minimum or maximum diameter at any cross section shall not exceed 5% of the nominal outside diameter of pipe.	
16.	REDUCTION OF WALL THICKNESS Reduction of wall thickness of a bend, as measured by difference between the nominal thickness and minimum thickness shall not exceed 10% of the nominal wall thickness of pipe. Welds having any imperfections which exceed the limitations specified in various clauses shall be repaired by welding, grinding or overlaying etc.	

However repair of welds shall be allowed only once.

4.4 Radiographic Examination

4.4.1 General

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a) The quality of radiographs shall meet or exceed all requirements of the appropriate International standards and applicable general specifications.

b) X - Ray is the preferred radiographic method. Use of Gamma ray for examination isnot permitted.

c) Particular attention shall be paid to using radiographic ultra fine grain film suitable for the application, maintaining correct radiographic geometry during exposure, obtaining correct density also required by the appropriate standard and the correct placement and exposure ofimage quality indicators (IQI's or penetrameters).

d) ASTM wire type IQI's are preferred. The OWNER may permit the use of ASTM whole type IQI's on a pre-approved basis, provided the NDT CONTRACTOR can demonstrate satisfactory results.

e) Radiographic technique shall produce maximum contrast and good definition of IQI wires and shall obtain minimum radiographic density of 2.0 in the weld image. Fluorescent intensifying screens shall not be used.

f) Max radiographic density shall be 4.0 in all areas of the weld and parent metal.

g) The inability to view the appropriate wire or hole on any radiograph shall be cause for automatic rejection of that radiograph which shall be re-radiographed at no expense to the OWNER.

4.4.2 Operator Certification

a) Radiographers supplied by the CONTRACTOR shall be certified to ASNT Level II, AWS QC and as per AWS B1.10 (guide for non-destructive inspection of welds).

b) An operator qualified to ASNT Level I may assist the Level II operator but all film and sentencing interpretation shall be carried out by a Level II or higher operator who shall sign off all report sheets.

c) Visual welding inspection shall be conducted only by a qualified welding inspector, who shallhave a minimum AWS (QC. I) CWI or CSWIP 3.1 certification.

d) The OWNER shall review and approve all QA/QC personnel prior to deployment on the project.

4.5 Magnetic Particle Testing (MPT)

a) MPT shall be carried out in accordance with the requirements of ASME Section V Article 7 &Section VIII DIV 1, Appendix 6 and as modified by this specification.

b) AC electromagnetic yokes shall be used. A background of white contrast paint shall be used in conjunction with a black magnetic ink (wet particle). The technique shall be carried out in the continuous mode and two examinations shall be carried out at right angles to cover for both transverse and longitudinal defects. There shall be sufficient overlap to allow 100% coverage.

c) All unacceptable or spurious indications found by this method shall be investigated and removed by grinding followed by thickness check.

4.6 Dye Penetrate Test (DPT)

a) DPT shall be carried out accordance with the requirements of ASME BPV, Section V, Article

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6, & ASME Section VIII DIV 1, Appendix 8, and as modified by this specification.

b) Unless requested otherwise, DPT shall be carried out using the solvent removable method.

c) If necessary welds may be lightly dressed to facilitate DPT testing or to assist in theinterpretation of any indications.

d) All unacceptable or spurious indications found by this method shall be investigated andremoved by grinding followed by thickness check.

4.7 ULTRASONIC WELD EXAMINATION (UT)

4.7.1 Ultrasonic Operators

a) Ultrasonic operators supplied by the NDE CONTRACTOR shall be certified to a General Standards Board (ASNT/PCN) approved by the OWNER.
b) Ultrasonic testing shall be carried out by minimum ANST Level-II qualified personnel.

4.8 Extent of Inspection And Testing

4.8.1

a) Piping systems which are designed and constructed in accordance with ASME StandardB31.3, Chemical Plant and Petroleum Refinery Piping shall be radiographed as per Table II.

b) Piping systems which are designed and constructed in accordance with ASME B31.8 standard for gas pipeline systems shall have all welds Ultrasonic and Radiographically inspected for 100%,

4.8.2 Hardness testing shall be carried out of welds on vessels and piping in sour or corrosive service and 10% of local PWHT weld as per ASTM Specification E 10, ANSI 1331.3.

4.8.3 Ultrasonic Testing

a) UT testing shall be carried out as per ASME B31.3 and ASME Sec. V article 5.

b) All category 'D' welds which are not being radio graphed and all other welds configuration, which does not permit to be radio graphed, shall be ultrasonic tested.

c) All tie-in welds where pressure testing are not possible shall be radiographically as well as ultrasonically tested in addition to MPT/ DPT.

TABLE-I

EXAMINATION CATEGORIES

CATEGORY I	HIGHER DUTY PIPING
	• Severe cyclic conditions as indicated in the respective isometric drawings, all service. • Carbon Steel material, ASME rating 600# all services • All ASME classes for lethal substances.(Category `M'fluid service)
CATEGORY II	NORMAL FLUID SERVICE ASME rating 150 & 300# not covered by Categories I & III

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CATEGORY III	CATEGORY 1) FLUID SERVICE
	ASME rating 150 for all systems in Category `1' Fluid servicessuch as: • Service air • Instrument air • Open Drains

Notes:

(1) Irrespective of category, all process piping connection shall be hydrostatically as well as pneumatically tested with 6 hours of holding period.
(2) Golden Tie-in joints root & hot pass shall be examined by DPI. Final weld shall be examinedby MPI, RT & UT.

TABLE – II

EXTENT OF TESTING AND INSPECTION

METHOD	EXAMINATION CATEGORY I	EXAMINATION CATEGORY II	EXAMINATION CATEGORY III
Visual	100%	100%	100%
MPI (or DPI for non-ferromagnetic materials) (Note 2)	100% examination of all branch and attachment welds	100% examination of 1 in 10 branchand attachmentwelds	100% examination of 1 in 10 branch and attachmentwelds
RT (butt weld) (Note 1)	100% examination of all welds	100% examination of 1 in 10 welds (Nose 5)	100% examination of I in10 welds
UT (Branch weld) (Note 5)	100% examination of all welds	0	0
Hydro test and Pneumatic test	Yes	Yes (Note 3)	Service Test
Minimum Duration	6 hour	6 hour	6 hour
Records	Yes	Yes	Yes

Notes:

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1) Ultrasonic testing, in lieu of radiography, is acceptable only where radiography is notpracticable e.g. branch connections.
2) UPI or DPI test of branch welds to be performed prior to and lifter attachment ofcompensating plate if applicable.
3) Open drains vents or other open ended line shall be leak tested only.
4) For piping within skid packages, the CONTRACTOR shall use this table as a guide only and prepared NDE plan for review and approval by OWNER as required in the respective package specification.
5) VAT required where wall thickness of scanning surfaces are less than 10mm and where branch size is less than NPS 4". Non-ferrite materials shall not be examined with UT methods.
6) RT shall be 20% of welds for all class 300# series.

5.0 REPAIRS OF WELDS

5.1 With the prior permission of ENGINEER IN CHARGE welds that do not comply with the standards of acceptability shall be repaired or the joint cut out and re-welded.

A separate welding procedure specification sheet shall be formulated and qualified byCONTRACTOR for repair welds simulating the proposed repair to be carried out. Separate procedures are required to be qualified for (a) through thickness repair (b) external repairand (c) internal repair. Welders shall be qualified in advance for repairs. The root pass, for repairs opening the root, shall be replaced by the vertical uphill technique. The procedure shall be proven by satisfactory procedure tests to API 1104 including the special requirements of the specification, and shall also be subjected to metallographic examination,hardness surveys and Charpy test to determine the effects of repair welding on the associated structure.

Root sealing or single pass repair deposit shall not be allowed. Internal root defects shall be ground thoroughly and welded with a minimum of two passes. However, while grinding for repairs, care shall be taken to ensure that no grinding marks are made on the pipe surface anywhere.

The repair shall be subjected, as a minimum requirement, to the same testing and inspection requirements as the original weld. Re-radiography of the repaired area shall be carried out. In addition, a minimum of 6" weld length on the either side of the repaired area, shall be re- radiographed. A 100% ultrasonic test shall be done at the repaired area externally. Any repaired area that is wide, irregular or rough shall be rejected and a full cut out shall bedone.

Repairs are limited to a maximum of 30% of the weld length. Welds containing cracks shall be cut out and rebeveled to make a joint. COMPANY shall authorize all repairs.

5.2 Weld Rejected by Accumulation of Defects

Where a weld is rejected by accumulation of defect clause, as defined by API 1104 and this specification, repairs within these limitations are permitted. Defects in the filling and capping passes shall be repaired preferentially.

6.0 INSPECTION

6.1 The CONTRACTOR shall extend all facilities, assistance and co-operate fully with the OWNER in all aspects of inspection and NDE and shall give adequate notice of any requiredfabrication inspection stages, together with sufficient time for thorough inspection by the

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OWNER. OWNER shall have the right to establish hold points at any point in the fabricationsequence.

6.2 Although is the Contractor's primary responsibility to perform weld examination, OWNER shall have the right to observe the examination of all welds by nondestructive means. The inspection may be at any time before, during and after fabrication. The CONTRACTOR shall conduct daily NDE percentage of welds to assess weld quality. Up-to-date examinations are required to identify and prevent the reoccurrence of weld defects on subsequent welds. Records and evidence of all weld examinations shall be available at all times for OWNER to review and approve.

6.3 OWNER may use any method of inspection necessary to establish quality control and ensure adherence to welding procedures. OWNER shall have the right to accept or reject any weld not meeting the requirements of this specification.

6.4 OWNER reserves the right to perform inspection at shop / field where fabrication and erection of piping is in progress for (but not limited) for the following objective:

a) To check conformance to relevant stands and suitability of various welding equipment's andwelding performance.
b) To witness the welding procedure qualification.
c) To witness the welder performance qualification.
d) To witness the Electrode qualification Test.

6.5 Contractor shall intimate sufficiently in advance the commencement of qualification test, welding works and acceptance tests to enable the owner/ owner's representative to be present to supervise them.

6.6 Any discrepancies between the approved WPS and the production welds noted by OWNER, any or all of the work made under these conditions is subject to rejection.

7.0 DOCUMENTS TO BE SUBMITTED BY THE CONTRACTOR

a) Electrode and welding consumables qualification records for the welding consumablestested and approved for the work.
b) Batch test certificate, for the electrodes used, obtained from the Electrode Manufacturers.
c) Proposed heat treatment chart procedure.
d) Heat treatment chart.
e) Weld joint tensile, hardness test, Impact test result.
f) Welding procedure specification immediately after receipt of order.
g) Welding procedure qualification records.
h) Welder performance qualification records immediately after conducting welder qualificationtests.
i) Radiography procedure and the NDT procedure.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR FABRICATION AND INSTALLATION

ENG-STD-PI-DOC-TS-010

BGL/632/2024-25

0	31.10.16	First Issue				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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I GENERAL

1.0 SCOPE

This specification covers general requirements of fabrication and installation of aboveground and underground piping systems at site. The specification covers the scope of work of contractor, basis of work to be carried out by contractor and standards, specifications and normal practice to be followed during fabrication and erection by the contractor. Its scope is essentially the same as that of ASME Code B31.3. This specification shall apply to all piping installed by or pre-fabricated for installation by CONTRACTOR.

The welded pipe joints shall include the following and shall not relieve the contractor of hisresponsibilities and guarantee.

a) All pipe joints, longitudinal butt welds, circumferential butt welds and socket welds.
b) Attachments of forging, flanges and other supports to pipes.
c) Welded manifold headers and other sub assemblies.
d) Welded branch connections with or without reinforcing pads.
e) Joints in welded / fabricated piping components.
f) The attachments of smaller connection for vents drain drips and other instrument tapings.

2.0 CODES AND STANDARDS

Unless otherwise stated the design of piping systems shall confirm to the requirement oflatest edition of following Codes and Standards.

i) AWS (American Welding Society).
a) A2.4 (Symbols for Welding and Non destructive Testing).
b) A3.0 (Standard Welding Terms and their Definitions).
c) A5.1 (Specification for Mild Steel Covered Arc Welding Electrodes).
d) A 5.17(Specification for Bare Carbon Steel Covered Electrodes).
e) A 5.18 (Specification for Carbon Steel Filler Metals for Gas Shielded Arc Welding).
f) A 5.20 (Specification for Mild Steel Electrodes for Flux Cored Arc Welding Electrodes).iI)

	ASME B31.8	-	Gas Transmission and Distribution piping systems
iiI)	ASME B31.3	-	Process piping for refineries and chemical plant and terminals.iV)
	API 1104	-	Standard for Welding Pipelines and related facilities.
v)	API 1105	-	Bulletin on construction practices for oil and products pipelines.
vii)	OISD 118	-	Layout of Oil & Gas Installations
vii)	API 598	-	Valve Inspection and Test
viii)	ASME Sec. VIII Div. 1	-	Pressure Vessels.
viii)	ASME Sec. IX	-	Welding and Brazing Qualifications

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ix) PNGRB NOTIFICATION- Technical Standards and specifications including safety standards for city or local natural gas distribution Schedule-1 network.

All welding procedures used by fabricators and CONTRACTORS shall have been establishedand qualified in accordance with the appropriate sections of one or more of the codes and standards listed above, and approved by the OWNER.

Where a conflict occurs between these specifications and / or any of the above codes orstandards the more stringent shall apply.

Dimensional Standards

Flanges	- ASME B16.5, B 16.47
Welding Fitting	- ANSI B16.9, B16.11
Pipe	- ANSI B36.10
Gaskets	- ANSI B16.20, B16.21
Butt Weld Ends	- ANSI B 16.25
Spec. for line pipe	- API 5L
Valves – Flanged, Threaded end Welding end	- ASME B 16.34

In the event of any conflict between the requirements of this specification and any code/standard, the most stringent requirement shall be followed.

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II PIPING FABRICATION

1.0 GENERAL

Fabrication and erection of all piping systems by CONTRACTOR shall be in accordance withthis specification and applicable drawings and standards.

a) Fabrication and erection of supporting elements i.e. shoes, guides, stop anchors, clips, cradles etc, shall include applying one coat of epoxy red oxide zinc phosphate primer (Minimum DFT 100µ) and two coat of final painting of high build epoxy paint 125µ for each coat.

b) Fabrication and erection of supporting fixtures i.e. brackets, cantilever struts etc. shall include application of one coat of epoxy red oxide zinc phosphate primer (Minimum DFT 100µ) and two coat of final painting of high build epoxy paint (Min. 125µ per coat)

c) Fabrication and erection of drain assemblies

The contractor shall fabricate all pipe work in conformity with the requirements of pertinent general arrangement drawings and specifications where specific details of fabrication are notindicated on the drawings or not specified, herein, fabrication and erection shall be done in accordance with ASME B 31.3/ ASME B 31.8 latest edition.

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2.0 CUTTING

Following shall be applied for all cutting works:

2.1 For laying out headers, tees, laterals and other irregular details, cutting templates shall beused to ensure accurate cutting and proper fit-up.

2.2 Machine cut bevels to form the welding groove are preferred in carbon steel pipe. However,smooth, clean, slag free false cut bevels are acceptable.

2.3 Cutting of pipes may be done either by mechanical means or by thermal cutting. Whenever cutting is employed all oxides and traces of previously melted metal and occasional notches shall be removed from edges by grinding or machining.

2.4 Pipe cutting is to be performed using sawing only for galvanized, stainless steel and coppernickel materials.

2.5 Cutting shall be made with suitable allowance taken in to account for shape of connectionsand shrinkage due to cutting and welding.

2.6 All cutting shall follow the outline of the templates.

2.7 Special care shall be taken to remove internal burrs resulting from cutting especially on pipesequal to or less than 2" NPS in diameter.

3.0 WELDING

3.1 Welders shall be qualified in accordance with the Welding Specification ENG-STD-PI-DOC- TS-009 and other applicable standards i.e. ASME SEC. IX.

3.2 The joints to be field welded shall be beveled as per ASME B 16.25.

3.3 Adjacent sections of longitudinally welded pipe that are joined by butt-welding shall have the longitudinal weld seams positioned so that they are at least 30 degrees apart from the horizontal centerline.

3.4 Wherever possible, longitudinal weld seam should not be located on the top or bottom of theline so that branch connections are not positioned on the seam.

3.5 No backings strips/ rings shall be used.

3.6 Welding shall be is per approved as per Welding Procedure Specification (WPS) andProcedure Qualification Record (PQR).

3.7 Non-Destructive Testing (NDT) such as Radiography Testing (RT), Ultrasonic Testing (UT),etc. should be carried out, after Post Weld Heat Treatment (PWHT).

3.8 Tack welds with full penetration shall be used and shall become the part of the finished weld,defection welds or tack welds with lack of penetration are not acceptable and shall be chipped/ ground out.

4.0 INTERNAL MISALIGNMENT

The pipes to be joined by welding shall be aligned correctly with existing tolerances on diameters, wall thickness and out of roundness. The same alignment shall be preserved during welding for the internal

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misalignment due to difference in wall thickness of the mating components exceeding 1/16"; the component with higher wall thickness shall be internally machined/ grounded so that the adjoining surfaces are approximately flushed.

4.1 Internal misalignment shall be as per the criteria set out in ASME B 31.3 and as per the following guidelines:

a) 24" NPS and smaller pipe-to-pipe fitting: 1.5mm maximum deviation.

b) Greater than 24" pipe-to-pipe or pipe-to-fitting: 3.2mm maximum Deviation when permitted by the relevant WPS.

c) Dimensional tolerances for the fabrication and installation of piping systems shall be ± 1/8 inch and ± 2 degrees. Misalignment of flange faces and welding ends shall be limited to 3/64 inch per foot measured across any diameter.

4.2 If the deviation factors are exceeded, one of the following procedures shall be used:

a) Rotate the pipe or fittings to reduce misalignment to the acceptable tolerances (before attempting any of the following methods) allowing for seam alignment.

b) Use spreaders or internal or external line-up clamps to correct moderate out-of- round Condition.

c) Taper the wall of the component internally after obtaining approval from OWNER for the proposed method and ensure wall thickness is not reduced below the minimum required by the ASME B 31.8 code.

d) If allowable deviations are exceeded beyond repair methods, the fabrication shall be redone.

4.3 All flange facing shall be true and perpendicular to the axis of the pipe to which they are attached. Flange bolt holes shall span the normal center lines unless different orientation is shown in drawings to match the equipment connections etc.

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5.0 FLANGES

Flange bolt holes are to be oriented as follows, unless otherwise indicated in the fabricationdrawings:

5.1 Flange faces vertical - bolt holes to straddle vertical centerline.

5.2 Flange faces horizontal - bolt holes to straddle the horizontal plane centerline.

5.3 Where line taps are called for, the hole shall be drilled square to the axial centerline clean, sharp, free from burrs, wire edges, or other irregularities. The hole shall be drilled after first attaching the connection fitting.

5.4 Where slip-on flanges are called for, they shall be welded inside and outside (See Figure 328.5.2B of ASME B 31.3). The weld shall be applied so that the flange face shall be free of weld spatter and does not require facing.

5.5 Orifice flanges shall be installed with the taps in the exact orientation shown in the isometric. The sections of pipe to which the orifice flanges are attached may be standard mill run pipe, but shall be choice selected pieces and shall be round, smooth and free from blisters and scale. The interior of the pipe, at welds, shall he ground smooth, Welds to be performed on site shall be kept at a maximum

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distance hack from the face of the orifice flange.

6.0 NON PRESSURE ATTACHMENTS

6.1 The CONTRACTOR shall be responsible for working to the exact dimensions as shown on the drawings irrespective of individual tolerances permissible. Where errors and/ or omissions occur on the drawings, it shall the Contractor's responsibility to notify the Engineer-in-charge prior to fabrication or erection.

6.2 Non-pressure attachments shall he installed in accordance with the isometric and anysupplemental data provided by the detailed engineering CONTRACTOR.

6.3 Piping requiring post weld heat treatment shall have all welded-on non-pressure attachmentsinstalled by the shop fabricator. Piping not requiring post-weld heat treatment may have the welded-on non-pressure attachments installed by the installation CONTRACTOR. If field welding is required on post weld heat-treated piping, then localized field post weld heat treatment shall be done after welding as approved by the OWNER.

7.0 FABRICATION TOLERANCES

7.1 The CONTRACTOR shall be responsible for working the exact dimensions as shown on the drawings irrespective of individual tolerances permissible. Where errors and/ or omissions occur on the drawing it shall be the contractor's responsibility to notify the OWNER prior to fabrication or erection.

7.2 Thinning of Wall Thickness and Quality in Bends.

The maximum decrease of wall thickness shall not exceed 10% of the nominal wall thickness as specified in the line classes and in any case shall not be less than that required by the design.

The tolerances for the maximum flattering of a bend shall be per ASME B 31.3 section 332.2.

7.3 Flange Face Alignment

The maximum deviation measured in any direction shall not exceed 2.5mm. When branches are in the same plane and their flanges are also positioned in one plane, the flange facings shall not deviate more than 1 mm from the latter plane in the same direction.

7.4 Position of Bolt Holes for Flanged Piping

The maximum deviation allowed from the required position as measured along the bolt circleis 1.5mm.

7.5 Field-Fit Weld

Where the requirement is called for in the isometric, a field-fit weld is used when the exact piping dimension cannot be predetermined, to allow the installation CONTRACTOR adjustability of two spool pieces. 150mm to be added the calculated length of one of the spools. The installation CONTRACTOR is to verity the dimension before trimming and beveling. The isometric will indicate only the calculated length.

7.6 Pup-pieces installed to make-up a spool length shall be a minimum of (2) pipe diameters long or 150mm whichever is higher unless stated otherwise by the OWNER.

8.0 EXAMINATION AND INSPECTION

8.1 Examination and Inspection shall be as per NDT Specification of document No. ENG-STD- PI-DOC-TS-011

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8.2 In case of fillet welds where carrying out radiography is not possible, magnetic particle test or dye penetrant test shall be carried out. The extent of inspection shall be same as for radiography. Finished weld shall also he visually inspected for parallel and axial misalignment of the work, cracks, inadequate penetration and shall present neat workman like appearance.

8.3 All the lines, which are stress relieved or have design pressure more than 50 kg/cm^2 shall befully radiographed (100%)

9.0 SURFACE PREPARATION AND PAINTING

Applicable surface preparation and painting shall be in accordance with paintingSpecification document No. ENG-STD-PI-DOC-TS-008 attached elsewhere in the bid document.

10.0 PROTECTION, PRESERVATION AND STORAGE

Piping shall be protected as follows:

10.1 After fabrication, flange faces shall be cleaned, coated with rust preventative, & protected with non-metallic flange covers, secured to the flange prior to erections/ installation/ shipment. Other methods and products for flange protection may be acceptable, subject to OWNER approval.

10.2 Socket-weld connections shall be cleaned and plugged, or capped with metal or plastic protectors.

10.3 The open ends of pipe shall be protected with metal or plastic caps.

10.4 A metal cap secured by a steel strap around the pipe shall be used to protect open end "O- lets".

10.5 Fabricated spool pieces shall be carefully loaded with the proper amount of tonnage and ample tie-downs to protect each piece during shipping. Tie-downs shall be nylon straps; chains or cable are prohibited.

10.6 Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the job site.

10.7 Fabricated spool pieces and materials shall be protected to withstand ocean transit and extended period of storage at the job site for a minimum period of 18 months. Fabricated spool pieces and piping components shall be protected to safeguard against all adverse environments, such as humidity, moisture, rain, dust, dirt, sand, mud, salt air, salt spray, and seawater.

10.8 Field weld joints shall be coated and wrapped as per specification.

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III PIPING INSTALLATION

1.0 GENERAL

Unless specified otherwise, the piping in general shall:

1.1 Be run level and plumb.

1.2 All piping shall be fabricated and installed to the configurations as shown in the Isometric.

1.3 Be run on the North-South and East-West axis

2.0 ERECTION

The intent of pre-fabrication at the shop is to accelerate progress of pipe work and to minimize work in the field. Such prefabrication should be based on approved isometric and piping layouts furnished to the CONTRACTOR. Field weld is indicated by "FW" on isometrics. Field weld means position weld of prefabricated piece at site or near the plant.

However the contractor shall bear in mind that there can be variations in dimensionsbetween those appearing at the site due to minor variations in the location of equipment, inserts etc. The CONTRACTOR shall, therefore, provide adequate field joints, if required, other than shown in isometrics and fit-in sections permitting the pre-assembly to be installed without any modification.

All piping shall be routed and located as shown in piping drawings keeping in view the piping specifications.

While fitting up mating flanges, care shall be exercised to properly align the pipes and to check the flanges for trueness, so that faces or the flanges can be pulled up together withoutinducing any stresses on the pipes. The bolt holes of flanges in the vertical plane shall straddle the vertical center line of the pipe in the erected position and for flanges in the horizontal plane, the bolt holes shall straddle horizontal plane unless otherwise indicated on the drawings.

The CONTRACTOR shall maintain slopes specified for various lines in the drawings. In casethe CONTRACTOR is unable to maintain the indicated slope he shall check the sagging of the pipe with a precision spirit level. Vents and drains are shown in the isometric of each line and these are intended, during hydrostatic test for releasing the trapped air and draining out the test fluid after testing. Valves vents and drains are also shown wherever required.

Where practicable and except when otherwise shown on the drawings, valve stems shall be installed in a vertical direction and shall not be installed with stems below the horizontal axis.

3.0 UNDERGROUND PIPING

3.1 Underground piping shall be laid according to piping general arrangement drawingIssued during the course of construction

3.2 Pipeline trenches shall be dug wherever necessary according to drawing, true to line andgradient as per specification

3.3 No excavation material shall be deposited within 1.5m from excavated trench.

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3.4 Coated pipes shall not be placed in trenches until sharp, hard stones, skids, welding rods etc.have been removed.

3.5 Coated pipe shall not be handled or moved by means of cables or chains or by prying.

3.6 With skids or bars, it shall be tied and lowered by using lowering-in belts of a Standard Widthfor the size of pipe being used.

3.7 Coated pipe shall not be dragged along the ground or otherwise handled in a manner that willbe detrimental to its coating.

3.8 Backfilling with the excavated material shall be done in layers of 200 mm. well watered and rammed to avoid settling afterwards.

4.0 FLANGE BOLTING

4.1 Use a logical sequence of bolt tightening to ensure even gasket compression, as indicated inANSI B16.5.

4.2 Prior to bolt up, inspect flange faces. Flange faces shall be in "as-new" condition and shall be wiped clean of any debris excess oil or grease and dirt. Do not perform weld repairs on flange faces or flanges.

4.3 Do not use washers or spacers to make-up bolt length. Bolt lengths are specified prevent oversizing.

4.4 While fitting up mating flanges, care shall be exercised to properly align the pipes and check the flanges for trueness, so flanges can be pulled together without inducing stresses at pipes.

5.0 JOINTS

The relevant piping class will be assigned to each line identified on the isometric. In general, joining for lines 2" and above in utility piping system shall be accomplished by butt-welding connections. Pipe lines of size 1½" and below shall have socket welded/butt welded/screwedjoints as specified in the piping materials specifications.

5.1 Do not apply insulation over any joints until testing has been completed.

5.2 Gaskets on flanged joints shall be used only once.

5.3 Gaskets shall be selected in accordance with Piping Materials.

6.0 SUPPORTS

6.1 Installation of supports shall be as indicated in the isometric / support piping layouts.

6.2 Supports, guides and anchors for piping shall be fabricated and provided as shown in the drawings. No anchors on piping shall be used except at locations shown in the drawings.The pipe shall be secured firmly at anchor supports.

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6.3 Fabrication and erection of supporting elements and structural fixtures wherever required whether indicated in drawings or not, to prevent vibration, excess sag etc. shall be carried out by the CONTRACTOR.

6.4 Erection of these additional supports will be deemed as part of piping erection work scope.

7.0 CLEANLINESS OF PIPING

7.1 On completion of fabrication, all pipes and fittings shall be cleaned inside and outside by suitable means (mechanical cleaning tool, Wire brush, etc.) before erection to ensure that assembly is free from all loose foreign materiel such as scale, sand, weld spatter particles, cutting chips etc.

7.2 All field fabricated piping shall also be cleaned at the completion of the fabrication. All burrs, welding circles and weld spatter shall be removed by any suitable means (mechanical tools, wire brush etc.).

7.3 Both shop and field fabricated piping shall be blown out with compressed air at the termination of cleaning and capped.

7.4 Open end and flanges protection shall be used throughout installation. Protect open pipes at all times when work on them is not actually taking place.

7.5 Inspect individual pipe section, prefabricated spools and pipeline items internally during installation and remove any foreign matter before final welding or bolting.

7.6 Adjoining Piping with special equipment or piping within a packaged, vendor provided "skid", which requires cleaning in accordance with the equipment's Manufacturer's procedures, shall be inspected by, and have cleaning supervised by, the Manufacturer's representative.

8.0 INSTALLATION PROCEDURE FOR SOCKET WELDED SMALL BORE VALVES

As well as complying with all applicable code requirements for quality and strength of the weld, it is necessary to avoid damage to soft seats and distortion of "small bore" valve bodies by excessive heat input.

a) Process

The process to be used shall be manual metal arc, metal inert gas or CO_2 with preference for the lower heat input high deposition (dip transfer) processes. Gas welding shall not be used because of its excessive heat input.

b) Preparation

Ensure that valve is in open position. Correctly locate and align the pipe in the valve socket with a clearance of approximately 1.6 mm (1/16 inch) between the end of the pipe and the bottom of the socket.

c) Procedure

Deposit the first run of weld metal around the pipe. Deposit metal for making additional runs as required, ensuring that each run of weld metal is cleaned and any visible defects such as cracks, cavities or other faults are removed before deposition of further weld metal.

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9.0 DRAIN AND VENT CONNECTION

High point vents and low point drains required for the purpose of hydro testing shall be ofsize 1" and consist of sockolet, Plug & Ball valve for vent, Globe & Ball Valve for drain, flange & blind flange.

All low points in a line shall be provided with drain connections of nominal size as given in table below. All drains shall be with valve and blind except for water lines where valves are not required.

10.0 LINE MARKING / IDENTIFICATION

Process and utility type shall be identified stenciled lettering used to identify service and flow direction. Lettering shall be identified every 10 meters in pipe rack and should be visible fromground level.

IV TESTING

1.0 PIPING

Pressure tests shall be performed as per ANSI B 31.8 latest edition or as per design basis and appropriate piping material specification class chart per Piping Material Specification document No. ENG-STD-PI-DOC-TS-001.

The field test pressure shall not be less than the highest of the following:

a) 1.4 times the design line class pressure.
b) 1.4 times the maximum operated pressure
c) 1.4 times the maximum pipeline static pressure
d) Sum of the maximum sustained operating pressure or maximum operating or maximumpipe line static pressure and the maximum calculated surge pressure.

The hold period shall be minimum 6 hours.

The testing shall be carried out in convenient section as approved by site engineer. Thejoints of pipe connecting the testing section shall be 100% radiographed and UT tested and shall be tested with other applicable NDT method as specified in specification.

If some defects are noticed during the hydrostatic testing, the same shall be brought to the notice of the OWNER. Joints, if leaking, shall be rectified as per welding specification and instructions and tested to the complete satisfaction of the OWNER.

The following items shall not be subjected to field pressure testing

a) Pressure relieving devices such as rupture discs and pressure relief valves.

b) Locally mounted pressure gauges.

c) Control valves, shutdown/ isolation valves etc.

d) Any other equipment designated by the OWNER.

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All the elements, which are not to be tested along with the piping, shall either be blanked off during testing or spool pieces inserted during testing.

Any temporary corrosion protection coating given on piping at manufacturer's shop/fabrication yard is to be removed at all inspection points, before final testing.

Prior to Hydro testing, vessels and piping are to be flushed by high pressure, high volumefresh water or inhibited water.

Following are the general requirements for testing of piping:

a) Test pressures shall be maintained for a sufficient length of time to permit through inspectionof all the joints for a leakage or sign of failure. The duration shall in no case be less than six (6) hours.

b) Instrument take-off piping up to the first block valve shall be tested with the connectedpiping.

c) Lines open directly to atmosphere such as vents, drains, safety valve discharge etc. shall beleak tested and all the joints shall be visually inspected.

2.0 MAXIMUM ALLOWABLE VALVE TEST PRESSURE

Test pressure applied to valves under closed position shall not be greater than the manufacturer's recommendations nor less than required API 6D latest edition where the required test pressure is greater than the allowable seat pressure, test shall be made through the 50% open valve.

3.0 HYDROSTATIC TEST FLUID

3.1 Fresh potable water shall be used as the testing medium for hydrostatic testing of piping in fabrication yard and at site.

3.2 The lines shall be completely drained and dried by air immediately after the successful completion of testing.

3.3 Salt water shall not be used for testing.

3.4 A strainer shall be installed in the line to minimize the possibility of foreign matter beingintroduced into the system during the pressure test and flushing operations.

4.0 PNEUMATIC TESTING

4.1 Pneumatic testing of instrument air, utility air, starting air and instrument gas piping shall be performed with compressed air. The test pressure shall be 110% of design pressure or 49 bar (g) whichever is higher in case of 300# rating piping.

4.2 In addition to hydro test, all the station piping shall be pneumatic tested. The test pressureshall be per clause 4.1 above.

4.3 When pneumatic testing at over 25 psi, a preliminary test at 25 psi shall be made to locatemajor leaks. Then the pressure shall be increased gradually to test pressure.

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5.0 TEST PROCEDURE

5.1 All events and other connections, which serve as vents, shall be open during filling so that allair is vented prior to applying test pressure to the system.

5.2 Gauges used for testing shall be installed as close as possible to the highest point of thepiping system.

5.3 Care shall be exercised to avoid increase in pressure due to temperature variation during thetest.

5.4 After completion of the recorded test pressure recorder, the pressure shall be reduced to thedesign pressure and all valves, including check valves, in the section of the line shall be tested by being closed for a ten (10) minutes period with pressure contained by specific valve at one end and by positive closure at the other to determine whether each valve is in turn positively shutting off and holding pressure.

5.5 After completion of hydrostatic test, the pressure shall be released gradually in steps. All the vents and drains shall be kept open till the lines are fully drained. The CONTRACTOR shall then dry the system by blowing compressed dry air and reinstall items removed during Hydrotesting.

5.6 Record shall be made of each piping system during the testing. These records shall beprepared in tabulated foams and shall include.

a) Date of Test

b) Identification of piping and equipment tested with medium

c) Test medium

d) Test Pressure

e) Test Duration

f) Acceptance of Test Results by OWNER

g) Calibration certificates of test gauges, recorders and PSV's.

5.7 Testing shall be deemed as complete only after defects noticed during testing have been rectified and testing of the system / line has been done to the satisfaction of the OWNER's representative.

5.8 The CONTRACTOR shall supply all plain test blanks required for the pressure testing.

5.9 Gauges and pressure recorders used for testing shall be calibrated at a reputed laboratory atleast every 6 months.

5.10 Temporary supports shall be provided wherever required during testing to the satisfaction ofOWNER.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR NDT

ENG-STD-PI-DOC-TS-011

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1.0 SCOPE

This specification covers the general requirements for non destructive examination of shop & field fabricated and inspection of all pressure Piping and Distribution Pipeline.

2.0 CODES AND STANDARDS

Referred codes/ standards are as follows. Latest editions of the Codes/ Standards referred to shall befollowed.

a) ASME Boiler & Pressure Vessel Codes, Section V & VIII (Div. 1) including addenda.

b) ASME B31.3 Chemical Plant and Petroleum Refinery Piping.

c) ASME 31.8 -Gas Transmission and Distribution Systems.

d) Standard Specification for Fabrication & Installation of Piping

e) ASNT/PCN/CGSB Standards for certification of Non Destructive testing Personnel.

Work shall also be carried out in compliance with all general specification dealing with welding and fabrication of various equipment / piping.

2.1 CONFLICT

Where a conflict occurs between this Specification and any of the above Codes or Standards the more stringent shall apply. The contractor shall inform the OWNER in writing and receive written certification form the OWNER. The contractor shall have readily available for use at the request of the OWNER, latest editions of all codes, specification and standards necessary for execution of the work atwork site.

3.0 NDE COMPANY CERTIFICATION

All Non Destructive Examination (NDE) CONTRACTORs contracted by the OWNER, or working for fabricators or CONTRACTORs carrying out work on the OWNER's behalf shall have in place an up-to- date Quality Control Manual and Code of Practice which shall cover the following:

i) All aspects of NDE of which the CONTRACTOR / SUB-CONTRACTOR is qualified.

ii) Current resumes of all presently employed personnel including their certifications (PCN, ASNT,CGSB or equivalent).

iii) All proposed specific NDE procedure.

A registered copy of QC manual shall be reviewed by the OWNER.

All equipment shall be certified and current, to recognized calibration standard and in first class working condition. There shall be full compliance with all government and local regulatory requirements of HSE which shall be fully complied with.

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4.0 VISUAL EXAMINATION

4.1 Visual examination shall be carried out before, during and after fabrication in accordance with ASMESec. V article 9 and ASME B31.3.

4.2 Cracks, (regardless of size and location) and under cutting or any evidence of poor workmanship,materials, etc., if not repairable shall be cause for rejection.

4.3 Weld shall be visually inspected wherever accessible in accordance with the following requirements:

a)	Internal misalignment	1.5 mm or less
b)	Cracks or lack of fusion	Not permitted
c)	Incomplete penetration	Not permitted (For other than 100% radiography butt-weld)
d)	Surface porosity and exposed slag inclusions	Not permitted (For nom. wall thickness 4.7 mm and less)
e)	Concave root surface (Suck up)	For single sided welded joints, concavity of the root surface shall not reduce the total thicknessof joint, including reinforcement, to less than the thickness of the thinner of the components being joined.
f)	Weld ripples irregularities	2.5 mm or less.
g)	Lack of uniformity in bead	2.5 mm or less width
h)	Lack of uniformity of leg	2.5 mm or less length
i)	Unevenness of bead	2.0 mm or less.
j)	Weld undercutting	0.8 mm or 12.5% of pipe wall thickness, whichever is smallerand there shall not be more than 2 in. (50 mm) of

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undercutting in any continuous 12-in. (300 mm) length ofweld

k) Overlap — 1.5 mm or less

l) Bead deflection — 2.5 mm or less

m) External weld reinforcement and internal weld protrusion (when backing rings are not used) shall be fused with and shall merge smoothly into the component surfaces. The height of the lesser projection of external weld reinforcement or internal weld protrusion from the adjacent base material surface shall not exceed the following limits:

Wall thickness of thinner component joined by butt weld (mm)	Weld reinforcement or internal weld protrusion (mm) max
6.4 and under	1.6
Over 6.4 -12.7	3.2
Over 12.7 -25.4	4.0
Over 25.4	4.8

n) Throat thickness of fillet welds: Nominal thickness of the thinner component x 0.7 or more.

p) Flattening

Flattening of a bend, as measured by difference between the nominal outside diameter and minimum or maximum diameter at any cross section shall not exceed 5 % of the nominal outside diameter of pipe.

q) Reduction of wall thickness

Reduction of wall thickness of a bend, as measured by difference between the nominal thickness and minimum thickness shall not exceed 10 % of the nominal wall thickness of pipe.

4.4 Welds having any of imperfections which exceed the limitations specified in various clauses of 4.3shall be repaired by welding, grinding or overlaying etc. However a weld shall be allowed to be repaired only once.

5.0 NON DESTRUCTIVE TESTING

The type and extent of weld examination shall be in accordance with Table-1. All visual and supplementary methods of girth weld examination shall be in accordance with ASME B31.8 & the requirements of this standard specification.

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5.2 Welds between dissimilar materials shall be examined by method & to the extent required for thematerial having the more stringent examination.

5.3 All non-pressure tie-in welds and all field welds, regardless of pipe class shall be examined by 100%visual, radiography and MPI / DPI.

5.4 Contractor shall not deviate from any requirement of this specification without written approval to doso from OWNER.

5.5 Welds between dissimilar materials shall be examined by method & to the extent required for thematerial having the more stringent examination.

5.6 RADIOGRAPHIC EXAMINATION

5.6.1 General

a) The Contractor shall be responsible for carrying out Radiography, rectification of defects and re- radiography of welds repaired/rectified at his cost.

b) The quality of radiographs shall meet or exceed all requirements of the appropriate International standards and applicable general specifications.

c) X – Ray is the preferred radiographic method. Use of Gamma ray for examination is permitted wherever X-ray is not possible; however contractor has to get prior approval from client /consultant before start of the work.

d) Particular attention shall be paid to using radiographic ultra fine grain film suitable for the application, maintaining correct radiographic geometry during exposure, obtaining correct density as required by the appropriate standard and the correct placement and exposure of image qualityindicators (IQI's or Penetrometers).

e) ASTM wire type IQI's are preferred. The OWNER may permit the use of ASTM hole type IQI's on a pre-approved basis, provided the NDT CONTRACTOR can demonstrate satisfactory results.

f) Radiographic technique shall produce maximum contrast and good definition of IQI wires and shall obtain minimum radiographic density of 2.0 in the weld image. Fluorescent intensifying screens shall not be used.

g) Max radiographic density shall be 4.0 in all areas of the weld and parent metal.

h) The inability to view the appropriate wire or hole on any radiograph shall be cause for automatic rejection of that radiograph which shall be re-radiographed at no expense to the OWNER.

i) The Contractor shall fulfil all the statutory and owner's safety requirements while handling X-ray andGamma-ray equipment's .

j) The joints for Radiography shall be selected by the Owner's Inspector and the Radiography shall be performed in his presence, if he instructs the contractor to do so. The contractor shall furnish all the radiographs, to the Owner's Inspector immediately after processing along with evaluation by a person

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qualified to ASNT Level-II in Radiographic testing. The certificate of ASNT Level-II (RT) personnel shallbe submitted to owner's inspector for his approval prior to start of job.

k) The Contractor shall provide the Owner's Inspector all the necessary facilities at site such as a dark room with controlled temperature, illuminator (viewer) suitable varying densities, a duly calibrated electronic densitometer with batteries, magnifying glass, tracing papers, ruler marking pencils etc. to enable him to review the radiographs.

5.6.2 Operator Certification

a) Radiographers supplied by the contractor shall be certified to ASNT Level II, AWS QC1 and as per AWS B1.10 (guide for non-destructive inspection of welds).

b) An operator qualified to ASNT Level I may assist the Level II operator but all film and sentencing interpretation shall be carried out by a Level II or higher operator who shall sign off all report sheets.

c) Visual welding inspection shall be conducted only by a qualified welding inspector, who should preferably have a minimum AWS (QC.1) CWI or CSWIP 3.1 certification.

d) The OWNER shall review and approve all QA/QC personnel prior to deployment on the project.

5.6.3 MAGNETIC PARTICLE INSPECTION (MPI)

a) MPI shall be carried out in accordance with the requirements of ASME, Section V. Article 7, & Section VIII DIV 1, Appendix 6, and as modified by this specification.

b) AC electromagnetic yokes shall be used. A background of white contrast paint shall be used in conjunction with a black magnetic ink (wet particle). The technique shall be carried out in the continuous mode and two examinations shall be carried out right angles to cover for both transverse and longitudinal defects. There shall be sufficient overlap to allow 100% coverage.

c) All unacceptable or spurious indications found by this method shall be investigated and removed bygrinding followed by thickness check.

5.6.4 DYE PENETRATE INSPECTION (DPI)

a) DPI shall be carried out in accordance with the requirements of ASME BPV Section V, Article 6, & ASME Section VIII DIV 1, Appendix 8, and as modified by this specification.

b) Unless requested otherwise, DPI shall be carried out using the solvent removable method.

c) If necessary, welds may be lightly dressed to facilitate DPI testing or to assist in the interpretation ofany indications.

d) All unacceptable or spurious indications found by this method shall be investigated and removed bygrinding followed by thickness check.

5.6.5 ULTRASONIC WELD EXAMINATION (UT)

a) Ultrasonic operators supplied by the NDE CONTRACTOR shall be certified to General Standards Board (ASNT/PCN) approved by the OWNER.

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6.0 TABLE-I (with applicable notes)

TABLE 1: CLASS, TYPE & EXTENT OF WELD EXAMINATION

INSPN. CLASS	SERVICE	MATERIAL	TEMP (DEG.C)	PRESS. CLASS	TYPE OF EXAMINATION	TYPE OF WELD EXAMINED		
						GIRTH BUTT WELD	SOCKET WELD	ATTACH - MENT/ BRANCH WELD
I	RLNG/ NG	CARBON STEEL	-29 TO 65	300#	a) VISUAL	100%	100%	100%
					b) RADIOGRAPHY	100%	10% for gap check	100%
					c) LP, MP & UT	-	100%	-
					d) HARDNESS	NOTE a	NOTE a	NOTE a

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Notes:

a. Hardness Test:

i. Hardness test shall be in accordance with ASTM specification E10. Hardness tests of the heat affected zone shall be made at a point as near as practicable to the edge of the weld. One test perweld shall be performed.

ii. Hardness test where specifically called out in QAP (attached elsewhere in the bid document) or in Piping Material Specification (PMS), shall be carried out irrespective of thickness and to the extent (% age) as mentioned therein.

iii. All welds which are given heat treatment shall be hardness tested. Hardness test shall be performed after final heat treatment.

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iv. A minimum of 10% of welds of hot formed and hot bent materials in each heat treatment batch which are furnace heat treated and 100% of those which are locally heat treated, shall behardness tested.

v. For C-0.5 Mo steels, a minimum of 10% of welds shall be hardness tested.

vi. Hardness test requirement not covered in ii) & v) above shall be as per ASME B31 .3.

vii. The hardness limit applies to the weld and heat affected zone. Following hardness values shall be maintained:

Base Metal Group	**Maximum Hardness (BHN)**
CS	238 BHN

b. For branch connections, LP/ MP test shall be done on root pass and final pass.

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR INSPECTION, FLUSHING AND TESTING

ENG-STD-PI-DOC-TS-012

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1.0 SCOPE

This specification covers the general requirements for inspection, flushing and testing of piping systems.

Flushing and testing of all piping systems shall be witnessed by the owner/ consultant.

2.0 CODES AND STANDARDS

ASME B31.8 : Gas Transmission and Distribution piping systems

3.0 INSPECTION

During various stages and after completion of fabrication and erection, the piping system shall be inspected by the Engineer-In-Charge to ensure that:

- Proper piping material has been used.

- Piping has been erected as per drawings and instructions of Engineer-In-Charge.

- All supports have been installed correctly.

- Test preparations mentioned in this specification have been carried out.

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4.0 FLUSHING

Flushing of all lines shall be done before pressure testing.

Flushing shall be done by fresh potable water or dry compressed air, wherever water flushing is not desirable, to clean the pipe of all dirt, debris or loose foreign material Required pressure for water flushing shall meet the fire hydrant pressure or utility water pressure.

For air flushing, the line / system will be pressurized by compressed air at the required pressure which shall be 50 psi maximum. The pressure shall then be released by quick opening of a valve, already in line or installed temporarily for this purpose. This procedure shall be repeated as many times as required till the inside of the pipe is fully cleaned.

In line instruments like control valves, orifice plates, rotameters, safety valves and other instruments like thermowells which may interfere with flushing shall not be included in flushing circuit.

The screens / meshes shall be removed from all permanent strainers before flushing. Screens/meshes shall be reinstalled after flushing but before testing.

During flushing temporary strainers shall be retained. These shall be removed, cleaned andreinstalled after flushing but before testing.

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In case of equipment such as column, vessel, exchanger etc. form part of a piping circuit during flushing, this shall be done with the approval of Engineer-In-Charge. However, equipment's thus included in the circuit shall be completely drained and dried with compressed air after flushing is completed.

During flushing discharged water/air shall be drained to the place directed by the Engineer- In-Charge. If necessary, proper temporary drainage shall be provided by the contractor.

Care shall be taken during flushing so as not to damage/spoil work of other agencies. Precautions shall also be taken to prevent entry of water/foreign matter into equipment's , electric motors, instruments, electrical installations etc. in the vicinity of lines being flushed.

The contractor shall carry out all the activities required before, during and after the flushing operation, arising because of flushing requirements, such as but not limited to the following

Dropping of valves, specials, distance pieces, inline instruments and any other piping part before flushing. The flanges to be disengaged for this purpose shall be envisaged by the contractor and approved by the Engineer-In-Charge. These flanges shall be provided with temporary gaskets at the time of flushing.

After flushing is completed and approved, the valve distance pieces, piping specials etc. shall be reinstalled by the contractor with permanent gaskets. However, flanges at equipment nozzles and other places where isolation is required during testing, only temporary gaskets shall be provided.

Records in triplicate shall be prepared and submitted by the contractor for each piping system for the flushing done in the Performa provided/approved by the Engineer-in-Charge.

5.0 TESTING

Pressure testing, in general shall be as per requirements of ASME B31.8, unless otherwise specified.

5.1 Extent of Testing

With the exclusion of instrumentation, piping systems fabricated or assembled in the field shall be tested irrespective of whether or not they have been pressure tested prior to site welding of fabrication.

To facilitate the testing of piping systems, vessels and other equipment's may be included inthe system with the prior approval of Engineer-In-Charge if the test pressure specified is equal to or less than that for the vessels and other equipment's .

Pumps, compressors and other rotary equipment's shall not be subjected to field test pressure.

Lines which are directly open to atmosphere such as vents, drains, safety valves discharge need not be tested, but all joints shall be visually inspected. Wherever necessary, such lines shall be tested by continuous flow of fluid to eliminate the possibility of blockade.

Seats of all valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Test pressure applied to valves shall not be greater than the manufacturer's recommendation nor less than that required by the applicable code. Where allowable seat pressure is less than test pressure, test shall be made through an open valve.

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Instruments in the system to be tested shall be excluded from the test by isolation orremovals, unless approved otherwise by the Engineer-In-Charge.

Restrictions which interfere with filling, venting and draining such as orifice plates etc. shallnot be installed unless testing is complete.

Control valves shall not be included in the test system. Where bypasses are provided testshall be performed through the bypass and necessary spool shall be used in place of the control valve.

Pressure gauges which are part of the finished system, but cannot withstand test pressure shall not be installed until the system has been tested. Where piping systems to be tested are directly connected at the battery limits to piping for which the responsibility rests with other agencies, the piping to be tested shall be isolated from such piping by physical disconnection such as valve or blinds.

5.2 General Requirements / Test Preparation for Testing

Testing shall be carried out with permanent gaskets installed unless specified otherwise or instructed by the Engineer-in-Charge.

No pressure test shall be carried out against closed valve unless approved by the Engineer-in-Charge.

The Engineer-in-Charge shall be notified in advance by the Contractor, of the testingsequence and program, to enable him to be present for witnessing the test.

Before testing, all piping shall be cleaned by flushing to make it free from dirt, loose scale,debris and other loose foreign materials.

All piping systems to be hydrostatically tested shall be vented at the high points and thesystems purged of air before the test pressure is applied.

Wherever in the line any void exists due to any reasons, like absence of control valves,safety valves, check valves etc. it shall be filled with temporary spools.

All joints welded, screwed or flanged shall be left exposed for examination during the test. Before pressuring the lines, each weld joint shall be cleaned by wire brush to free it fromrust and any other foreign matter.

Where a system is to be isolated at a pair of companion flanges, a blank shall be inserted between the companion flanges. Minimum thickness of the blank shall be designed in accordance with applicable design code.

Open ends of piping system where blanks cannot be used, such as pumps, compressors, turbines or wherever equipment or pipe spools have been recovered or disconnected prior to hydrostatic testing, shall be blinded off by using standard blind flanges of same rating as the piping system being tested.

Pressure gauges used in testing shall be installed as close as possible to the lowest point inthe piping system to be tested, to avoid overstressing of any of the lower portions of the system. For longer lines and vertical lines, two or more pressure gauges shall be installedat locations decided by the Engineer-in-Charge.

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For lines containing check valves any of the following alternatives shall be adopted forpressure testing:

Whenever possible pressurize up-stream side of valve.

Replace the valve by a temporary spool and reinstall the valve after testing.

Provide blind on valve flanges and test the upstream and downstream of the line separatelyand remove the blind after testing. At these flanges, temporary gaskets shall be provided during testing and shall be replaced by permanent gaskets subsequently.

For check valves in lines 1 1/2" and below flapper or seat shall be removed during testing (ifpossible). After completion of testing the flapper/seat shall be refitted.

Gas lines when hydrostatically tested shall be provided with additional temporary supports during testing as directed by the Engineer-in-Charge.

Piping which is spring or counter-weight supported shall be temporarily supported, where the weight of the fluid would overload the support. Retaining pins for spring supports shall be removed only after testing is completed and test fluid is completely drained.

When testing any piping system, air or steam of approximately 2 kg/cm^2 (g) may be used as preliminary test to detect missing gaskets etc. as this avoids the necessity of draining the line to make repairs. However, steam shall not be used for this purpose, if the steam temperature is more than the design temperature of the line.

For jacketed pipes testing of core pipes shall be done on individual pieces where the pipe is continuously jacketed, before it is jacketed. The outer jacket shall be tested separately as a system. For piping with discontinuous jacketing the core pipe and the jacket shall be tested as separate continuous systems.

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5.3 Testing Media, Test Pressure and Test Pressure Gauges

5.3.1 Testing Media

In general all pressure test shall be hydrostatic using iron free water, which is clean andfree of silt. Maximum chlorine content in water for hydrostatic testing shall be 15-20 PPM.Air shall be used for testing only if water would cause corrosion of the system or overloading of supports etc. in special cases as directed by Engineer-in-Charge.

Where air/water tests are undesirable, substitute fluids such as gas oil, kerosene, methanol etc. shall be used as the testing medium, with due consideration to the hazards involved. These test fluids shall be specified in the line list given to the contractor.

5.3.2 Test Pressure

The hydrostatic/pneumatic test pressure shall be as indicated in the line list or as per the instruction of Engineer-in-Charge.

The selection of the piping system for one individual test shall be based on the following:

a. Test pressure required as per line list.

b. Maximum allowable pressure for the material of construction of piping.

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Depending upon the above requirements and based on construction progress, maximum length of piping shall be included in each test.

5.3.3 Test Pressure Gauge

All gauge used for field testing shall have suitable range so that the test pressure of the various system falls in 35% to 65% of gauge scale range. Pressure gage shall be minimum of 150 mm. Size of Bourdon shall not be less than 75% of nominal diameter of dial range. Gauge shall be of a good quality and in first class working condition.

Prior to the start of any test or periodically during the field test programmes, all test gauges shall be calibrated using a standard dead weight gauge tester or other suitable approved testing apparatus. Any gauge having an incorrect zero reading or error of more than ± 2% of full scale range shall be discarded. The Engineer-in-charge shall check the accuracy of master pressure gauge used for calibration.

5.4 Testing Procedure

5.4.1 Hydrostatic Test

All vents and other connections used as vents shall be left open while filling the line withtest fluid for complete removal of air. In all lines for pressurizing and depressurizing the system, temporary isolating valves shall be provided if valves vents, drains do not exist in the system.

Pressure shall be applied only after the system / line is ready and approved by the Engineer-in- charge.

Pressure shall be applied by means of a suitable test pump or other pressure source which shall be isolated from the system as soon as test pressure is reached and stabilized in the system.

A pressure gauge shall be provided at the pump discharge for guidance in bringing the system to the required pressure.

The pump shall be attended constantly during the test by an authorized person. The pump shall be isolated from the system whenever the pump is to be left unattended.

Test pressure shall be maintained for a sufficient length of time to permit thorough inspection of all joints for leakage or signs of failure. Any joint found leaking during a pressure test shall be retested to the specified pressure after repair. Test period shall be maintained for a minimum of three hours.

The pump and the piping system to be tested are to be provided with separate pressure indicating test gauges. These gauges are to be checked by the standard test gauge before each pressure test.

Care shall be taken to avoid increase in the pressure due to temperature variation duringthe test.

5.4.2 Air Test

When testing with air, pressure shall be supplied by means of a compressor. The compressor shall be portable type with a receiver, after cooler and oil separator.

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Piping to be tested by air shall have joints covered with a soap and water solution so that the joints can be examined for leaks.

All other details shall be same as per hydrotesting procedure (specified above)

5.5 Completion of Testing

After the hydrostatic test has been completed, pressure shall be released in a manner and at a rate so as not to endanger personnel or damage equipment's .

All vents and drains shall be opened before the system is to be drained and shall remain open till all draining is complete, so as to prevent formation of vacuum in the system. After draining, lines / systems shall be dried by air.

After testing is completed the test blinds shall be removed and equipment/ piping isolated during testing shall be connected using the specified gaskets, bolts and nuts. These connections shall be checked for tightness in subsequent pneumatic tests to be carried out by the contractor for complete loop/ circuit including equipment's (except rotary equipment's).

Pressure test shall be considered complete only after approved by the Engineer-in-Charge. Defects, if any, noticed during testing shall be rectified immediately and retesting of the system / line shall be done by the contractor at his cost.

5.6 Test Records

Records in triplicate shall be prepared and submitted by the contractor for each piping system, for the pressure test done in the Performa provided/approved by the Engineer-in- Charge.

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DATA SHEET FOR FITTINGS

Sr. No.	Description	Specification
GENERAL		
1	Size	0.5 to 24" NB
1	Schedule no./Class Rating	
a)	Butt-welded fittings	STD/XS/ SCH.20,30,40,60,80,160
b)	Socket welded fittings, sock-o-let and weld-o-let	3000#, 6000#
SERVICE CONDITIONS		
2	Service Fluid	Natural Gas
3	Temperature	-29 to 65 °C
4	Design Pressure	19 Bar-g/ 49 Bar-g/ 98 Bar-g
5	Operating Pressure Maximum	19 Bar-g/49 Bar-g/ 98 Bar-g
CONSTRUCTION DESIGN		
6	Design Standard	ASME B 16.9/ASME B 16.11/MSS SP 75
7	Allowable Stress Value	ASME B 31.8
8	Bevelled angle	$32.5^{o} \pm 2.5^{o}$
MATERIAL SPECIFICATION		
	Part	**Specified Material**
9	Material of Construction	ASTM A105/ASTM A 234 Gr. WPB/ASTM A 694, ASTM A 350 Gr. LF2/ASTM A 420 WPL 6/MSSSP75
TESTING & INSPECTION		
10	Proof test	ASME B 16.9
11	Charpy Impact Test	ASTM A 370
12	Hardness test	• A105 - 187 BHN max. • A234 - 197HBW max • ASTM A 350 & A420 WPL6 - 197HBW max • MSS SP 75 - 235 BHN max

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13	Tensile test	• A105 -TS-485MPa min • A234 TS-415MPa min • A350 LF2 TS-485-655 MPa, • A420 WPL6 TS-415-655MPa , • MSS SP 75 WPHY 52 TS-455MPa min
14	Yield strength (Minimum)	• A105 YS-250MPa min • A234 YS-240MPa min • A350 LF2 YS-250MPa min; • A420 WPL6 YS-240MPa min • MSS SP 75 WPHY 52 YS-358MPa min
15	Elongation	AS PER APPLICABLE CODE
16	Reduction Ratio	AS PER APPLICABLE CODE
17	UT	100% Surface
18	MPT	100% at Bevel Ends
19	DPT (if thickness less than 6MM)	100%
20	Marking	MSS SP 25

NOTE:-

1. Bidder shall clearly mention deviation, if any.
2. Welded fittings shall be normalized and 100% radiographed.

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	DATA SHEET FOR FLANGES ABOVE 6”	**Doc No.** / DS/ MECH/ 010 Page 1 of 1

Sr. No.	Description	Specification
GENERAL		
1	Size	6” to 24’’ NPS
2	Class Rating	150#,300#, 600#
SERVICE CONDITIONS		
3	Service Fluid	Natural Gas
4	Temperature	-29 to 65 °C
5	Design Pressure	19 Bar-g/ 49 Bar-g/ 98 Bar-g
6	Operating Pressure Maximum	19 Bar-g/49 Bar-g/ 98 Bar-g
CONSTRUCTION DESIGN		
7	Design Standard	ASME B 16.5/ASME B 16.47/ASME B 16.48
8	Allowable Stress	ASME B 31.3
9	Flange Type	WNRF/BLRF/ SORF
10	Flange Facing	Raised face(125 AARH) / Ring Type Joint
11	Bevel End & Bevel Angle for WNRF	32.5º+2.5º
MATERIAL SPECIFICATION		
	Part	**Specified Material**
12	Material of Construction	• ASTM A105, • ASTM A 350 Gr. LF2 • MSS SP 44 F 52
13	Studs and Bolts	ASTM A 193 GR. B7/ASTM A 194 Gr. 2H (HDG)
TESTING & INSPECTION		
15	Charpy Impact Test	ASTM A 370
16	Hardness test	• ASTM A105 - 187 BHN max. • ASTM A 350 LF2- 197HBW max. • MSS SP 44 Gr. F 52 -359MPa min.
17	Tensile test	• A105 -485 MPa min. • A350 LF2-485-655 MPa • MSS SP 44 Gr. F 52 -455 MPa min.
18	Elongation	AS PER APPLICABLE CODE
19	Reduction Ratio	AS PER APPLICABLE CODE
20	UT	100% Surface
21	MPT	100% at Bevel Ends
22	DPT (if thickness less than 6MM)	100%
23	Marking	MSS SP 25

BGL/632/0625

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DATA SHEET FOR FLANGES			
Sr. No.	Description		Specification
GENERAL			
1	PMS		
2	Class Rating		150#,300#, 600#
3	Diameter		0.5”-6”
SERVICE CONDITIONS			
4	Service Fluid		Natural Gas
5	Temperature	Minimum	-29 °C
		Maximum	65 °C
6	Operating Pressure Maximum		19/49/98 Bar-g
CONSTRUCTION DESIGN			
7	DESIGN STANDARD		ASME B 16.5/ASME B 16.47/ASME B 16.48
8	Allowable Stress Valve		ASME B 31.3
MATERIAL SPECIFICATION			
	Part		Specified Material
9	Material of Construction		ASTM A105
10	Flange Type		Weld Neck
11	Flange Facing		Raised Face 125 AARH
12	Studs and Bolts		ASTM A 193 B7/ASTM A 194 Gr 2H
TESTING & INSPECTION			
13	Hydrostatic Test		1.5 times the Pressure Design
14	Charpy Impact Test		ASTM A 370
15	Marking		MSS SP 25
NOTE:-			
1. Bidder shall clearly mention deviation, if any.			

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DATA SHEET FOR FLANGES			
Sr. No.	Description		Specification
GENERAL			
1	Class Rating		150#,300#, 600#
2	Diameter		0.5”-6”
SERVICE CONDITIONS			
3	Service Fluid		Natural Gas
4	Temperature	Minimum	As per PMS
		Maximum	As per PMS
5	Operating Pressure Maximum		As per PMS
CONSTRUCTION DESIGN			
6	Design Standard		ASME B 16.5/ASME B 16.47/ASME B 16.48
7	Allowable Stress Valve		ASME B 31.3
MATERIAL SPECIFICATION			
	Part		Specified Material
8	Material of Construction		ASTM A 106 Gr. B (Charpy)
10	Flange Type		Weld Neck Type
11	Flange Facing		Raised Face 125 AARH
12	Studs and Bolts		ASTM A 193 Gr. B7/ ASTM A194 Gr. 2H
TESTING & INSPECTION			
13	Hydrostatic Test		1.5 times the Pressure Design
14	Charpy Impact Test		ASTM A 370
15	Marking		MSS SP 25
NOTE:-			
1. Bidder shall clearly mention deviation, if any.			

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			QUALITY ASSURANCE PLAN FOR FASTNER			QAP NO: / FASTNER/001 REV: 00 DT:		
PROJECT :			ITEM DETAIL :					
CLIENT :			QAP NO:					
CONSULTANT :			REV NO. & DATE:					
MANUFACTURER NAME :			REF DOC:					
TPIA/ INSPECTION:			PO NO:					
CONTRACTOR :					PO NO :	DT:		
SR. NO	COMPONENTS & OPERATIONS	TYPES OF CHECK	QUANTAM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMET OF RECORD	INSPECTION	
							MANUFACTURER	TPI/CLIENT
1	RAW MATERIAL							
	RAW MATERIAL	1. MANUFACTURING PROCESS OF STEEL	PER HEAT	MOC	MOC	MTC / LAB TEST REPORT 3.1	R	R
		2. CHEMICAL COMPOSITION	PER HEAT	MOC	MOC	MTC / LAB TEST REPORT 3.1	R	R
		3. MECHANICAL PROPERTIES	PER HEAT	MOC	MOC	INSPECTION REPORT 3.1	R	R
		4. VISUAL	100%	MOC	MOC	INSPECTION REPORT 3.2	P	W
2	INPROCESS INSPECTION.							
	1. MFG. OF BOLT & NUT	1.CUTTING , GRINDING, FORGING, THREADING ETC.	100%	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	DIMENSION REPORT 3.1	P	R
		2. PRODUCT DIMENSIONS	100%	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	DIMENSION REPORT 3.1	P	R
	2. HEAT TREATMENT	1. HEAT TREATMENT CYCLE	TEMP. / TIME	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	HT GRAPH / INSPECTION REPORT 3.1	P	R
	3.STAMPING OF SAMPLE FOR	1. STAMPING OF TEST SAMPLE	100%	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	INSPECTION REPORT 3.2	P	W
	4. MECHANICAL TESTING	1. TENSILE TESTING (TS,YS,EL%)	ONE / HEAT/LOT	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	INSPECTION REPORT 3.2	P	W
		2. PROOF LOAD TEST	ONE / HEAT/LOT	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	INSPECTION REPORT 3.2	P	W
		3. HARDNESS TESTING	ONE / HEAT/LOT	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	INSPECTION REPORT 3.2	P	W
		4. IMPACT TEST AT -101° C , NOTE - 4	ONE / HEAT/LOT	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	INSPECTION REPORT 3.2	P	W
	5. PRODUCT CHEMICAL CHECK ANALYSIS	1. CHEMICAL ANALYSIS	ONE / HEAT/LOT	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	INSPECTION REPORT 3.2	P	W
		2. PMI TEST	ONE / HEAT/LOT	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	INSPECTION REPORT 3.2	P	W
3	FINAL INSPECTION							
	FINAL INSPECTION	1. VISUAL\ STAMPING \ MARKING	100%	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	INSPECTION REPORT 3.2	P	100% W
		2. DIMENSIONS	100%	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	INSPECTION REPORT 3.2	P	100% W
4	FINAL DOCUMENTS							
	FINAL DOCUMENTS	1. QAP / PO / MTC / IR / COMPLIANCE CERTIFICATES	100%	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	COMPLIANCE CERTIFICATE	P	R
		2. INSPECTION RELEASE NOTE	100%	VENDOR DRG./ TECHNICAL SPEC.	VENDOR DRG./ TECHNICAL SPEC.	COMPLIANCE CERTIFICATE	H	P

BOL/32204-25

Legend: P-Perform, R-Review, W-Witness, H-Hold TPIA-Third Party Inspection Agency

NOTE:

1. **TPIA SHALL ISSUE 3.2 CERTIFICATE AS PER BS EN 10204**
2. **MATERIAL & TYPE SHALL BE AS PER TENDER SPECS/DATA SHEET**
3. **SAMPLE FROM ANY ONE LOT/HEAT SHALL BE TESTED BY CLIENT UNDER THEIR WITNESS THIRD PARTY LAB AT DISCRETION**
4. **AVERAGE J VALVE (27 J) AND ONE SPECIMEN 'J' VALUE (20J) SHALL BE MAINTAINED.**

PREPARED BY:	APPROVED BY	REVIEWED & ACCEPTED BY	
		CONSULTANT	CLIENT

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			QUALITY ASSURANCE PLAN FOR GASKET				**QAP NO: /GASKET/001**	
							REV: 00 DT:	
PROJECT :			**ITEM DETAIL :**					
CLIENT :			**QAP NO:**					
CONSULTANT :			**REV NO. & DATE:**					
MANUFACTURER NAME :			**REF DOC:**					
TPIA/ INSPECTION:			**PO NO:**					
CONTRACTOR :					**PO NO :**	**DT:**		
SR. NO	**COMPONENTS & OPERATIONS**	**TYPES OF CHECK**	**QUANTAM OF CHECK**	**REFERENCE DOCUMENTS**	**ACCEPTANCE NORMS**	**FORMET OF RECORD**	**INSPECTION**	
							MANUFACTURER	**TPI/CLIENT**
1	**RAW MATERIAL**							
	1. SPIRAL WOUND GASKET WINDING MATERIAL SS316/316L	CHEMICAL TESTING	100%	ASME B 16.20 /ASTM A 240 /TENDER SPEC.	ASME B 16.20 /ASTM A 240 /TENDER SPEC.	MTC/LAB TEST REPORT 3.1	P	R
		PHYSICAL TESTING	PER HEAT	ASME B 16.20 /ASTM A 240 /TENDER SPEC.	ASME B 16.20 /ASTM A 240 /TENDER SPEC.	MTC/LAB TEST REPORT 3.1	P	R
	2.FILLER MATERIAL GRAPHITE	CHEMICAL TESTING	100%	AS PER APPLICABLE CODE OF MAT. / ASME B 16.20	AS PER APPLICABLE CODE OF MAT. / ASME B 16.20	MTC/LAB TEST REPORT 3.1	P	R
	3.OUTER RING MATERIAL CARBON STEEL	CHEMICAL TESTING	100%	ASME B 16.20 /ASTM A 240 /TENDER SPEC.	ASME B 16.20 /ASTM A 240 /TENDER SPEC.	MTC/LAB TEST REPORT 3.1	P	R
		PHYSICAL TESTING	PER HEAT	ASME B 16.20 /ASTM A 240 /TENDER SPEC.	ASME B 16.20 /ASTM A 240 /TENDER SPEC.	INSPECTION REPORT 3.1	P	R
2	**INPROCESS INSPECTION**							
	FINISH INSPECTION	FINISH DIMENSION MEASURING OF SPW	100%	APPR. VENDOR DRG/ASTM A 240 / ASME B 16.2	APPR. VENDOR DRG/ASTM A 240 / ASME B 16.2	DIMENSION REPORT 3.1	P	R
	COMPRESSION & RECOVERY	TESTING SPW	ONE/SIZE/LOT	ASTM A 370/ ASME B 16.20	ASTM A 370/ ASME B 16.20	INSPECTION REPORT 3.1	P	R
	MARKING	VISUAL	100%	APPR. VENDOR DRG/ASTM A 240 / ASME B 16.2	APPR. VENDOR DRG/ASTM A 240 / ASME B 16.2	INSPECTION REPORT 3.2	P	W
3	**FINAL INSPECTION**							
	FINAL INSPECTION	1.VISUAL/TAGGING/ MARKING	100%	TENDER SPEC./ASME B 16.20	TENDER SPEC./ASME B 16.20	INSPECTION REPORT 3.2	P	100% W
		2. DIMENSIONS	100%			INSPECTION REPORT 3.2	P	100% W
4	**FINAL DOCUMENTS**							
	FINAL DOCUMENTS	QAP/PO/MTC/IR/COMPLINACE CERTIFICATE	100%	AS PER TENDER SPEC./ AS PER DRG. & QAP	AS PER TENDER SPEC./ AS PER DRG. & QAP	COMPLINANCE CERTIFICATE	P	R
		INSPECTION RELEASE NOTE	100%	AS PER TENDER SPEC./ AS PER DRG. & QAP	AS PER TENDER SPEC./ AS PER DRG. & QAP	COMPLINANCE CERTIFICATE	H	P

Legend: P-Perform, R-Review, W-Witness, H-Hold TPIA-Third Party Inspection Agency

NOTE:

1. TPIA SHALL ISSUE 3.2 CERTIFICATE AS PER BS EN 10204

2. MATERIAL & TYPE SHALL BE AS PER TENDER SPECS/DATA SHEET

PREPARED BY:	APPROVED BY	REVIEWED & ACCEPTED BY	
		CONSULTANT	CLIENT

BGL/632/2024-25

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Date: 2024.09.16 18:15:02 IST

			QUALITY ASSURANCE PLAN FOR FITTINGS (300 # & 600#)			QAP NO: /FITTINGS/001 REV: 00 DT:		
PROJECT :			**ITEM DETAIL :**					
CLIENT :			**QAP NO:**					
CONSULTANT :			**REV NO. & DATE:**					
MANUFACTURER NAME :			**REF DOC:**					
TPIA/ INSPECTION:			**PO NO:**					
CONTRACTOR :					**PO NO :**	**DT:**		
SR. NO	**COMPONENTS & OPERATIONS**	**TYPES OF CHECK**	**QUANTAM OF CHECK**	**REFERENCE DOCUMENTS**	**ACCEPTANCE NORMS**	**FORMET OF RECORD**	**INSPECTION**	
							MANUFACTURER	**TPI/CLIENT**
1	**RAW MATERIAL**							
	RAW MATERIAL	1. MANUFACTURING PROCESS OF STEEL	PER HEAT	ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 350 LF 2 / TENDER SPEC.	MTC / LAB TEST REPORT 3.1	P	R
		2. CHEMICAL COMPOSITION	PER HEAT	ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 350 LF 2 / TENDER SPEC.	MTC / LAB TEST REPORT 3.1	P	R
		3. MECHANICAL PROPERTIES	PER HEAT	ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 350 LF 2 / TENDER SPEC.	INSPECTION REPORT 3.1	P	R
		4. VISUAL	100%	ASTM A 350 LF 2 / TENDER SPEC./ ASME B 16.5	ASTM A 350 LF 2 / TENDER SPEC./ ASME B 16.5	INSPECTION REPORT 3.2	P	W
2	**INPROCESS INSPECTION.**							
	1. FORGINGS	1. REDUCTION RATING	ONE PER SIZE	ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 350 LF 2 / TENDER SPEC.	DIMENSION REPORT 3.1	P	R
		2.TEMP. DURING FORGING (OPTIONAL PYROMETER)	ONE PER SIZE	ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 350 LF 2 / TENDER SPEC.	DIMENSION REPORT 3.1	P	R
		FORGINNG DIMENSIONS	100%	APPR. VENDOR DRG./ ASTM A 350 LF 2 / ASME B 16.5/ ASME B 16.11 / TENDER SPEC.	APPR. VENDOR DRG./ ASTM A 350 LF 2 / ASME B 16.5/ ASME B 16.11 / TENDER SPEC.	DIMENSION REPORT 3.1	P	R
	2. HEAT TREATMENT	1. HEAT TREATMENT CYCLE	TEMP. / TIME	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	HT GRAPH / INSPECTION REPORT 3.1	P	R
	3.MACHINING	1.MACHINING OF FORGING	100%	APPR. VENDOR DRG./ ASTM A 350 LF 2 / ASME B 16.5/ ASME B 16.11 /	APPR. VENDOR DRG./ ASTM A 350 LF 2 / ASME B 16.5/ ASME B 16.11 / TENDER SPEC.	DIMENSION REPORT 3.1	P	R
	4. MECHANICAL TESTING	1. TENSILE TESTING (TS,YS,EL%)	ONE / HEAT/LOT	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	INSPECTION REPORT 3.2	P	W
		2.HARDNESS TESTING	100% OF LOT SIZE	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	INSPECTION REPORT 3.2	P	W
		3. MICRO TEST	100% OF LOT SIZE	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	INSPECTION REPORT 3.2	P	W
		4. IMPACT TEST AT -20° C ,	ONE / HEAT/LOT	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	AVG. 35 J & IND 28 J / TENDER SPEC.	INSPECTION REPORT 3.2	P	W
		AT -46° C ,			AVG. 27 J & IND 20 J / TENDER SPEC.			
	5. NDT(WHICHEVER IS APPLICABLE)	1. DP	100%	ASME Section V	SEC. VIII DIV. 2 ART.9 - AM 9.2	INSPECTION REPORT 3.2	P	W
		2. MPT	100%	ASME Section V	ASME SEC. VIII DIV. 1 APPENDIX 6	INSPECTION REPORT 3.2	P	W
		3. UT	100%	ASME Section V	ASME SEC. VIII DIV. 1 UF-55	INSPECTION REPORT 3.2	P	W
		3.1 BASE MATERIAL (IF WT ≥ 6 MM)						
		3.2 BEVEL						
3	**FINAL INSPECTION**							
	FINAL INSPECTION	1. VISUAL\ TAGGING \ MARKING	100%	ASTM A 350 LF 2 / TECHNICAL SPEC/ ASME B 16.5 / B 16.11	ASTM A 350 LF 2 / TECHNICAL SPEC/ ASME B 16.5 / B 16.11	INSPECTION REPORT 3.2	P	100% W
		2. DIMENSIONS	100%	ASTM A 350 LF 2 / TECHNICAL SPEC/ ASME B 16.5 / B 16.11	ASTM A 350 LF 2 / TECHNICAL SPEC/ ASME B 16.5 / B 16.11	INSPECTION REPORT 3.2	P	100% W
4	**FINAL DOCUMENTS**							
	FINAL DOCUMENTS	1. QAP / PO / MTC / IR / COMPLIANCE CERTIFICATES	100%	AS PER TECHNICAL SPEC./ AS PER APPVD. DGW. & QAP	AS PER TECHNICAL SPEC./ AS PER APPVD. DGW. & QAP	COMPLIANCE CERTIFICATE	P	R
		2. INSPECTION RELEASE NOTE	100%	AS PER TECHNICAL SPEC./ AS PER	AS PER TECHNICAL SPEC./ AS PER APPVD. DGW.	COMPLIANCE CERTIFICATE	H	P

BGL/63/2024-25

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Date: 2024.09.16 18:15:02 IST

	QUALITY ASSURANCE PLAN FOR FITTINGS (300 # & 600#)	QAP NO: /FITTINGS/001 REV: 00 DT:
PROJECT :	**ITEM DETAIL :**	
CLIENT :	**QAP NO:**	
CONSULTANT :	**REV NO. & DATE:**	
MANUFACTURER NAME :	**REF DOC:**	
TPIA/ INSPECTION:	**PO NO:**	
CONTRACTOR :	**PO NO :** **DT:**	

SR. NO	COMPONENTS & OPERATIONS	TYPES OF CHECK	QUANTAM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMET OF RECORD	INSPECTION	
							MANUFACTURER	TPI/CLIENT
				APPVD. DGW. & QAP	& QAP			

Legend: P-Perform, R-Review, W-Witness, H-Hold TPIA-Third Party Inspection Agency

NOTE:

1. TPIA SHALL ISSUE 3.2 CERTIFICATE AS PER BS EN 10204

2. MATERIAL & TYPE SHALL BE AS PER TENDER SPECS/DATA SHEET

3. FOR ALL FORGING MATERIALS , THE SPECIMEN SHALL BE TAKEN FROM THE INTEGRAL PART OF THE FORGING

4. START & STOP TEMP. CHART SHALL BE SIGNED BY TPIA , ALSO POWER FAILURE LOG SHALL BE MAINTAINED.

5 EACH HEAT OF STEEL USED FOR THE FORGE FITTINGS SHALL BE HAVE CARBON EQUIVALENT (CE) NOT GREATER THAN 0.45

6. RESIDUAL MAGNETISATION SHALL BE LESS THAN 15 GAUSS SHALL BE MEASURE AFTER MPI.

7. RED OXIDE PAINT TO BE APPLIED WITH MIN. DFT 50 MICRON AFTER SURFACE PREPARATION

3. SAMPLE FROM ANY ONE LOT/HEAT SHALL BE TESTED BY CLIENT UNDER THEIR WITNESS THIRD PARTY LAB AT DISCRETION

PREPARED BY:	APPROVED BY	REVIEWED & ACCEPTED BY	
		CONSULTANT	CLIENT

BGL/632/2024-25

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST

			QUALITY ASSURANCE PLAN FOR FLANGES WNRF & SPACER BLIND (300 # & 600#)				QAP NO: /FLANGES/001 REV: 00 DT:	
PROJECT :			ITEM DETAIL :					
CLIENT :			QAP NO:					
CONSULTANT :			REV NO. & DATE:					
MANUFACTURER NAME :			REF DOC:					
TPIA/ INSPECTION:			PO NO:					
CONTRACTOR :					PO NO :	DT:		
SR. NO	COMPONENTS & OPERATIONS	TYPES OF CHECK	QUANTAM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMET OF RECORD	INSPECTION	
							MANUFACTURER	TPI/CLIENT
1	RAW MATERIAL							
	RAW MATERIAL	1. MANUFACTURING PROCESS OF STEEL	PER HEAT	ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 350 LF 2 / TENDER SPEC.	MTC / LAB TEST REPORT 3.1	P	R
		2. CHEMICAL COMPOSITION	PER HEAT	ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 350 LF 2 / TENDER SPEC.	MTC / LAB TEST REPORT 3.1	P	R
		3. MECHANICAL PROPERTIES	PER HEAT	ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 350 LF 2 / TENDER SPEC.	INSPECTION REPORT 3.1	P	R
		4. VISUAL	100%	ASTM A 350 LF 2 / TENDER SPEC./ ASME B 16.5	ASTM A 350 LF 2 / TENDER SPEC./ ASME B 16.5	INSPECTION REPORT 3.2	P	W
2	INPROCESS INSPECTION.							
	1. FORGINGS	1. REDUCTION RATING	ONE PER SIZE	ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 350 LF 2 / TENDER SPEC.	DIMENSION REPORT 3.1	P	R
		2.TEMP. DURING FORGING (OPTIONAL PYROMETER)	ONE PER SIZE	ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 350 LF 2 / TENDER SPEC.	DIMENSION REPORT 3.1	P	R
		FORGINNG DIMENSIONS	100%	APPR. VENDOR DRG./ ASTM A 350 LF 2 / ASME B 16.5/ ASME B 16.11 / TENDER SPEC.	APPR. VENDOR DRG./ ASTM A 350 LF 2 / ASME B 16.5/ ASME B 16.11 / TENDER SPEC.	DIMENSION REPORT 3.1	P	R
	2. HEAT TREATMENT	1. HEAT TREATMENT CYCLE	TEMP. / TIME	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	HT GRAPH / INSPECTION REPORT 3.1	P	R
	3.MACHINING	1.MACHINING OF FORGING	100%	APPR. VENDOR DRG./ ASTM A 350 LF 2 / ASME B 16.5/ ASME B 16.11 /	APPR. VENDOR DRG./ ASTM A 350 LF 2 / ASME B 16.5/ ASME B 16.11 / TENDER SPEC.	DIMENSION REPORT 3.1	P	R
	4. MECHANICAL TESTING	1. TENSILE TESTING (TS,YS,EL%)	ONE / HEAT/LOT	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	INSPECTION REPORT 3.2	P	W
		2.HARDNESS TESTING	100% OF LOT SIZE	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	INSPECTION REPORT 3.2	P	W
		3. MICRO TEST	100% OF LOT SIZE	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	INSPECTION REPORT 3.2	P	W
		4. IMPACT TEST AT -20° C ,	ONE / HEAT/LOT	ASTM A 370/ASTM A 350 LF 2 / TENDER SPEC.	AVG. 35 J & IND 28 J / TENDER SPEC.	INSPECTION REPORT 3.2	P	W
		AT -46° C ,			AVG. 27 J & IND 20 J / TENDER SPEC.			
	5. NDT(WHICHEVER IS APPLICABLE)	1. DP	100%	ASME Section V	SEC. VIII DIV. 2 ART.9 - AM 9.2	INSPECTION REPORT 3.2	P	W
		2. MPT	100%	ASME Section V	ASME SEC. VIII DIV. 1 APPENDIX 6	INSPECTION REPORT 3.2	P	W
		3. UT	100%	ASME Section V	ASME SEC. VIII DIV. 1 UF-55	INSPECTION REPORT 3.2	P	W
		3.1 BASE MATERIAL (IF WT ≥ 6 MM)						
		3.2 BEVEL						
3	FINAL INSPECTION							
	FINAL INSPECTION	1. VISUAL\ TAGGING \ MARKING	100%	ASTM A 350 LF 2 / TECHNICAL SPEC/ ASME B 16.5 / B 16.11	ASTM A 350 LF 2 / TECHNICAL SPEC/ ASME B 16.5 / B 16.11	INSPECTION REPORT 3.2	P	100% W
		2. DIMENSIONS	100%	ASTM A 350 LF 2 / TECHNICAL SPEC/ ASME B 16.5 / B 16.11	ASTM A 350 LF 2 / TECHNICAL SPEC/ ASME B 16.5 / B 16.11	INSPECTION REPORT 3.2	P	100% W
4	FINAL DOCUMENTS							
	FINAL DOCUMENTS	1. QAP / PO / MTC / IR / COMPLIANCE CERTIFICATES	100%	AS PER TECHNICAL SPEC./ AS PER APPVD. DGW. & QAP	AS PER TECHNICAL SPEC./ AS PER APPVD. DGW. & QAP	COMPLIANCE CERTIFICATE	P	R
		2. INSPECTION RELEASE NOTE	100%	AS PER TECHNICAL SPEC./ AS PER APPVD. DGW. & QAP	AS PER TECHNICAL SPEC./ AS PER APPVD. DGW. & QAP	COMPLIANCE CERTIFICATE	H	P

Legend: P-Perform, R-Review, W-Witness, H-Hold TPIA-Third Party Inspection Agency

NOTE:

1. TPIA SHALL ISSUE 3.2 CERTIFICATE AS PER BS EN 10204
2. MATERIAL & TYPE SHALL BE AS PER TENDER SPECS/DATA SHEET
3. FOR ALL FORGING MATERIALS , THE SPECIMEN SHALL BE TAKEN FROM THE INTEGRAL PART OF THE FORGING
4. START & STOP TEMP. CHART SHALL BE SIGNED BY TPIA , ALSO POWER FAILURE LOG SHALL BE MAINTAINED.
5 EACH HEAT OF STEEL USED FOR THE FORGE FITTINGS SHALL BE HAVE CARBON EQUIVALENT (CE) NOT GREATER THAN 0.45

BGL/QAP/2024-25

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	QUALITY ASSURANCE PLAN **FOR FLANGES WNRF & SPACER BLIND (300 # & 600#)**	**QAP NO:** **/FLANGES/001** **REV: 00 DT:**
PROJECT :	**ITEM DETAIL :**	
CLIENT :	**QAP NO:**	
CONSULTANT :	**REV NO. & DATE:**	
MANUFACTURER NAME :	**REF DOC:**	
TPIA/ INSPECTION:	**PO NO:**	
CONTRACTOR :	**PO NO :** **DT:**	

SR. NO	COMPONENTS & OPERATIONS	TYPES OF CHECK	QUANTAM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMET OF RECORD	INSPECTION	
							MANUFACTURER	TPI/CLIENT
6. RESIDUAL MAGNETISATION SHALL BE LESS THAN 15 GAUSS SHALL BE MEASURE AFTER MPI.								
7. RED OXIDE PAINT TO BE APPLIED WITH MIN. DFT 50 MICRON AFTER SURFACE PREPARATION								
3. SAMPLE FROM ANY ONE LOT/HEAT SHALL BE TESTED BY CLIENT UNDER THEIR WITNESS THIRD PARTY LAB AT DISCRETION								

		REVIEWED & ACCEPTED BY	
PREPARED BY:	APPROVED BY	CONSULTANT	CLIENT

BGL/632/2024-25

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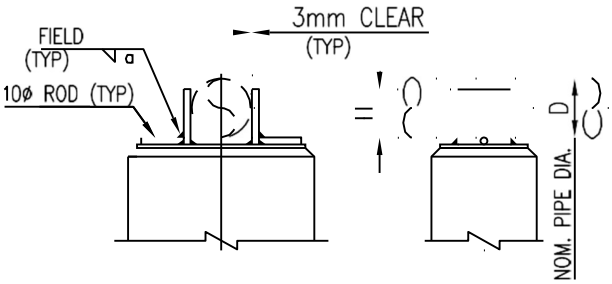
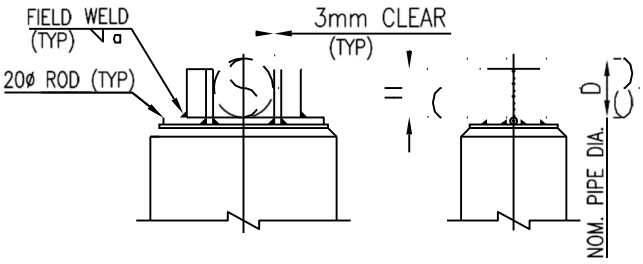
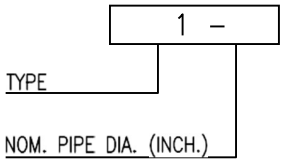


FOR SIZES UPTO 4"



FOR SIZES 6" THRU 24"



SYMBOL

D	H	a	METERIAL
2" SMALLER	40		FLAT 60 x 10
3" TO 4"	70		FLAT 75 x 10
6" TO 8"	130		NOS. ISA 50 x 50 x
10" TO 18"	230	10	2 NOS. ISA 75 x 75 x 10
20" TO 24"	350	10	2 NOS. ISA 90 x 90 x 10

BGL/63/2024-25

NOTES:–

1. GUIDE ANGLES SHOULD BE SUITABLY TRIMMED WHEREVER THESE OBSTRUCT ADJOINING GUIDE ANGLES.

REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
0	5-12-2015	ISSUED FOR STANDARD	SC	SM	AKG

GUIDE SUPPORT FOR BARE PIPE (SIZE 1/2" TO 24" TYPE GS-1)

SCALE: NTS (SHEET 1 OF 1) REV 0

ENG-STD-PI-DWG-TP-002

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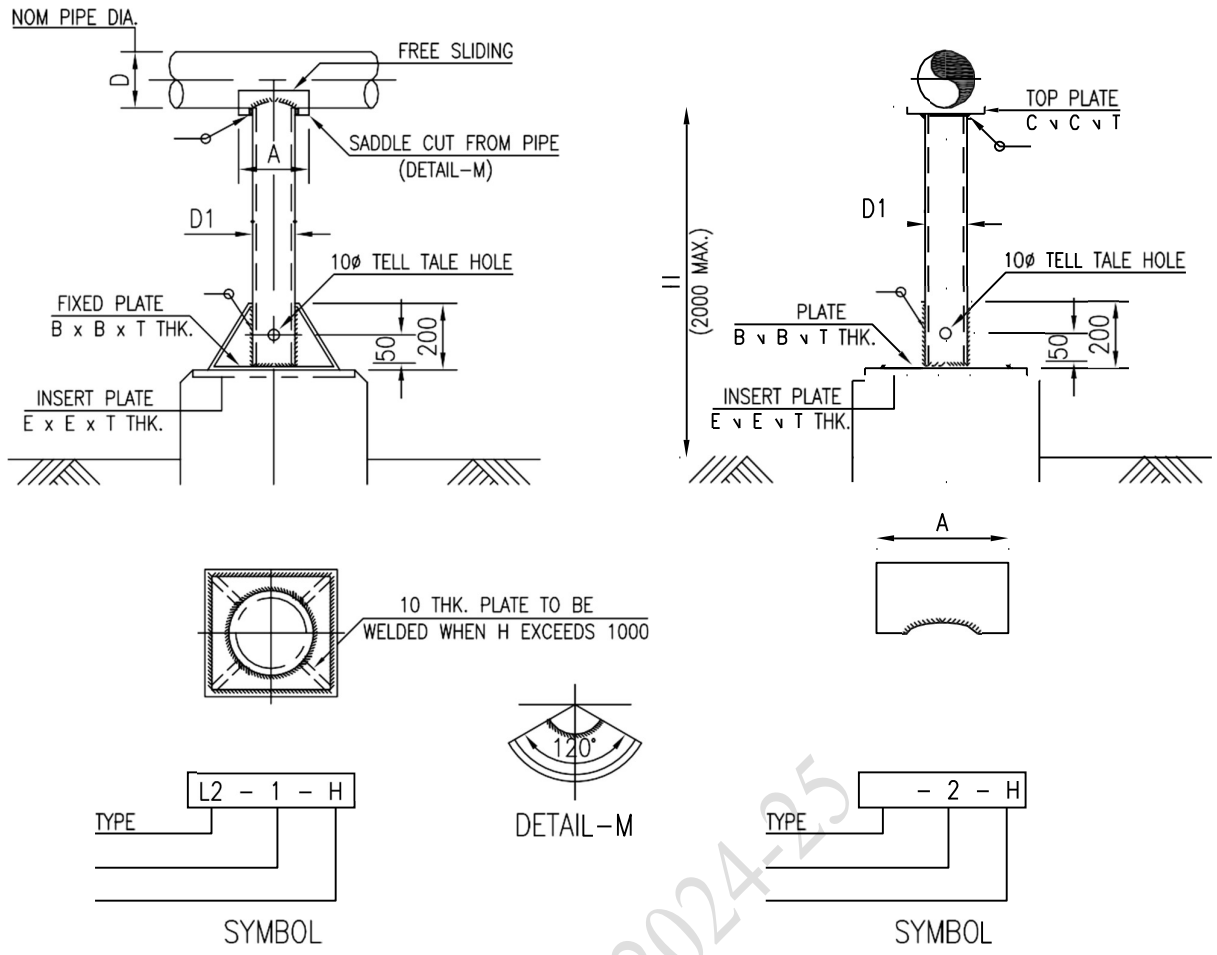

SIZE NO.	D	A	D1 (NOTE-1)	C	B	E	T
	3/4"	2" NB x 100 Lg.	2" HEAVY IS :1239	150	150	200	12
	1"						
	1.1/2"	3" NB x 100 Lg.		200			
	2"						
2	3"	6" NB x 150 Lg.	2" HEAVY IS :1239	200	150	200	12
	4"						
3	6"	10" NB x 250 Lg.	3" HEAVY IS :1239	300	200	250	16
	8"						
4	10"	14" NB x 350 Lg.	4" HEAVY IS :1239	350	200	250	16
	12"						
5	14"	18" NB x 350 Lg.	6" HEAVY IS :1239	400	250	300	20
	16"						
~~6~~	~~18"~~	~~20" NB x 350 Lg.~~	~~8" SCH. 40~~	~~400~~	~~300~~	~~350~~	~~20~~
	~~20"~~						
7		24" NB x 350 Lg.	10" SCH. 40	450	350	400	20
	24"						
8	~~26"~~	~~30" NB x 350 Lg.~~	12" ~~SCH.~~ 40	~~550~~	~~400~~	~~500~~	~~20~~
	~~30"~~						
	~~36"~~	~~36" NB x 400 Lg.~~					

NOTES:-

1. IN CASE AND/OR SUPPORT PIPE (D) LISTED IN THE TABLE IS NEXT HIGHER AND/OR AVAILABLE.

CARBON STEEL.

RGL/032/2024-25

REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
0	5-12-15	ISSUED FOR STANDARD	SC	SM	AKG

LOW SUPPORT SLIDING FOR BARE PIPE SIZE 3/4" THRU. 36" TYPE-L2 & L2A)

SCALE: NTS (SHEET 1 OF 1) REV 0

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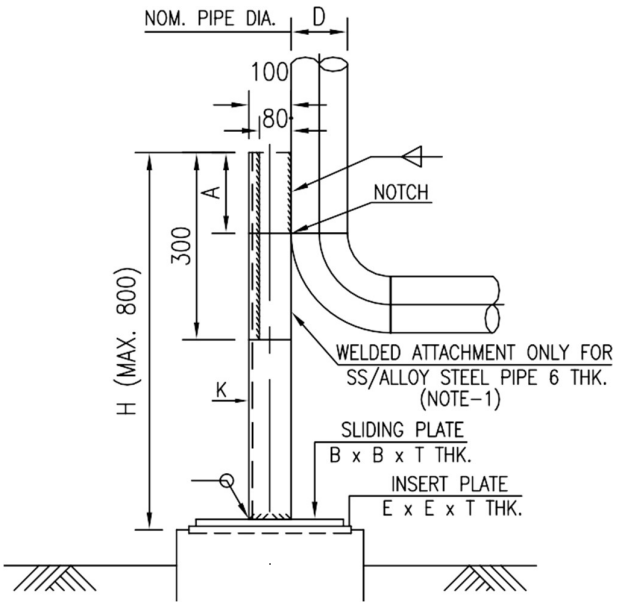
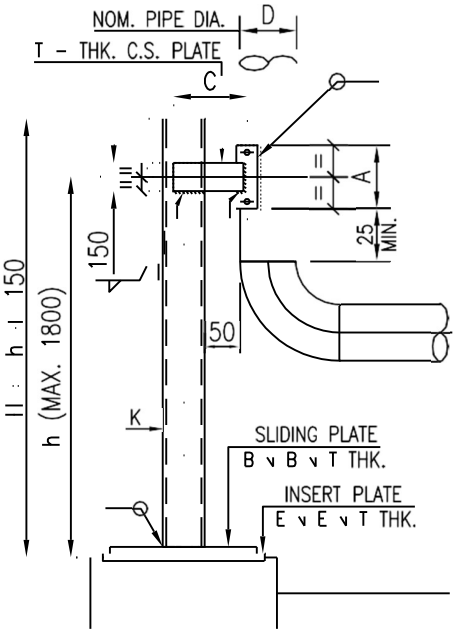
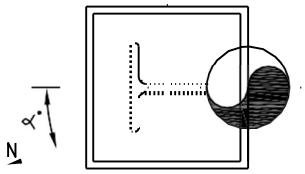
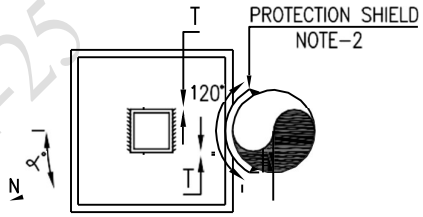




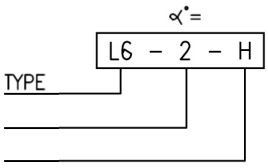


FOR PIPE SIZES 2" THRU 4"



FOR PIPE SIZES 6" THRU 24"

BGL/632/2024-25



SYMBOL

NOTES:-

1. MATERIAL FOR WELDED ATTACHMENT SHALL BE EQUIVALENT TO PIPE MATERIAL.
2. PROTECTION SHIELD IS TO BE CUT FROM LINE PIPE.

SIZE NO.	D	N	A	T	C	E	B
1	2" TO 4"	CUT FROM ISMB 200	200	10	-	250	150
2	6" TO 10"	ISMC-125 2 NOS.	200	12	150	300	200
3	12" TO 24"	ISMC-225 2 NOS.	300	12	230	400	300

FOR TEMP. UP TO 400 °C ONLY

REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD
0	5-12-15	ISSUED FOR STANDARD	SC	SM	AKG

LOW SUPPORT SLIDING FOR BARE & INSULATED PIPE SIZE 2" THRU. 24" TYPE-L6)

SCALE: NTS (SHEET 1 OF 1) REV

ENG-STD-PI-DWG-TP-004 0

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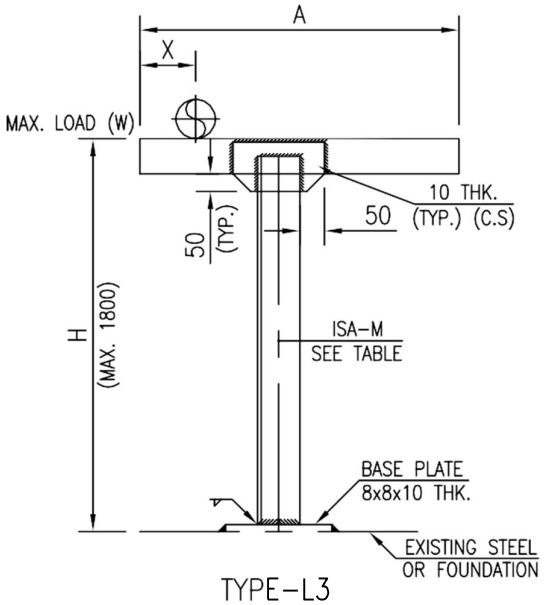
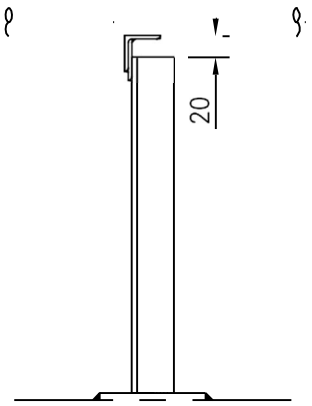
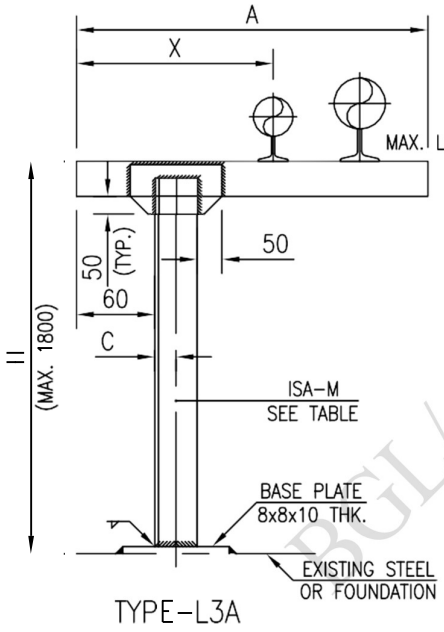


TYPE-L3



SIDE VIEW

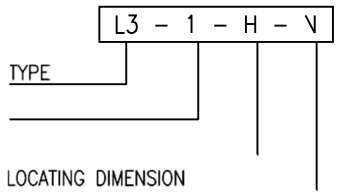


TYPE-L3A

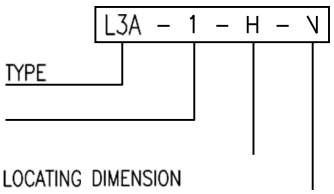
NOTE:-

1. DO NOT USE FOR ANCHORING THE PIPE.

SIZE NO.	MAX. LOAD (W) Kg.		A	B	
	500	ISA 80x80x8	600	150	45
2	800	ISA 100x100x10	700	150	60
3	1500	ISA 130x130x12	800	150	80



SYMBOL



SYMBOL

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0	5-12-15	ISSUED FOR STANDARD	SC	SM	AKG

LOW SUPPORT STANCHION TYPE-L3 AND L3A

SCALE: NTS (SHEET 1 OF 1) REV

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4.CATHDOICPRTOECTION

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR TCP & PCP

ENG-STD-CP-DOC-TS-001

BGL/632/2024-25

1	30.12.16	Issued For Bid				
0	19.10.2016	Issued for Review				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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1.0 GENERAL

Cathodic protection system is envisaged to protect the outer surface of the Carbon steel pipeline laid underground. The protection is provided in two(2) stages: Temporary Cathodic Protection (TCP): using sacrificial [Zn or Mg] Anodes for an initial One (1) year construction period, followed by Permanent Cathodic Protection (PCP) with Jumper connection from existing pipeline ICCP or Impressed Current Cathodic Protection [ICCP] system using [MMO] Anodes & external Power source for a Design Life of forty (40).
This specification defines the basic guidelines to develop a suitable temporary Cathodic protection [TCP] system followed by permanent [PCP] Cathodic protection [ICCP] system for the underground pipeline [external surface coated with 3LPE required to be protected from ravages of soil side corrosion. All data required in this regard including site surveys to verify the design data shall be taken into consideration by the CP contractor to develop an acceptable state of the art [TCP], [PCP] design and for proper Engineering & detailing of the [TCP], [PCP] systems.

This specification also defines the requirements of site surveys for design data generation, CP design, detailed Engineering, supply of materials, quality assurance (QA) and quality control (QC), installation, testing and pre-commissioning, commissioning of temporary Cathodic protection system [TCP] and permanent Cathodic protection system [PCP] including detection of A.C & D.C. interference / interaction with neighbouring structures all along the pipeline ROW, as well as Installation of requisite mitigating measures for the [A.C/D.C.] interaction / Interference mitigation. Post-commissioning surveys such as CIPL ("On" & "Off") computerized logging along ROW and Coating conductance measurements along the pipeline ROW, Pearson detection followed by DCVG [for defect classification] at defect locations are also in supplier's scope. .

Compliance with these specifications and/or approval of any of the contractor's documents shall in no case relieve the contractor of his contractual obligations of providing adequate Cathodic protection [TCP],[PCP] system suitable for desired number of service [1+40] years free of interference.

Attenuation calculations for PCP shall be submitted for approval. TR unit and associated work shall be considered.

BGL/632/2024-25

1.1 Codes and Standards

The vendor has to follow the requirements of latest relevant applicable standards, as listed below, for system design, performance and materials to be supplied shall unless otherwise specified:

i. ANSI Standards
ii. ASTM Standards
iii. API Model code of safe practices
iv. BIS Standards
v. BS Standards and codes of practice
vi. DIN Standards
vii. DNV Standards
viii. IEEE Standards
ix. IEC Standards
x. NACE Standards and Recommended practices
xi. NFPA Standards
xii. OISD Standards & CCE Norms
xiii. CLIENT Safety Standards

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xiv. PNGRB Standards

1.2 Conflicting Requirement

In the event of any conflict between this standard specification, job specification, datasheets, statutory regulations, related standards, codes etc. the following order of priority shall govern:

i) Statutory Regulations
ii) Standard Specification
iii) Codes and Standards

1.3 Additional Responsibility of Vendor

In addition to compliance to purchaser's specifications/datasheets, vendor's extent of responsibility shall include the following:

a) Activities of permanent [PCP] system which are common to temporary [TCP] system shall be completed as part of temporary [TCP] system. The facilities installed for [TCP], if useful & required in [PCP] system (such as TLP, permanent Reference CSE electrodes, Cable to Pipe connection, Corrosion coupons, etc.) shall be utilized for [PCP] also & hence are to be designed & installed as per [PCP] requirements.

b) All works to be performed and supplies to be effected as part of this contract shall require specific approval of owner or his authorised representative. Major activities requiring approval shall include, but not be limited to, the following:

i. Quality Assurance Control [QA/QC] methodology.
ii. Methodology of Corrosion survey site data generation and interpretation report and design basis for [TCP],[PCP] system.
iii. CP System design package including formulae used, design calculations, BOQ, Technical Specifications, Installation work procedure, and Post Commissioning Monitoring Methodology, Data Recording Formats etc.
iv. Procedures for A.C and D.C. interference testing and mitigation.
v. Procedure for field testing and commissioning.
vi. Procedure for Post Commissioning surveys.
vii. As-Built Documentation.
viii. O&M Manual.

c) The Intending Bidder shall be deemed to have visited the Site pipeline ROW and familiarized before submitting the tender. Non familiarity with site conditions will not be accepted as a reason either for extra claims or for not carrying out the work in total conformity with these tender specifications.

d) The CP vendor will have to accordingly mobilize work and deploy adequate skilled & trained manpower conversant with work procedure, adequate number of tools, tackles, testing and Construction equipment's requisite for smooth work progress so that CP work could also be completed within Schedule specified for the project. The CP vendor shall work in close coordination with the main pipeline contractor.

1.4 Design Report

1.4.1 On completion of all field work a composite report incorporating all the results generated from site surveys for data generation and details of additional data collected and complied with in the attached Compliance Report format clause wise as above shall be furnished to owner for Approval. The report shall

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also contain detailed interpretation of survey results and resistivity data enclosed, probable interference prone areas etc. to form design basis for the scheme of Cathodic protection [TCP] & [PCP] system. This report shall also include various drawings prepared in connection with the above work. The soil resistivity values shall be plotted on semi-log graph sheets and in Histograms. Log mean resistivity values to be calculated and used for the Design of CP system.

1.4.2 The Cathodic Protection Design of [TCP] and [PCP] systems should be part of this composite Report. The Bill Of Materials [B.O.M.], Technical Specifications, CLIENT approved Vendor list etc. will be included in this Report for Approval of Owner. The Drawings for Owners Approval shall be part of this composite report.

1.5 Drawings and Documents

1.5.1 Within three weeks from the date of issue of PURCHASER ORDER, CONTRACTOR shall submit four copies of the list of all drawings/ data manuals/procedures for approval, identifying each by a number and descriptive title and giving the schedule date.

1.5.2 All drawings and documents shall be in English and shall follow metric system. Number of copies of each submission shall be as per Scope of work document.

1.6 Document List For Submission

1.6.1 As a part of the contract, drawings and documents shall be furnished which shall include but not be limited to the following:

a. Report on corrosion survey
b. Basis of system design and design calculations, equipment selection criteria and sizing calculations.
c. Bill of material, material requisitions, purchase requisitions.
d. Quality assurance / Quality control procedures

1.6.2 Detailed construction drawings (including as built status)

a. Sacrificial anode fabrication drawings
b. Typical layout drawing for anode ground bed installation and connection.
c. Equipment layout, cable layout and schedules.
d. TLP & Junction Box Erection / Installation Details Drawing
e. Permanent Cu-$CuSO_4$ reference electrode installation Drawing
f. Fabrication, installation details of surge diverter, grounding cell and polarisation cell with its enclosure and housing.
g. Cable- to-pipe joint details for charged and non charged pipelines.
h. Incorporation of anode beds, polarisation cell, surge diverters, test stations, etc. and other relevant features of CP system-design in Pipeline alignment sheet and other related drawings.
i. Identification of section of pipeline affected by interference, source of interference and details of interference mitigation arrangements provided. Various measurement data at all relevant test stations with and without mitigation measures provided.
j. Detailed commissioning report including various measurement data at all test stations etc.
k. Vendor drawings and catalogues, test certificates.
l. Operation and maintenance manual.
m. Miscellaneous
   - Equipment inspection and testing procedure
   - Construction, installation procedures
   - Field testing and commissioning procedures
   - Procedure for monitoring of Cathodic protection after commissioning
   - Quality control procedures.

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- Post Commissioning Testing/Monitoring Periodicity and Methodology

2.0 TECHNICAL DATA

2.1 Site Conditions

The system shall be designed to conform following design conditions:

Max / Min. Temperature	60°C / -5°C
Design Temperature	55°C(for outdoor installation)
Design Temperature	45°C (for indoor installation)
Relative Humidity Max / Min.	90%/ 41%
Altitude above Sea level	Less than 1000 Meters.
Atmospheric condition	Tropicalised to withstand the Site condition, dust, vapour etc.
Hazardous Area classification for Plant	Zone-1 or Zone-2, Gas group IIA, IIB. Temp class T3
Battery, TRU room	Safe Area

2.2 Pipeline Data

The Pipeline details are:

Line Size		Refer Schematic Diagram
Line Length		Refer Schematic Diagram
Class		300
Design Pressure		49 Bar (g)
Material of Pipe		API 5L X42
Coating Material		3 LPE
Wall Thickness		6.4 mm

2.3 Corrosion Survey Data

Corrosion Survey Data collected from site [pipeline ROW & Anode bed locations] viz: Soil Resistivity, Soil Chemical analysis for chemical and microbial loading shall be enclosed as follows:

i. Soil Chemical Analysis

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ii. Soil Resistivity

It will be entire responsibility of the CP contractor.

2.4 Additional Data Collection- Vendor scope

The CP contractor shall have to generate/collect additional Data from site such as:

The CP contractor shall carry out a site survey along pipeline ROW and at proposed Anode bed locations, in order to verify design data, prior to the final design of the [TCP], [PCP] system. The site survey shall generally include the following:
General information [Topographic] of terrain along which the pipeline is to be routed.

Measurement of soil resistivity [ρ] along ROW and at Anode bed plots. Each selected Anode bed plot shall be sub-divided into sub-plots. Size of the sub-plots shall depend upon investigation of soil resistivity upto requisite depth. Each of these sub-plots shall be investigated individually. Sufficient observations at each of these plots shall be recoded as recommended hereunder:

1) Soil Resistivity at every 1 Kms along ROW to be carried out at 1,2,3 M depths. Wherever, abrupt changes are observed additional readings to be recorded in between.
2) Soil Resistivity at Anode-bed plots to be recorded at 1,3,5,7M for shallow Anode beds and 1,3,5,7,10,15,20,25,30,35,40… M for Deep well Anode beds.

Chemical Analysis of Soil / Water samples collected from two depths [1.0M] and [2.0M] of pipeline ROW at every 5 Kms. and at each intersection of a grid from sub-plots for each anode beds location. Theair dried soil samples to be quartered, coned and aqueous extract prepared for chemical and microbial analysis of following:

S. No.	Sample from Locations Kms.	0	0	5	5
1	Depth in M	1	3	1	3
2	pH				
3	Redox Potential V				
4	Total Dissolved Solids ppm				
5	Chloride ppm				
6	Sulphate ppm				
7	Sulphide ppm				
8	Carbonate ppm				
9	Bi-carbonate ppm				

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10	Nitrate ppm				
11	Nitrite ppm				
12	Phosphate ppm				
13	Sodium ppm				
14	Potassium ppm				
15	Calcium ppm				
16	Magnesium ppm				
17	Sulphate Reducing Bacteria (SRB) Counts				

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This data to be used for calculating soil/water corrossivity based on which and clause 3.1 of this specification, the protective current density and Anode material shall be selected/decided.

Stray Current Survey:

Survey for investigating possible sources of stray currents along ROW so that requisite Mitigative measures are included in the CP design. The CP contractor carrying out CP Interference survey due to DC current will have to get necessary permissions from other utilities such as underground pipelines of ONGC, IOCL, HPCL, BPCL, GAIL, etc., over ground water pipeline running parallel on concrete pedestal, and DC rail traction etc. so that composite studies for interference detection are done and recommended Mitigative measures are installed. At the time of handing over the interference free systemto owners (CLIENT), the contractor will hand over these permissions of other utility owners, for further needful by CLIENT.

Where a site survey is not possible the C P contractor shall ensure that requisite data is available for him to fulfil requirements of the work order.

Survey for knowing the location of **Cathodic Protection system** to maintain appropriate clearance between the existing and upcoming C P Systems. CP contractor, prior to CP Design for, shall carry out extensive site surveys and attenuation calculations and data collection, from pipeline ROW and proposed Anode bed locations. Likely interfering elements along ROW, survey for sources of stray currents likely to cause interference, and shall base the CP System Design on this Data collected from site.
Ground Water Table Data to be collected either from GSI [Geological Survey of India] by CP contractor or measured at site to ensure Anode bed location in appropriate perennially moist environment round the year throughout service life.

The following data shall be collected to generate design data for evaluation of interaction/ interference possibilities due to presence of other services in ROW/ in close vicinity:

i. Route and types of foreign service/pipeline in and around or crossing the right of way (including

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those existing and those which are likely to come up during contract execution or any abandoned pipelines).

ii. Diameter, wall thickness, pressure, pipeline coating against corrosion, soil cover used in case of pipelines.

iii. Details of the existing pipeline Cathodic protection systems protecting the services i.e. location, rating, type of protection, anode beds, test station locations and their connection schemes.

iv. Graphical representation of existing structure/pipe-to-soil potential [P-S-P] records, T/R unit current/ voltage input/output ratings, present current/Potential Input/Output Data etc for the existing pipelines.

v. Remedial measures existing on foreign pipeline/ services to prevent interaction.

vi. Possibility of integration/ isolation of existing CP systems, which may involve negotiations with owners of other existing pipeline services.

vii. Crossing and parallel running of electrified and non-electrified traction (along with information regarding operating voltage, type AC/DC etc.) as well as abandoned tracks near ROW having electrical continuity with the tracks in use.

viii. Crossing or parallel running of any HT AC/DC overhead line (existing/proposed) along with details of distance from pipeline, voltage, type AC/DC, distance from pipeline of earthing of towers etc.

ix. Voltage rating, number of cores and sheathing details of underground power cables, along ROW or in its vicinity.

x. Information on existing and proposed DC/AC power sources and system having earth as return path, in the vicinity of the entire pipeline route such as HV DC sub stations, fabrication yards with electric welding etc.

xi. Any other relevant information that may be needed in designing and implementing proper protection scheme for the proposed pipeline.

Unless otherwise mentioned, CP contractor shall conduct necessary potential gradient survey for any existing anode ground bed that may interfere with the CP system of the pipeline covered under this project.

3.0 CATHODIC PROTECTION DESIGN PARAMETERS

Unless expressly varied and otherwise specified in the project specifications, following parameters shall be used for design of temporary Cathodic protection [TCP] system and permanent Cathodic protection [PCP] system.

Those parts of sacrificial anode Cathodic protection [TCP] system which will be integrated with permanent CP system [PCP] such as Reference Cu-$CuSO_4$ electrodes, Test Lead Points, Junction Boxes, Thermit welds epoxy encapsulation, Markers, Polarization coupons etc. shall be designed based on permanent CP parameters.

3.1 Protection Current Density

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Pipeline surrounding	Protection Current density *	
	Temporary CP (μA/m2)	Permanent CP (μ A/m2)
Normal soil	35	35
Marshy area	45	45

However, the Protective Current Density to be chosen at site as per measured Environmental conditions obtained as per Detailed Chemical & Microbial Analysis and presence or absence of interfering elements in close vicinity of CLIENT pipeline ROW.

Pipe to soil potential shall not be more negative than (-) 1.5V ("ON") or (-) 1.18V ("Off") w.r.t. Cu- CuSO4 Reference electrode.

*Actual current density to be adopted shall be decided based upon soil/water corrossivity and other environmental conditions, proximity of foreign pipelines and structures resulting in interference. Where considered necessary for satisfactory protection of pipeline the current density shall be suitably increased by contractor with appropriate justifications.

3.2 Other Parameters for Design

Other parameters to be considered for [TCP] and [PCP] design:

3.2.1 Safety Factor for Current Density : 1.3

3.2.2 Anode Utilization Factor : 0.85 for centre connected Anode
: 0.5 for Ribbon Anode

3.2.3 Pipeline natural potential (-) 0.45V [as measured from existing /upcoming structure in the same soil matrix].

3.2.4 Unless otherwise specified in project specification the design life of the TCP system shall be (1) year or till PCP commissioning whichever is earlier and that of [PCP] permanent CP shall be (40) Forty years.

3.2.5 Along the ROW where soil resistivity is higher than 100 Ω m temporary CP for the pipeline may not be necessary subject to Owner's Approval.

3.2.6 Steel Resistivity 2.2 X 10^{-7}Ω M

3.2.7 Maximum Loop Resistance 1 Ω

4.0 CATHODIC PROTECTION DESIGN CRITERIA

Cathodic protection system shall be designed to meet the following criteria.

4.1 Temporary Cathodic Protection [TCP]

4.1.1 The pipe to soil potential measurements shall be between –0.95V ("On") and –1.5V ("On") both "On" Potentials w.r.t. Cu-$CuSO_4$ reference electrode. In case sulphate reducing bacteria [SRB] are present in soil the minimum protective potential shall be (-) 0.95V ("On"), the maximum remaining the same (-) 1.5V ("On") w.r.t. Cu-$CuSO_4$ reference electrode. At the location of Polarization coupons, the coupon to soil

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potential measurement shall be between (-) 0.95 ("Off") minimum and (-) 1.18 V("Off) maximum w.r.t. CuCuSO$_4$ reference electrodes, both being "Off" potential. During [TCP] monitoring using Reed Magnetic switch "Off" potentials to be recorded.

4.1.2 In rare circumstances a minimum polarisation shift of (-) 100 millivolts w.r.t. Cu-CuSO$_4$ reference electrode shall indicate adequate levels of cathodic protection for the pipeline.
Discretion to use any of the criteria, listed above, shall solely rest with the Owner/ Owner's representative.

4.1.3 A positive potential swing of ›20 mV [P-S-P] shall be considered as the criteria for presence of an interaction situation requiring investigation and incorporation of suitable mitigation measures by the C P Contractor.

4.2 Permanent Cathodic Protection [PCP]

4.2.1 The pipe to soil potential measurements [PSP] shall be between (–) 0.95V ("Off") minimum and (-) 1.18V ("Off") maximum [both "Off" Potentials] w.r.t. Cu-CuSO$_4$ reference electrode, the maximum remaining the same (-) 1.5V ("On") w.r.t. Cu-CuSO$_4$ reference electrode. At the location of Polarization coupons, the coupon to soil potential measurement shall be between (-) 0.95 ("Off") minimum and (-) 1.18 V ("Off") maximum w.r.t. CuCuSO$_4$ reference electrodes [both being "Off" potential].

4.2.2 In rare circumstances a minimum polarisation shift of (-) 100 millivolts w.r.t. Cu-CuSO$_4$ reference electrode shall indicate adequate levels of Cathodic protection for the pipeline.
Discretion to use any of the criteria, listed above, shall solely rest with the Owner/ Owner's representative.

4.2.3 A positive potential swing of ›20 mV [P-S-P] shall be considered as the criteria for presence of an interaction situation requiring investigation and incorporation of suitable mitigation measures by the C P Contractor.

5.0 SYSTEM COMPONENTS

5.1 Temporary Cathodic Protection (TCP)

The [TCP] system unless specified otherwise, may include the following major equipment/ sub-systems.

- Sacrificial anodes [Zn or Mg] ground beds in carbonaceous back-fill
- Test stations [TLP]
- Junction Boxes with shunts and resistors [AJB] & [CJB]
- Permanent Reference Cu-CuSO4 Electrodes [CSE]
- Pin Brazing epoxy encapsulated
- Surge diverter/ Grounding cell at Insulation Mono – blocks, or
- Grounding cell at Insulation mono - blocks
- Solid state DC Decoupling device at A.C. Interference locations
- Earthing of Motor Operated Valve [MOV] and other Electrical equipment's without disturbing CPSystem through Sacrificial anodes
- Polarization ER Coupons for corrosion monitoring
- Interconnecting cables
- Cable to pipe connections-Pin Brazing.
- Markers for Cable,Anode bed etc.
- CP System at Cased Railway Crossings

5.2 Permanent Cathodic Protection (PCP)

The [PCP] system may include the following major equipment/ sub-systems unless otherwise specified.

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- Digital Power Source AC Input DC Output [TRU] with built-in Current interrupter and GPS based timer.
- Distribution Board [dB]
- MMO [LIDA Single] anodes and anode ground beds in carbonaceous back-fill
- Test stations [TLP]
- Computerized Test Stations [CTSU]
- CPPSM
- Junction Boxes with shunts and resistors [AJB] [CJB]
- Permanent Reference Cu-CuSO4 Electrodes [CSE]
- Pin Brazing for pipe to cable connection [epoxy encapsulated]
- Surge diverter/ Grounding cell across Insulation Mono - blocks
- Grounding cell at Insulation mono - blocks
- Solid state DC De-coupling device at A.C. Interference locations
- Polarization ER Coupons for Corrosion monitoring
- Interconnecting cables
- Cable to pipe connections.
- Markers [for cable route, anodebed etc.]
- Insulating fittings

5.3 General Requirements for Components

5.3.1 All equipment shall be new and supplied by CP contractor sourcing from approved manufacturers of repute with proven track record and approved by the owner for the supply for this project. Equipment offered shall be field proven. Equipment requiring specialised maintenance or operation shall not be acceptable hence should be avoided, as far as possible, and prototype equipment shall not be accepted. Make and construction of all the material shall be as per CLIENT Vendor list and Standard specification of this document.

5.3.2 The detailed specification of each system and equipment shall be furnished by the contractor. However, certain minimum requirements for the major equipment are highlighted in this document.

5.3.3 Equipment Location In Hazardous / Non Hazardous Area
As far as possible equipment including Power source, test stations, anodes, junction boxes, TLP etc. shall be located in safe area. However, all equipment located in hazardous areas shall be of flame proof type as per BIS: 2148, IEC 79 for gas groups IIA & IIB and temp. Class T3 (200^0 C). All equipment to be located in Hazardous area should conform to and comply with BIS 2148 and IEC 79 (or equivalent) code requirements. All indigenous flame proof equipment should be certified by CMRI. All flame proof equipment of indigenous origin should also be **BIS** marked.

6.0 ANODE GROUND BEDS

6.1 Anode Ground Beds –TCP

6.1.1 Along ROW where soil resistivity predominantly remains low and ranges from 0-10 Ω m Zinc (Zn) anodes shall be provided.However,at locations where soil/water pH is more than 9,Zn anodes not to be used as these get Passivated.

6.1.2 Along ROW where soil resistivity is predominantly higher than 10 Ω m Magnesium (Mg) anodes shall be provided.

6.1.3 At high resistivity area where resistivity is of the order of 50 Ω m and above Magnesium (Mg) ribbon anodes shall be provided.

6.1.4 Anodes shall be installed along the pipeline at suitable intervals as per pipeline protection voltage attenuation calculations and ground bed resistance/current output of anode installations.

6.1.5 Each electrically continuous section of pipeline shall preferably be protected totally by one type (material) of anodes [either Zn or Mg] to avoid inter-anode [Zn ↔ Mg] circulation currents. Grounding cell should also conform to this specific requirement.

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6.1.6 The anodes shall be installed at sufficient depth to reach perennially moist soil [ascertained by ground water table data] but minimum 2M depth from grade level and shall be separated linearly from the pipe line by at least 5m and 2m for Magnesium (Mg) and Zinc (Zn) anodes respectively. The ribbon anodes should be laid at least 0.5 M away from pipe. The anode connections to pipe line shall be routed through test stations.

6.1.7 However, environment suitability [such as pH, excessive carbonate, bi-carbonates, sulphates, chlorides, nitrates etc. which could result in anode passivation] should be checked prior to lowering of sacrificial anodes suitability in the anode beds. Zn should not be used if soil/water pH is over 9.

6.1.8 At the temporary CP anode ground bed, the leads of all the anodes shall be connected individually through Shunt and Resistor [for controlling each anode output individually] in the TLP/ junction box. The junction boxes should contain 20% extra terminals points.

6.1.9 For sacrificial anode ground beds which shall be integrated with permanent CP system the leads of all the anodes shall be brought up to the test station and shall be terminated individually with shunts inserted in between so that individual anode current output can be regulated & measured as required.

6.1.10 For Sacrificial anode CP system the Anodes shall be supplied with Tail cable [6 mm2 PE PVC copper conductor single core multistrand cable] of sufficient length so as to reach Junction box, for termination, without difficulty. No joints are permissible on the cable run from anode tail to junction box.

6.1.11 The tail cable connection with the Iron Insert of Cable should be tightly done followed by Epoxy encapsulation so as to ensure that no Necking takes place which could result in snapping of cable connection due to spark. Anode cap of heat shrinkable PE material should be able to ensure this.

6.2 Anode Ground Beds –PCP

6.2.1 Anode beds(if applicable) to be installed at every CP Station and located at least 100 M away from pipeline ROW to ensure adequate remoteness which should also be calculated.

6.2.2 All [MMO] Anodes to be placed in Petroleum coke breeze, in appropriate [deep –horizontal or vertical, or semi-, deep well, deep well] configuration as per design to achieve requisite circuit resistance and protective Current output throughout the [40 years] service life. However, anode bed configuration selected should be technically justified.

6.2.3 The MMO anode should be supplied with sufficient length of 10 mm2 XLPE PVC cable so as to run up to junction box for termination in the junction box without in-between joints. No joints are permitted in cable run from Anode tail to junction box. This cable size is minimum only and wherever necessary, for appropriate operation of the CP system, higher sized cables should be provided.

6.2.4 Appropriate tamping of carbonaceous backfill [petroleum coke breeze] should be done so as to ensure appropriate compaction around [MMO] anode.

6.2.5 Anode bed Plot: CP contractor shall acquire[for CLIENT] & anode bed plot to be as per design requirement) & at least 100 M away from pipeline ROW for locating anode bed, at each Anode bed location along the pipeline ROW. CP Contractor to indicate the location of anode beds along pipeline ROW and mark it on As-Built Drawings and handover the requisite ownership documents to CLIENT at the time of Handing over of the system.

7.0 ANODES

7.1 Sacrificial Anodes

7.1.1 Magnesium Anode

The anode shall be of low voltage (-) 1.5 V type Magnesium [**Mg**] alloy packed in special back fill and suitable for use with three layer extruded polyethylene coating. The anode to conform to ASTM B 843

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specifications such as the metallurgical composition, potential and consumption rate of anode shall be as below:

i. Composition:

Element	Weight
Manganese	0.15 – 0.7%
Copper	0.02% max.
Silicon	0.10% max.
Zinc	2.5 – 3.5%% max.
Aluminium	5.3 – 6.7% max
Iron	0.003% max
Nickel	0.002% max
Other metallic elements	
- Each	0.05% max.
- Total	0.3% max.
Magnesium (Mg)	Balance

ii. Anode open circuit potential (-)1.5 volts. W.r.t. CSE

iii. Anode consumption rate 7.9 kg / (A Yr) Max.

7.1.2 Zinc Anode

The Zinc [**Zn**] anode shall conform to ASTM B 418 standard. The anode (other than ribbon anode) shall be packaged with special back fill. The metallurgical composition of anode, potential and consumption rate shall be as below:

Composition:

Element	Weight
Aluminium	0.3 – 0.5% max.
Cadmium	0.075-0.1% max.
Copper	0.005% max.
Iron	0.002% max.
Silicon	0.005% max.
Lead	0.005% max.
Zinc	Remainder

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Anode open circuit potential	(-) 1.1 volts w.r.t. CSE
Anode consumption rate	11.24 kg / (A yr) Max.

7.1.3 Contractor shall furnish spectrographic analysis from each heat both for Zinc (**Zn**) and Magnesium (**Mg**) anodes along with electrochemical test results .CP Contractor shall mention specifically the method of Spectrography (Atomic Absorption/Emission Spectrometry/Photometrics) for Owner's Approval.

7.1.4 Special Backfill For Sacrificial Anodes
The composition of special backfill for sacrificial anodes shall be as below:

Gypsum	75%
Bentonite	20%
Sodium sulphate	05%

7.1.5 Some Specific Requirements for sacrificial anodes are as follows:
The anodes shall be provided with cable tail of sufficient length to reach junction box/test station [TLP] as applicable in single run without tension and without in between joints.

7.1.6 Tolerance In Fabrication Of Sacrificial Anodes
Visual Inspection shall be carried out on all the Anodes regarding surface finish, excessive shrinkage, cracks, cable joint to anode core etc.

- The anode surface shall be free from cracks (which may reduce the performance of the anode.).
- Any cracks which follow the longitudinal direction of elongated anodes shall not be acceptable.
- Small cracks in the transverse direction of elongated anodes and in anodes of other shapes may be accepted provided the cracks would not cause any mechanical failure during service of the anode considering that the combination of cracks and lack of bond to the anode core is detrimental.
- For transverse cracks the acceptable limits shall be furnished by the bidders along with the offer.
- The anode shall be free from excessive shrinkages. The following limits shall be used.

Maximum 10% of the depth of anode or 50% of the depth of the anode core whichever is less. The depression may be measured from the edges of one side.

- The surface of the anodes shall be free from coatings and slag/ dross, inclusions etc.
- The maximum deviation from straightness shall not exceed 2%.
- The weight tolerance on individual anodes may be taken as ± 5%. The total weight of the anodes shall not have negative tolerance.
- Recommended dimensional tolerance shall be as follows:

Length	± 2.5%
Width/ thickness	± 5%

- One Anode per heat shall be radiographed to evaluate slags, voids, inclusion etc.
- At least 10% number of Anodes from each heat to be checked for conformity to Dimensions & Weight.
- One Anode, at least shall be Tested Destructively to check bond between Anode material and steel insert, slag, inclusion etc. Failure of one anode during the test shall make the entire anode lot liable for rejection.

7.2 Mixed Metal Oxide [MMO] Anodes: LIDA SINGLE

The Permanent Cathodic Protection [PCP] system will have Mixed Metal Oxide [MMO] Strip Anodes also known as LIDA [Linear Distributed] Anodes and LIDA single. The [MMO] LIDA single anodes shall

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be centre connected sealed tubular type. These Anodes shall be of Noble metals [group VIII] MixedMetal Oxide coated Titanium [having Ti substrate composition conforming to ASTM B 338 Grade I and/or Grade II]. The LIDA [MMO] anodes shall be dimensionally stable.

7.2.1 The characteristics of the [MMO] LIDA singe anodes are as follows:

- Shape and Dimension
  1,000 mm ± 5 mm long
  25 mm ± 0.2 mm wide
  3 mm ± 0.1 mm thick
- Weight 0.27 Kgs ± 0.020 Kgs. Recommended Maximum

7.2.2 Operating Current Density

➢ With Carbonaceous Backfill	75 Amp / M^2
➢ Current Output with Carbonaceous Backfill	3 Amp /M^2
➢ Electrical Resistivity	6 x 10-5 Ω cms.
➢ Type of Joint	Epoxy Splicing
➢ Contact Resistance of Anode to Cable joint	9 x 10-5 Ω {maximum}
➢ MMO Coating thickness	≥ 6 gms/M2
➢ Anode Consumption Rate	1 mg/Amp. Yr.
➢ Type of Cable	XLPE PVC 10 mm^2
➢ Length of Cable	As Required so as to reach JB
➢ Design Life	40 Years

7.2.3 The Anodes shall be provided Bare for Deep well, and with sheet steel canisters and petroleum coke breeze for deep bed configuration

7.2.4 The Anodes to be Installed at a distance of 5m (Minimum) apart and shall be **electrically remote to the pipeline [to be ascertained by calculations]**. Normally the nearest part of anode for deep horizontal/vertical type of anode beds shall not be less than 100M from the pipeline. However, the actual distance will be as per site conditions. For Deep well anode bed the first anode should be at least more than 15 M deep [as per NACE RP 0572 Standard] and the actual depth shall be as per Approved Design. However, for Deep well Anode bed also LIDA Single [MMO] anodes (& not LIDA String Anodes) shall be used.

- ➢ Anode LIDA [MMO] Single to cable [XLPE PVC 10 mm2] jointing and insulation shall be done by anode manufacturer at MMO anode fabrication shop.
- ➢ Dimension & weight of all anodes to be checked & recorded. Negative tolerance will not be acceptable.
- ➢ Routine & type test certificates of cable manufacturer to be furnished for anode lead cable as per IEC 502 – 1983 or relevant BIS code. Length and identification tag to be verified by measurement
- ➢ Each anode to cable joint shall be tested for it's electrical contact resistance & its value in Ω shall be recorded.
- ➢ First Anode to cable joint shall be subjected to accelerated ageing test & destructive test to determine pullout strength of cable to anode joint as well as effectiveness of the joint insulation.
- ➢ Manufacturer shall furnish detailed dimensioned fabrication drawing of anodes as well as details of cable connection& it's insulation sealing to owner for approval. Manufacturer of anode will commence only after this Approval from owner.
- ➢ Vendor shall furnish, for Owner's Approval, the following information
  - type & make of Heat Shrink cap & it's properties

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- procedure for making the joint
- procedure for accelerated ageing test
- Vendor shall submit all test reports for Owners review.

8.0 PETROLEUM COKE BREEZE

Lubricated calcined petroleum coke breeze backfill material for use with LIDA Single [MMO] Anodes in [PCP] system shall have a carbon content of 91.77% minimum and a bulk density of 74 pounds per cubic ft. Zero percent shall be retained by a screen size of 16 mesh.
The coke breeze shall have low resistance carbon lubricant added for lowering the combined resistance while developing the pumping qualities. Earth contact resistance shall be 0.1 Ω cm at 150 PSI.

8.1 Backfill Data Sheet

Carbon	91.770%
Volatiles	00.700%
Ash	02.230%
Sulphur	05.850%
Silicon	00.060%
Iron	00.020%
Moisture	00.000%

8.2 Typical Particle Analysis

Screen Size	% Retained	% Retained (Cumulative)
16 Mesh	00.000	000.00
28 Mesh	02.100	002.10
48 Mesh	21.100	023.20
100 Mesh	60.300	083.50
200 Mesh	15.000	099.50
200+Mesh	01.500	100.00

8.3 Typical Physical Analysis

Bulk Density	54 lb/cu ft.
Real Density	02 gm/ml
Porosity	40.8%

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The Petroleum Coke Breeze Material shall be tested for chemical composition, bulk density, real density, particle size and resistivity, sieve analysis.

9.0 AC OPERATED AUTO/MANUAL TRANSFORMER RECTIFIER UNIT [TRU]

The TRU shall be supplied in accordance with the following specifications and Data sheets:

9.1 General Description

This specification covers the requirements of design, manufacture, inspection, testing and supply of Automatic Controlled Transformer Rectifier Unit for Cathodic Protection of underground structures. Reliability of equipment and ease of maintenance is of utmost importance. The workmanship shall be of highest grade and entire design and construction in accordance with the best modern practice. The C.P. Units shall be capable of continuous trouble free operation at full load rating specified. The protection devices and control components shall be of standard design and carefully chosen to meet the requirements of the sets.

All similar materials and parts of similar equipment's shall be interchangeable with each other. Special care shall be exercised in the design and manufacture for aging effects, low input voltage, DC voltage fluctuations, high forward current through the rectifying elements and high temperature conditions during operation.

Apart from the derating for site conditions an additional derating of 20% shall be considered for the specific use. The components of the units shall be designed for maximum operating efficiency. The C.P. Units shall be provided with all the necessary protections required as detailed in the following pages. The

C.P. Units shall have Automatic/Manual control and shall be metal clad, compact, indoor installation type, air natural cooled, dust and vermin proof systems exactly confirming to the following specificationsand no deviations shall be allowed.

9.2 Technical Requirement

9.2.1 The CP Transformer Rectifier Units' scheme for protection, monitoring, control, metering and indication shall be designed to meet requirements of this specification. The control shall be achieved using thyristors and fully solid state logic only. The various features of the unit will be as per the details provided in the data sheet in this specification.

9.2.2 Transformer shall be of double wound, air cooled type with an electrostatic shield between the windings. The transformer insulation shall be Class F. The winding size shall be based on maximum current density of 1.6 Amps/sq. mm of copper conductor.

9.2.3 Rectifier shall be silicon type of approved make with adequate cooling arrangement and with moisture and humidity resistant finish. It shall be mounted on spindles or other suitable supports. It shall have configuration suitable for full wave rectification. Adequate filtering in the form of L-C filtering circuit shall be provided on output side to smoothen out the D.C. output to limit ripple content to less than 5% at rated output.

The input and output of rectifier shall be protected by fast acting fuses of suitable ratings. Lightning Arrestors/Surge Suppressors shall also be provided across D.C. output terminals and A.C. input terminals to protect the rectifier against surges. Each diode and SCR shall be provided with suitable surge suppressers.

9.3 Operation of The CP Transformer Rectifier Unit

The T/R unit shall be provided with two modes of working as under. A mode selector switch shall be provided to select the desired mode of operation. Both the modes shall be independent of each other and failure of the unit in one mode shall not affect working of the unit in other mode. A brief description of these modes is given below.

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A) Auto Ref. Mode

The unit will be generally working in this mode. The operation of the unit in this mode shall be controlled by a reference signal. The output D.C. voltage of the unit in this mode shall vary right from 0V to rated voltage and form 0A to rated current to maintain the reference signal within ± 20 mV of the set value under all operating conditions. The response of the unit shall be instantaneous to suppress extremely fast acting external stray currents if present. The typical reference regulation in this mode shall be within ± 20mV under all conditions.
Fully solid state Automatic Reference Selector logic shall be provided to select the lowest of the Three Reference Inputs automatically. Facility shall also be provided for Manual selection of any one out of the three reference inputs for control. Suitable metering arrangement shall also be provided to monitor all the three external reference signals as well as the internal reference signals independently.
In the event of failure of all the reference signals, the unit will provide alarm - " All Reference Fail" and the output of the unit shall get adjusted to a preset value, which will be operator adjustable from 0V to rated voltage.
Independent ultra fast acting electronic current limit circuit shall be provided to limit the output current of the unit in Auto mode to any value from 0 A to rated value as desired by the operator. The current limit circuit will be capable of protecting the unit even under dead short circuit across output. The unit will be capable of sustaining dead short circuit across output indefinitely without degrading or damaging any internal components in this mode.

B) Automatic Voltage-Current Control mode (AVCC mode)

This will be the second mode of operation. The working of this mode shall be totally independent of the Auto mode and failure of the unit in Auto mode shall not affect operation in this mode.
The output voltage of the unit shall be adjustable to any value from 0V to rated voltage by means of a stepless voltage setter. The set voltage shall be maintained within ±0.25V of the set value for change in DC input voltage within specified limits and change in load from 0A to full load.
The output current of the unit shall also be adjustable to any value from 0A to rated current by means of a stepless current setter. The current shall be regulated within ± 0.5A of the set value for change in DC input voltage within specified limits and change in load from zero to the rated value. The response of both current controller and voltage controller shall be ultra fast, instantaneous type. The current limit circuit will be capable of protecting the unit even under dead short circuit across output. The unit will be capableof sustaining dead short circuit across output indefinitely without degrading or damaging any internal components in this mode.

9.4 Local & Remote Monitoring & Control

The unit will be capable of working in Local Mode of control as well as Remote mode of control. For this purpose a mode selector switch will be provided on the unit. With this switch in 'Local Mode' it will be possible to control the various parameters of the unit by means of local controls located in the unit.

Facility will be provided for monitoring and control of various parameters by means of controls provided on the front panel of the unit. The details of the parameters to be monitored and controlled locally are as under:

9.4.1 Local Monitoring

Facility will be provided for local monitoring of following:

A) Metering on Panel

- AC Input Voltage - Digital Voltmeter

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- AC Input Current - Digital Ammeter
- DC Output Voltage - Digital Voltmeter
- DC Output current - Digital Ammeter
- PSP (Set & Actual) - Digital Voltmeter with 10 Meg Impedance

B) LED Indications on Panel

- AC Supply ON - LED indication
- Pipeline Under protection - LED indication
- Pipeline Overprotection - LED indication
- Reference 1 Lowest - LED indication
- Reference 2 Lowest - LED indication
- Reference 3 Lowest - LED indication
- Reference 1 Fail - LED indication
- Reference 2 Fail - LED indication
- Reference 3 Fail - LED indication
- All Reference Fail - LED indication
- Overcurrent (Current Limit) - LED indication
- Unit Working in Auto Mode - LED indication
- Unit Working in AVCC Mode - LED indication
- Unit Working in Local Mode - LED indication
- Unit Working in Remote Mode - LED indication

9.4.2 Local Control

Facility will be provided for local control of following:

- O/P Voltage - By means of potentiometer on panel
- DC O/P Current - By means of potentiometer on panel
- PSP - By means of potentiometer on panel
- Selection of Auto/AVCC Mode - By means of selector switch on panel

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- Start/Stop of Current Interrupter - By means of Keypad on Timer

9.4.3 System Software

The vendor will supply the necessary system software such as all programs for the PLC, PLC display etc. which are required to perform all the PLC functions including communication and self-diagnostics. Logic program with necessary instructions shall be recorded on compact disc (CD) and shall be delivered with the system.
The PLC system shall be rated for 24 V DC power supply voltage. The 24 V DC power supply shall be derived from 230V AC power supply for the TR unit, through a suitably rated 24 V DC Power supply module.
The PLC and the DC for power supply module for the PLC shall be mounted inside the TR Unit panel.

9.4.4 Parameters For Remote Monitoring

Facility will be provided for remote monitoring of following:

A) Analog Signals

- DC Output Voltage - Hardwired
- DC Output current - Hardwired
- Lowest/Selected PSP - Hardwired

B) Digital Status Signals

- Pipeline Underprotection - Through PLC / RS 485
- Pipeline Overprotection - Through PLC / RS 485
- All Reference Fail - Through PLC / RS 485
- Unit Working in Auto Mode - Through PLC / RS 485
- Unit Working in AVCC Mode - Through PLC / RS 485
- Unit Working in Local Mode - Through PLC / RS 485
- Unit Working in Remote Mode - Through PLC / RS 485

9.4.5 Parameters For Remote Control

Facility will be provided for Remote control of following:

- Setting of DC O/P Voltage - Through PLC / RS 485
- Setting of DC O/P Current - Through PLC / RS 485
- Setting of PSP - Through PLC / RS 485

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- Selection of Auto/AVCC Mode - Through PLC / RS 485
- Start/Stop of Current Interrupter - Through hard wired potential free contact

9.5 Reliability And Factor Of Safety

Due to very harsh conditions under which the units are going to operate, prime importance shall be given to ensure reliability and trouble-free operation. To take care of high transient voltages and high peak current demands adequate factor of safety shall be provided in choosing all the components. Minimum factor of safety to be provided for critical components is as under.

Components		Factor of Safety
All wound components	:	50% additional capacity

Components		Factor of Safety
Thyristor & diodes	:	PIV : 1200V minimum Iav : At least 3 times actual max. average current at full load.
Passive components like switches, resistors	:	50% safety margin in current rating.

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Overall system	:	The unit shall be capable of delivering 125% rated current output at rated voltage for 1 hour.
Electronic Control	:	The entire electronic circuitry shall be assembled on plug-in type glass epoxy PCBs. The control circuit shall be designed using the latest advanced ICs to minimize the component count. Status indicator LEDs shall be provided on each control card to indicate functioning of the card. All the control cards shall be completely sealed usingprotective coatings. The control circuit shall be capable of operating at elevated temperatures of upto 70 °C without any degradation in performance or life expectancy.

9.6 Working Life

The TR Unit shall be designed for a working life of minimum 40 years.

9.7 Technical Specifications And Data Sheet – TR Unit

A)	A. C. Input Voltage	:	230V ± 10%, 1Ph, 50 Hz ± 5%, AC
B)	A. C. Input Current	:	8.0 A (max)
C)	D. C. Power Output	:	625W
D)	D. C. Output Voltage	:	0 to 25V DC
E)	D. C. Output Current	:	0 to 25A DC
F)	Controls	:	1. Auto PSP 2. AVCC (Manual)
G)	Full load efficiency of the TR unit	:	Not less than 70%
H)	Power Factor at full load	:	Better than 0.8 Lag
I)	Insulation Level	:	2 KV for 1 minute
J)	Cable entry	:	A.C. input, D.C. output, Ref. Cells and Alarm cables. From the bottom plate of the unit, thru suitable cable glands.
K)	Filtering circuit	:	L. C. Filter
L)	Ripple & Hum	:	Less than 5% at rated load

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M)	Surge Diverters for diodes/SCRs/Transistor	:	Metal oxide varistors / capacitors / R-C Networks
N)	Lightning Arrestor	:	At both input & output side of the unit R.M.S. Voltage Rating : 500V R.M.S. Current Rating : 1.5KA Type : LT 0.5 or Eqv.
O)	Protection	:	- 2 pole MCB in AC input for overload protection & Isolation. - 2 pole MCB in DC output. - HRC fuses in input & output. - Glass cartridge fuses in the live line of all lamps, auxiliary power lines to control circuit. - Built in electronic current limit and short circuit protection feature. Current limit adjustable from 0 to rated value. - All reference fail indication and automatic setting of O/P DC voltage to preset value.
P)	Ref. Fail Safe Feature		In the event of failure of all the Reference Electrodes the unit will provide "All Reference Fail" indication and the DC O/P voltage will get adjusted to a programmable preset value.
Q)	Reference Electrode [Permanent]	:	3 Nos. Cu/CuSo4 Automatic Reference Selector Logic shall be provided to automatically select the lowest (least protected) reference signal out of three reference signals fed to the unit simultaneously. Facility shall also be provided to select one out of three ref.

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			Electrodes by means of a Manually operated Reference Selector switch.
R)	Control element	:	The DC output will be controlled using latest solid state SCRs. These SCRs will be controlled by the commands from the control circuits. All the electronic circuits will be assembled on plug-in type control cards.
S)	Modes of operation	:	Following modes of control shall be provided. a) Auto Ref. Mode: The operation of the unit in this mode will be fully Automatic and will be controlled by the Reference electrode feedback (PSP). The unit will automatically maintain Reference voltage or P.S.P. within ± 20mV of the set value under all conditions. b) AVCC Mode: This will be the second mode of operation. In this mode the unit can be operated in either constant voltage or constant current mode. The output voltage will be adjustable from 0 to rated value by means of stepless voltage setter potentiometer. The output current will be adjustable from 0 to rated value by means of stepless current setter potentiometer.
T)	Voltage Setting Range in AVCC Mode (Manual) Mode	:	0 to 25V
U)	Current Limit setting Range	:	0 to 25A
V)	P. S. P. setting Range	:	-0.8V to –2.5V
W)	Ref. Regulation in Auto Mode	:	Better than ± 20mV
X)	DC Voltage regulation in AVCC (Manual) Mode	:	Better than ± 0.25V
Y)	Current Regulation in current limit mode	:	Better than ± 0.5A
Z)	Indications	:	a) Underprotection b) Overprotection

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c) Reference cell 1 Lowest

d) Reference cell 2 Lowest

e) AVCC mode of operation

AA) Annunciations : a) Under protection

b) Overprotection

c) Reference cell 1 Lowest

d) Reference cell 2 Lowest

e) Reference cell 3 Lowest

f) Reference cell 1 fail

g) Reference cell 2 fail

h) Reference cell 3 fail

i) Reference cell All fail

j) Overcurrent (Current Limit Mode)

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AB) Meters/Instruments	:	Digital Meters as under: AC Input Voltage : 0 to 300V AC AC Input Current : 0 to 10A with CT 3-1/2 Digit Digital Meters as under: Output Voltage : 0 to 50V DC Output Current : 0 to 50A with shunt PSP & Set PSP : 0 to + 19.99 V DC
AC) Local control Mode	:	Following controls will be provided in local mode from local control panel. 1. Setting of Ref. PSP through Potentiometer 2. Setting of Output Voltage through Potentiometer. 3. Setting of output current limit through Potentiometer. 4. Auto/AVCC Mode Selection 5. START/STOP of Current Interrupter
AD) Remote Monitoring and control through PLC through RS 232C / RS 485 Serial Link	:	Following features will be provided by means of PLC and RS232C / RS 485 Serial Link with MODBUS RTU Protocol. 1. Under Protection 2. Over protection

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3. All Ref. Fail

4. TR unit in Auto mode

5. TR unit in AVCC mode

6. TR unit in Local mode

7. TR unit in Remote mode

1. TR unit Operation in AUTO mode

2. TR unit Operation in AVCC mode

1. Lowest/selected PSP value

2. Output DC voltage

3. Output DC current

1. Setting of PSP

2. Setting of DC output voltage

3. Setting of DC output Current

AE) Current Interruption : Current interruption facility will be provided by means of a built-in contactor & microprocessor based fully programmable and GPS enabled Synchronisable digital timer with real time clock & ON/OFF time display. The timer will have facility for adjusting the ON time & OFF time from 0 to 999 sec. by means of front panel keypad. Timer will have START, STOP & RESET facility thru local keypad or thru remote potential free contacts.

The Timer will have typical time accuracy of + 5 PPM

Facility for interconnection of an external timer shall also be provided.

A removable bypass link will be provided for bypassing the

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interrupter contactor contacts.

AF)	Enclosure/Construction	:	Floor mounted Indoor type. Fabricated from 1.5mm/2.0mm CRCA sheet. Confirming to IP55 degree of protection. Lockable doors shall be provided in the front and back.
AG)	Cooling	:	Natural air cooled
AH)	Painting	:	Baked epoxy paint/Powder Coating of shade RAL 7032 Siemens grey with proper pre-treatment and primer application as per standard Industrial Practice.
AI)	Earthing	:	2 Nos. M6 earthing bolts and 1 no. nickel plated copper earth bus bar shall be provided.

9.8 Manufacturer's Technical Expertise & Experience

The manufacturer should be a reputed and established manufacturer of CP Rectifier & CPPSM Units and should have experience in manufacturing of C.P. rectifiers & CPPSM units of similar specifications. The manufacturer will have to submit a list of C.P. Rectifier & CPPSM installations having similar specifications executed in the past 5 years, giving present working status of various units.

9.9 Testing And Inspection

The Manufacturer/Contractor shall provide all the necessary facilities to carry out full performance tests on the AC operated DC Output TR Units at his works.

9.10 Guarantee

The manufacturer/Contractor will have to guarantee the successful working of the units for a period of 12 months from date of Installation & commissioning.

10.0 REFERENCE ELECTRODE [CuCuSO4] PERMANENT TYPE

Permanent Copper / Copper Sulphate reference electrodes three (3) numbers at each CP Station .All the three reference electrodes shall be routed individually to TRU through test station. Reference Cell tail cable length shall be sufficient enough to reach the test station and further to the TRU without any splicing or jointing.
As per Owner or Owner's representative's direction, Permanent Copper Copper sulphate reference electrodes are to be installed for [P-S-P] Monitoring. One number CSE (Permanent type) at each ER Probe shall be installed.

11.0 TEST STATIONS [TLP]

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11.1 Test stations [TLP] shall be provided along the pipeline ROW for monitoring the performance of the cathodic protection system at intervals of 1000 meters unless otherwise specified. In addition to above, test stations of requisite type [A, B, C, D, E or Combination of any two of these Viz: DE] shall be provided at the following locations:

a. At both sides of major road crossings
b. At all insulating joints
c. At vulnerable locations with drastic changes in soil resistivity.
d. At connections of surge diverters, grounding cells and polarisation cells.
e. At HT AC/DC overhead line crossings and selected locations where HT overhead line is in the close vicinity of the pipeline.
f. At railway line crossings and running parallel to the pipeline.
g. At both sides of major river crossings.
h. At high voltage cable crossings or along routes where HV cables are running in parallel.
i. In the vicinity of DC net works or grounding system where interference problems are suspected.
j. At crossings/parallel running of other pipelines/ structures.
k. At both sides of cased crossings.
l. At any other locations considered vulnerable/locations where interference is expected.
m. At any other locations considered necessary by owner/ owner's representative.

Non Metallic [TLP] is to be installed at every 1Km. of Salt Pan Area. For Other Areas metallic [TLP] may be provided.

11.2 Between the pipeline and foreign pipelines or structures that may exist in common ROW. Test stations for bonding shall be provided with shunt and resistor as a means to monitor and control current to ensure zero net flow of Current from one to the other.

11.3 Test stations used for sacrificial anodes shall have shunt for measurement of individual anode current, and provision of resistance to limit & control the anode current output.

11.4 Test station with current measuring facility shall be provided at each intermediate CP station drainage point (to measure pipeline current on any one or both side of the pipeline from drainage point), at interference prone areas, on both sides of major river crossings and at least at two additional locations along the pipeline ROW between two CP stations.

11.5 All test stations shall have weather proof enclosure, having degree of protection IP55 with hinged lockable shutter. Enclosure shall be made of sheet steel of at least 3 mm thickness and shall be suitable for M.S. post mounting. The test stations shall be designed with terminals required for both temporary [TCP] and permanent CP system [PCP] and shall be suitable for total life of permanent CP system.

11.6 The test stations shall be installed with the front of the test station facing the pipeline. The name plate of test stations shall in minimum carry following information.

- Test station number
- Chainage in km
- Test station connection scheme type
- Distance from pipeline in meters

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- Direction of product flow

11.7 Terminal blocks and different scheme of wiring as required shall be provided in the test station as per the test station connection scheme sketch.

11.8 The location of all the test stations shall be marked with their connection schemes and other relevant information on alignment sheets. A detailed test station schedule shall be prepared.

11.9 Computerized test stations (CTSU) shall be provided at remote places. Minimum 1 number with 3 channel Computerised Test Stations shall be supplied along with reading units.

12.0 SURGE DIVERTER, GROUNDING CELL AND POLARISATION CELL

12.1 At the crossing or parallel run of pipeline and overhead HT line of 66 KV and above, the pipeline shall be grounded through solid state polarisation cell/device. Alternatively, grounding could also be done with galvanic anodes [grounding cells] at the discretion of the owner. The grounding shall be done at regular intervals where transmission line run parallel within 25 m of the pipeline, to ground any surges in the pipeline potential that may appear in case of faults [phase to phase or phase to ground] in overhead transmission line.

Locations along pipeline where continuous induced over-voltage due to HT line etc. is expected &/or observed during commissioning, the pipeline shall be earthed through solid state polarisation cell/device to the HT tower earth system causing the voltage induction to ground or through a separate earthing system. Alternatively the pipeline shall be grounded with galvanic anodes [Grounding cells] at the discretion of the owner.

12.2 The solid state polarisation cell/device shall be installed in a vandal proof steel housing by the contractor.

12.3 Spark gap surge diverter shall be connected across each insulating joint to protect it from high voltage surges.

Alternatively, Zinc or Magnesium grounding cell may be provided across insulating joints along ROW where the pipelines on both sides of the insulating joint are Cathodically protected and difference of protection voltage is not more than 0.4 volts.

12.3.1 Surge diverter shall be provided for the protection of insulating joints located at the ends of the pipe line/at terminals & in between. Alternatively owner on his own discretion may permit use of Magnesium (Mg)/Zinc (Zn) galvanic anodes [grounding cells] appropriately sized for protection of insulating joints. Choice between Zn & Mg anodes will depend up on the potential values on either side of the insulating joint locations. These anodes shall be sized for the specified design life of permanent cathodic protection system [PCP].

12.3.2 The total system including cable, cable termination, anodes/surge diverters shall be suitable for the anticipated fault current magnitude at the location of its installation.

12.3.3 Unless otherwise specified the minimum rating of grounding cell, polarisation cell and surge diverter shall be as below:

i. Grounding Cell

-	Type	:	2 or 4 plate type
-	Current rating	:	Suitable to pass more than 10 kA surge

ii. Polarisation Cell

-	Type	:	*Solid state device*
-	Current rating	:	The rating shall be based on actual fault current expected at site.

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iii. Surge Diverter

-	Type	:	Spark gap
-	Current 8/20 µs)	:	100 kA
-	Spark over AC voltage	:	
-	50 Hz		1 KV
-	Impulse (1.2/50 µs)	:	2.2 KV

12.4 The grounding cell, surge diverter and the solid state polarisation cell/device system shall be sized for the design life of permanent CP system. The Zinc (Zn) or Magnesium (Mg) anodes meant for pipeline grounding shall also be sized for the life of the permanent CP system and the surge magnitude taking into account the current discharge from the anodes. The grounding system shall have minimum resistance to earth to restrict the pipeline voltage [PSP] as per NACE protection criteria.

13.0 CP AT CASED CROSSING

At all cased crossings the casing shall be coated using 2 pack epoxy, 750 micros thick, both on internal and external surface of the casing. The casing shall be protected additionally by independent [from carrier pipe protection system] sacrificial anode installations. The sacrificial anode installations shall be provided at both ends of casing. The anode installation shall be sized based on the permanent CP design parameters specified for the main pipeline.

The carrier pipe inside casing shall be protected by Zn or Mg ribbon anodes well connected to the outer surface of bottom of carrier pipe extending between hour hand positions of 4 and 8 o' clock. The anodes shall be placed at close intervals as per design calculations and sized based on the permanent CP design parameters. Casings upto 20 mts in length may not be provided additional cathodic protection to carrier pipe bottom inside casing. More than 20 mts length casing additional cathodic protection to carrier pipe bottom shall be provide.

The annulus between the casing and the carrier pipe shall be filled with graded sand/ betonite.

The HDD contractor will arrange an agency to check the coating condition of the casing pipe post erection of HDD so that requisite repairs(if required) are done to the damaged coat.

14.0 PAINTING

The sheet steel used for fabrication shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under surfaces shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under surfaces shall be free from all imperfections before undertaking the finished coat. After preparation of the under surface, spray painting with two coats of final paint shall be done. The finished panel shall be dried in oven in dust free atmosphere. Panel finish shall be free from imperfections like pin holes, orange peels, run off paint etc.

All unpainted steel parts shall be cadmium plated to prevent rust formation.

15.0 CABLES

Cables shall be annealed high conductivity, tinned, stranded copper conductor, PE insulated 650V grade, and PVC sheathed FRLS. The size of the copper conductor shall be 6 sq mm for anode cable from anode to junction box, 10 mm2 from junction box to test station, 10 mm2 from test station to pipeline. The size of the conductor shall be 4 mm2 for potential measurement and 25 mm2 for bonding, polarization cell / grounding cell and surge diverter connection purpose. The anode cable from anode to junction box shall be unarmored. The length of anode tail cable shall be sufficient enough to reach junction box (buried) in

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case of temporary CP anode and up to test station in case of permanent CP anodes.

16.0 INSTALLATION

16.1 Cable Laying

16.1.1 Cables shall be laid in accordance with approved layout drawings to be prepared by the contractor. No straight through joint shall be permitted in a single run of cable. Cable route shall be carefully measured and cables cut to required length.

16.1.2 All cables inside station/plant area shall be laid at a depth of 0.75 M. Cables outside station/plant area shall be laid at a depth of 1.5 m . Cables shall be laid in sand under brick cover back filled with normal soil. Out side the station/ plant area the routes shall be marked with polyethylene cable warning mats placed at a depth of 0.9 m from the finished grade.

16.1.3 All underground unarmoured cables forming part of permanent CP system shall run through PE sleeves. Cables along the pipeline shall be carried along the top of the pipe by securely strapping it with adhesive tape or equivalent as required.

16.1.4 RCC or GI pipes of proper size shall be provided for all underground cables for road crossings.

16.1.5 Cables shall be neatly arranged in trenches in such a manner that crisscrossing is avoided and final take off to equipment is facilitated.

16.1.6 Cable root markers shall be installed overground at suitable intervals.

16.1.7 In no case cables shall pass from below underground pipeline. All cables shall be placed above underground pipeline and tightened with tape.

16.2 Cable To Pipe Connections

All cable connections to the pipeline including charged foreign pipeline shall be made using an (owner) approved exothermic process e.g.: Pin Brazing.

The Pin Brazing to have

i.	extremely low Contact Resistance	$\leq 0.1\ \Omega$.
ii.	Low transition resistance	7.5 to 14 $\mu\Omega$ per brazed joint
iii.	High mechanical strength	Binding strength 490 N/mm^2
iv.	Shear Strength	245 N/mm^2
v.	Brazing Temperature	650^0 C
vi.	Time per Braze	2 Seconds
vii.	Weather Effect	Suitable for all weather operation
viii.	Life	40 Years + 1

16.3 Field Test

Cable Connection through Pin Brazing to be field tested for contact resistance & Temperature etc.

17.0 CIVIL WORKS

All civil works associated with the complete cathodic protection work shall be included in the scope of CP contractor. This shall include providing cable trenches, foundation for equipment and all test stations etc.

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18.0 TESTING AND INSPECTION AT WORKS

18.1 Owner/ Owner's representative shall visit the works during manufacture of various equipment [Anodes, Cables, Junction Boxes, Test Lead Points etc.] to assess the progress of work as well as to ascertain that only quality raw material and fabrication technology is used for the same. All necessary assistance during such inspections shall be provided by the contractor/fabricator to owner's representative.

18.2 The minimum testing, inspection requirements for all components/ equipment shall conform to the requirements as defined in the relevant codes and standards. Detailed inspection and testing procedures along with the acceptance criteria, including various stages where hold points, review etc shall be for owners inspection, shall be prepared by CONTRACTOR for Owner's approval.

18.3 Test certificates including test records, performance curves etc. shall be furnished. All test certificates shall be endorsed with sufficient information to identify equipment to which the certificate refers to and must carry project title, owner's name and purchase order details etc.

18.4 Owner reserves the right to ask for inspection of all or any item under the contract and witness all tests and carry out inspection or authorise his representative to witness test and carry out inspection. CONTRACTOR shall notify the Owner or Owner's representative at least 20 days in advance giving exact details of tests, dates and addresses of locations where the tests would be carried out.

19.0 PACKING AND TRANSPORT

All equipment/ material shall be protected for inland/ marine transport, carriage at site and outdoor storage during transit and at site. All packages shall be clearly, legibly and durably marked with uniform block letters giving the relevant equipment/ material details. Each package shall contain a packing list in a water proof envelope. Copies of the packing list, in triplicate, shall be forwarded to owner prior to despatch. All items of material shall be clearly marked for easy identification against the packing list.

20.0 SYSTEM TESTING, COMMISSIONING AND INTERFERENCE MITIGATION

20.1 System Testing At Site

Contractor shall furnish the detailed field testing and commissioning procedure for approval. Field tests as per the approved procedures shall be carried out on the equipment/ systems before being put into service. The acceptance of the complete installation shall be contingent upon inspection and field test results being satisfactory.

20.1.1 Before the CP facilities are placed in operation all necessary tests shall be carried out to establish that all equipment, devices, wiring and connection, etc. have been correctly installed, connected and are in good working condition as required for intended operation.

20.1.2 Owner/Owner's representative may witness all the tests. At least one week's notice shall be given before commencing the tests.

20.1.3 All tools, equipment and instruments required for testing shall be provided by C P CONTRACTOR.

20.1.4 Generally following tests shall be carried out and recorded in perform given in subsequent clauses.

Checking: Visual inspection, comparison with drawings and specifications.

Inspection: Detailed physical inspection & Dimensions measurement Testing:

Simulation tests of equipment to determine its operational fitness.

i. Cables

- Cable no.

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- Voltage grade
- Conductor cross section
- Continuity check
- Voltage test
- Insulation resistance values between core and earth.
- All cables shall be tested by 500 V megger.

ii. Insulating Joints

Checking of insulating joint for leakage, before and after energisation of C.P.by means of insulating joint tester. Structure-to-electrolyte potential of both protected and non-protected sides of insulating joint shall be checked before and after energisation of CP system. Grounding cell/Surge diverter shall be connected thereafter.

iii **Polarisation cell**

- Location/ identification number
- Rating
- Check for continuity
- Check for wiring
- Check for standby current drain with CP energisation (current drain with respect to voltage across the device/cell shall be recorded).

iv. Grounding Cell

- Location
- Type (no. of anodes)
- Ratings

v. Surge diverter

- Location/ identification number
- Ratings
- Check for healthiness

vi **Anode ground beds**

- Location/ test station number
- Current Output of each Anode
- Current output of the ground bed

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20.2 Commissioning

20.2.1 Natural pipe to soil potential [P-S-P] shall be measured at each test station [TLP] location prior to connecting anodes to pipeline. The pipe to soil potential observation shall be repeated after connecting the anodes and allowing sufficient time for polarisation. The current output of the anode installation shall also be measured to ensure that it does not exceed the output current capacity of the anodes. In case the anode output current exceeds the rated capacity it shall be controlled by insertion of resistance element in the anode circuit inside test station and the pipe to soil potential shall be rechecked for adequacy of protection. Additional anodes shall be provided where required to achieve desired level of protection [PSP].
Each anode installation shall become individually operational as above.

20.2.2 After connecting all the anode ground beds to pipe line, measurement of pipe to soil potentials shall be taken at each test station [TLP] to ensure adequate conformity to protection criteria.

20.2.3 In case of insufficient protection as per the NACE CP design criteria on any portion of the pipe line, CONTRACTOR shall carry out necessary additions/ modifications to the provided protection in consultation with the OWNER so that NACE criteria is met.

20.3 Interference Mitigation

Investigation shall be made by an expert agency with prior experience for stray current electrolysis of the pipeline. Interference due to high voltage DC lines, electric traction & installed CP System of existing underground utilities and make suitable Recommendations so that recommended D.C. Interference Mitigative measures could be installed.The C.P. Contractor to carry out Interference due to overhead AC lines and install suitable Mitigative measures for AC Interference.
Measurements including pipe to soil potential [PSP] and pipe line current etc. on the pipeline/ structure being CP protected shall be made to investigate the current discharge [into surrounding soil electrolyte] and collectionlocations. In case of fluctuating stray currents investigation shall be made continuously over a period of time and if required simultaneously at different locations to find out the stray current source. For long line measurements, data logges shall preferably be used.
Where foreign pipeline (unprotected or protected by independent CP system) runs in parallel to the pipeline in same trench or very near to the pipeline, and is not bonded to the pipeline then investigation shall be made for current pickup & discharge points on both the pipelines.
Mitigation measures shall be provided depending on type of interference. These shall include installation of bond with variable resistor and diodes, installation of galvanic anodes for auxiliary drainage of current, adjustment/ relocation (if possible) of offending interference source, provision of electrical shield etc. depending on the type of interference.
Between an existing pipeline & upcoming pipeline a concrete raft [size to be approved by owner as per OISD] is to be provided as a barrier. The new pipeline will pass below the existing U/G Pipeline.
Bonding with foreign pipeline/ structure as a mitigation measure shall be provided where the owner of the pipeline/ structure has no objection, otherwise alternative mitigation measure shall be provided.
Wherever bonding is provided for mitigation the bonding resistor shall be adjusted for optimum value for minimum / no interference so that no net current flows from one to the other pipeline. Galvanic anodes installed as a mitigation measure shall be sized for the life specified for permanent CP.

21.0 SYSTEM MONITORING

21.1 The temporary CP system provided shall be monitored at all test stations once in a month for healthiness/ adequacy of protection till commissioning of permanent CP or for design life of temporary CP specified, whichever is less. During this period if any deficiency/ interference in protection system is noticed the same shall be rectified / augmented by additional anodes as required. The monitoring report shall be submitted regularly to owner for his review / information.

21.2 PCP system after commissioning shall be monitored by the CP contractor for One Year once a month and During this period if any deficiency/ interference in protection system is noticed the same shall be rectified / augmented by additional fixtures as required.

22.0 INSTRUMENTS, TOOLS AND SPARES

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22.1 CONTRACTOR shall include a List of all instruments, tools and tackles necessary for proper operation and maintenance [O&M], Monitoring of complete Cathodic protection [TCP] [PCP] systems and associated equipment that are to be deployed at site, such as Corrosion Voltmeter, Multi-combination Meter, CPL Survey Data Logger, DCVG Meter, Holiday Detector, Pipe Locator, Elcometer for Coating thickness measurement, CAT survey, Soil resistivity meter etc. duly calibrated by an Owner Approved agency in last six (6) months.

22.2 CONTRACTOR shall provide number of spares and consumables being provided for proper operation and maintenance of part of Cathodic protection [TCP] system to be integrated with permanent CP system [PCP] designed on the basis of permanent CP design parameters and associated equipment, for two (2) years un-interrupted operation of the system.

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APPENDIX A

COMPUTERISED TEST STATION UNITS (CTSUs)
FOR
CATHODIC PROTECTION PERFORMANCE MONITORING

Each CTSU (Computerised Test Station Unit) (**To be installed at pre-identified locations**) is a Microprocessor based low CMOS circuitry with built in RTC, installed near a Computerised Test Station to acquire and store the complete CP System performance data available for each Test station. CTSUs are typically designed for outdoor applications and are NEMA4 protected.
Once stored, the data can be downloaded as under:

a) By a remote computer by telephone, cellular phone or radio link/OFC.
b) By portable handheld data reader using local communication port.

Key features of the CTSU are as under:

1.	Recording Rate	To be configured from 1 reading per second to 1 reading per 365 days.
2.	Battery backup	Lithium battery back up option allowing CTSU ECU to retain data for 10 years on a single charge.
3.	Timing	Status input sampling time 10m sec to 2.5 m-sec.
4.	Power requirement	The CTSU to be powered by 24 ±15% Volts DC
5.	The CTSU shall be able to read and record.	PSP and current data of pipeline & foreign pipeline/pipelines upto 10,000 sets to be stored till downloaded
6.	Inputs available	Minimum 10 nos. [5 inputs for PSP & 5 inputs for current.]
7.	Protection against	Voltage/current surges expected along the pipeline & foreign structure.
8.	Test Station Reader (TSR)	Portable type suitable for field transport & handing. Unit enclosure is weather proof, IP55.
9.	Input battery for TSR	Internal rechargeable battery provided.

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APPENDIX-B

POST C.P. COMMISSIONING SURVEYS

1. COATING CONDUCTANCE SURVEYS

For evaluation of the electrical strength of the coating, post commissioning of the C.P. System, after one (1) Month, Coating Conductance surveys to be conducted, to serve as Reference for future comparison. Although same coating specifications are used throughout the length of the pipeline, effective electrical strength thereby it's ability to resist flow of current would reasonably vary on account of terrain, construction defects, soil resistivity along the Pipeline length.

For conducting coating conductance surveys, Potential (ΔV)& (ΔI) Current are to be measured at two consecutive "B" type Test Lead Points [TLP],w.r.t remote earth using $CuCuSO_4$ reference electrode, alternatively with current interrupter "On" & "Off" at each measurement point.

The difference of the two **ΔI** will be the C.P. Current being collected by this section of the pipeline. The difference of the two **ΔV** will be the average change in pipeline potential within the test section owing the current received from C.P. System.

The above procedure to be repeated for all "B" type TLP for evaluating coating conductance value for different sections along the pipeline. All the Data obtained is to be handed over to the owner & will form part of final Technical Documentation.

Before commencement of site surveys the survey procedure shall be got duly approved from the Owner.

2. CURRENT ATTENUATION TEST (CAT) SURVEY

Current attenuation test (Cat) survey for impressed current cathodic protection service for underground Gas pipelines. To identity of pipeline sections where coating is good and bad, To pinpoint coating defect in pipeline sections where coating is bad with Use of 'PCM'- A frame equipment, To give accurate coating defect locations for future coating repairs, To size the defects by standard method, Classify defects as Anodic or Cathodic.

Vendor shall carryout Pipeline current mapping followed by A frame survey at pipeline sections where coating is suspected to be damaged. Vendor shall also make coating defect co-ordinates drawing for subsequent coating repairs.

The survey need to be carried out by the Instrument "Pipeline Current Mapper" or any other equivalent equipment.

The survey along the pipeline should be carried out after duly identifying the pipeline alignment using the instrument's peak and null modes of operation. The pipeline alignment should be identified using temporary markers, at defined distance intervals. This shall facilitate retracing back high current attenuation locations for PCM-'A' frame survey.

Distance of survey traverse - survey Chainage shall be accurately measured with tape for accurate demarcation of the coating fault. The same shall be re matched with Pipeline marker Chainage /TLP Chainage, at regular intervals to avoid accumulation of error of measurement.

Prior to commencement of **CAT** survey, the survey procedure to be got approved from the Owner. Only Good & Proven survey equipment and trained, experienced manpower to be used.

All survey Data to be submitted to Owner as part of Technical Documentation.

3. DCVG SURVEY

Post commissioning of the C.P. System, after 30 days of Line polarization, CPL Survey will be conducted for

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evaluation of coating condition to serve as future Benchmark for comparative evaluation.
Any finding of coating defect in particular, where coating defects and holidays are high, have to be further established through a separate **DCVG** survey for the defective stretch delineated as above from CPL survey findings.

Prior to commencement of **DCVG** survey, the survey procedure to be got approved from the Owner. Only Good & Proven survey equipment and trained, experienced manpower to be used.
All survey Data to be submitted to Owner as part of Technical Documentation.

3. COMPUTERIZED POTENTIAL LOGGING [CPL] SURVEY

Post commissioning of the C.P. System, after 30 days of Line polarization, a Computerized Potential Logging [CPL] survey will be conducted, as per procedure, already got approved by the Owner. The "On"/"Off" Potential survey. For the survey, Data Logger of repute & Current interrupter [if not available in the TRU] willbe used by experienced and trained manpower. All the survey data and findings of under-protected, over- protected zones, short etc. shall be handed over to the owner as part of final technical Documentation. Suitable remediation measures to be recommended for achieving adequacy of protection throughout the pipeline length. This CPL survey Data will serve as base Data for future comparative evaluations of the Protective system adequacy.

4. A.C. /D.C. INTERFERENCE DETECTION & MITIGATION

Post commissioning of the C.P. System, after 30 days of Line polarization, an AC / DC Interference survey to detect presence (or absence) of induced AC Voltages [which in certain circumstances may be fatal] on the underground pipeline that run parallel to AC transmission systems [having voltages greater than or equal to ≥11KV] shall be carried out. Measurement of P-S-P shall be taken at every TLP of the pipeline that run parallel to overhead AC transmission lines and are within 20 M of transmission line alignment. On detection ofAC induced Hazardous voltages suitable Mitigative measures such as grounding of the pipeline with Zn / Mg Grounding cell, installation of Polarization cell etc. shall be resorted to dissipate Ac induced hazardous voltages to ground in controlled manner. Type "A" TLP shall be provided at these locations having AC induced Hazardous voltages on the pipeline.

DC Interference Detection from existing CP system in close vicinity of ROW and any other DC source such as electric traction, switching yard, welding shop etc. Appropriate measures for mitigation to be recommended for installation by CP contractor.
Prior to site survey commencement, the Approval for survey procedure, from the Owner, shall be taken.

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ENGINEERING STANDARD

TECHNICAL DATASHEET FOR TCP & PCP

ENG-STD-CP-DOC-DS-001

BGL/632/2024-25

0	19.10.2016	Issued for Review				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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TECHNICAL DATA SHEET
TCP & PCP

1.0 E/R Probes

1.1 Make and model no. of E/R probe :
1.2 Material of E/R probe :
1.3 Size of the exposed area of the probe :
1.4 Make and mode no. of E/R probe : reading instrument

2.0 Permanent reference electrodes

2.1 Make & model no. :

2.2 Design life of electrode under burial condition :_____Years

3.0 Polarisation cells

3.1 Type :

3.2 Make & model no. :

3.3 Maximum DC leakage current at 40 degree C at

- 1V DC across the Polarisation cell :_____mA
- 1.5V DC across the Polarisation cell:_____mA
- 2.0V DC across the Polarisation cell:_____mA

3.4 50 Hz AC current rating at 400 C

- Continuous :____A
- Short time :_____KA for_____sec

3.5 Rated no. of operations over life time under maximum ratings _____Nos.

4.0 Polarisation Coupons

4.1 Exposed area of metal :

4.2 Metal type :

4.3 Make and model no. of reed switch :

4.4 Make and model no. of reed switch operator magnet :
4.5 Rating of reed switch :

-Continuous current rating :_____A DC, at_____V DC

-Breaking current :_____A DC, at_____V DC

5.0 Surge Diverters

5.1 Type :

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5.2 Ratings :

5.3 Current, 8/20 micro second wave :

5.4 AC spark over voltage

-50Hz AC :

-Impulse(1.2/50 micro second) :

5.5 Make :

6.0 Anode type and make :

6.1 Impressed current anodes

- Type :
- Make :

6.2 Sacrificial anodes make –

- Zinc anodes :

-Zinc ribbon anodes :

7.0 TR Unit :

7.1 CPTR unit :
7.2 CPPSM :
7.3 Test stations :
7.4 Anode junction box :
7.5 Cathode junction box :
7.6 Calcined petroleum coke breeze :
7.7 Permanent reference electrodes -$CuCuSO_4$ type :

-Ag-AgCl type :

7.8 Special Backfill for sacrificial anodes:
7.9 Make:

8.0 Cables

8.1 Type and voltage grade :

-For anode tail cables :_____/_____V

-For other CP cables :_____/_____V

8.2 Make :

-For anode tail cables :

-For other CP cables :

9.0 Cable to pipe connection

9.1 Connection Type

- For charged pipeline :
- For non charged pipeline :

9.2 Make and model number of

- Cad weld Material :
- Pin brazing equipment :

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QAP FOR TCP AND PCP

ENG-STD-CP-DOC-QP-001

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0	19.10.2016	Issued for Approval				
REV	**Date**	**Purpose of Issue**	**Prepared By**	**Checked By**	**Approved By**	

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	QUALITY ASSURANCE PLAN FOR TEST STATIONS			
PROJECT				
OWNER				
PROJECT NO		DATE:-		
TPIA				
CONSULTANT				
CONTRACTOR				
CP CONTRACTOR				
QAP NO	01	REV.	0	
REFERENCE SPECIFITACION	ENG-STD-PC-OC-DTS-001			
REFERENCE DESIGN DOCUMENT				
REFERENCE DATA SHEET				
REFERENCE DRAWING				
VENDOR				

DESICRPTION/ TYPE OF ISNPECTION	**REFERENCE DOCUMENT**	**FORMAT OF RECORD**	**INSPECTION BY**			**Remarks**
			M	**CT**	**PIA**	
Compliance with approved Drawing & Data sheet (Manufacturer, type &Model)	Approved Drawing & Data Sheet	Inspection Report	P	W	W	
Visual Inspection: 100%	Approved Drawing & Data Sheet	Inspection Report	P	W	W	
Dimensional Check: 25%	Approved Drawing	Inspection Report	P	W	W	
fitness test, terminal to body resistance.	Approved Drawing & Data Sheet	Inspection Report	P	W	W	
Thickness Check :25%	Approved Drawing	Inspection Report	P	W	W	
Terminals to TS Body	Approved Drawing & Data Sheet	Inspection Report	P	W	W	
Manufacturer Test Certificate (IP 55)	Approved Drawing & Data Sheet	IP 55 Test Certificate	S	R	R	
Document / Marking	Approved Drawing & Data Sheet	IRN	H	R	R	

LEGEND: P-PERFORM, -WIWTENSS ALL, S-SMIUBTTEDBY, R-REVIEWEDBY, H-HOLD M-Manufacturer C-Contractor TPI-A Third Party Inspection Agency -

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	QUALITY ASSURANCE PLAN FOR SECRIFICIAL ZINC ANODE					
PROJECT						
OWENR						
PROJECT NO			DATE:-			
TPIA						
CONSULTANT						
CONTRACTOR						
CP CONTRACTOR						
QAP NO	02		REV.		0	
REFERENCE SPECIFITCAION	ENG-STD-CP-DOC-TS-001					
REFERENCE DESIGNDOCUMENT						
REFERENCE DATA SHEET						
REFERENCE DRAWING						
VENDOR						
DESCRIPTION/ TYPE OF INSPECTION	REFERENCE DOCUMENT	**FORMAT OF RECORD**	**INSPECTIONBY**			**Remarks**
REFERENCE DOCUMENT			**M**	**C**	**TPIA**	
Compliance with approved Drawing & Data sheet (Manufacturer, type &Model)	Approved Drawing & Data Sheet	Inspection Report	P	W/R	W/R	
Inspection	Approved Drawing & Data Sheet	Inspection Report	P	W/R	W/R	
a. Surface 100 %, Length ± 2.5 %, Width/ Thickness ± 5%						
b. Visual : Longitudinal cracks of more than 40 m long and 3 m deep not acceptable						
c. Weight tolerance: + %5 (Total weight of all anodes shall not have negative tolerance)						
Radiographic Test	Approved Drawing & Data Sheet	Test Report	P	W/R	W/R	
One anode per heat shall be subjected to radiography to evaluate cracks, voids, slack inclusion etc.						
Destructive Testing	Approved Drawing & Data Sheet	Test Report	P	R	W	
One anode per heat shall be subjected to destructive testing for slag inclusions, bond between anode and insert.						

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	QUALITY ASSURANCE PLAN FOR SECRIFICIAL ZINC ANODE					
PROJECT						
OWENR						
PROJECT NO			DATE:-			
TPIA						
CONSULTANT						
CONTRACTOR						
CP CONTRACTOR						
QAP NO	02		REV.		0	
REFERENCE SPECIFITCAION	ENG-STD-CP-DOC-TS-001					
REFERENCE DESIGNDOCUMENT						
REFERENCE DATA SHEET						
REFERENCE DRAWING						
VENDOR						
DESCRIPTION/ TYPE OF INSPECTION	**REFERENCE DOCUMENT**	**FORMATOF RECORD**	**INSPECTIONBY**			**Remarks**
			M	**C**	**TPIA**	
be subjected to destructive testing for slag inclusions, bond between anode and insert.	Approved Drawing & Data Sheet Test	Report	P	R	R	
Chemical Analysis ; One anode sample per heat by Spectrography Sample in the beginning for first heat, end of second heat, at the beginning of third heat and so on.	Approved Drawing & Data Sheet	Test Report	P	R	R	
Mass per liner meter ALL	Approved Drawing & Data Sheet	Test Report	P	R	W	
Anode to core resistance Randomly	Approved Drawing & Data Sheet	Test Report	P	R	W	
Electrochemical Test	Approved Drawing & Data Sheet	Test Report	R	R	W	
a.)Open circuit potential shall lie within (+) 10 mV and (-) 50 mV of the guaranteed value.						
b.)Consumption rate by weight loss method (consumption rate shall not be more than the specified value).						
All the above Manufacturer Test Reports	Approved Drawing & Data Sheet	Test Report	Submission	R	W	
Document / Marking	Approved Drawing & Data Sheet	IRN	H	P	R	
LEEGND: P-PERFORM, W-WITNESS ALL, S-SUBMITTEDBY, R-REVIEWEDBY, H-HOLDM-Manufacturer C-Contractor TPI-A Third Party Inspection Agency						

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	QUALITY ASSURANCE PLAN FOR SACRIFICIAL MAGNESIUM ANODE					
PROJECT						
OWNER						
PROJECT NO			DATE-			
TPIA						
CONSULTANT						
CONTRACTOR						
PC TONCTCARRO						
QAP NO	03		RE V		0	
REFERENCE SPECIFICATION	EG-NSTD-PC--OCDTS-001					
REFERENCE DOCUMENT						
REFERENCE DATA SHEET						
REFERENCE DRAWING						
VENDOR						
DESCRIPTION / TYPE OF INSPECTION	**REFERENCE DOCUMENT**	**FORMAT OF RECORD**	**ISNPECTIONBY**			**Remarks**
			M	**C**	**TPIA**	
Compliance with approved Drawing & Data sheet (Manufacturer, type &Model)	Approved Drawing & Data Sheet	Inspection Report	P	W	R	
Inspection	Approved Drawing & Data Sheet	Inspection Report	P	W	W/R	
a. Surface 100 %, Length ± 2.5 %, Width/ Thickness ± 5%						
b. Visual : Longitudinal cracks of more than 40 m long and 3 mdeep not acceptable						
c. Weight tolerance: + %5 (Total Weight of all anodes shall not have negative tolerance)						
Radiographic Test	Approved Drawing & Data Sheet	Test Report	P	W	W	
One anode per heat shall be subjected to radiography to evaluate cracks, voids, slack inclusion etc.						
Destructive Testing	Approved Drawing & Data Sheet	Test Report	P	R	R	
One anode per heat shall be subjected to destructive testing for slag inclusions, bond between anode and insert.						

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	QUALITY ASSURANCE PLAN FOR SACRIFICIAL MAGNESIUM ANODE					
PROJECT						
OWENR						
PROJECT NO		DATE				
TPIA						
CONSULTANT						
CONTRACTOR						
CP CONTRACTOR						
QAP NO	03	REV	0			
REFERENCE SPECIFICATION	EG-NSTD-PC--OCDTS-001					
REFERENCE DESIGN DOCUMENT						
REFERENCE DATA SHEET						
REFERENCE DRAWING						
VERDON						
DESCRIPTION/ TYPE FO ISNPETCION	**REFERENCE DOCUMENT**	**FORMAT OF RECORD**	**ISNPECTION BY**			**Remarks**
			M	**C**	**TPIA**	
ChemicalAnalysis; One anode sample per heat by Spectrography Sample in the beginning for first heat, end of second heat, at the beginning of third heat and so on.	Approved Drawing & Data Sheet	Test Report	P	R	R	
Mass per liner meter ALL	Approved Drawing & Data Sheet	Test Report	P	R	W	
Anode to core resistance Randamly	Approved Drawing & Data Sheet	Test Report	P	R	W	
Electrochemical Test One anode per heat shall be tested for a.)Open circuit potential shall lie with in (+) 10 mV and (-) 50 mV of the b.)Consumption rate by Weight loss method (consumption rate shall not be more than the specified value).	Approved Drawing & Data Sheet	Test Report	R	R	R	
All the above Manufacturer Test Reports	Approved Drawing & Data Sheet	Test Report	Submission	R	R	
Document/ Marking	Approved Drawing & Data Sheet	INR	H	P	R	
LEGEND: P-PERFORM, OW-WITNESSALL, S-SMIUBTTEDYB, R-ERVIEWEDYB, H-HOLD M-Manufacturer C - Contractor TPI-A Third Party Inspection AGENCY						

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST

		QUALITY ASSURANCE PLAN FOR MMO ANODE					
PROJECT							
OWNER							
PROJECT NO			DATE:-				
TPIA							
CONSULTANT							
CONTRACTOR							
CP CONTRACTOR							
QAPNO		04	RE V.			0	
REFERENCE SPECIFITACION		ENG-STD-PC-OC-DTS-001					
REFERENCE DESIGN DOCUMENT							
REFERENCE DATA SHEET							
REFERENCE DRAWING							
VENDOR							
DESCRIPTION/ TYPE OF ISNPECTION		**REFERENCE DOCUMENT**	**FORMAT OF RECORD**	**INSPECTIONBY**			**Remarks**
				M	**C**	**TPIA**	
Compliance with approved Drawing & Data sheet (Manufacturer, type &Model)	ALL	Approved Data Sheet	Inspection Report	P	W	W	
Diamentional hCeck	ALL	Approved Drawing & Data Sheet	Inspection Report	P	W	W	
Electrical Test , coating consumtion rate	ALL	Approved Drawing & Data Sheet	Inspection Report	P	W	W	
Leak proof test (HeliumTest), cable length, coating resistivity & oCating thickness	Randamly	Approved Drawing & Data Sheet	Inspection Report	P	W	w	
Inspection as per belowattached vendor's ITP	ALL	Vendor's ITP is attached below	Inspection Report	P	R	R	
Document / Marking	ALL	Approved Drawing & Data Sheet	IRN	H	P	R	
LEGEND: P-PERFORM, W - WITNESS ALL , S-SMIUBTTEDBY, -RERVIEWEDBY, H-HOLDM-Manufacturer C-Contractor TPI-AThird Party Inspection AGENCY H - Hold							

BGL/32/2024-25

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Date: 2024.09.16 18:15:02 IST

		LUQAITY SASNCEURA PLANFROPOLRIASTAINOCELL					
PRJOECT							
WNEOR							
PRJOECT NO			DATE:-				
TPIA							
CONSULTANT							
CONTRACTOR							
CP CONTRACTOR							
PAQ NO		05	RE V.	0			
REFERENCE SPECIFITCAION		EN-GSTD-CP-CDO-TS-001					
REFERENCE DESIGNEDOCUMNT							
REFERENCE DATA SHEET							
REFERENCE DRAWING							
VENDOR							
DESCRIPTION/ TYPE OF INSPECTION		**REFERENCE DOCUMENT**	**FORMAT OF RECORD**	**INSPECTIONBY**			**Remarks**
				M	**C**	**TPIA**	
Compliance with approved Draiwng & Data sheet (Manufacturer, type &Model)	Approved Data Sheet & Design Specification	Inspection Report	Inspection Report	P	W/R	/VR	
Manufacturer Test Report	Approved Data Sheet & Design Specification	Test Certificate	Test Certificate	P	R	R	
Inspection Release Note			IRN	H	P	R	
LEGEND: P-PERFRM,O-WIWTNESS ALL, S-SUBMITTEDBY, R-REVIEWEDBY, H-HLODM-Manufacturer C-Contractor TPI-AThird Party Inspection AGENCY H-Hold							

BGL/632/2024-25

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST

	QUALITY ASSURANCEPLAN FORPENERMANT REFERENCE CELL (gA/gAcl)					
PRJOECT						
OWNER						
PRJOECT NO			DATE:-			
TPIA						
CONSULTANT						
CONTRACTOR						
CP CONTRACTOR						
QAP NO	06		REV.		0	
REFERENCE SPECIFITCAION	EN-GSTD-CP-DOC-TS-001					
REFERENCE DESIGNDOCUMENT						
REFERENCE DATA SHEET						
REFERENCE DRAWING						
VENDOR						
DESCRIPTION/ TYPE OF INSPECTION	**REFERENCE DOCUMENT**	**OF RECORD**	**INSPECTIONBY**			**Remarks**
			M	**C**	**TPIA**	
Compliance with approved Drawing & Data sheet (Manufacturer, type &Model)	Approved Data Sheet & Drawing	Inspection Report	P	W/R	W/R	
Visual Inspection 100%	Approved Data Sheet & Drawing/ Technical specification		P	W/R	W/R	
Manufacturer Certificates	Approved Data Sheet & Drawing	Test Certificate	Submission	R	R	
Inspection Release Note	IRN		H	P	R	
LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTEDBY, R-REVIEWEDBY, H-HLOD M-Manufacturer C-Contractor TPI-A Third Party Inspection AGENCY H-Hold						

BGL/03/2024-25

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST

	QUALITY ASSURANCEPLAN FORPENERMANT REFERENCE CELL (uC/CuSo4)					
PROJECT						
OWNER						
PROJECT NO			DATE:-			
TPIA						
CONSULTANT						
CONTRACTOR						
CP CONTRACTOR						
QAP NO	07		RE V.		0	
REFERENCE SPECIFITACION	ENG-STD-PC-OC-DTS-001					
REFERENCE DESIGN DOCUMENT						
REFERENCE DATA SHEET						
REFERENCE DRAWING						
VENDOR						
DESICRPTION/ TYPE OF ISNPECTION	**REFERENCE DOCUMENT**	**FORMAT OF RECORD**	**INSPECTION BY**			**Remarks**
			M	**C**	**TPIA**	
Compliance with approved Drawing & Data sheet (Manufacturer, type &Model)	Approved Data Sheet & Drawing	Inspection Report	P	W/R	W/ R	
Manufacturer Certificates	Approved Data Sheet & Drawing	Test Certificate	Submi ssion	R	R	
Inspection Release Note		IRN	H	H	P	
LEGEND: P-PERFORM, W - WITNESS ALL , S-SMIUBTTEDBY, -RERVIEWEDBY, H-HOLD M-Manufacturer C-Contractor TPI-AThird Party Inspection AGENCY						

PGL/632/2024-25

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST

QAP FOR TRANSFORMER UNIT

PROJECT			
CLIENT		REV. NO.-	0
PMC	Lyons Engineering Engineering Pvt. Ltd.	RATING AND QUANTITY	
CONTRACTOR		DATE:-	
MANUFACTURER			
P.O NO.		P.O DATE	
QAP NO.	08		
REF. DOC.			

Sr.No.	Item/ Component	Characterstics	Type of Check	Extent of Work	Reference Document	Acceptance Norms	Format of Record	Agency			REMARKS
								M	TPIA	CLIENT	
1	**BOUGHT OUT ITEMS**										
1	Receving Inspection for Fabricated	1. Physical Check	Measuring Tape	100%	Approved Drawing Manufacturer specification	Incoming Test Certificate	Incoming Test Certificate	P	R	R	
		2 Physical damge if any.	Physical Test	1 in Lot				P			
		3 Verification with Manufacturer specification.	Verification of Test Certificate		Approved Drawing			P	R	R	
1.2	Receving Inspection of Meters,PCB'S,Semiconductor & Electrical Iterms	1. Dimensions, Size	Functional test 2.Mechnical/Ele ctrical Measurement	sampling 10%	Approved Drawing Manufacturer specification	Test Report	1.Manufacturer Test Report 2.IncomingTest Report	P	R	R	
		2. Electrical Parameters		1 in Lot				P	W	W	
1.3	Sub assembly-Transformer,Choke,	1. Insulation Test 2. No Load Test		100%	Approved drawing	Test Certificate	Test Certificate	P	R	R	
1.4	Sub assembly- Timer-Inspection & Test	1. Visual inspection 2. Functional Test 3. Internal settings	Functional test 2.Mechnical/Ele ctrical	100%	Approved drawing	Test Certificate	Test Certificate	P	R	R	
1.5	Assembly Process	1. Electrical wiring and tighteness of all connections 2. Labeling and Marking	Measurement Visual	100%	Approved drawing	Test Report	Test Report	P	R	R	
1.6	Auxilary device check	Verification as per BOM	Visual	100%	Approved Drawing	Test Report	Test Report	P	R	R	
1.7	Insulation Test	Insulation and High Voltage Test between primary to Earth,Secondary to Earth and/or Primary to secondary	Electrical Measurement	100%	Approved Drawing	Test Report	Test Report	P	R	R	
1.8	Sub/assembly-control card Inspection & Test	1. Visual inspection 2. Functional Test	Functional Test	100%	Approved Drawing	Test Report	Test Report	P	R	R	
1.9	Heat Run Test	Heat run at at rated Load for at least 12/16 Hrs with Temperature measurement on all power devices and Magnetics at the end of test	Electrical Test & Inspection	100%	1.Approved Drawing 2.Approved Specification	Test Report	Test Report	P	R	R	

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST

QAP FOR TRANSFORMER UNIT

PROJECT			
CLIENT		REV. NO.-	0
PMC	Lyons Engineering Engineering Pvt. Ltd.	RATING AND QUANTITY	
CONTRACTOR		DATE:-	
MANUFACTURER			
P.O NO.		P.O DATE	
QAP NO.	08		
REF. DOC.			

Sr.No.	Item/ Component	Characterstics	Type of Check	Extent of Work	Reference Document	Acceptance Norms	Format of Record	Agency			REMARKS
								M	TPIA	CLIENT	
FINAL TEST											
		6. Continuity (ON-OFF)	Electrical	100%				P	R	R	
2	Functional Test of Unit	1. Visual Inspection 2. Insulation Test 3. Operation in Manual Mode 4. Operation in AVCC & Voltage/current. 5. Regulation 6. Operation in Auto and PSP regulation 7. Ripple content in DC Output 8. Indication and alarm 9. Remote signal and Potenrtial free contacts Conveter and Timer(if any)10.HV 11. Annuciation	Inspection	100%	1.Approved Drawing. 2. Approved Specification.	Test Report	Test Report	P	W	W	
2.1	Heat Run Test	10.Efficiency/power factor Heat run at at rated Load for at least 8 Hrs with Temperature measurement on all power devices and Magnetics at the end of test	Electrical Test & Inspection	40%	1.Approved Drawing 2.Approved Specification	Test Report	Test Report	P	W/R	W/R	
5	Inspection Release Note					Technical Specification	Technical Specification	H	P	R	
6	Documents to be Sumitted at time of Dispatch and Packing	10.1Warranty Certificate						P	R	R	
		10.2 Operation Manual						P	R	R	

LEGEND: P-PERFORM, W-WITNESSE, S-SUBMITTED, R-REVIEW OF RECORDS, H-HOLD, M-MANIFACTURER, C-CONTRACTOR, TPIA-THIRD PARTY INSPECTION AGENCY

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST

	QUALITY ASSURANCEPLAN FORPLAN SURGE DIVERTER					
PROJECT						
OWNER						
PROJECT NO		DATE:-				
TPIA						
CONSULTANT						
CONTRACTOR						
CP CONTRACTOR						
QAP NO	09	RE V.	0			
REFERENCE SPECIFITACION	ENG-STD-PC-OC-DTS-001					
REFERENCE DESIGN DOCUMENT						
REFERENCE DATA SHEET						
REFERENCE DRAWING						
VENDOR						
DESICRPTION/ TYPE OF ISNPECTION	**REFERENCE DOCUMENT**	**FORMAT OF RECORD**	**INSPECTIONBY**			**Remarks**
			M	**C**	**TPIA**	
Compliance with approved Drawing & Data sheet (Manufacturer, type &Model)	Approved Data Sheet & Drawing	Inspection Report	P	W/R	W/ R	
Manufacturer TEST Report	Approved Data Sheet & Drawing	Test Certificate	P	R	R	
Inspection Release Note	IRN		H	R	P	
LEGEND: P-PERFORM, -WIWTENSS ALL, S-SMIUBTTEDBY, R-REVIEWEDBY, H-HOLD M-Manufacturer C-Contractor TPI-A Third Party Inspection AGENCY.						

BGR/632/2024-25

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST

	QUALITY ASSURANCEPLAN FORERPROBE &ERPROBE ERDEAR					
PROJECT						
OWNER						
PROJECT NO			DATE:-			
TPIA						
CONSULTANT						
CONTRACTOR						
CP CONTRACTOR						
QAP NO	10		RE V.		0	
REFERENCE SPECIFITACION	ENG-STD-PC-OC-DTS-001					
REFERENCE DESIGN DOCUMENT						
REFERENCE DATA SHEET						
REFERENCE DRAWING						
VENDOR						
DESICRPTION/ TYPE OF ISNPECTION	**REFERENCE DOCUMENT**	**FORMAT OF RECORD**	**INSPECTIONBY**			**Remarks**
			M	**C**	**TPIA**	
Compliance with approved Drawing & Data sheet (Manufacturer, type &Model)	Approved Data Sheet & Drawing	Inspection Report	P	W/R	W/ R	
Manufacturer Certificates	Approved Data Sheet & Drawing	Test Certificate	Submission	R	R	
Inspection Release Note	IRN		H	H	P	
LEGEND: P-PERFORM, W - WITNESS ALL , S-SMIUBTTEDBY, -RERVIEWEDBY, H-HOLDM-Manufacturer C-Contractor TPI-AThird Party Inspection AGENCY						

PGI/632/2024-25

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST

	QUALITY ASSURANCEPLAN FORTCAHODE JCTUNIONBOX					
PROJECT						
OWNER						
PROJECT NO			DATE:-			
TPIA						
CONSULTANT						
CONTRACTOR						
CP CONTRACTOR						
QAP NO	11		RE V.		0	
REFERENCE SPECIFITACION	ENG-STD-PC-OC-DTS-001					
REFERENCE DESIGN DOCUMENT						
REFERENCE DATA SHEET						
REFERENCE DRAWING						
VENDOR						
DESICRPTION/ TYPE OF ISNPECTION	**REFERENCE DOCUMENT**		**FORMAT OF RECORD**	**INSPECTIONBY**		**Remarks**
				M	**C**	**TPIA**
Compliance with approved Drawing & Data sheet (Manufacturer, type &Model)		Approved Drawing & Data Sheet	spection Report	P	w	w
Visual InspectionALL		Approved Drawing & Data Sheet	spection Report	P	w	w
Dimensional Check, Physical verification, locking , painting	ALL	Approved Drawing & Data Sheet	spection Report	P	w	w
Fitness Test	Randamly	Approved Drawing & Data Sheet	Inspection ReportP	P	w	w
	ALL	Approved Drawing & Data Sheet	Inspection Report	P	w	w
Manufacturer Test Certificate (IP 55)	ALL	Approved Drawing & Data Sheet	Test Report	Submission	R	R
Document/Marking		Approved Drawing & Data Sheet	IRN	H	H	P
LEGEND: P-PERFORM, W - WITNESS ALL , S-SMIUBTTEDBY, -RERVIEWEDBY, H-HOLDM-Manufacturer C-Contractor TPI-AThird Party Inspection AGENCY						

BGL/632/2024-25

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST

	QUALITY ASSURANCE PLAN FOR ANODE JUNCTION BOX				
PROJECT					
EOWNR					
PROJECT NO		DATE:-			
TPIA					
CONSULTANT	.				
CONTRACTOR					
CPCONTRACTOR					
PQA NO	12	REV.	0		
REFERENCE SPECIFITACION	ENG-STD-PC-OC-DTS-001				
REFERENCE EDSIGNDOCUMENT					
REFERENCE TADASHEET					
REFERENCE IWRADNG					
VEORND					

DESICRPTION/ TYPE OF ISNPECTION		**REFERENCE DOCUMENT**	**FORMAT OF RECORD**	**INSPECTION BY**			**Remarks**
				M	**C**	**TPIA**	
Compliance with approved Drawing & Data sheet (Manufacturer, type &Model)	ALL	Approved Drawing & Data Sheet	Inspection Report	P	W	W	
Visual Inspection	ALL	Approved Drawing & Data Sheet	Inspection Report	P	W	W	
Dimensional Check, Physical verification, locking , painting	ALL	Approved Drawing & Data Sheet	Inspection Report	P	W	W	
Fitness Test	Randamly	Approved Drawing & Data Sheet	Inspection Report	P	W	W	
Thickness check, Terminal to body check	ALL	Approved Drawing & Data Sheet	Inspection Report	P	W	W	
Manufacturer Test Certificate (IP 55)	ALL	Approved Drawing & Data Sheet	Test cerficate	P	R	R	
Document / Marking		Approved Drawing & Data Sheet	IRN	H	P	R	

LEGEND: P-PERFORM, -WWITENSS LAL, S-SMIUBTTEDBY, -RERVIEWEDBY, -HOLHDM-Manufacturer C-oCntractor TPI-AThird Party Inspection Agency

DGL/632/2024-25

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST

	QUALITY ASSURANCEPLAN FORPIPE CONECTION					
PROJECT						
OWNER						
PROJECT NO			DATE:-			
TPIA						
CONSULTANT						
CONTRACTOR						
CP CONTRACTOR						
QAP NO	13		REV.		0	
REFERENCE SPECIFITACION	ENG-STD-PC-OC-DTS-001					
REFERENCE DESIGN DOCUMENT						
REFERENCE DATA SHEET						
REFERENCE DRAWING						
VENDOR						
DESICRPTION/ TYPE OF ISNPECTION	**REFERENCE DOCUMENT**	**FORMAT OF RECORD**	**INSPECTIONBY**			**Remarks**
			M	**C**	**TPIA**	
Compliance with approved Drawing & Data sheet (Manufacturer, type &Model)	Approved Data Sheet & Drawing	Inspection Report	P	W/ R	W/R	
Manufacturer Certificates	Approved Data Sheet & Drawing	Test Certificate	Submission	R	R	
LEGEND: P-PERFORM, W - WITNESS ALL , S-SMIUBTTEDBY, -RERVIEWEDBY, H-HOLDM-Manufacturer C-Contractor TPI-AThird Party Inspection AGENCY H - Hold						

BGR/32/2024-25

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Date: 2024.09.16 18:15:02 IST

	QUALITY ASSURANCEPLAN FOR CP CABLE					
PROJECT						
OWNER						
PROJECT NO			DATE: -			
TPIA						
CONSULTANT						
CONTRACTOR						
CP CONTRACTOR						
QAP NO	14		RE V.			0
REFERENCE SPECIFITCAION	ENG-STD-CP-DCO-TS-001					
REFERENCE DESIGNDOCUMENT						
REFERENCE DATA SHEET						
REFERENCE DRAWING						
VENDOR						
DESCRIPTION/ TYPE OF INSPECTION	**REFERENCE DOCUMENT**	**FORMAT OF RECORD**	**INSPECTION BY**			**Remarks**
			M	**C**	**TPIA**	
Compliance with approved Data sheet (Manufacturer, type)	Approved Data Sheet	Inspection Report	P	W	W	
Visual Inspection: 100%	Approved Data Sheet	Inspection Report	P	W	W	
Voltage Test, Conductor Cross Section, Insulation Test -100%	Approved Data Sheet	Inspection Report	P	W	W	
Continuity Check- Randalmy	Approved Data Sheet					
Voltage Grade - Randalmy	Technical specification	Test Report	P	W	W	
Type Test -100%	As per ref. Standard	Test Report	P	W	W	
Manufacturer Test Reports	Approved Data Sheet	Test Report	P	W	P	
Document / Marking	Approved Data Sheet	IRN	H	P	R	
LEGEND: P-PERFORM, W-WITNESS ALL, S-SUBMITTEDBY, R-REVIEWEDBY, H-HOLDM-Manufacturer C-Contractor TPI-AThird Party Inspection AGENCY H-Hold						

BCL/632/2024-25

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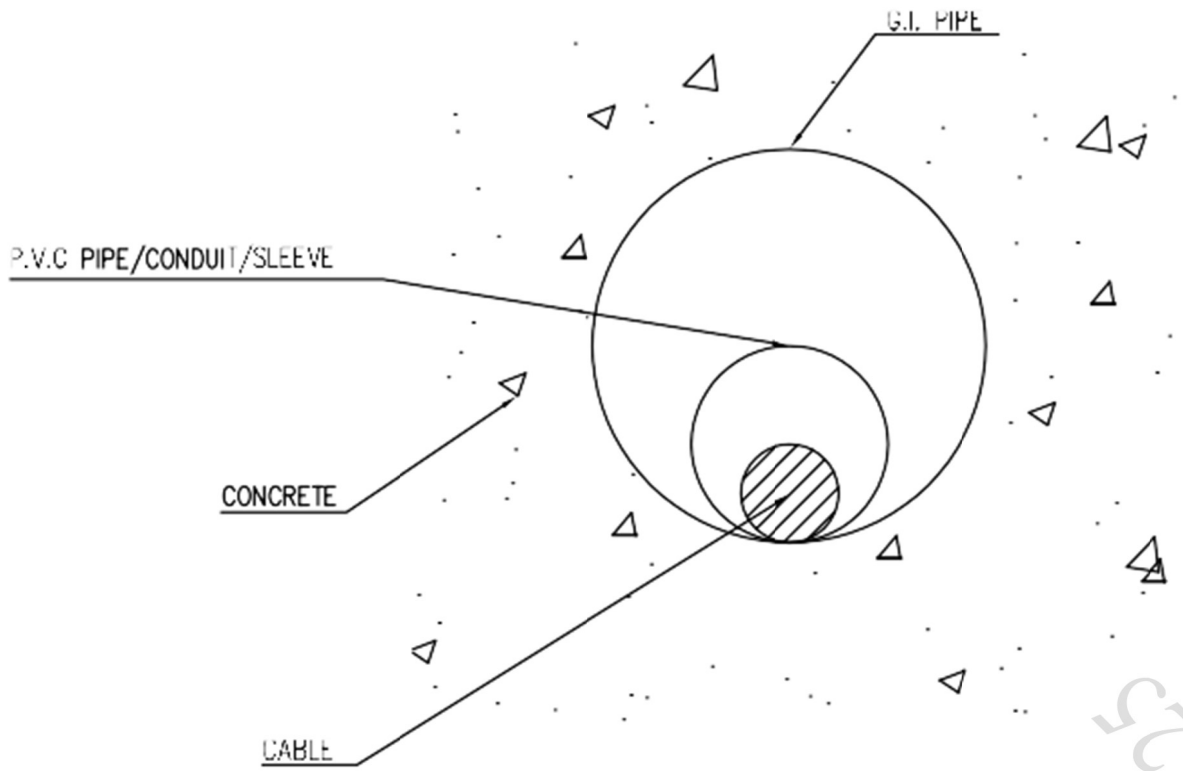
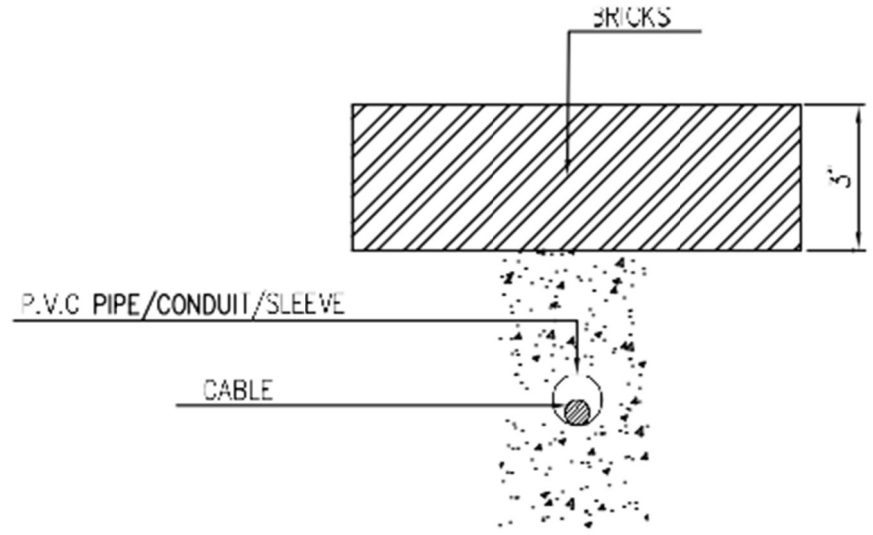
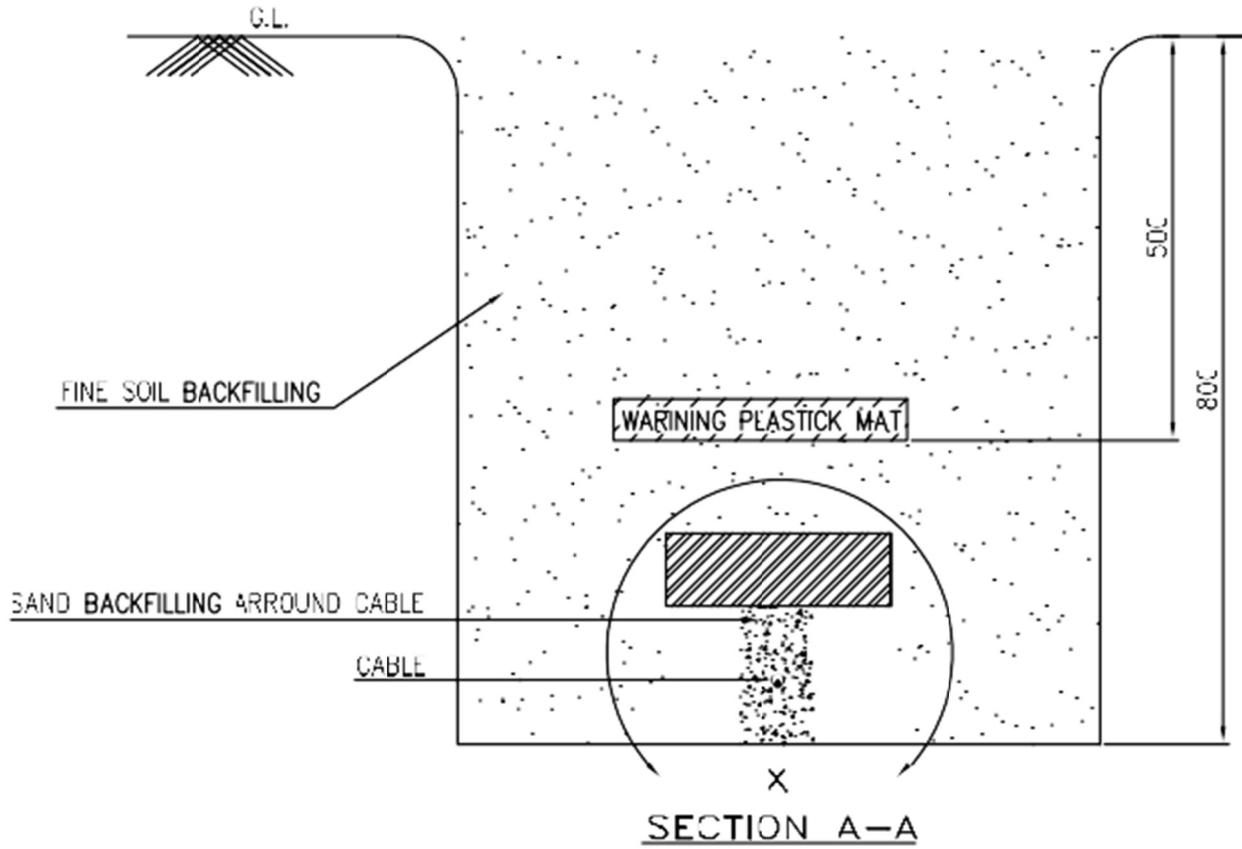
Date: 2024.09.16 18:15:02 IST



SECTION VIEW OF CABLE LAYOUT IN CONCRETE



ENLARGED DETAIL–X
FOR NORMAL LAYING IN EARTH



SECTION A–A

NOTES :–

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. ALL UNDERGROUND CABLE SHALL BE LAID IN BRICK COVERING WITH SAND BACKFILL.
3. FOR MORE THAN ONE CABLE IN THE SAME CABLE TRENCH CABLE SHALL BE LAID SIDE BY SIDE IN SEPARATE BRICK COVERING.
4. AT BOTH ENDS OF CABLE TERMINATION A LOOP OF ONE METER (MINIMUM) SHALL BE KEPT AS SPARE.
5. WHEREVER TERMINATION IN BETWEEN IS REQUIRED T–JOINTS OR ELBOWS SHALL BE PROVIDED.
6. AT ROAD/NALA CROSSINGS, G.I. PIPE CONDUIT SHALL BE USED.

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	19.10.16	ISSUED FOR STANDARD	SK	SKP	KG

SCALE	TITLE: FABRICATION AND INSTALLATION DETAILS OF CABLE LAYING (TYPICAL)			
1:5				
SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-	ENG-STD-CP-DWG-TD-001	1 OF 1	0

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BCIL/6524-25

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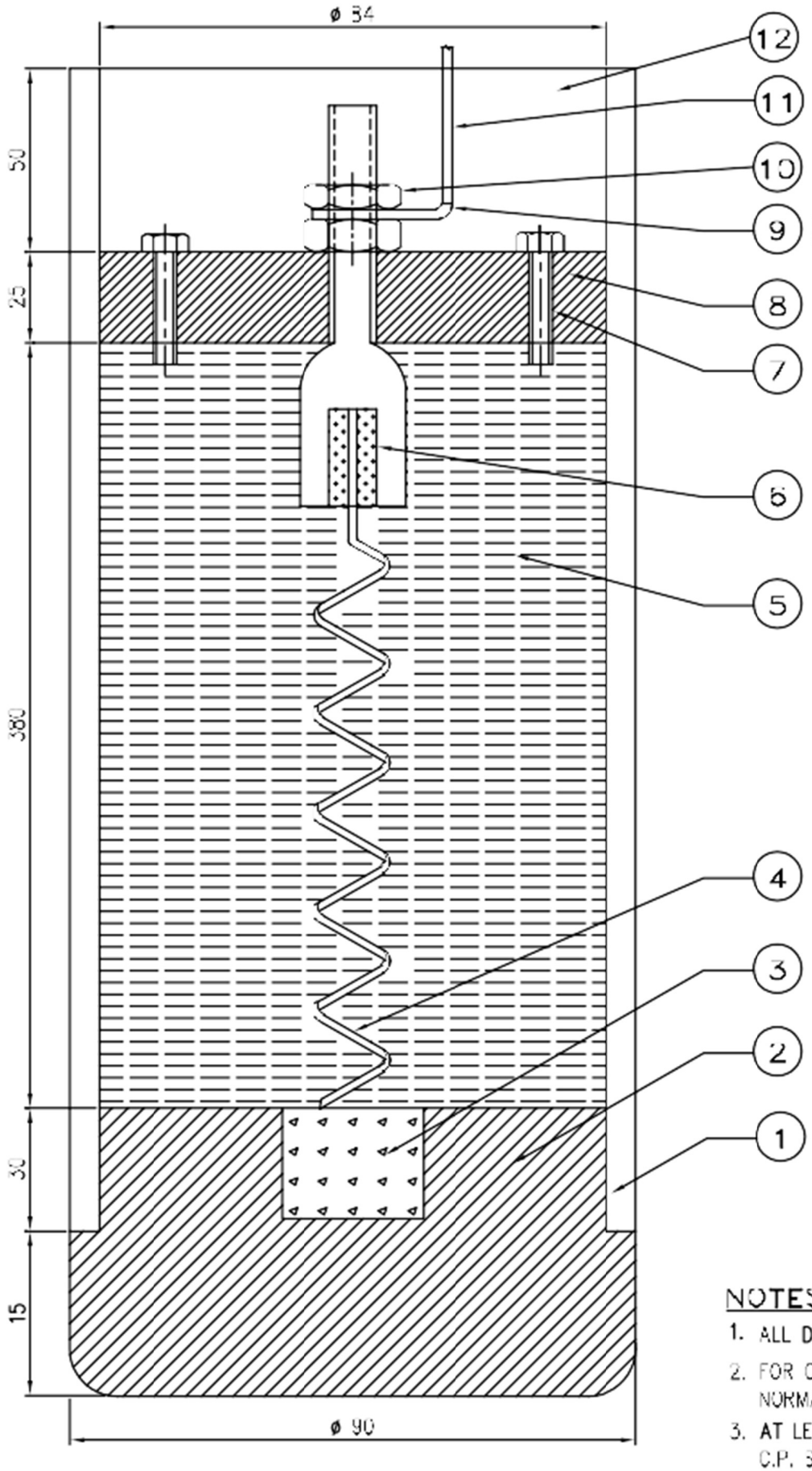
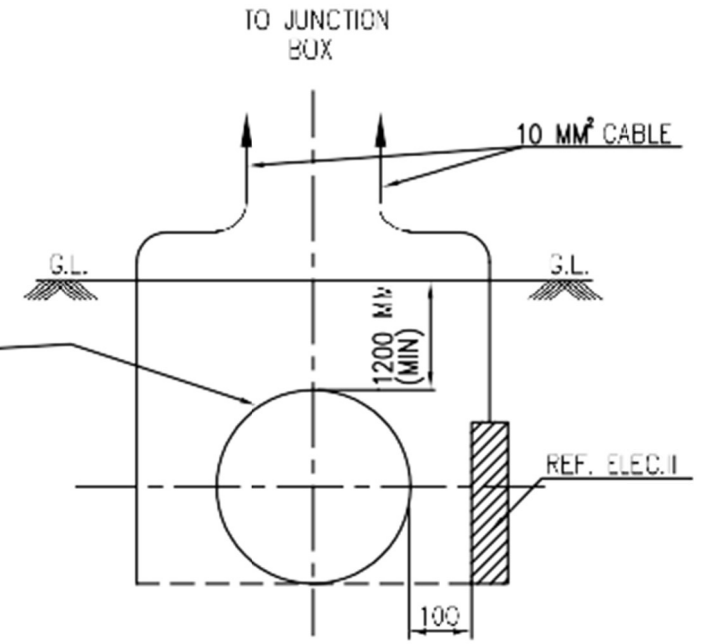
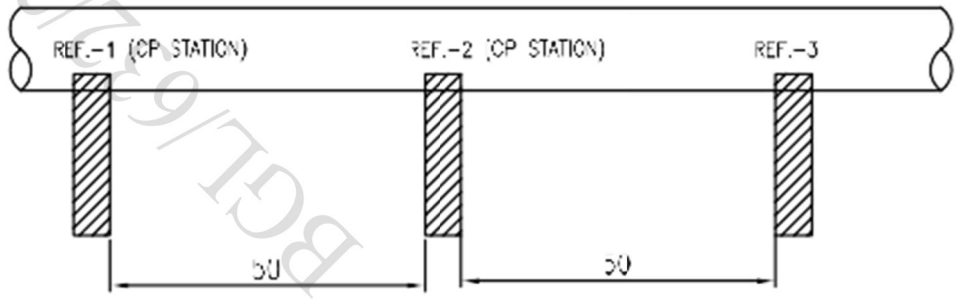
Date: 2024.09.16 18:15:02 IST





ARRANGEMENT OF TWO REFERENCE ELECTRODES ON PIPE LINE TYPICAL INSTALLATION DETAILS

CARRIER PIPE



BILL OF MATERIAL

SL NO.	DESCRIPTION	QTY.
1.	P.V.C PIPE 3 MM THICK	1 NO.
2.	SAL WOOD PLUG	1 NO.
3.	CUSO4 CRYSTALS	AS REQD.
4.	ELECTROLYTIC COPPER SPIRAL 8 MM ø	1 NO.
5.	CUSO4 SATURATED SOLUTION	AS REQD.
6.	BRAZED COPPER JOINT	1 NO.
7.	WATER FILLING BOLTED HOLES ø 8 MM	2 NOS.
8.	HYLAM BUSH	1 NO.
9.	COPPER LUG	1 NO.
10.	BOLTED CABLE CONNECTION	1 NO.
11.	CONNECTION CABLE 10 MM²	AS REQD.
12.	EPOXY FOR SEALING	AS REQD.

NOTES :-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. FOR CABLE TO REFERENCE CELL CONNECTION FOLLOW THE NORMAL CABLE CONNECTION PROCEDURE.
3. AT LEAST 2 NOS REF. ELECTRODE SHOULD BE INSIDE THE C.P. STATION.

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	19.10.16	ISSUED FOR STANDARD	SK	SKP	KG

SCALE	TITLE: FABRICATION AND INSTALLATION DETAILS OF ELECTRODES PIPELINE			
1/5				
SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-	ENG-STD-CP-DWG-TD-002	1 OF 1	0

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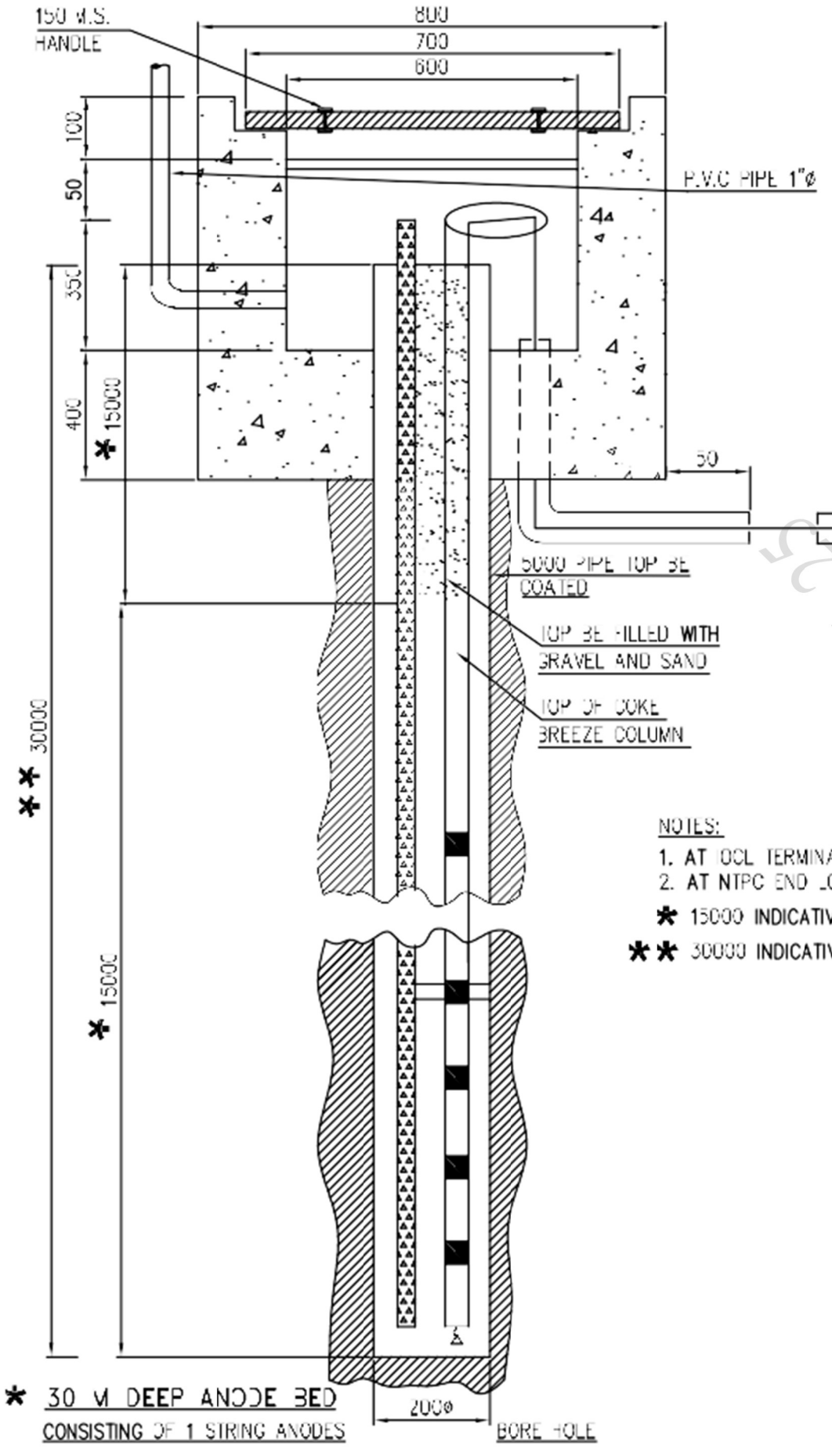
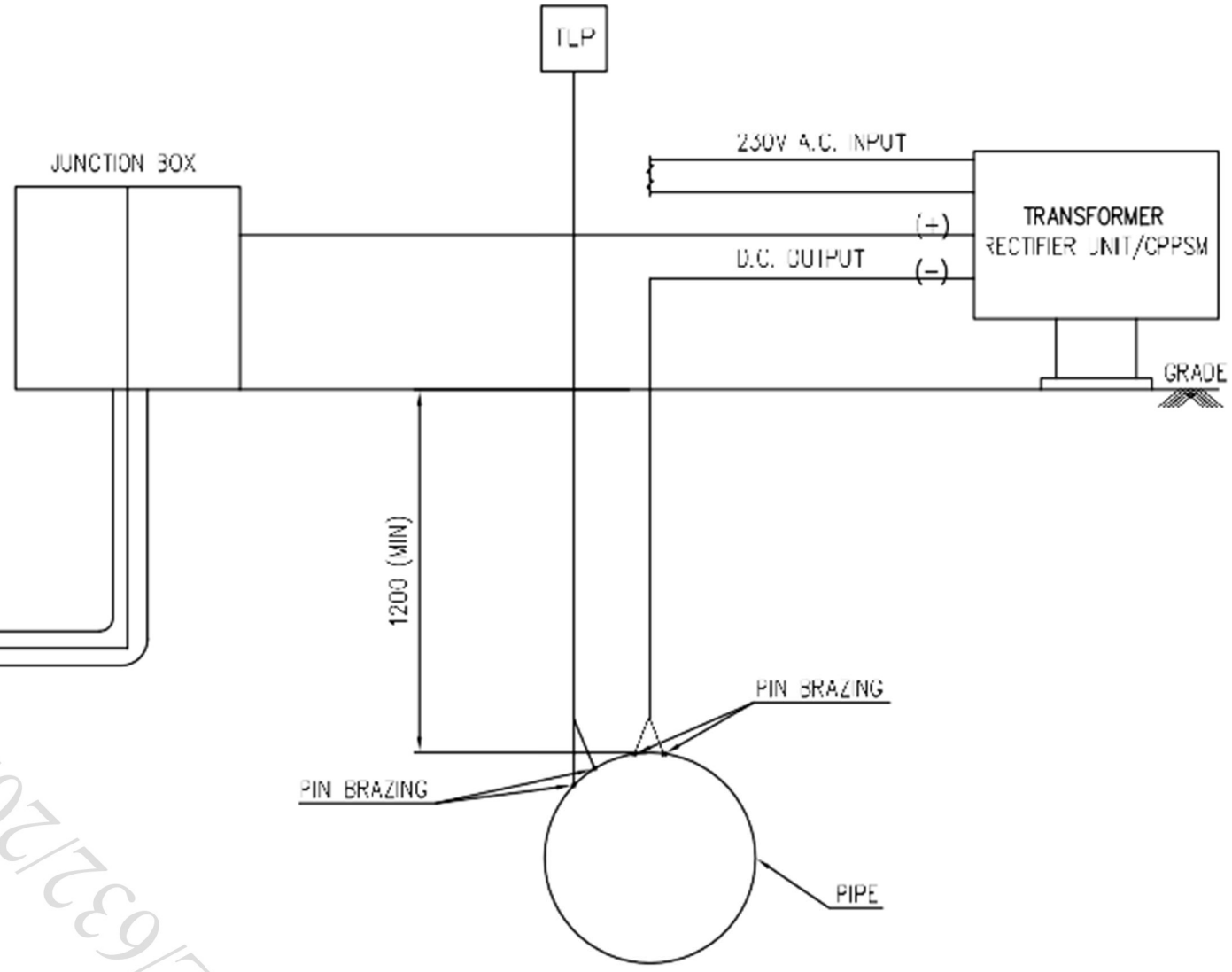
Date: 2024.09.16 18:15:02 IST



** 30 M DEEP ANODE BED
CONSISTING OF 1 STRING ANODES



NOTES:

1. AT IOCL TERMINAL LOCATED BY THE SIDE OF GATE (1), AFTER THE LICENCED AREA FENCING.
2. AT NTPC END LOCATED OPPOSITE TO TLD GANTYR LICENCED AREA FENCING ACROSS THE ROAD & DRAIN, BY THE SIDE OF BOUNDARY WALL.

* 15000 INDICATIVE TO SUIT ACTUAL SITE CONDITION

** 30000 INDICATIVE TO SUIT ACTUAL SITE CONDITION

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	19.10.16	ISSUED FOR STANDARD	SK	SKP	KG

SCALE	TITLE: IMPRESSED CURRENT CATHODIC PROTECTION SCHEMATIC			
1:75				
SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-	ENG-STD-CP-DWG-TD-003	1 OF 1	0

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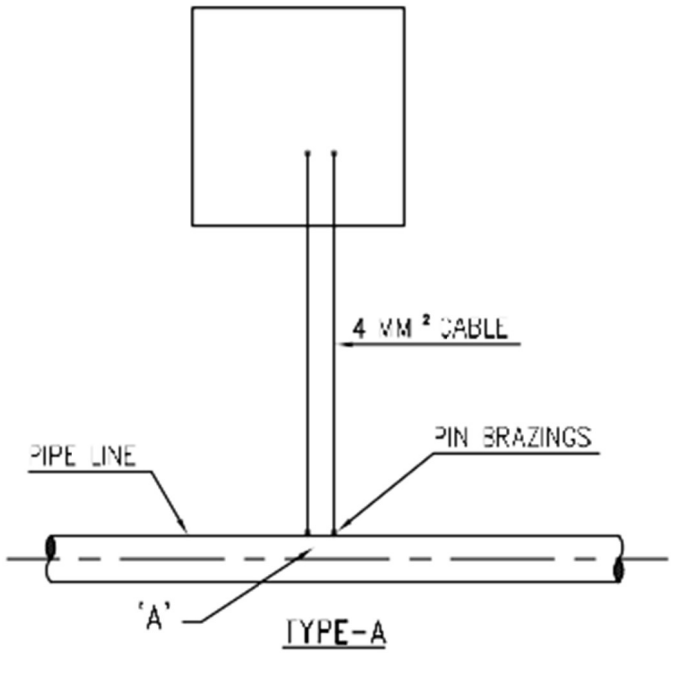
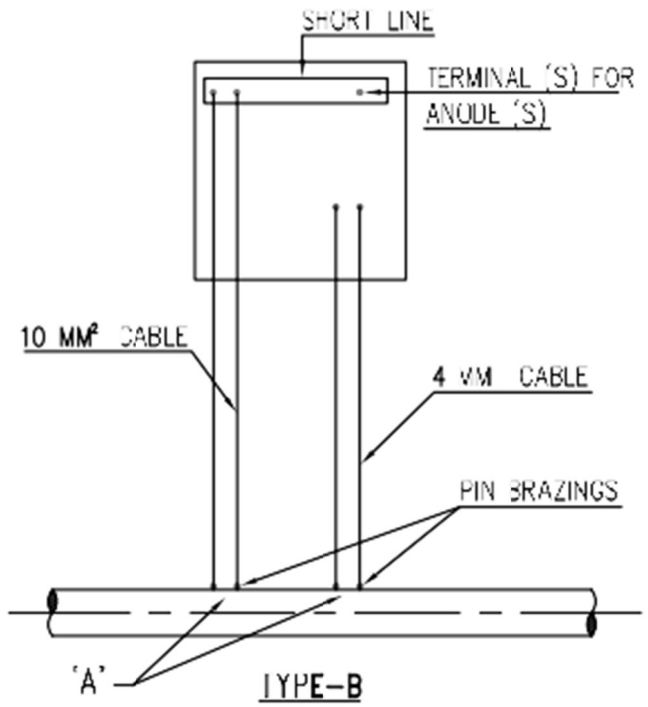
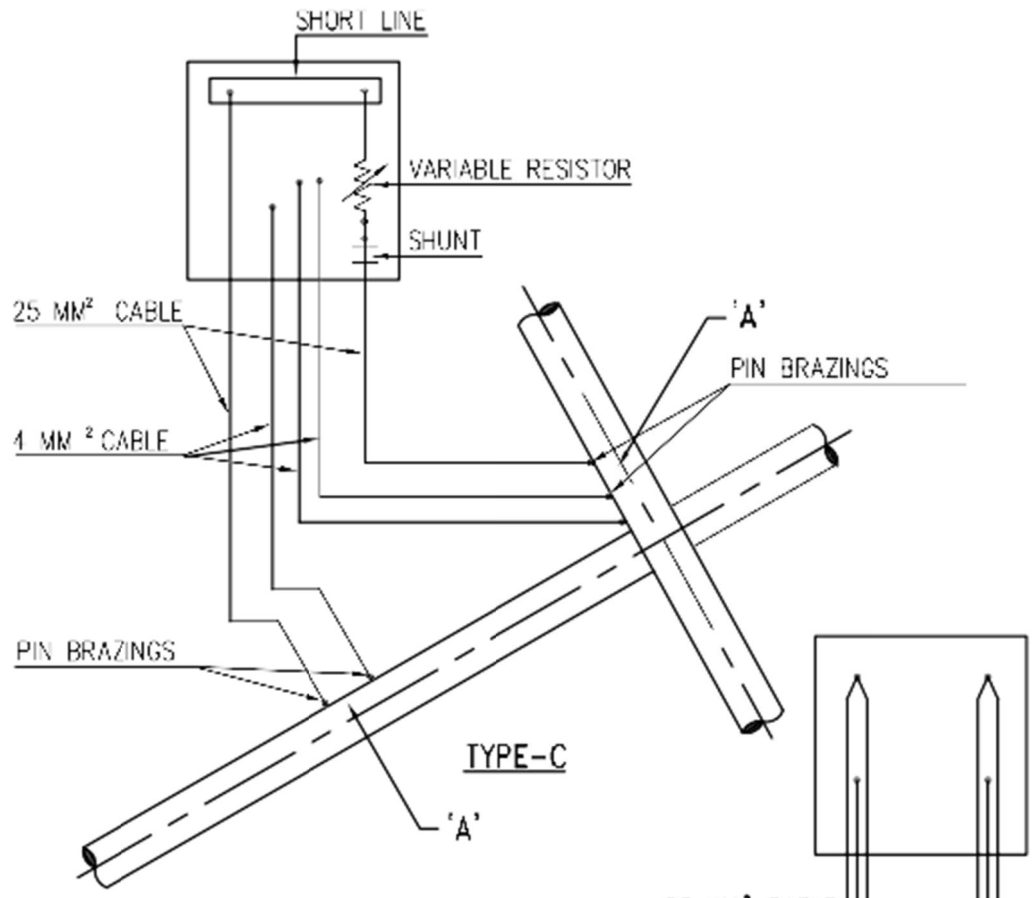


TYPE-A



TYPE-B



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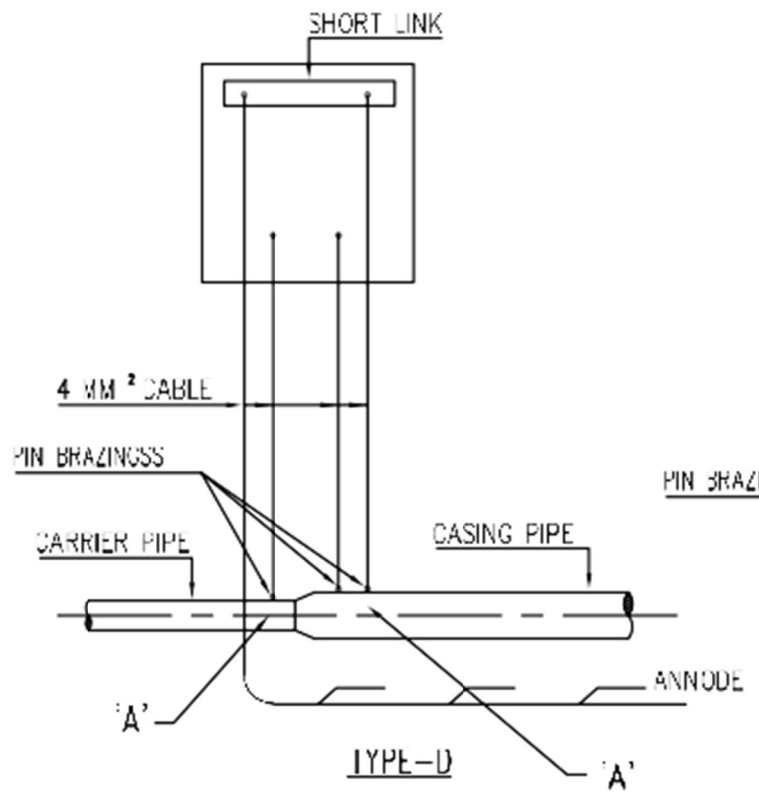

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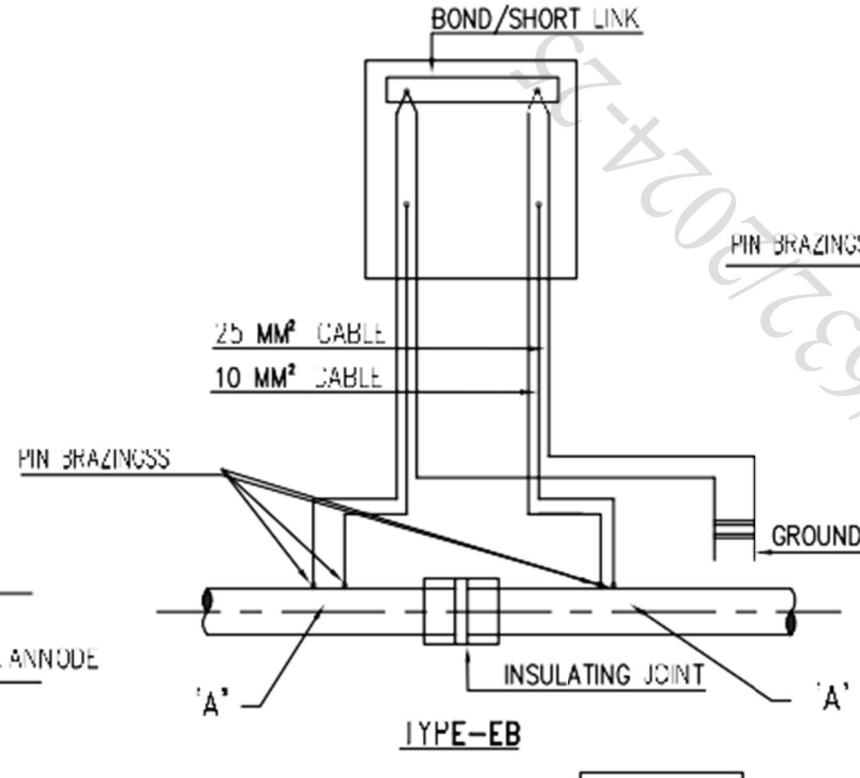
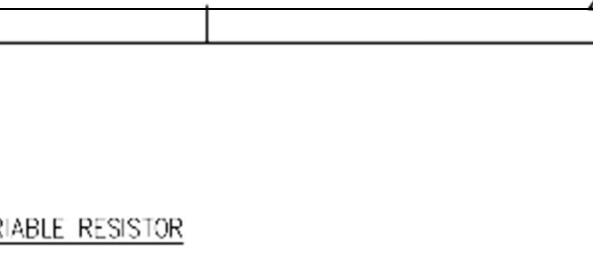
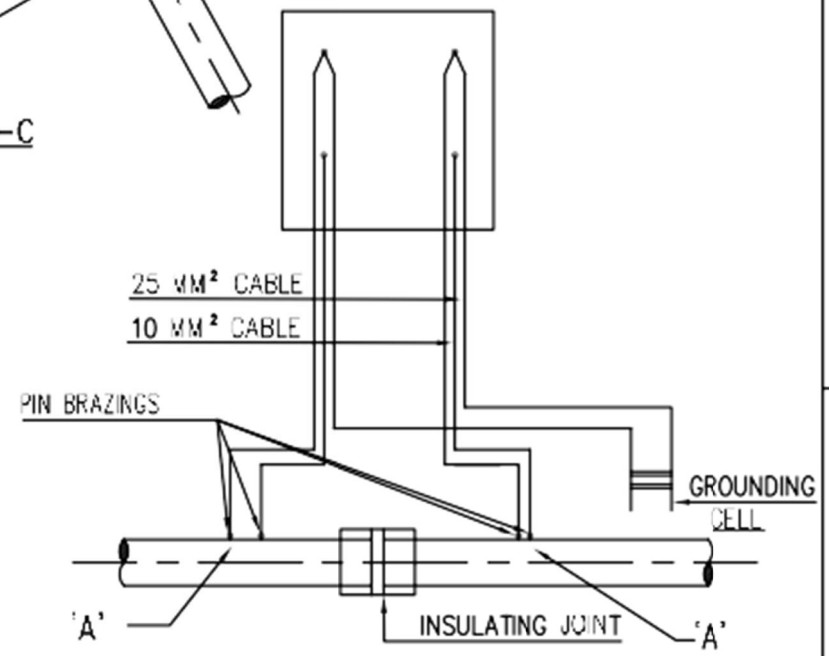


TYPE-EB



VIEW-'A'

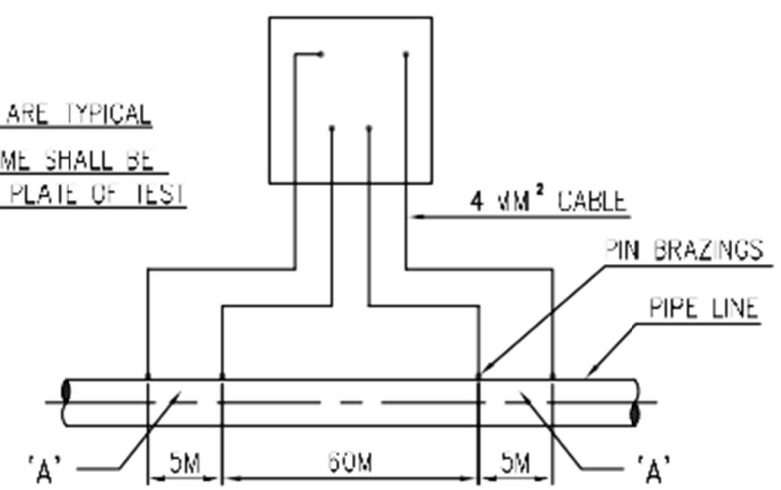


DETAILS OF CONNECTION SCHEME

TYPE A : PSP MONITORING ONLY.
TYPE A1 : LINE CURRENT MEASUREMENT.
TYPE B : ANODE TO PIPE CONNECTION.
TYPE C : PIPE LINE CROSSING.
TYPE D : CASED CROSSING.
TYPE E : GROUNDING CELL UNBONDED.
TYPE EB : GROUNDING CELL BONDED.

NOTES :-

1. THE CONNECTION SCHEMES ARE TYPICAL
2. REQUIRED CONNECTION SCHEME SHALL BE PROVIDED ON THE TERMINAL PLATE OF TEST LEAD POINT.



TYPE-A1

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	19.10.16	ISSUED FOR STANDARD	SK	SKP	KG

SCALE	TITLE:			
1:5	TEST STATION CONNECTION SCHEME (TYPICAL) DETAILS			
SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-	ENG-STD-CP-DWG-TD-004	1 OF 1	0

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BGR/6321/2024-25

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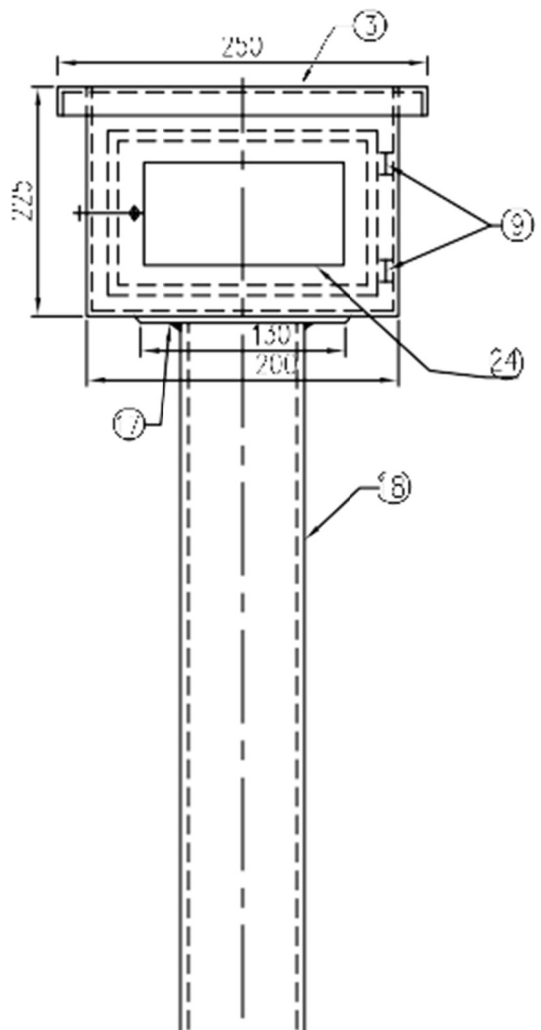
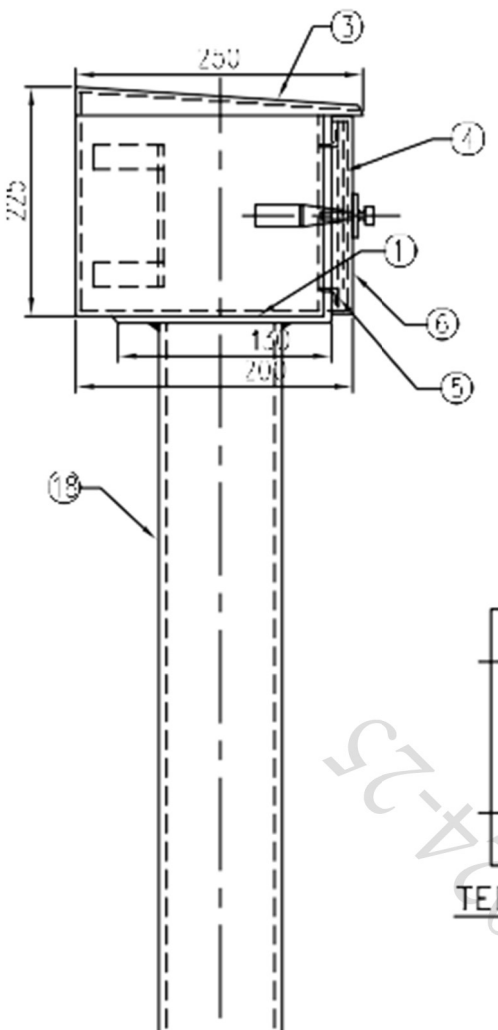
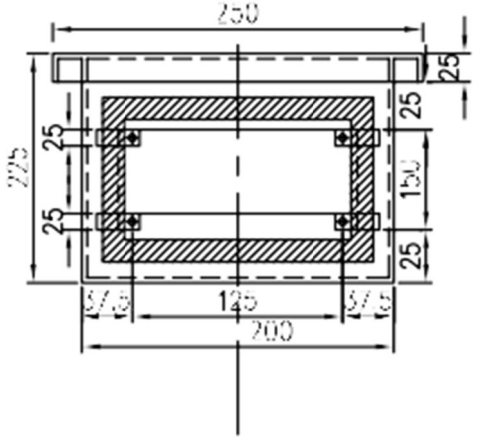
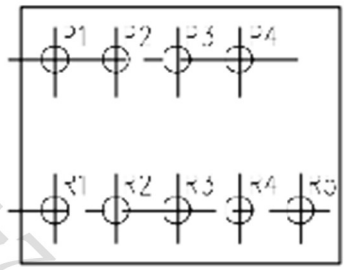


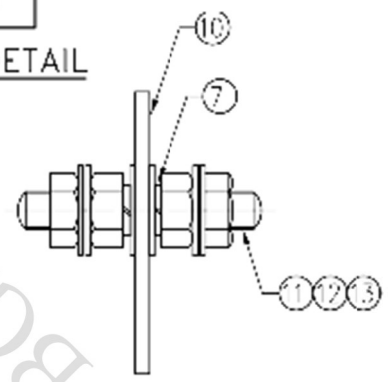




FRONT VIEW DOOR REMOVED



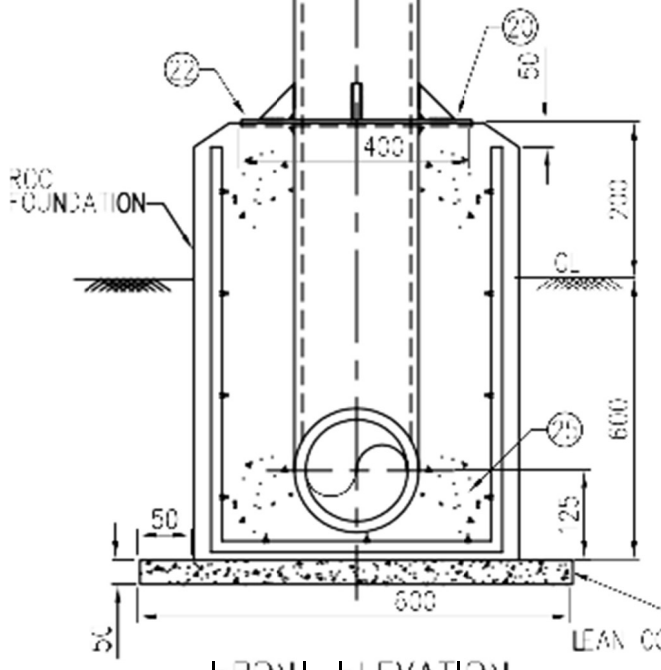
TERMINAL PLATE DETAIL



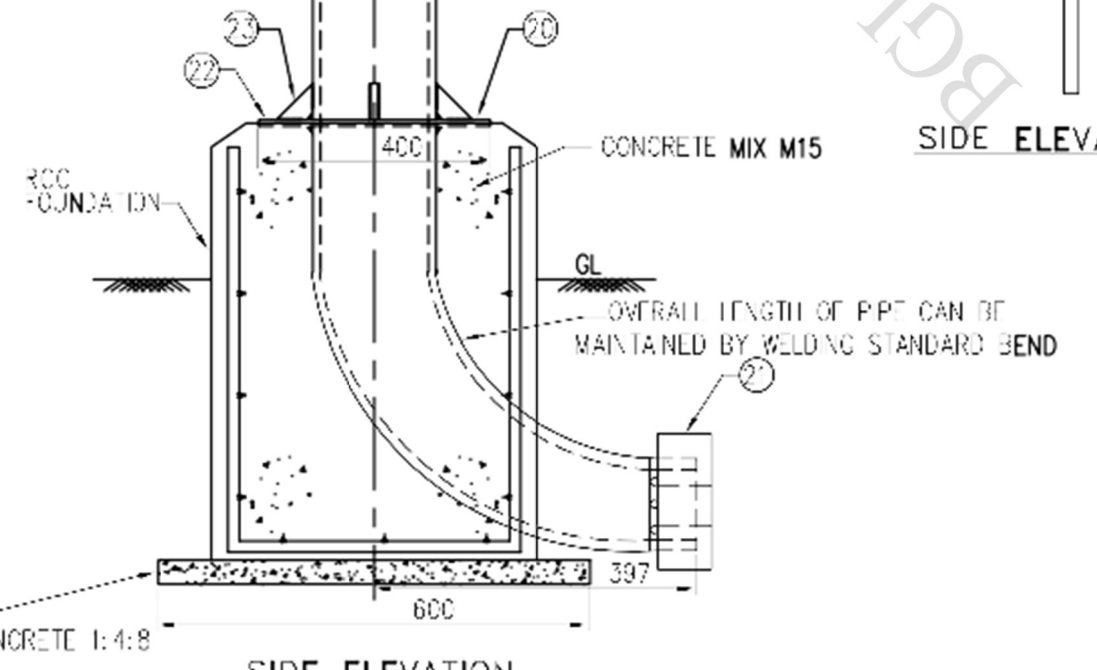
SIDE ELEVATION

BILL OF MATERIAL

SL NO	DESCRIPTION	QTY.
1.	BOTTOM PLATE, 5TKx194 MS PLATE	001
2.	REAR & SIDE, 2.67x217x704 MS	001
3.	TOP, 2.67x250x300 MS	001
4.	FRONT TOP 2.67 x190x81 MS	001
5.	FRONT BOTTOM, 2.67x190x81 MS	001
6.	SHUTTER 2.67x234x234 MS	001
7.	SPRING WASHER SC. 8.6	066
8.	CASTLE LOCK WITH MASTER KEY (3NOS. KEY)	001
9.	HINGE FOR SHUTTER	002
10.	TERMINAL PLATE, 6x150x150 PHENOLIC LAM SHT.	001
11.	BRASS STUD M6x50LG (FOR TERMINALS)	001
12.	BRASS NUT M6	044
13.	BRASS WASHER	044
14.	MS. ANGLE 5TKx50x50x30	004
15.	STEEL SCREW, M6x16	004
16.	LATCH FOR SHUTTER	001
17.	MS COUPLING PLATE, 5TKx130x130 MS PLATE	001
18.	MS PIPE, 100 NB x 5.4 TKx 12/5MM	001
19.	NEOPRENE RUBBER GASKET 6 TK.	001 SET
20.	FOUNDATION PLATE 6TKx400x400 AA 1J108	002
21.	RUBBER BUSH	001
22.	FOUNDATION BOLT M14x125 LG WITH SPRING WASHER AND NUT	001
23.	STIFFENER PLATE 5TKx100x100	001
24.	NAME PLATE ANNODISED AL 0.9x120x160	001



FRONT ELEVATION



SIDE ELEVATION

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	19.10.16	ISSUED FOR STANDARD	SK	SKP	KG

SCALE	TITLE:
1/5	TEST LEAD POINTS & JUNCTION BOX WITH FOUNDATION DETAILS

SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-	ENG-STD-CP-DWG-TD-005	1 OF 1	0

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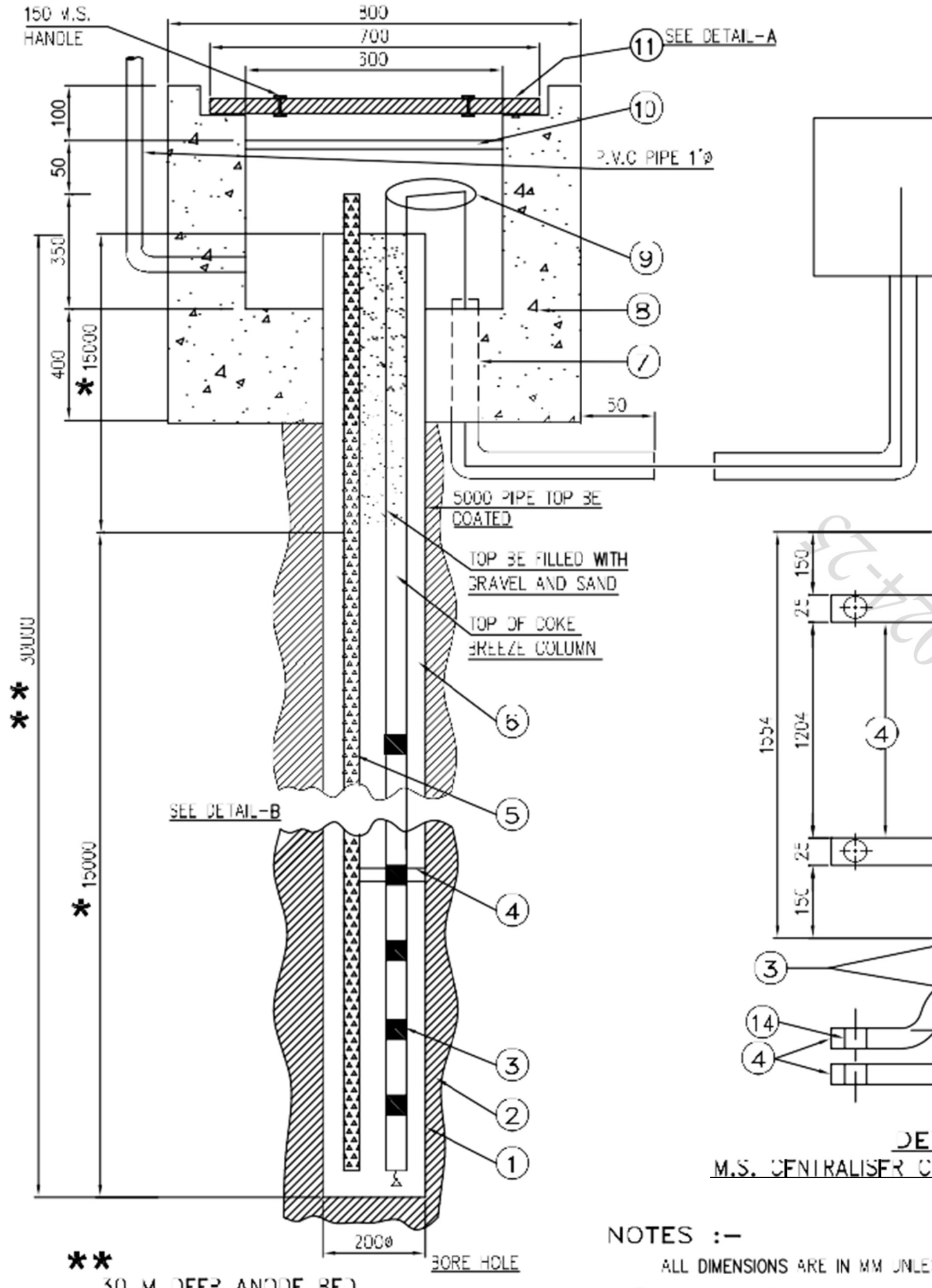
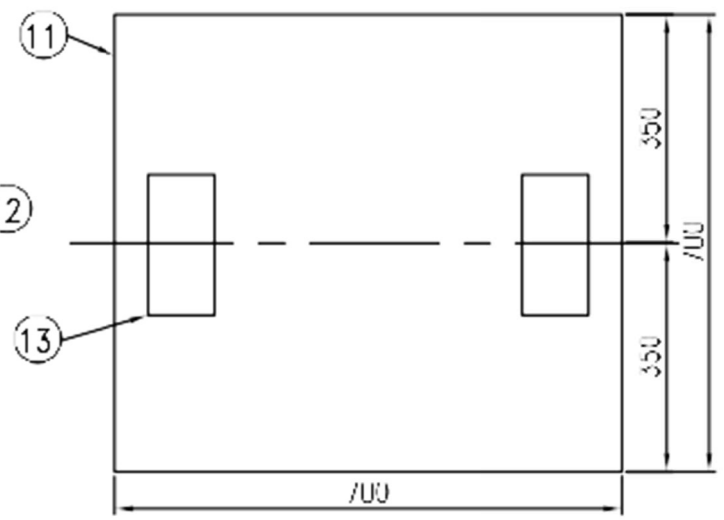
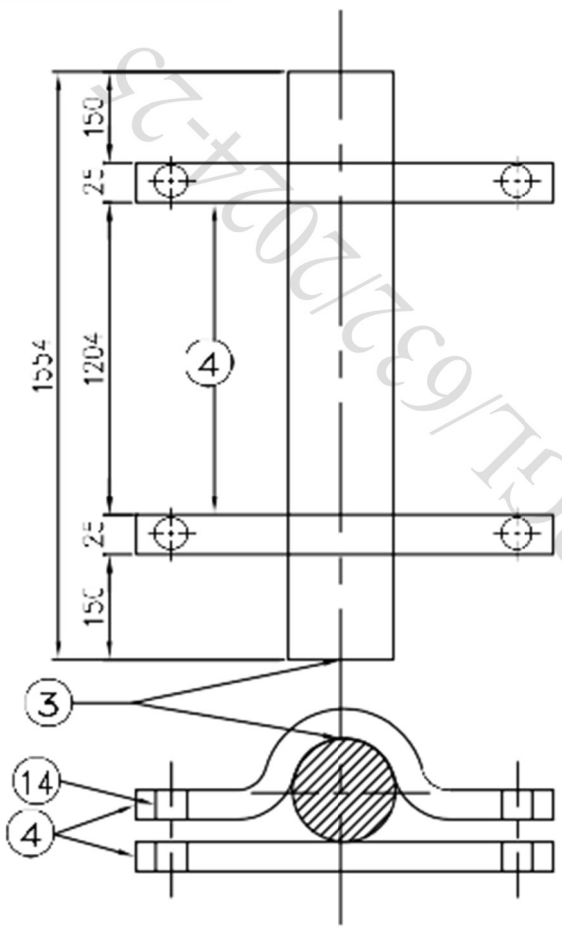


30 M DEEP ANODE BED
CONSISTING OF 1 STRING ANODES



DETAIL-A
PLAN OF PIT COVER



DETAIL-B
M.S. CENTRALISER CLAMP ARRANGEMENT

NOTES :-

ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

* 15000 INDICATIVE TO SUIT ACTUAL SITE CONDITION.

** 30000 INDICATIVE TO SUIT ACTUAL SITE CONDITION.

ANODE TAIL CABLE LENGTHS
30 M DEEPWELL ANODE BED.

ANODE NO.	ANODE TAIL CABLE LENGTH
1	31 M.

BILL OF MATERIAL

SL NO.	DESCRIPTION	QTY.
1.	M.S. CASING PIPE 200 NB	30 M
2.	COKE BREEZE	AS REQD.
3.	ANODE 60 MM ø x 1554 MM LONG	1 STRING MVO
4.	M.S. CENTRALISER	10 NOS.
5.	P.V.C PERFORATED VENT PIPE 1" ø	AS REQD.
6.	CABLE LEADS	1 NO.
7.	P.V.C PIPE 100 MM ø	AS REQD.
8.	CONCRETE WORK FOR TOP OF ANODE BED	AS REQD.
9.	CABLE TIE WITH 1/4" NYLON ROPE	AS REQD.
10.	G.I. PIPE 2" ø FOR SUPPORTING CABLE	1 NO.
11.	M.S. PLATE TOP COVER	1 NO.
12.	ANODE LEAD JUNCTION BOX	1 NO.
13.	M.S. LIFTING HANDLES	2 NO.
14.	M.S. NUT & BOLT	56 NOS.
15.	P.V.C PIPE 4" ø	AS REQD.

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	19.10.16	ISSUED FOR STANDARD	SK	SKP	KG

SCALE	TITLE:
1:5	FABRICATION AND INSTALLATION DEEP ANODE GROUND BED DETAILS

SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-	ENG-STD-CP-DWG-TD-006	1 OF 1	0

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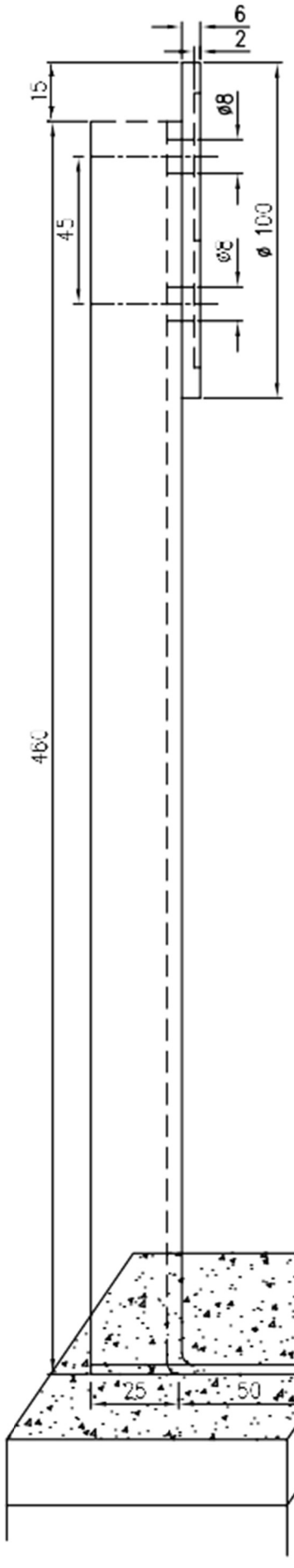
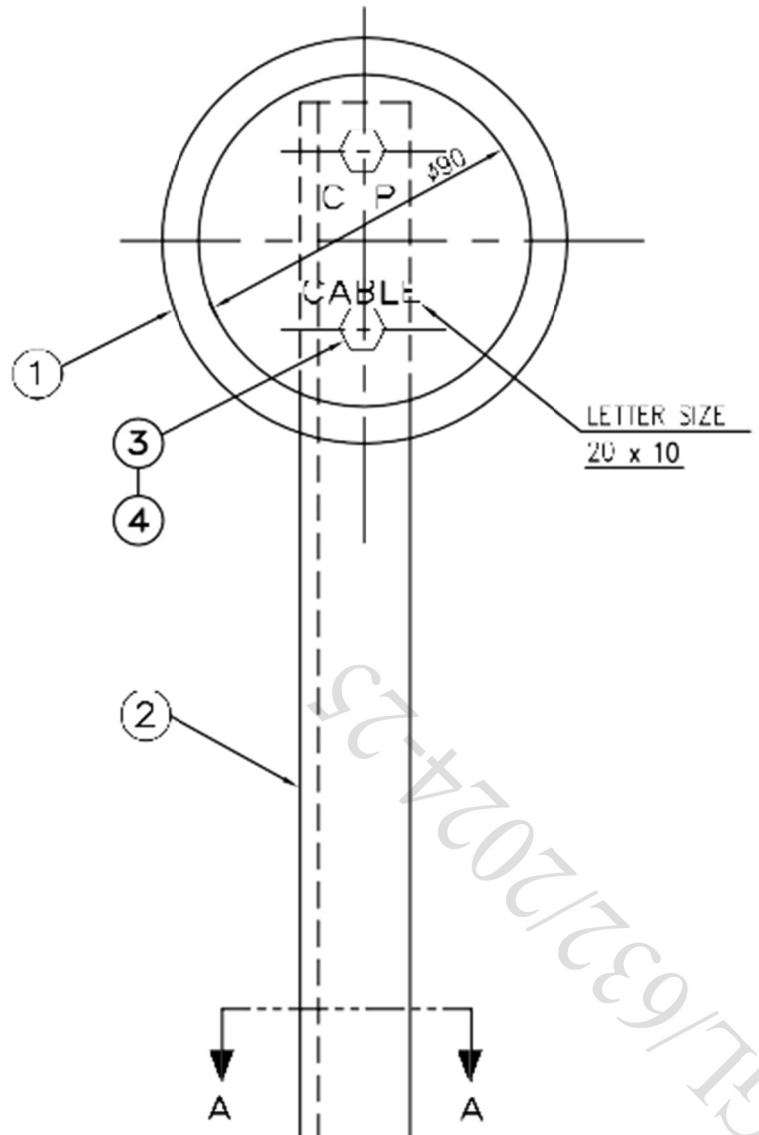
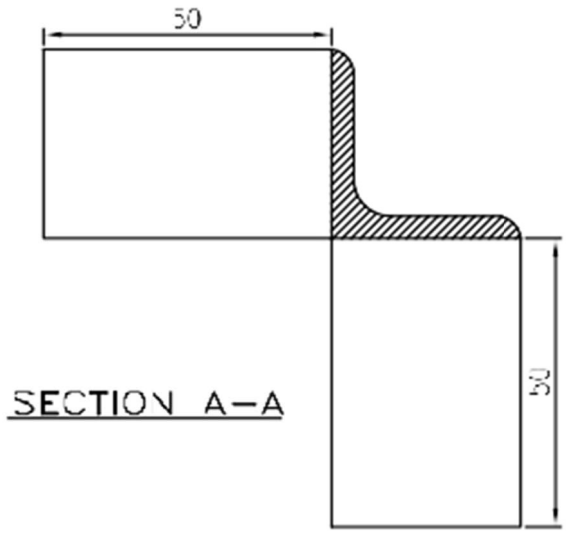
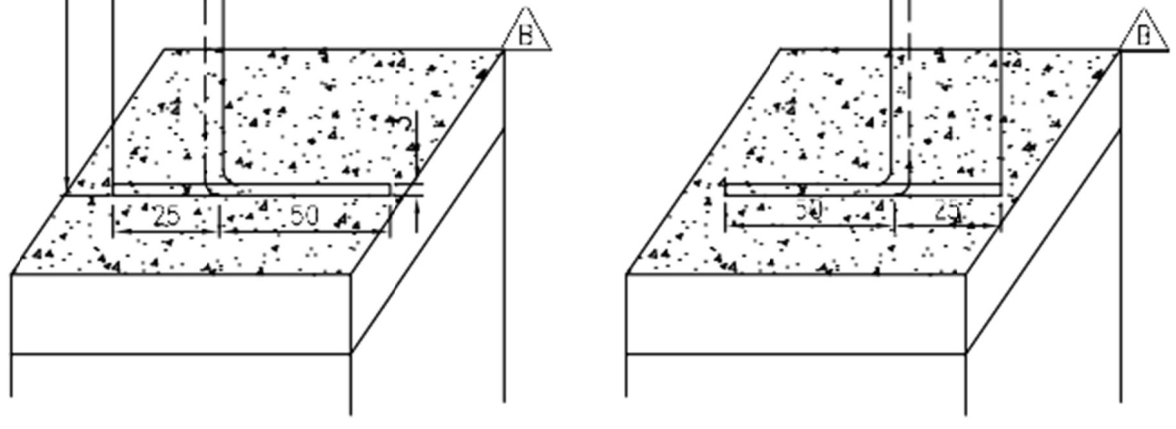






SECTION A–A



BILL OF MATERIAL

SL NO.	DESCRIPTION	QTY.
1.	MARKER PLATE (CAST IRON)	1 NO.
2.	M.S. ANGLE 25x25x510 LONG	1 NO.
3.	BOLTS M6x20 LONG	2 NOS.
4.	NUTS M6	2 NOS.

NOTES:

1. ALL DIMENSION ARE IN MM
2. IN CASE OF POWER CABLE REPLACE "C.P" WITH "POWER"
3. THE CABLE MARKER SHALL BE PAINTED WITH APPROVED GRADE ALUMINIUM PAINT.

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	19.10.16	ISSUED FOR STANDARD	SK	SKP	KG

SCALE	TITLE: FABRICATION AND INSTALLATION DETAILS CABLE ROUTE MARKER			
1/5				
SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-	ENG-STD-CP-DWG-TD-007	1 OF 1	0

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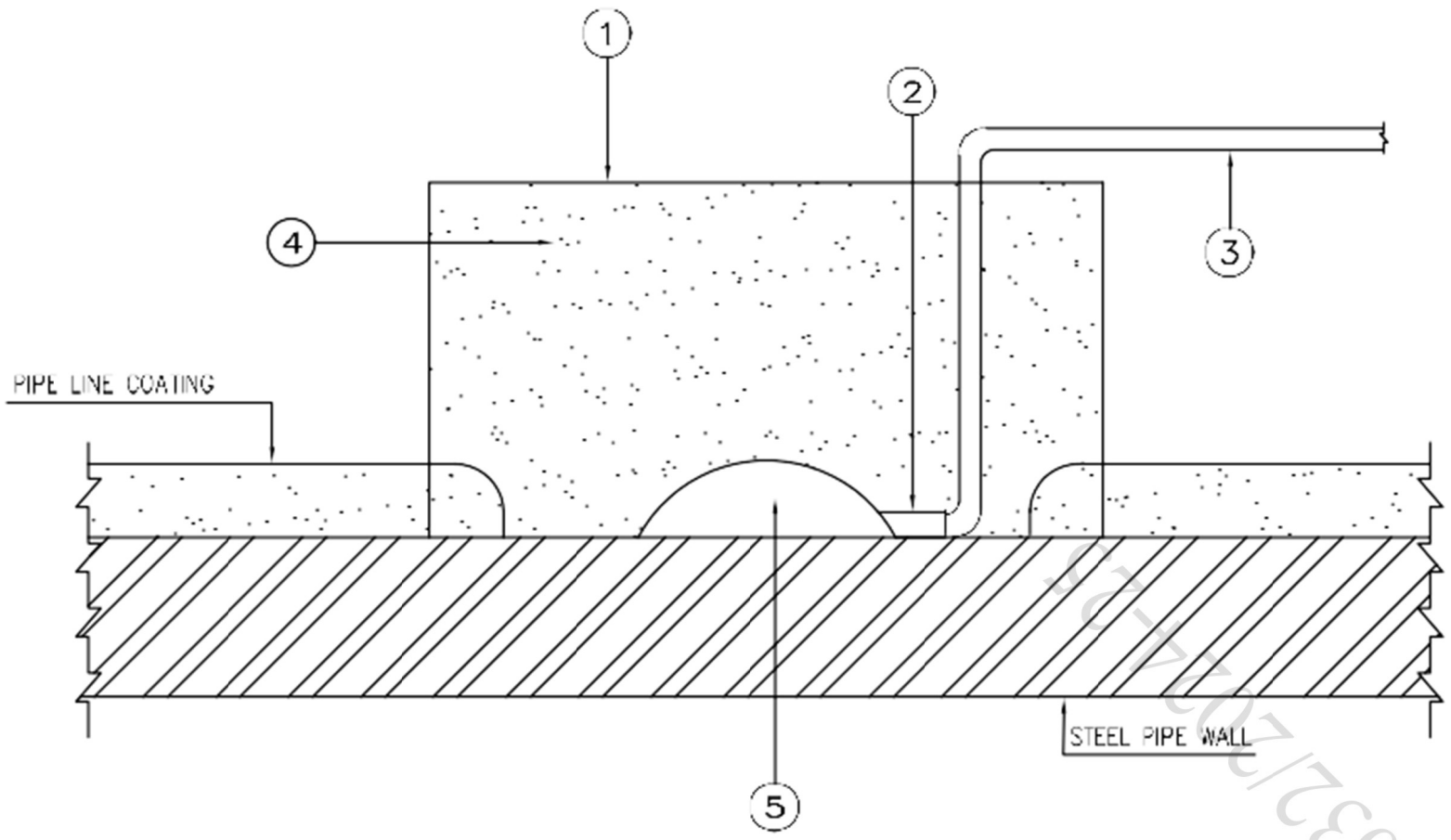

BILL OF MATERIAL

SL NO.	DESCRIPTION	QTY.
1.	P.V.C CAP	1 NO.
2.	COPPER SLEEVE	1 NO.
3.	CABLE	AS REQD.
4.	EPOXY RESIN	AS REQD.
5.	CAD WELD	1 NO.

NOTES :–

1. INSTRUCTION APPEARING WITH THIS DRG. ARE SUITABLE FOR Cu CABLE CONNECTIONS
2. FOR DIFFERENT SIZES OF CABLES, MATCHING SIZES OF WELDING MOULDS SHALL BE USED.
3. FOR SEALING THE COMPLETED JOINT FILL WITH EPOXY RESIN FORMULATION ENSURING THAT EVERY METALIC PART OF THE JOINT IS COMPLETELY INSULATED.
4. FOR EFFECTIVE SEALING, THE SIZE OF P.V.C CAP SHOULD BE SUCH THAT IT COVERS THE AREA FROM WHERE PIPE COATING HAS BEEN REMOVED AND IN ADDITION AT LEAST 15 MM OVERLAPPING THE EXISTING GOOD COATING OF THE PIPE LINE.

PROCEDURE FOR CARRYING OUT THERMIT WELDING CABLE TO PIPE JOINT

1. REMOVE PIPE COATING FROM A SPOT ON TOP OF PIPE APPROX. 15MM LARGER THAN MOULD BASE.
2. CLEAN PIPE TO BRIGHT METAL FOR APPROX. 40MM PIPE SPOT.
3. REMOVE 5MM OF INSULATION FROM END OF CABLE, CRIMP 10MM LONG COPPER SLEEVE ON CABLE END.
4. POSITION COPPER SLEEVE ON CLEAN PIPE SPOT.
5. SECURE AND FASTEN CABLE ON PIPE WITH ADHESIVE TAPE AND STRAPPING BANDS.
6. PLACE MOULD ON CABLE TO PIPE JOINT AND HOLD SECURELY.
7. PLACE METAL DISC IN MOULD DEPOSIT WELD CHARGE ON DISC AND PLACE LID ON MOULD.
8. IGNITE THE CHARGE WITH IGNITER FOR WELDING.
9. REMOVE MOULD AFTER COMPLETE IGNITION OF THE CHARGE.
10. TEST THE CONNECTION BY STRIKING SEVERAL BLOWS ON THE CONNECTIONS USING A 1 Kg. HAMMER. TOP OF WELD MAY BE HAMMERED FLAT, IF DESIRED.
11. COVER THE CONNECTION WITH P.V.C CAP.
12. FILL THE P.V.C CAP WITH EPOXY MIXED HARDENER AND ALLOW TO DRY TO BECOME HARD.

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	19.10.16	ISSUED FOR STANDARD	SK	SKP	KG

SCALE	TITLE: FABRICATION AND INSTALLATION OF THERMIT WELDING CABLE TO PIPE JOINT			
1.5				
SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-	ENG-STD-CP-DWG-TD-008	1 OF 1	0

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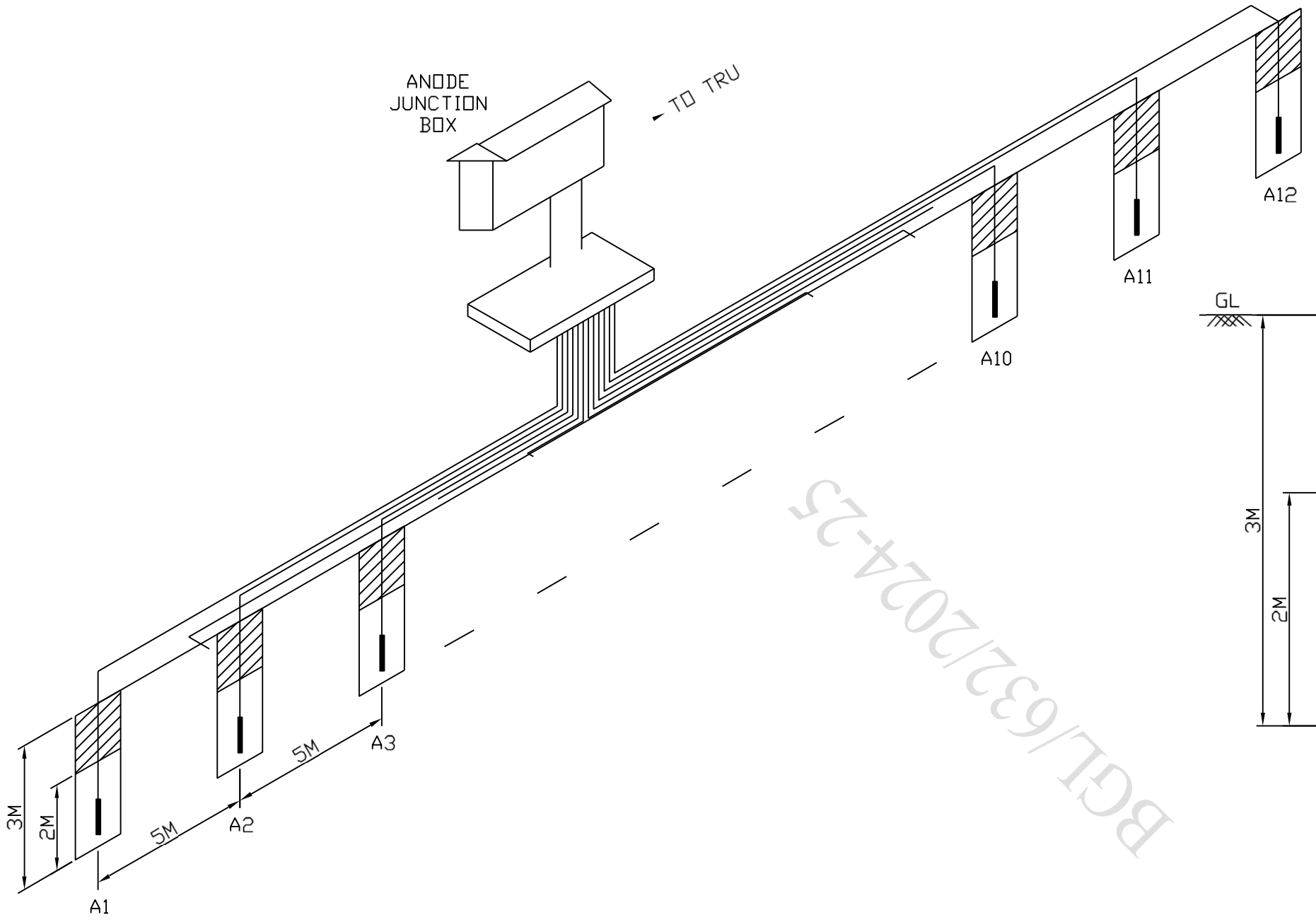

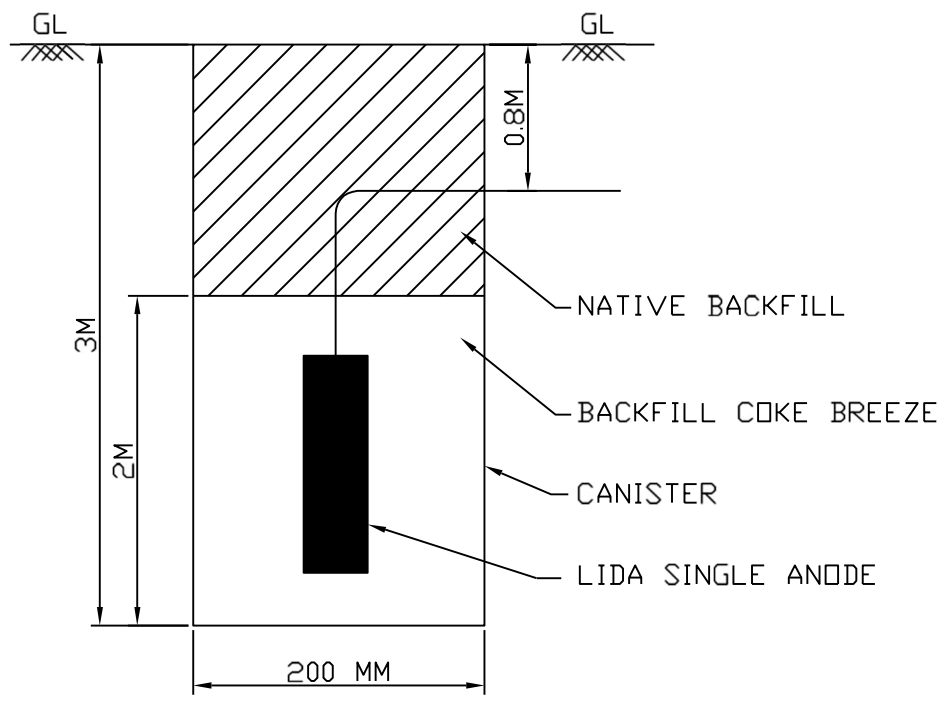

BGL/6332/2024-25

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Date: 2024.09.16 18:15:02 IST

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	19.10.16	ISSUED FOR STANDARD	SK	SKP	KG

SCALE	TITLE:			
1:75	INSTALLATION DETAILS OF LIDA SINGLE ANODES			
SIZE	**CLIENT JOB NO.**	**DRAWING NUMBER**	**SHEET**	**REV.**
A3	-	ENG-STD-CP-DWG-TD-009	1 OF 1	0

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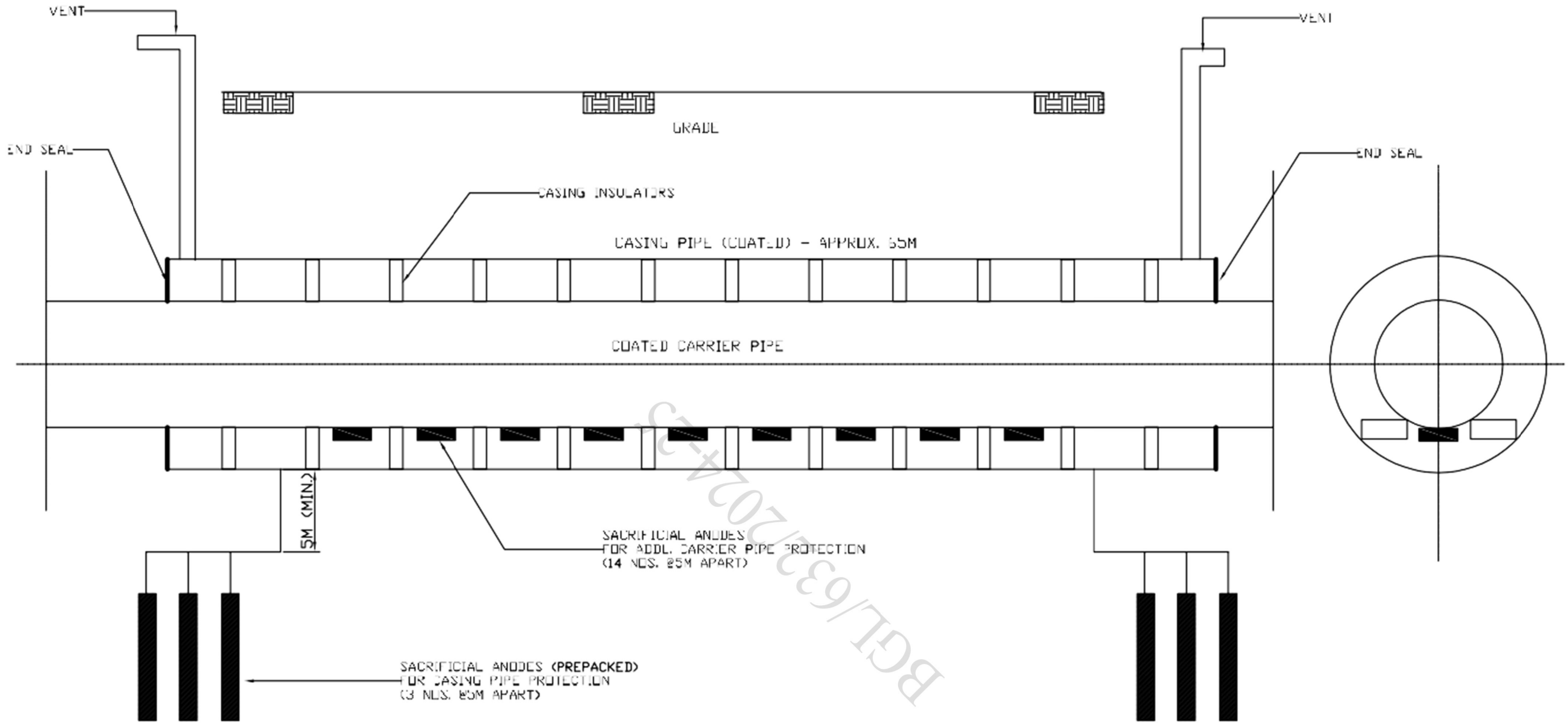

NOTES:

1. CASING PIPE- SACRIFICIAL ANODE CATHODIC PROTECTION AT THE TWO ENDS TO INDEPENDENTLY PROTECT THE CASING PIPE FROM RAVAGES OF SOILSIDE CORROSION.
2. CARRIER PIPE - ICCP IS ALREADY PROTECTING THE CARRIER PIPE. IN ADDITION SACRIFICIAL ANODES ARE INSTALLED, AS ABOVE, BETWEEN 4-7 O' CLOCK POSITION TO COUNTER ELECTROLYTE.
3. CASINGS OVER 20mtr. LENGTH SHALL HAVE ADDITIONAL CATHODIC PROTECTION FOR CARRIER PIPE BOTTOM AND THE ANNULUS SHALL BE PACKED WITH SAND OR BENTONITE.
4. CASINGS LESS THAN 20mtr. LENGTH SHALL NOT HAVE ADDITIONAL CATHODIC PROTECTION FOR CARRIER PIPE BOTTOM AND THE ANNULUS SHALL BE PACKED WITH SAND OR BENTONITE.

REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	19.10.16	ISSUED FOR STANDARD	SK	SKP	KG

SCALE	TITLE: TYPICAL CATHODIC PROTECTION SCHEME FOR CASED CROSSINGS			
1/5				
SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-	ENG-STD-CP-DWG-TD-010	1 OF 1	0

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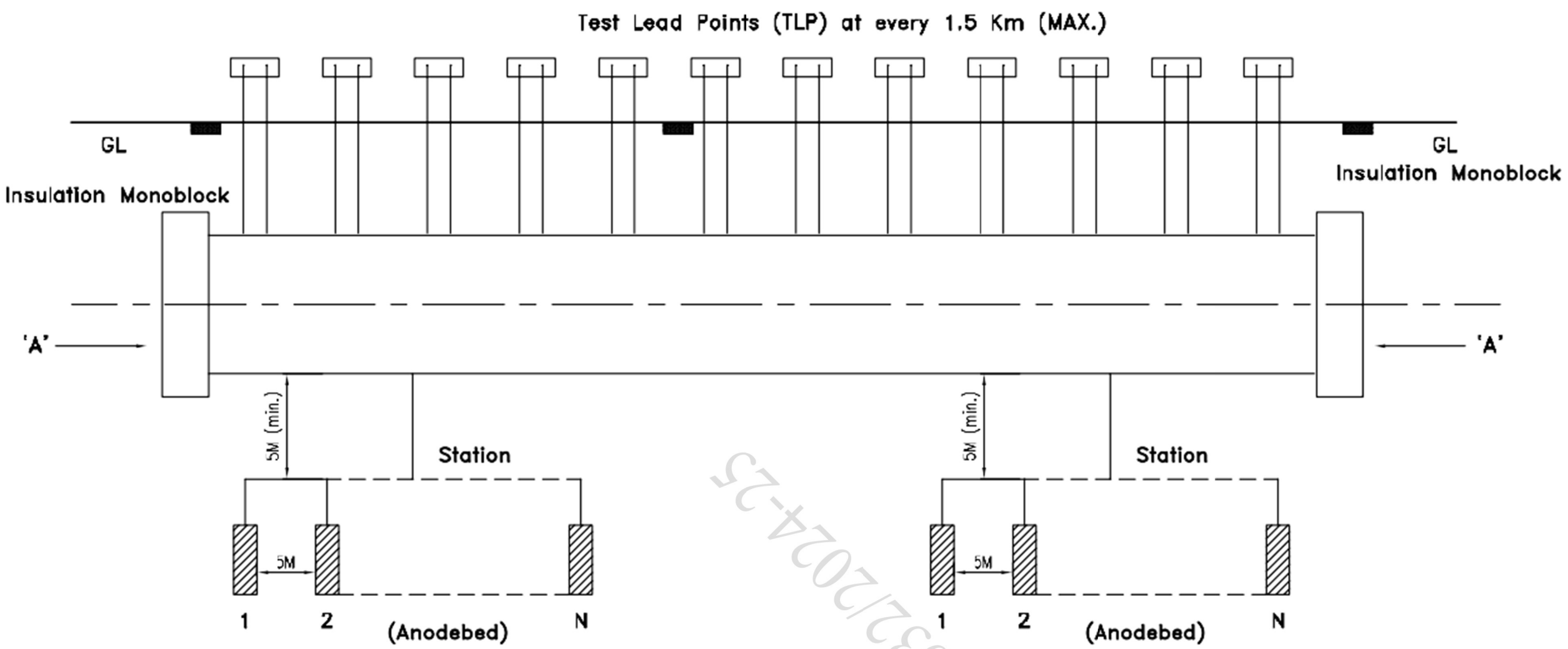
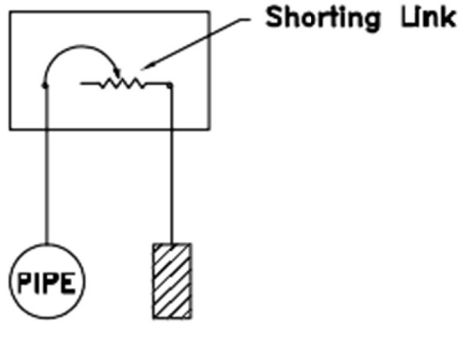
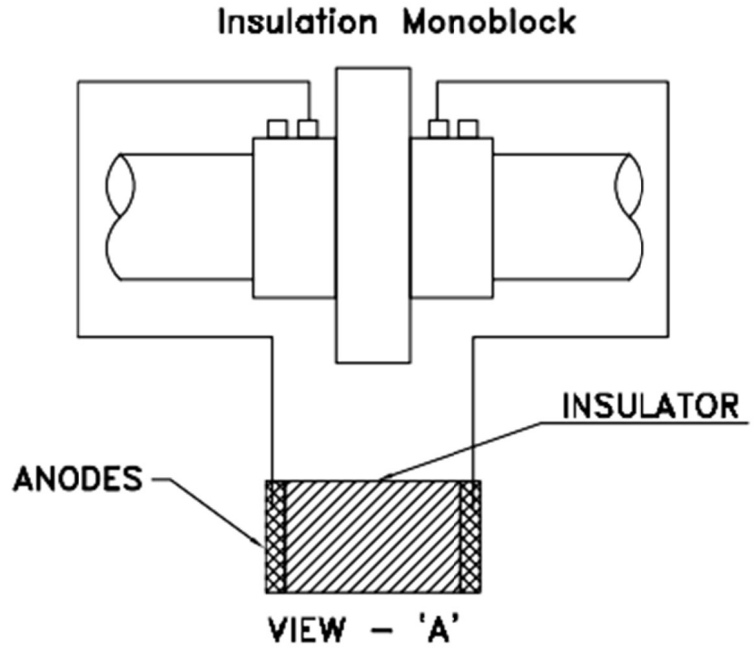


Pre-packed Mg Anodes.

NOTE:
Mg ANODES TO BE BUNCHED TOGETHER IN ANODEBEDS AT LOCATIONS MOST SUITED AS PER ATTENUATION CALCULATIONS.

TLP Connection Details





REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	19.10.16	ISSUED FOR STANDARD	SK	SKP	KG

SCALE	TITLE: FABRICATION AND INSTALLATION DETAILS OF ELECTRODES PIPELINE			
NTS				
SIZE	CLIENT JOB NO.	DRAWING NUMBER	SHEET	REV.
A3	-	ENG-STD-CP-DWG-TD-011	1 OF 1	0

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5. CIVIL / STRUCTURE

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Sr. No.	Description	Document / Drawing No.	Rev. No.
4	**Civil / Structure**		
1	Civil / Structural Design Basis	BGL-HYD-CV-DOC-DB-001	0
2	Technical Specification for Site Clearing, Area Grading, Excavation & Earth Work	ENG-STD-CV-DOC-TS-001	0
3	Technical Specification for Plain Cement Concrete and Allied Works	ENG-STD-CV-DOC-TS-002	0
4	Technical Specification for Porta Cabin	ENG-STD-CV-DOC-TS-003	0
5	Technical Specification for Chainlink Fencing	ENG-STD-CV-DOC-TS-004	0
6	Technical Specification for Structural Concrete	ENG-STD-CV-DOC-TS-005	0
7	Technical Specification for Masonry Work	ENG-STD-CV-DOC-TS-006	0
8	Technical Specification for Plaster & Pointing	ENG-STD-CV-DOC-TS-007	0
9	Technical Specification for Structural Steel Work	ENG-STD-CV-DOC-TS-008	0
10	Technical Specification for Road Work and Pavement	ENG-STD-CV-DOC-TS-009	0
11	Technical Specification for Drainage System	ENG-STD-CV-DOC-TS-010	0
12	Technical Specification for Dismantle & Demolishing	ENG-STD-CV-DOC-TS-011	0
13	Technical Specification for Barricades	ENG-STD-CV-DOC-TS-012	0
14	Technical Specification for Standard Field Quality Plan	ENG-STD-CV-DOC-TS-013	0
15	Technical Specification for Topographic and Route Survey	ENG-STD-CV-DOC-TS-014	0
16	Technical Specification for Soil Investigation for Stations	ENG-STD-CV-DOC-TS-015	0
17	Typical Detail of Road Curves and Crossing	ENG-STD-CV-DWG-TP-002	0
18	Typical Platform Details	ENG-STD-CV-DWG-TP-003	0
19	Typical Concrete Bedding	ENG-STD-CV-DWG-TP-004	0
20	Typical Storm Water Drain	ENG-STD-CV-DWG-TP-005	0
21	Typical Trench Sand Bedding	ENG-STD-CV-DWG-TP-006	0
22	Typical Grating Detail	ENG-STD-CV-DWG-TP-007	0
23	Typical Detail of Cross-over	ENG-STD-CV-DWG-TP-008	0
24	Typical Insert Plate Details	ENG-STD-CV-DWG-TP-009	0
25	Typical G.A. of Valve Pit	ENG-STD-CV-DWG-TP-010	0
26	Typical Barricades drawing	ENG-STD-CV-DWG-TP-011	0
27	Typical Gate Detail	ENG-STD-CV-DWG-TP-012	0
28	Typical Detail of Footpath	ENG-STD-CV-DWG-TP-013	0
29	Typical Cross Section of Road	ENG-STD-CV-DWG-TP-014	0
30	Typical RCC Pipe Support	ENG-STD-CV-DWG-TP-015	0
TC:	**Index - Civil & Structure**		**CLIENT:**

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BHAGYANAGAR GAS LIMITED

PIPELINE LAYING AT HYDERABAD GA

BGL/632/2024-25

DESIGN BASIS FOR CIVIL & STRUCTURAL WORKS

DOCUMENT NO. : BGL-HYD-CV-DOC-DB-001

0	24.03.2024	Issued for Approval				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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1 INTRODUCTION

M/s Bhagyanagar Gas Ltd. is a joint venture of GAIL (India) Limited & HPCL Ltd. BGL has been set up to implement City Gas Distribution Networks at different geographical areas in thecountry. Presently BGL is expanding the City Gas Distribution Networks to supply natural gas to various Domestic, Commercial, Industrial and Automobile Consumers in Geographical Area (GA) of Hyderabad.

This document presents the design criteria to be adopted for the various Civil / Structural facilities envisaged in construction. All the applicable statutory rules pertaining to factories act (as applicable for the State), Fire Safety Rules of Tariff Advisory Committee, Water Act for pollution control etc shall be complied with. Statutory clearance of respective OISD, CPWD/PWD, CCOE and norms of State Pollution Control Board shall be followed.

2 SCOPE

The scope of work to be performed under this contract shall include complete Civil and Structural works as per plans, equipment layout, drawings & technical specifications.

Following Civil & Structural work has been envisaged but not limited to

- Topographic and Soil Investigation Survey
- Process Area Development
- Skid foundations
- Valve Pit Chamber
- Pipe and Valve Support Foundation
- Valve Operating Platforms and Crossovers

All items in the Schedule of Rates shall be inclusive of all material, labour, constructional infrastructures like scaffolding/ staging, finishing, cleaning, cutting chases/holes etc. in brick work/ RCC work and making good the same and rectification of any damaged work shall be applicable for all heights and locations.

The procurement and supply of all materials, consumables and non-consumables, and hardware etc. including necessary tools and tackles required for satisfactory completion of the job shall be the responsibility of Contractor within the quoted rates.

3 DESIGN STANDARDS

Designs shall be based on the latest Indian Standard (IS) Specifications or Codes of Practice. The design standards adopted shall follow the best modern engineering practicein the field based on any other international standard or specialist literature. In case of any variation or contradiction between the provision of the IS Standards or Code and the specifications given with the submitted tender document, the provision as directed by Owner shall be followed.

All analysis work related with civil or structural design shall be carried out as per relevant Codes and Standards. Design of concrete structures shall be as per IS 456. Structuralsteel shall be designed based on elastic theory in conformation to IS 800. All connections

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shall be welded connection and it shall confirm to IS 808. Minimum thickness of weld shall be 6 mm for shop weld and 8 mm for field weld.

4 CODES & STANDARDS

The following Indian codes and standards shall be used for design of Civil and Structural works. In all cases, latest revisions with amendments, if any, shall be followed. Apart from the specific codes mentioned herein, all other relevant and related codes concerning the specific job under consideration and/or referred to in these codes and technical specifications shall be followed wherever applicable. (All codes shall be latest as on the date of issuing of tender/bid document).

LOADS & FORCES	
IS:875(part I to V)	Code of Practice for Design loads (other than earthquake) forBuildings & Structures.
IS:1893	Criteria for Earthquake resistant design of structure.
FOUNDATION	
IS:1080	Code of Practice for Design and Construction of ShallowFoundations in Soils (other than raft, ring and shell).
IS:1904	Code of Practice for Design and Construction of Foundationsin Soils- General Requirements.
IS:2911 (All Parts)	Code of Practice for Design and Construction of Pile Foundation.
IS:2974	Code of Practice for Design & Construction of MachineFoundation
IS:6403	Code of Practice for determination of Bearing Capacity ofShallow Foundations.
IS:8009 (Part-I)	Code of Practice for Settlement of Foundations.
CONCRETE STRUCTURES	
IS:456	Code of Practice for Plain and Reinforced Concrete.
IS:432	Specifications for Mild Steel and Medium Tensile Steel bars and Hard Drawn Steel Wires for Concrete Reinforcement (Grade-I)
IS:1566	Hard drawn Steel Wire Fabric for Concrete Reinforcement.
IS:1786	High Strength Deformed Steel bars and wires for Concrete Reinforcement.

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IS:3370	Code of Practice for Concrete Structures for Storage ofLiquids
IS:4326	Earthquake Resistance Design and Construction of Buildings.
IS:13920	Code of practice for ductile detailing of RCC structuressubjected to Seismic forces.
MASONRY	
IS:1905	Code of Practice for Structural use of Un-Reinforced Masonry.
STEEL STRUCTURES	
IS:800	Code of Practice for General Construction in Steel.
IS:808	Dimensions for Hot rolled steel beams, Channel and anglesections
IS:806	Code of Practice for use of Steel Tubes in general Building Construction.
IS: 811	Cold formed light gauge structural steel sections
IS:2062	Steel for general Structural Purposes.
IS:3502	Steel Chequered Plates.
IS:1363	Hexagonal head bolts, Screws and Nuts of Product Grade C
IS:1367	Technical Supply conditions for Threaded Steel Fasteners.
IS:2062/5624	Specification for Foundation Bolts.
IS:2016	Plain Washers.
IS:277	Galvanized Steel Sheet (Plain and Corrugated)
IS:1728	Specification for Sheet Metal Rain Water Pipes, normal sizegutters, fittings and accessories.
IS:278-1978	Specification for Galvanized Steel Barbed wire for fencing.
IS:2721-2003	Galvanized Steel Chain Link fence (Fabrication Specification)

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5. ENGINEERING DESIGN DATA

Design will be based on the latest soil investigation report. Life of Structure shall be takenas 50 years for wind load calculation.

PLOT DEVELOPMENT

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On finalization of the plot area, the location and its surroundings shall be surveyed and Geo-technical investigations shall be carried out for establishing contour plan, coordinates & design bearing capacity of soil for each location by the executing agency as required. Suitable approach roads and other services shall be ensured for the design work.

Finished Ground Level (FGL) shall match with existing finish ground level of customer premises. Top level of internal roads shall be 150 mm above FGL. Floor finish level of process area shall be 300 mm above internal road top level. Water from the proposed plot shall be drained to drain at a slope of 1 in 500 where applicable. The drain shall have a slope 1 in 750.

DESIGN OF FOUNDATIONS

Safe bearing pressure shall be based on settlement criteria for dead plus live load conditions. Maximum settlement for foundation for all types of equipment's , pipe racks, footings including raft, etc. shall be 25mm.

In case of wind or seismic forces, settlement is not the criteria and safe bearing capacity based on shear criteria shall be considered. While designing foundations at various levels, the bearing capacity at that particular level and also the effect of uplift/sub soil water table shall also be considered.

6. LOADS AND FORCES

Design loads shall comply with the requirements of IS: 875 and IS: 1893 as minimum, unless more stringent requirements are specified herein. All buildings, structures shall be ingeneral designed for the worst possible combination of the following loads.

1. Dead load (DL)
2. Live load (LL)
3. Wind load (WL)
4. Seismic load (SL)
5. Equipment Load (E)
6. Impact / Vibrating Load
7. Other Loads

DEAD LOAD (DL)

The dead load comprises of weights of all structural and architectural components and external loads pertaining to all permanent construction, including walls, floor, roofs, partitions, stairways, and equipment excluding their contents. Self-weight of material may be calculated on the basis of unit weights given in IS: 875 (Part I).

LIVE LOAD (LL)

Live loads shall comprise of all loads other than dead loads. This shall be in general as per IS: 875 (Part II).

WIND LOAD (WL)

Wind load shall be in accordance with IS: 875 (Part –III)

SEISMIC LOAD (SL)

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Seismic forces shall be as per IS: 1893.The detailing of reinforcement shall be as per IS:13920.

EQUIPMENT LOAD (E)

Equipment loads shall be considered as follows:

Equipment Load for Empty Condition E (E)
It is the weight of equipment excluding fire proofing, piping all loose internals, platformssupported from the equipment.

Equipment Load for Test Condition E (T)
It is the weight of equipment including fire proofing, piping, all loose internals, insulation,platforms supported from the equipment and weight of water.

Equipment Load for Operating Condition E (O)
It is the weight of equipment including fire proofing, piping, all loose internals, insulation,platforms supported from the equipment and liquid/gas contents.

Equipment Load (B)
It is the weight of equipment to be considered for maintenance purpose.

IMPACT LOAD

The live loads shall be assumed to include adequate allowance for ordinary impact conditions. However, for structures carrying loads which induce impact or vibration, calculations shall provide for increase in the imposed load due to impact or vibration as perrequirement of IS:875 (Part-2)

OTHER LOADS

Surcharge Load shall be considered as 1 t/m^2

Earth pressure

Unit wt. of soil shall be taken(γ)	=	As per latest soil report
Angle of repose (ϕ)	=	As per latest soil report

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K_a = As per latest soil report

7. ANALYSIS AND DESIGN METHODOLOGY

Limit state method as per IS: 456 shall be followed in the design for concrete structures except for liquid retaining structures. The design of liquid retaining structures shall be carried out using working stress method as per IS: 3370.

Steel structures shall be designed as per IS: 800.

Detailing of reinforcement shall be done according to IS: 4326, IS: 13920 and SP: 34.

Permissible stresses increase in materials shall be as per respective IS code and shall be considered under Wind/Seismic loading.

Appropriate load factor for Limit State Design shall be considered as per code provisions.

Architectural design of Porta Cabin shall fully meet the functional requirement, shall beadequately sized and provided with sufficient ventilation and natural lighting.

8. LOAD COMBINATION

The load combinations shall be generally as per IS: 875 (Part 5).In

general, all structures shall be designed for worst effect.

DL **±** Wind Load with no increase in allowable stress.

Underground structure shall be designed for the following load cases.

i) DL ± LL ± Equipment load
ii) DL ± LL ± Equipment load ± Seismic load.
iii) DL ± Seismic load.
iv) Combination I + Earth pressure + Surcharge pressure
v) Combination II + Earth pressure + Surcharge pressure

9. CONSTRUCTION MATERIALS

CONCRETE

Cement concrete used shall comply with provisions of IS: 456-2000 and as specified in the technical specification. All RCC works shall be in design mix concrete of grade M 25 with 20mm and down size aggregate & PCC Works shall be in nominal mix as specified on drawings.

CEMENT

Approved quality of Ordinary Portland Cement of Grade 43 / Grade 53 shall be used for reinforced concrete works; and Portland Pozzalano Cement may be used for non RCC works such as brick masonry and plaster etc. For all underground structure, Sulphate Resistant Cement (SRC) shall be used in accordance with Indian Standards based on detail soil investigation report.

AGGREGATE

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Aggregates shall be from approved sources and shall comply with IS 383. Fine and coarse aggregates shall be considered separate ingredients. Both shall meet the grading requirements of IS 383.
Aggregates shall be clean, hard, durable, chemically inert and impermeable. They shall be free from adherent coatings, laminated particles or admixtures of materials likely to be deleterious to the concrete. Dune and beach sand shall not be used for fine aggregate.

The grading for Sand shall conform to IS: 383-1970 and shall be within the limit of Grading Zone-III. The maximum size of particle shall be 4.75mm and shall be graded down.

WATER

Water used for concrete shall be clean and free from oil, acid, alkali, organic matter or other harmful matter in such quantities as would affect the concrete in the plastic or hardened state. Potable water shall generally be considered satisfactory for mixing of concrete. Tests on water samples shall be carried out in accordance with IS: 3025 and theyshall fulfill the guidelines and requirements of IS: 456.

BRICKS

Bricks shall be locally available bricks minimum of class designation 5.0 conforming to IS: 1077.

REINFORCEMENT STEEL

Reinforcement bars for RCC will be High Yield Strength Deformed/TMT steel bars for Grade Fe 415 / Fe 500 D conforming to IS: 1786-2008 and MS bars of Grade I conforming to IS: 432 (Part-I).The maximum spacing of bars shall be as per IS: 456.

STRUCTURAL STEEL

Structural steel is to be used for general structural purposes shall be of grade Fe 415 MPa conforming to IS: 2062. The minimum yield strength of steel shall be 410 MPa. The minimum yield strength for steel structure shall be as follows:

Thickness <20 mm	250 MPa
Thickness 20-40 mm	240 MPa
Thickness >40 mm	230 MPa

Equipment supports, Access / Operating platforms and crossover shall be fabricated from the structural steel as per requirement. All structural supports, operating platforms & cross over shall be protected with suitable paintings as specified.

Minimum thickness for various structural components shall be as follows:Stiffeners:

8mm
Base Plates: 10mm
Chequered Plate: 6mm
Grating: 3mm

ANCHOR BOLTS

Materials for anchor bolts shall be of mild steel conforming to IS: 226 and IS:432 grade-I. Materials such as MS bars, washers, nuts, pipe sleeves and plates etc. shall conforms to IS : 1363 & IS : 1364 of 1992.

GROUT

Approved quality Non Shrink (Premix Type), free flow grout shall be provided for all anchor bolts, sleeves, pockets, & spaces under column bases, shoe plate etc. with a crushing strength of 28 days

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minimum 40 MPa.

WELDING

Welding shall confirm to IS 814 -1963. Structural Steel shapes shall conform to IS: 808 (Hot Rolled Steel Beam, Column, Channel & angle Section).

10. SITE PREPARATION AND CHAIN LINK FENCING

Site preparation shall be conform to the requirement of the relevant section of this design basis and specification. Salient features of the plot to be developed. The layout and level ofplot shall be prepared and the benchmarks shall be set. Suitable provision of drainage system shall be made outside the plot to divert the natural storm water drainage into the nearest existing drainage system.

Chain link fencing of 1.8 m height made from 3.15 mm diameter GI wire with mesh size of 50x50 mm shall be provided.

11. ROADS, DRAINS AND CULVERTS

ROADS

Roads shall be of RCC and shall be designed for IRC loading.

Road width shall be 3 meter width within the plot area. The minimum radius of curvature of the turnings shall be 6.0m unless otherwise mentioned in the relevant drawings. Roads shall be constructed as per the specified drawings.

Approach road including culverts shall be of RCC and shall also be connected with nearest existing metallic road/approach road outside the customer plot for all stations. Carriageway for approach road shall be 4.5m wide or as per existing road.

Roads must be paved with 150 mm thick M25 concrete with nominal reinforcement of 8 diameter @ 200 c/c (both ways at top & bottom) laid over 75 mm P.C.C. (1:3:6). The PCC shall be laid over 200 mm thick compacted boulder layer with sand filling.

STORM WATER DRAIN

The design of storm water drainage shall be based on maximum hourly precipitation for storm deviation of 20 minutes. The drainage system shall be so designed so that the velocity of flow shall be within 1 m/sec to 2.5 m/sec.

Coefficient for design shall be as follows:

1	Open areas	0.5
2	Road and paved area parking area	0.7
3	Roof surface	1.0

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Storm water drain shall be constructed in brick masonry along the periphery of plot to carry storm water from plot area to nearby drain. The drain shall have slope of 1 in 1000 (minimum).

CULVERTS

RCC Hume pipe NP-3 class has been considered for crossing drains under the roads as per site conditions. Piping culverts under roads shall be of RCC box-shaped.

12. PROCESS AREA

Process area consists of valves, equipment's, metering skid etc. Entire process area shall be paved with 150 mm thick M25 concrete pavement with nominal reinforcement of 8 diameter @ 200 C/c (both ways at bottom) laid over 75 mm P.C.C. (1:3:6). The PCC shall be laid over 200 mm sand filled over well compacted sub base. The paving shall be laid in panels and designed joints shall be provided with approved quality separators & joint sealant. Boulders soling to be provided in sub-base based on geotechnical investigation recommendation, if required.

EQUIPMENT FOUNDATION

Equipment foundation supporting lightweight equipment and coming within the processarea may be made an integral part of the paved area. However, heavy equipment's shall have isolated equipment foundation even if coming within process area.

Loose fills, expansive soil etc if found beneath the equipment foundation shall be removed and back filled either with PCC (1:3:6).

PIPE SUPPORT FOUNDATIONS

Pipe supports shall be provided as per mechanical layout drawings for piping. The pipe support may lie within the process area or at any other location. The pipe support foundations shall be designed to take care of the loads and it's fixing details as per standard drawings. Pipe support in process area shall be integral part of pavement. Isolated pipe supports shall however be provided outside the process area.

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13. VALVE PIT

Valve Pit shall be constructed in reinforced concrete of grade M25. High density rubber padshall be wrapped around the pipe in contact with RCC. The valve pit shall be covered with precast concrete on top of pit with hook provision for lifting.

14. SIGN BOARDS

Signboards shall be provided at all sites as per direction of Owner.

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SPECIFICATION FOR
CIVIL & STRUCTURAL WORKS

SITE CLEARING, AREA GRADING
EXCAVATION & EARTHWORK

DGL/631/2024-25

ENG-STD-CV-DOC-TS-001

Rev	Date	Purpose	Prepared By	Checked By	Approved By	

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1.0 INTRODUCTION

This specification deals with site clearing, earthwork and excavation, leveling, cutting and grading, area filling and backfilling for area designated in the drawings.

2.0 SETTING OUT

Before commencement of earthwork, block levels of existing ground shall be taken by the Contractor jointly with the Engineer. Excavation shall not be commenced until the initial ground levels have been recorded and accepted. Reference lines, bench marks and base lines shall be set out by the Contractor for control of earthwork operation.

Setting out shall be done with pegs, blocks, bamboo poles, marking boundaries or centre lines, as the case may be, and the same shall be maintained for reference and future checking.

Engineer shall be provided with necessary men, material and instruments for checking and approval. However, such checking and approval by the Engineer shall in no way absolve the Contractor of his responsibilities for carrying out the work to the true lines, levels and positions as per drawing and subsequent corrections, if any.

3.0 SITE CLEARANCE AND DEMOLITION

The site shall be cleared of all trees, stumps, roots, brush wood, bushes and other objectionable materials. Useful and saleable material, if any shall be the property of the owner and shall be stacked properly as directed by the Engineer.

The areas to be covered with embankments shall be stripped of top soil to required depths to expose acceptable founding strata. Top soil unsuitable for use in embankment construction and other fills shall be disposed off as directed. All combustible materials shall be stacked and burnt in locations sufficiently remote to eliminate all danger of fire hazards. All old concrete, brick works and drains which interfere with construction works shall be dismantled with the approval of the Engineer taking all necessary precautions prescribed in safety specification. Top soil which is suitable for use in construction work shall be stockpiled for later use. Other objectionable materials such as trash, debris, stones, brick, broken concrete,scrap metal etc., shall be disposed off as directed by the Engineer.

4.0 CLASSIFICATION OF SOIL

The Engineer will decide the class of any particular soil. Classification of soil shall be as under and the decision of the Engineer shall be binding on the Contractor:

ORDINARY SOIL

Soils which yield to ordinary application of pick and shovel, phawra rake or other ordinary digging implements (including earth moving equipment such as bulldozer, shovels without resorting to blasting) without offering much resistance, shall be classified as ordinary soil. This includes organic soil, turf, sand, gravel, loam clay, mud, peat, black cotton soil, soft shale

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and loose moorum etc.

HARD SOIL

This comprises of all soils that cannot reasonably be excavated by the above mentioned digging implements, but can be excavated with close application of pick axe or scarifiers or jumpers to loosen. This includes compact moorum, stiff clay, hard shale, cobble stone etc.,

SOFT /DECOMPOSED ROCK

This comprises of rock or boulders which may be quarried or split with crow bars, pavement breakers etc., This include lime stone, sand stone, weathered rocks and hard conglomerates etc .and existing structures embedded in earth and tarred macadam roads, pavements, met in the excavation.

HARD ROCK

This comprises of rocks which require blasting for excavation. Where blasting is prohibited, excavation has to be carried out by chiseling, wedging or any other agreed methods.

5.0 METHOD OF EXCAVATION

The Contractor may carry out excavations, filling and compaction by any method considered most suitable and befitting the site conditions subject to any stipulations contained in the contract and the specifications. All excavations shall be required to be kept completely free from water, from whatever source it may come during the construction. No foundation work shall be taken up until the surfaces are properly drained.

6.0 EXCAVATION OF SOILS OTHER THAN HARD ROCK

Excavation shall be carried out in the most expeditious and efficient manner to the lines and levels as indicated in drawings or as directed by Engineer. Prior approval of the Engineer shall be taken for the method to be adopted for excavation including dimensions, side slopes, dewatering, shoring etc. Approval shall not make the Engineer responsible for any consequent damage or loss caused.

All precautions shall be taken to preserve the material below and beyond line of excavation in soundest condition. All damages done beyond limits of excavation shall be made good by the Contractor at his own cost in a manner approved by the Engineer.

All excavated materials shall be removed to spoil heaps, dumping yards or transported for filling as may be necessary. When soil heaps are formed for future use, heaps shall be protected from washing away due to rain or surface run off. The sides of excavation shall be maintained in stable condition by adequate stepping and batter. To prevent entry of surface water and accumulation of subsoil water in excavated areas, suitable drainage arrangements as may be needed and directed by Engineer shall be provided and maintained. Pumped out water shall be drained off properly avoiding damage to other existing works. If any pipelines, cables or service lines are likely to be exposed, excavation around these services shall be carried out manually and all such services shall be adequately supported and protected at no extra cost.

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Excavation shall be carried out in any material encountered including road surfaces, pavements, buried parts of old foundations, pits or other structures. Excavated materials shall be placed beyond 1.5 meters of the edge of the excavation pit/trench or half the depth of the pit/trench whichever is more or further away as directed by the Engineer. Sumps made for dewatering must be kept clear of the foundations.

In firm soil the sides of the trenches shall be kept vertical up to a depth of 2.0m from the bottom and for a greater depth, trench shall be widened by allowing steps of 50cm on either side after every 2.0m depth from the bottom, so as to give a vertical side slope of 1/4: 1. Where the soil is soft, loose or slushy, the width of the steps shall be suitably increased or sides suitably sloped or suitable shoring and strutting provided as directed by the Engineer. For trenches deeper than 2.0m, the Contractor shall obtain detailed instruction from the Engineer in writing regarding the stepping, sloping of sides or shoring and strutting to be done.For these bye-works, no extra cost will be paid to the Contractor.

7.0 EXCAVATION IN HARD ROCK

Where hard rock is met and blasting is considered necessary for its excavation, the Contractor shall intimate the Engineer in writing. Excavation in hard rock shall be done either by blasting or chiseling or by such other agreed methods as may be required. Levels of hard rock surface shall be taken and got approved by Engineer before start of excavation. Blasting shall be permitted only when proper precautions are taken for protection of persons, works and property. The Contractor shall obtain the necessary license for procuring, storing and using explosives.

Blasting operations shall be carried out by a licensed Blaster. The quality and quantity of explosives, size and spacing of holes depth of holes etc. shall be such that they will neither open seams nor damage/shatter the rock beyond the specified lines of excavation. A tolerance of 150 mm will however be allowed beyond the excavation lines. As excavation approaches final stages, the depth of holes and the amount of explosives used shall be reduced progressively to avoid over breakage or damage to founding strata. Any fissures, cracks and voids below prescribed depth of excavation shall be corrected by removing loose pieces, shattered or affected rock and replaced by lean concrete of M-7.5 grade in the case of foundations. Where excavated surface is to receive structural concrete, the surface shall be cleaned of dust and other objectionable materials.

In cases where blasting, though otherwise required is prohibited because of any reason, the excavation shall be carried out by chiseling, wedging or such other agreed methods. All materials excavated from blasting, chiseling or any such methods shall be stacked for measurement as directed by Engineer.

8.0 CUTTING AND FILLING FOR SITE LEVELING

Excavation and filling operations for site leveling shall be so planned and executed, that transportation and re-handling are minimized. The sides of excavation and fills shall be maintained in stable condition by adequate batters, stepping and dewatering. Materials not desirable shall be disposed off in area indicated by Engineer. When it is required to blend the material, it shall be done by selective excavation and filling operation. Wells, ponds, cesspools and water logged areas shall be emptied of water before filling. Filling shall be done in horizontal layers not exceeding 300mm in thickness as specified or as directed by the

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Engineer. All clods shall be broken before placing the fill. Earth moving equipment shall be allowed to ply over the fill to permit compaction. Adequate allowance shall be made for subsidence of fill material. Levels shall be taken and excess or shortfall shall be made good by appropriate cutting or filling.

9.0 EXCAVATIONS FOR FOUNDATIONS

Excavation for foundation shall be done to the lines and levels indicated in the drawings. Excavated material shall be transported and stored at convenient spots for reuse in back filling of foundations and other fills. Surplus material shall be transported, spread and leveled at dumping areas. Side slopes of excavation and/or shoring shall be adequate from consideration of stability and working space. When so required and authorized by Engineer, the sides of excavation shall be protected with proper shoring, strutting, sheeting and sand bags etc. These shall be removed only when work in the pit is completed with the approval ofthe Engineer. When it is felt that removal of supports may result in side collapse or settlementof adjoining ground or endanger adjoining structures and foundations, they shall be left permanently in position. The last 150 mm of excavation shall be done and the bottom trimmed to the required levels only when concreting is imminent. If at any point the natural ground is disturbed or loosened for any reason, it shall be consolidated by tamping or rolling or made up with concrete of M-7.5 grade cement concrete at no extra cost. Where the soil encountered at depths indicated in drawings is loose or weak, it shall be further excavated tolevels of firm strata as may be directed by the Engineer and filled with lean concrete of M-7.5grade cement concrete or sand as directed.

10.0 EXCESS EXCAVATION

All excavation done beyond the specified limits or directions of Engineer shall be considered as excess excavation. They shall be made good as prescribed below by the Contractor at his cost:

(i). Excess excavation in case of site leveling shall be made good by filling and compacting with material same as the surrounding material. Degree of compaction shall be at least the same as the surrounding material.

(ii). Excess excavation in case of foundation beyond required depths shall be made good by filling with lean concrete of M-7.5 grade cement concrete.

11.0 DISPOSAL

Excavated materials that are unsuitable for use in construction works or in excess of construction requirements shall be disposed off in dumping yards or in locations indicated by Engineer. Waste piles/heaps shall be located in such places where they will not interfere with natural flow of rain water access or transport or with the access to nearby structures. When required, they shall be leveled and trimmed to such lines and levels as indicated by Engineer

12.0 BACKFILLING

Backfilling of foundations shall be done using suitable soils from excavations. Soil shall be free from organic matter and other materials which would affect the stability of the fill and shallbe free from boulders, brick bats wood pieces and other injurious materials, lumps and clods.

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Before commencement of backfilling of foundations all shoring and formwork, bits of timber, cement bags and all other rubbish shall be removed. Backfilling operation shall not commence without approval of Engineer. Backfilling shall be carried out in well compacted layers of 150 mm thickness. Each layer shall have near optimum moisture content. Layers will extend to the entire width of excavation and shall be sprinkled with water during compaction process. Ramming shall be done to achieve firm compaction. Backfill shall be trimmed and finished to levels indicated in the drawings and/or as directed by the Engineer. Mechanical equipment like vibratory roller, vibro earth rammer or vibratory compactor shall be used for compaction.

13.0 EARTH FILLING

Material for filling shall be selected earth obtained from excavations for site leveling, trenches and foundations or from selected borrow areas as may be required. Soil shall be of uniform quality and free from boulders, organic materials and other objectionable matter and shall not be expansive soils. Filling shall be done in well compacted layers not exceeding 150 mm in thickness. Each layer shall be compacted to 95% Standard Procter Density. Sufficient soaking shall be done before compaction. The entire area shall be finally dressed and trimmed to required levels. Mechanical equipment like vibratory roller, vibro earth rammer or vibratory compactor shall be used for compaction.

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SPECIFICATION FOR
CIVIL & STRUCTURAL WORKS

PLAIN CEMENT CONCRETE & ALLIED WORKS

BGL/632/2024-25

ENG-STD-CV-DOC-TS-002

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1. INTRODUCTION

This specification covers the general requirements for concrete to be used on jobs using on-site production facilities including requirements in regard to the quality, handling, storage of ingredients, proportioning, batching, mixing and testing of concrete, and also requirements in regard to the quality, storage, bending and fixing of reinforcement. This also covers the transportation of concrete from the mixer to the place of final deposit and the placing, curing, protecting, repairing and finishing of concrete.

2. PLAIN CEMENT CONCRETE 1:3:6 OR AS SPECIFIED :

Plain cement concrete shall be in proportion of 1:3:6 or as specified. i. e. in volume by one part of cement, three part of coarse sand and six parts of black stone aggregate of size 40 mm size.

The building materials as stated above shall be mixed in dry condition with power driven concrete mixer. After materials are properly mixed, water shall be added and materials shall again be mixed in concrete mixer It should be watched that no excessive water is added so that permissible water cement ratio is maintained throughout during the progress of concrete work. Before the concreting work, necessary centering work if so necessary shallbe provided for which payment shall be done separately under respective items. All the materials shall be got tested for every lot from govt. approved Engineering testing laboratories as per I.S. code of practice and test certificates shall be submitted to Owner/site engineer .

The concrete so prepared shall be stacked in water tight platform .The concrete should not be thrown from height so that segregation may not take place. The concrete so placed shall be properly compacted with concrete vibrator machine to avoid voids .Moreover concrete shall be compacted in such a way that the surface is become smooth and no honey combing is observed.

After properly setting of concrete, curing shall be done for minimum period of seven days.

3. M-20 CEMENT CONCRETE :

The cement concrete shall be in proportion.(1:1.5:3) i.e. in volume by 1 part of cement,1.5 parts of coarse sand and 3 parts of black stone aggregate of size 20 mm size. The stone aggregate shall be of even size and black in color without any white spot. The aggregate shall be got approved from engineer in charge /Owner. The building materials as stated above shall be mixed in dry condition with power driven concrete mixer. After materials are properly mixed, water shall be added and materials shall again be mixed in concrete mixer. It should be watched that no excessive water is added so that permissible water cement ratio is maintained throughout during the progress of concrete work. Before concreting work, necessary centering work and reinforcement as per structural drawing shall be placed for which payment shall be done under respective items. All the materials shall be got tested for every lot from govt. approved Engineering testing laboratories as per I.S. code of practice and test certificates shall be submitted to Owner/Owners representative.

After setting of concrete, sufficient curing shall be done for minimum period of seven days. During concrete work, concrete cube of size 150m.m. x 150 m.m. x 150 m.m. shall be prepared and these concrete cubes shall be got tested for compressive strength from approved engineering testing laboratories and testing certificate should be submitted to Owner/Owners representative. The slump test shall also be carried out on site of work during every concrete work on site.

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4. APPLICABLE CODES AND SPECIFICATIONS

The following specification, standards and codes shall form a part of this specification. All standards, tentative specifications, codes of practice, referred to herein, shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy, if any, between this specification and those referred to in the following, the latter shall be govern.

Applicable Specifications and Codes of Practices.

I.S. 269 - Specification for ordinary and low heat Portland cement.

I.S. 383 - Specification for coarse and fine aggregate from natural source for concrete.

I.S. 2386 - Method of test for aggregates for Concrete (Part I to VIII)

I.S. 516 - Method of test for strength of concrete

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SPECIFICATION FOR
CIVIL & STRUCTURAL WORKS

PORTA CABIN

BGL/632/2024-25

ENG-STD-CV-DOC-TS-003

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1.0 INTRODUCTION

The Porta Cabin shall be insulated type steel structure, shall be well ventilated and shall be brought to site in knock down condition and assembled at site or factory prefabricated. All components of the prefabricated cabin shall be reclaimable and reusable.

2.0 DESIGN

The structure of the prefabricated Cabin (i.e. all walls, ceiling, floor etc.) shall be tubular steel/ structural steel members. The fully erected and anchored prefabricated Cabin after installation/ placing in position shall be structurally strong enough to withstand wind force of minimum speed 47 m/sec. and earthquake for seismic zone 3, importance factor1.5.

3.0 FOUNDATION

RCC M25 foundation shall be constructed up to a height of 450 mm from finished ground level for installation of Porta Cabin.

4.0 SHELL

The shell structure shall comprise of side walls, end walls and self draining roof.

5.0 SKID

The floor shall be made up of ISMC (channels) or tubes of required sizes and shall be used to form the floor grid of minimum size 600mm x 600mm. Materials of structural steel members shall conform to IS: 2062 Grade A. The floor shall be minimum 200mm above bottom level and shall be covered with marine Ply board (IS: 2202/ 1991) of required thickness or cement fiber board of required thickness; finished neatly with floor vinyl (of required thickness), in roll/ tiles by means of neoprene base adhesive as per manufacturer's recommendations.

6.0 WALLS

Walls shall be made up of 'sandwich' insulated panels manufactured using outer sideminimum 0.63mm thick profiled pre-coated galvanized steel sheet (Rib Profile) and inner sideminimum 0.63mm thick profiled pre-coated galvanized steel sheet (Plain) confirming to IS: 277 with insulation of PUF/ mineral wool/ glass wool)/rock wool of approved make, in between steel sheets. Average 75 mm thick thermal insulation of thermocol shall be provided on the side walls, end walls and roof with proper fixing arrangement. It shall be waterproof, termite proof, heat and fire resistant and comfortable in extreme hot and cold climate. The walls shallbe provided with internal paneling of laminated plywood of required thickness. Necessary provisions shall be provided in the walls (at desired locations) for installing split type air-conditioners and exhaust fans.

7.0 STEPS

Fabricated steel steps of detachable type having necessary treads shall be provided at doors for getting inside. These shall be made of checkered plates and formed channel sections.

8.0 WINDOWS

The windows shall be provided in the desired location. The windows shall be horizontal sliding type having overall dimensions 1600x1200 mm (H x W). The windows shall be decorated by

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anodized aluminum extruded section fitted with 5.5mm toughened glass and grill. Iron grills made of 20 mm M.S. flats shall also be provided in the windows for safety purpose. Stainless Steel fly-proof mesh in suitable framework shall also be provided in the windows. The windows shall be provided with steel rain-shed made from min. 2 mm thick sheet (IS:1079 Gr.O) from outside.

9.0 DOORS

Doors having overall dimensions 2100x900 mm (H x W) shall be of aluminum extruded sections with partly glazed portion (from lock rail level to top rail; with 5.5mm toughened glass) and partly with 10mm thick cement bound particle board panel (from bottom rail to lock rail level). The doors shall be complete with necessary fittings and fixtures like mortice lock, handles, tower bolt, floor mounted double action floor spring hinges etc. The peripheral edges of the door shall be provided with rubber seal to prevent ingress of water and dust. The door panels shall be outward opening type with single leaf closing The door shall be provided with steel rain-shed made from 2 mm thick sheet (IS:1079 Gr. O) from outside.

10.0 ROOFS

Roof shall be made up of 'sandwich' insulated panels manufactured using outer side minimum 0.63mm thick profiled pre-coated galvanized steel sheet (Rib Profile) and inner sideminimum 0.63mm thick profiled pre-coated galvanized steel sheet (Plain) confirming to IS: 277 with insulation of PUF/ mineral wool/ glass wool)/rock wool, of approved make, in between steel sheets. Average 75 mm thick thermal insulation of thermocol shall be provided on the side walls, end walls and roof with proper fixing arrangement. The roof shall be waterproof, termite proof, heat and fire resistant and comfortable in extreme hot and cold climate. The ceiling shall be provided with internal paneling of laminated plywood of required thickness. Roof shall be supported on suitable trusses and purlins. Roof shall be extended by minimum 600mm on all sides to provide rain/ sun protection to doors and windows.

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11.0 SURFACE TREATMENT AND PAINTING

The surface preparation of all fabricated steel components shall be done by manual grit blasting to achieve SA-2 quality finish, followed by one coat of zinc based primer and two coats of enamel of approved make and shade. The under frame and skid shall be painted with bituminous / red lead paint of reputed make. Necessary marking/ logos shall be provided as per the instruction of Owner. All the internal walls shall be finished with Oil bound distemper of approved make and shade.

12.0 ELECTRICALS

PVC insulated copper wire of ISI mark shall be used for the wiring. This wiring shall be done in PVC conduits. As a measure of safety, continuous copper earth wire shall be provided as necessary. For lighting circuits 3/1.09 cable shall be used. For connecting power supply, 3 pin input industrial socket of 32 Amps capacity shall be provided. Concealed type (1x36) roof hanging florescent light shall be provided. In addition, one number each of 15 Amps and 5 Amps 3 pin sockets shall be provided at suitable locations inside the cabin. All electrical points & switches shall be of Anchor or equivalent make.

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13.0 HANDLING AND TRANSPORTATION

Necessary arrangement shall be provided at top four corners for safe and easy lifting and transportation of the bunkhouse.

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SPECIFICATION FOR
CIVIL & STRUCTURAL WORKS

CHAIN LINK FENCING

BGL/632/2024-25

ENG-STD-CV-DOC-TS-004

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1.0 INTRODUCTION

This specification specifies the requirements of chain link fence for security purposes.

2.0 MATERIALS

Material for chain link fencing shall conform to IS: 2721 latest edition. Mesh for chain link fencing shall be of 3.15mm hot dip galvanized steel mesh wire, the diameter being measured over zinc coating. The diameter of mesh wire shall not vary from the specified diameter by more than 0.05mm. The material for mesh wire and line wire of chain link fencing shall conform to IS: 280-1978. Stretcher bar for erection of mesh shall consist of mild steel flats 25mmx4.75mm. The stirrup wire for securing the line wires to the intermediate post shall be of 2.5mm mild steel wire. Hairpin staples for fastening the bottom line wire to the foundation concrete shall be of 6mm mild steel wire with ends of staples bent outwards for adequate anchorage. The cleats for eyebolts shall be of mild steel plate 10mm thick.

Material for barbed wire shall conform to IS: 278 latest edition. Line wire for the barbed wire shall be made from two strands of galvanized steel wire of nominal diameter 2.5mm twisted together. Barbs shall be made of point wire of galvanized steel of nominal diameter 2.5mm in such a way that four points of the barbs are set and located or locked as far as possible at right angles to each other. The barbs shall have a length of not less than 13mm and not more than 18mm.Droppers for barbed wire shall be of mild steel flat 25mmx4.75mm with 38mmx4.85mm half round staples for fastening the barbed wire.

3.0 ERECTION

Straining posts shall be provided at all ends and corners of fences, at changes in direction or acute variations in level and at intervals not exceeding 60m on straight lengths of fence. Intermediate posts shall be spaced at regular intervals not exceeding 3m. Struts shall be fitted to all straining posts behind the chain link fabric in the direction of the line of fence.

There shall be four evenly spaced rows of line wire. The top wire shall be doubled, making five line wires in all. The bottom wire shall be close to the ground. Each line wire shall be strained lightly by means of eyebolt strainer at each straining point. The eyebolt strainer shall consist of bolt with welded eye. The bolt shall be sufficiently threaded and fitted with a nut and washer. Each line wire shall be secured to each of the intermediate posts by a wire stirrup passing through holes in the posts and secured to the line wire by three complete turns on each side of the post. Two-way eyebolt strainers shall have suitable ring nuts fitted after wires have been strained on one side.

The mesh shall be strained between each pair of straining posts and shall be secured to each straining post by means of a stretcher bar. One of the top line wires shall be threaded through the appropriate adjacent rows of mesh, care being taken that no meshes in the rows are by-passed by the line wire except where deviation is necessary at the straining posts. The second top line wire shall be strained in front of the fencing. The mesh shall be attached to top and bottom line wires by wire ties spaced 150mm apart and to other line wires by wire ties spaced 450mm apart. Bottom row of the mesh shall be threaded to the foundation concrete using staplesspaced 500mm apart and set in concrete to a depth of 150mm. The top of concrete shall be 50mm above G.L. and 50mm below the fencing.

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SPECIFICATION FOR
CIVIL & STRUCTURAL WORKS

STRUCTURAL CONCRETE

ENG-STD-CV-DOC-TS-005

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1.0 INTRODUCTION

This specification covers the materials, workmanship, special requirements & regulations with which the contractor must comply to achieve dense workable concrete, having the specified characteristic strength.

The mixing, placing, compacting, curing and finishing of concrete shall be done according to IS: 456-2000 "Code of Practice for Plain and Reinforced Concrete".

2.0 MATERIALS FOR CONCRETE

AGGREGATES

Aggregates shall comply with the requirements of IS: 383-1970 "Coarse and Fine Aggregates for Concrete". They shall be hard, strong, dense, durable, clean and free from veins and adherent coating, vegetable matter and other deleterious substances; and shall be obtained from approved sources. Aggregates shall not contain any harmful material such as pyrites, coal, lignite, shale or similar laminated material, clay, alkali, soft fragments, sea shells and organic impurities in such quantity as to affect the strength or durability of concrete. Aggregates which are chemically reactive with alkalies of cement shall not be used. Aggregates which are not sufficiently clean shall be washed in clean fresh water to the satisfaction of the Engineer.

TESTING

All aggregates shall be subject to inspection and testing. The Contractor shall submit samples for testing as may be required by the Engineer. Sampling and testing shall be carried out in accordance with IS: 2386-1963 "Methods of Test for Aggregates for concrete".

GRADING

The Contractor shall ensure that the full range of aggregate used for making concrete is graded in such a way as to ensure a dense workable mix. The delivery of aggregates will commence only when the Engineer has approved the samples and the quality and grade shall be maintained consistent and equal to the approved sample. Before construction commences, the Contractor shall carry out a series of tests on the aggregates and on the concrete to determine the most suitable grading of the available aggregates. Once the most suitable grading has been found, the grading shall be adopted for the construction of the works and periodic tests shall be carried out to ensure that it is maintained.

SIZE AND GRADING OF FINE AGGREGATES

The grading shall conform to IS: 383 and shall be within the limits of Grading Zone-III. The maximum size of particle shall be 4.75mm and shall be graded down. Sand containing more than 10% of fine grains passing through 150 micron sieve or having the fineness modulus less than 2 shall not be used for concrete work.

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SIZE AND GRADING OF COARSE AGGREGATES

The nominal maximum size of the aggregates for each mark of concrete or for each type of work shall depend upon the description of the particular item in the Schedule of Items and/or according to relevant clauses of IS: 456-2000. The aggregates shall be well graded and the grading shall conform to relevant requirements of IS: 383 depending upon the maximum nominal size as specified or as required.

TYPE OF COARSE AGGREGATES

The type of coarse aggregate viz., stone chips, gravel or broken brick shall be as described in the Schedule of Items. Unless otherwise specified in the Schedule of Items, stone chips shall be used as coarse aggregate.

- STONE CHIPS

It shall be crushed or broken from hard stone obtained from approved quarries of igneous or metamorphic origin. The stone chips shall be hard, strong, dense, durable and angular in shape. It shall be free from soft, friable, thin, flat, elongated or laminated and flaky pieces and free from dirt, clay lumps, and other deleterious materials like coal, lignites, silt, soft fragments, and other foreign materials which may affect adversely the strength & durability ofconcrete. The total amount of deleterious /foreign materials shall not exceed 5% by weight according to relevant clause of IS: 383.

- GRAVEL

It can be either river bed shingle or pit gravel. It shall be sound, hard, clean, and irregular in shape and suitably graded in size with or without some broken fragments. It shall be free from flat particles, powdered clay, silt, loam and other impurities. Before using, the gravel shall be screened and washed to the satisfaction of the Engineer. However, the foreign/deleterious materials shall not exceed 5% by weight.

- BROKEN BRICKS

These shall be obtained by breaking well burnt or over burnt dense brick bats. They shall be homogeneous in texture, well graded in size, roughly cubical in shape, clean and free from dirt, clay, silt or any other deleterious matter. Before use, these shall be screened.

FINE AGGREGATES

Unless specified otherwise it shall either be natural river sand or pit sand.

Sand shall be clean, sharp, strong, angular and composed of hard siliceous material. It shall not contain harmful organic impurities in such form or quantities as to affect adversely the strength and durability of concrete. Sand for reinforced concrete shall not contain any acidicor other impurities which are likely to attack steel reinforcement. The percentage of all deleterious materials including silt, clay etc., shall not exceed 5% by weight. If directed, sandshall be screened or washed before use to the satisfaction of Engineer.

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CEMENT

Ordinary Portland cement / Portland slag cement complying with the requirements of IS:269-1989 and I.S. 455-1989 respectively shall be used for making plain and reinforced concrete, cement grout and mortar.

Other types of cement may be used depending upon the requirements of certain jobs with the approval of the Engineer. These shall conform to the following standards:

The Contractor shall supply a copy of the manufacturer's test certificate for each consignment of cement supplied by him and consignments shall be used on work in the order of delivery. The Contractor shall supply samples of cement to the Engineer as frequently as he may require for testing. The sampling of cement for testing shall be according to IS: 3535-1986. All tests shall be in accordance with the relevant clauses of IS: 4031 (Part-I to Part-15) 1988 to 1991 & IS: 4032-1985.

In order to ensure due progress, the Contractor shall at all times maintain on the site at least such stock of cement as the Engineer may from time to time consider necessary. No cement shall be used upon the works until it has been accepted as satisfactory by the Engineer.

The cement shall be stored in such manner as to permit easy access for proper inspection and in a suitable weather-tight, well ventilated building to protect it from dampness caused by ingress of moisture from any source. Different types of cement shall be stored separately. Cement bags shall be stacked at least 15 to 20 cm clear of the floor leaving a space of 60 cm around the exterior walls. The cement shall not be stacked more than 10 bags high. Each consignment of cement shall be stacked separately to permit easy access for inspection.

WATER

Water used for mixing concrete and mortar and for curing shall be clean and free from injurious amounts of oil, acid, alkali, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. The pH value of water shall generally be not less than '6'. Water has to meet the requirements mentioned in clause 4.3 of IS: 456-2000. Watershall be obtained from an approved source.

Where it is obtained from a source other than a supply main, it shall be tested to establish its suitability. Water for construction purpose shall be stored in proper storage tanks to prevent any organic impurities getting mixed up with it.

ADMIXTURE

Admixtures to concrete shall not be used without the written consent of the Engineer. When permitted, the Contractor shall furnish full details from the manufacturer and shall carry out such test as the Engineer may require before any admixture is used in the work.

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REINFORCEMENT STEEL

Reinforcing bars for concrete shall be round steel bars of the following types as may be shown on the drawing:

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- Plain mild steel bars conforming to Grade-I of IS: 432-1982 "Mild Steel & Medium Tensile Steel for Concrete Reinforcement".
- "High strength deformed steel bars conforming to IS : 1786-2008 for Concrete Reinforcement".
- Reinforcement fabrics conforming to IS:1566-1982 "Hard Drawn Steel Wire Fabric for Concrete Reinforcement"

All reinforcement bars shall be of uniform cross sectional area and be free from loose mill scales, dust, loose rust, coats of paint, oil or other coatings which may destroy or reduce bond. Unit weight of reinforcement bars conforming to I.S. 1786-1985 is given below.

Nominal Size (Dia) (mm)	Mass Per Meter Run (Kg)
6	0.222
8	0.395
10	0.617
12	0.888
16	1.580
20	2.470
25	3.850
32	6.310

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Binding wire for reinforcement shall be annealed steel wire 20 BWG conforming to IS : 280 - 1978 "Specification for Mild Steel Wire".

FOUNDATION BOLTS

Bolts to be embedded in concrete shall, unless otherwise detailed in drawings, conform to IS : 5624-1970 "Specification for Foundation Bolts". Material for bolts, shall, unless otherwise mentioned in drawings or the schedule of items, be of steel conforming to IS : 2062-1992.

Nuts and locknuts shall conform to IS : 1363 (Part 1 to 3) -1992 "Specification for Black Hexagon Bolts, Nuts and Lock Nuts (Diameter 6-39 mm) and Black Hexagon Screws "Specification for Hexagon Bolts and Nuts (M-42 to M-150)".

Plain washers shall conform to IS : 2016 -1967 "Specification for Plain Washers and spring washers shall conform to IS : 3063 -1972 "Spring Washers for Bolts, Nuts & Screws".

3.0 CONCRETE MIX PROPORTIONING

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The mix proportion shall be selected to ensure adequate workability when handling and placing. On hardening, concrete shall have the required strength, durability and surface finish. The determination of the proportions of cement aggregates and water to attain the required strength shall be either:

- By determining the concrete mix; such concrete shall be called "Design Mix Concrete", or
- By adopting nominal concrete mix; such concrete shall be called "Nominal Mix Concrete".

Concrete of grade M20 and above shall be 'Design Mix Concrete' unless otherwise specified.
In either case, the Contractor shall be solely responsible to ensure that the concrete has all the essential properties, i.e. characteristic compressive strength, and any additional properties that may be specified.

MIXES & MIXING

Concrete for construction shall be as detailed in the table of concrete mixes & as shown by test cube results as specified. This list may be extended by the addition of other mixes as required and to the approval of the Owner/Owner's Representative.
The criteria stated in the table of concrete mixes are designed to produce concrete of the required strength & durability.
The specified characteristics strength is for concrete which has been cured at a temperature of 20°C ± 1°C. The term "characteristics strength" represents the value of the strength of concrete corresponding to the probability that, for a normal statistics distribution of the test results for determining the strengths by the compression tests, only 5% of the test result have a value lower than the one determined in this way.
The mixes shall be designed mean strengths that are greater than the specified characteristics cube strength by a margin of 1.64 times the standard deviation expected fromthe concrete batching plant, except that no standard deviation of less than 3.5N/mm² shall beused as a basis for designing a mix.
Mixes shall be designed with due regard for minimum workability necessary to allow the contractor to place & compact the concrete as specified with the equipment he proposes to use in any particular situation.

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TABLE OF CONCRETE MIXES			
Concrete Grade	**Minimum Qty of cement Kg/m³**	**Maximum free water-cement ratio**	**Characteristics strength150 mm Cube**
M20	300	0.55	20
M25	300	0.5	25
M30	320	0.45	30
M35	340	0.45	35
M40	360	0.4	40

Where air-entrainment is specified the average air content as measure in accordance with relevant Indian codes:

a. Concrete containing 40 mm max. size aggregate 4.0%±1.0%
b. Concrete containing 20 mm max. size aggregate 5.0%±1.0%

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These air contents are applicable at the time of concrete placing.

Concrete for paving or non structural pre-cast units shall have minimum flexural beam strength of 3.5 N/mm² at 28 days.

DESIGN MIX CONCRETE

At least two weeks before commencement of concreting of a particular grade in permanent works, the Contractor shall have obtained the Owner/Owner's Representative's approval of the Design Mix for that particular grade.

TRIAL MIXES

STRUCTURAL CONCRETE

The mix(s) shall be designed mixes in accordance with IS SP23 Handbook on Concrete Mixes and IS 10262 and as specified in this document. The relative proportions of the fine and coarse aggregates, the workability and strengths of the mixes shall be determined byproduction equipment trial mixes. The trial mixes shall be carried out in order to produce a concrete which can be properly placed and compacted, so that a dense impermeable concrete can be produced which shall adequately resist the ingress of damaging salts. If an admixture is proposed it shall be used in the trial mixes. The required workability for large foundations will differ from that for tall thin sections of structural concrete cast above ground and the trial mixes shall allow for both cases.

When the proposed workability and proportion of the aggregates and admixture (if any) for each of the grades of concrete has been established, test concrete shall be produced for approval. The following tests shall be carried out for each grade of concrete:

Four separate test mixes shall be prepared and six test cubes shall be made from each test mix for each grade of concrete. The test cubes shall be made and cured in accordance with IS 516.Testing shall be made in threes or multiples of threes. Only 28-day result shall be considered and the mean strength and standard deviation established for each grade.

The test mixes shall be accepted provided that:

a) The mix proportions and workability are in accordance with this Specification.

b) The standard deviation for all the different grades shall be worked out as per clause 2.1 of IS: 10262-1982.

c) The acceptance criteria shall be in accordance with clause 16 of IS 456.

Maximum Water Cement Ratio in Cement Concrete to Ensure Durability under specified exposure		
Condition of Exposure	**Concrete**	
	Plain	**Reinforced**
Mild	0.6	0.55
For Example Completely Protected against weather, or aggressive conditions, except for A brief period of exposure to normal condition during construction		
Moderate	0.6	0.50

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For Example Sheltered from heavy and wind driven rain and against freezing, whilst saturated with water, buried concrete in soil and concrete continuously under water		
Severe	0.5	0.45
For Example Exposed to Sea water, alternate wetting and drying and to freezing while wet, subject to heavy condensate or corrosive fumes		

Based on the results of the preliminary test, the contractor shall select a final design mix for the trial mixes and shall furnish the same to the Owner/Owner's Representative. The contractor shall demonstrate that the proposed design mix will produce the grade and quality of concrete required with adequate workability

A fresh mix design shall be arrived at each time there is a change in the quality or source of materials

Minimum Cement Content (Ref IS 456, Table 5)
Plain Concrete

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Exposure	Min. Grade of Concrete	Min. Cement Content (kg/m3)
Mild	-	220
Moderate	M15	240
Severe	M20	250
Very Severe	M20	260
Extreme	M25	280
Reinforced Concrete		
Exposure	**Min. Grade of Concrete**	**Min. Cement Content (kg/m3)**
Mild	M20	300
Moderate	M25	300
Severe	M30	320
Very Severe	M35	340
Extreme	M40	360

NOMINAL MIX CONCRETE

No mix design or preliminary tests are necessary for Nominal Mix Concrete. Nominal Mix Concrete shall be restricted to works of minor nature in which the strength of concrete is not critical as decided by the Engineer. The limit of chloride content of concrete shall be as follows:

Type or Use of Concrete	Max. Total Acid Soluble chloride content expressed as kg/m3 of concrete
Concrete containing metal and steam cured at elevated temperature and pre-stressed concrete.	0.4
Reinforced or plain concrete containing embedded metal	0.6
Concrete not containing embedded metal	3.0

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BATCHING

In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. If fine aggregate is moist and volume batching is adopted, allowance shall be made for bulking in accordance with IS 2386 (Part III). All measuring devices shall be accurate to + 3% and shall be regularly checked.
The water-cement ratio shall be maintained constant at its correct value. To this end, determination of moisture content in both fine and coarse aggregate shall be made by the Contractor at no extra cost. The frequency of tests shall be determined by the Engineer according to weather conditions.

4.0 FORMWORK

The design and construction of the formwork shall be the responsibility of the Contractor. However, if instructed by the Engineer, the drawings and calculations for the design of the formwork shall be submitted to the Engineer for approval. Design of formwork shall take account of safety and surface finish. The formwork shall be sufficiently rigid and tight to prevent loss of grout or mortar from the fresh concrete.

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Formwork shall be designed to withstand the worst combination of self weight, reinforcement weight, wet concrete weight, concrete pressure, construction and wind loads together with dynamic effect caused by placing, vibrating and compacting the concrete. Forms shall be designed and constructed to maintain rigidity throughout the placing, ramming, vibration and setting of the concrete to the required shape, position and level and specified class of finish within the allowable tolerances. All joints shall be sufficiently tight to prevent leakage of grout. If movement or deflection of the formwork or loss of grout occurs, the damaged concrete supported by such formwork shall be removed and the concrete re-cast so that the required finish is obtained. Formwork and its supports should be designed to withstand the worst combinations of self-weight, reinforcement and wet concrete weights, concrete pressure, construction and wind loads. Due regard shall be taken to the type of mix when considering the design pressure on the formwork. The formwork shall be precambered by an amount equal to the expected maximum deflection shall be as shown on the drawings.

If timber forms are used they shall be of sound, well-seasoned timber free from loose knots. The forms shall be faced to give the specified class of finish for the structures. The formed surfaces of exposed concrete shall be smooth, true and free from all irregularities.

For below ground concrete except against existing structures, rough formwork, steel pans etc., provided all joints prevent the loss of grout.

The formwork shall be capable of being dismantled and removed from the cast concrete without shock, disturbance or damage. The arrangement shall be such that the soffit forms properly supported on props, can be retained in position for such period as may be required by maturing conditions or specifications.

CLEANING AND TREATMENT OF FORMS

All rubbish shall be removed from the interior of the forms before the concrete is placed. The faces of the forms in contact with the concrete shall be clean and treated with a suitable release agent, where applicable. Release agent shall be applied so as to provide a thin uniform coating to the forms without contaminating the reinforcement.

STRIKING OF FORM WORK

In normal circumstances where Ordinary Portland Cement is used, forms shall generally be removed after the expiry of the following periods:

Walls, Columns and vertical faces of all structural members	24 to 48 hours
Slabs (Props left Under)	3 Days
Beam Soffits (Props left Under)	7 Days
Removal of Props under Slabs:	
1) Spanning upto 4.5m	7 Days
2) Spanning over 4.5m	14 Days

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Removal of Props under Beams and Arches:	
1) Spanning upto 6.0m	14 Days
2) Spanning over 6.0m	21 Days

For other cements, the stripping time recommended for Ordinary Portland Cement shall be suitably modified. The number, size and position of props left under shall be such as to be able to safely carry the dead load of the slab, beam or arch, together with any live load likely to occur during curing or further construction.
Sleeves for through bolts shall not be provided in formwork for liquid retaining structures as they are potential hazard for leakage. Special devices shall be fabricated using two ordinary M20 nuts separated by two numbers 10 mm rounds welded to opposite flat side of the nuts. The faces of the nuts will have a compressible rubber bushing 20 mm thick. The overall dimension of the assembly shall be 50 mm less than the designed thickness of the concrete. Adjusting bolt shall pass through formwork and will lock into the nuts. While these bolts are tightened, the formwork will travel inwards.
Once the desired dimension is achieved, concrete will be poured. During removal of shuttering, the bolts will be removed to loosen the shuttering plates. The depression will be sealed using suitable concrete sealant.

SURFACE FINISHES FROM FORMWORK

Generally formwork shall be specified as either wrought or unwrought depending on the required surface finish.

UNWROUGHT FORMWORK

Unwrought Formwork shall consist of sawn boards, brick or concrete block work, sheet metal or other suitable material to give adequate support to the concrete.
Appearance is not of primary importance for this class of formwork.
Surfaces to which plaster, granolithic or other finish is to be applied shall be roughened while the concrete is still green.

WROUGHT FORMWORK

Wrought formwork shall be provided for concrete surfaces that are required to be finished smooth.
Wrought formwork shall be lined with metal or plywood having smooth surfaces and edges.
Formwork shall be furnished in largest practicable sizes to minimize the number of joints. Care shall be taken that there are no irregularities or roughness between successive sections of shuttering such that finished surfaces shall be free of board or shutter marks. Upon removal of formwork, surfaces of finished concrete shall be rubbed down with carborundum stone where necessary to obtain a uniform and smooth appearance.
The finish shall be such as to require no filling of surface pitting, butt fins, surface discoloration and other minor defects shall be remedied by approved methods.
Rendering of defective concrete as a means of making good will not be permitted except that, in case of minor porosity on the surface, approval may be given for the surface to be treated by rubbing down with a cement mortar of the same fine aggregate/cement ratio as the concrete. The treatment shall occur immediately after removing the formwork. Both cement and aggregate shall be from the same source as the concrete materials.

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Concrete containing honeycombing, major air holes or similar defects shall be cut out and replaced as directed. No repair shall be executed without approval.

TIES

Where it is required to use internal ties and spacers, their type, spacing and use shall be approved. No part of any such tie or spacer remaining permanently embedded in the concrete shall be nearer than the specified cover to the finished surface of the concrete. Wire ties projecting through the concrete face shall not be permitted.

PERMANENT FORMWORK

Permanent formwork for elevated concrete floors in steel structures shall be profiled steel sheet. The sheet shall be of sufficient thickness to sustain all construction loads plus the weight of fresh concrete between supporting beams without excessive deflection. The underside of the sheet shall be coated with an approved corrosive resistant paint. The material shall conform to IS 513. The deflection shall be limited to span / 150. The sheet shallbe fixed on the supporting beams at every alternate valley by 10 mm dia fusion welding with 22 mm dia x 2.5 mm thick reinforcing washer. Minimum 100 mm overlap shall be provided. The deck sheet end resting on wall shall have a seating of 150 mm minimum. Side laps shallbe secured with tack welding to ensure that the slurry does not leak down. End laps shall always be on the supporting walls or on supporting beams. The overhang of the deck sheet shall be limited to 300 mm maximum. Temporary supports, where ever advised by the construction manager, shall be firm, and at the same level as the permanent supports and shall be in place till the concrete attains its full strength. While removing the temporary supports, care shall be taken that the slab is not disturbed.

FORMWORK FOR VIBRATED CONCRETE

If external vibrators are to be used for compaction of concrete, the type of vibrator, design of the formwork and the method of fixing the vibrators shall all be approved.

CLEANING AND TREATMENT OF FORMS

Before concreting is commencing the forms and previously cast concrete shall be thoroughly cleaned and free from all sawdust, tie wire, shavings, dust, dirt and other debris. Temporary openings shall be provided where necessary to drain away water and remove rubbish.
Release agents shall be applied and be compatible with the class of finish. Care shall be taken not to contaminate the reinforcement.

5.0 CONSTRUCTION JOINTS

The number of construction joints shall be kept to the minimum necessary for the execution of the work. Their location shall be carefully considered and approved by Engineer before concrete is placed. Construction joints shall normally be at right angles to the general direction of the member. The concrete at the joint shall be bonded with that subsequently placed against it, without provision for relative movement between the two. When the work has to beresumed on surface, which has hardened, such surface shall be roughened. It shall then be swept clean and thoroughly wetted. For vertical joint neat cement slurry shall be applied on the surface before it is dry. For horizontal joints the surface shall be covered with a layer of

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mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in concrete mix. This layer of cement slurry or mortar shall be freshly mixedand applied immediately before placing of the concrete.
Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire brushes, care being taken to avoid dislodgement of particles of aggregate. The surface shall be thoroughly wetted and all free water removed. The surface shall then be coated with neat cement slurry. On this surface, a layer of concrete not exceeding 150 mm in the thickness shall first be placed and shall be rammed against old work, particular attention being paid to corners and close spots; work thereafter shall proceed in the normal way. The number, size and positions of props left under shall be able to carry safely the dead load of the slab, beam or arch together with any live load likely to occur during curing or further construction. Cambers and chamfers, wherever shown in drawing shall be provided accordingly.

EXPANSION JOINTS

Expansion joints and joints around equipment in concrete paving shall be as detailed in the drawing and shall be formed with an approved bitumen impregnated fibreboard. The upper 20 mm shall be sealed with an approved two part, Polysulphide, oil resistant sealant (H.C. grade) or hot applied bitumen sealing compound, applied strictly in accordance with the manufacturer's instructions.
The joint filler shall be fixed firmly to the first placed concrete before the adjoining concrete is placed. The concrete must be thoroughly compacted on both sides of the joint. The location of expansion joints shall be shown on the engineering drawings.

CONTRACTION JOINTS

Contraction joints (either complete or partial) shall be located on the drawings and formed with a building paper membrane interface, or equivalent separating membrane and the upper 25 mm depth sealed. The steel reinforcement shall be continuous through partial contraction joints. The use of contraction joints should be kept to a minimum compatible with freedom from cracking.

JOINT FILLERS

Joint fillers and sealing compounds shall comply to IS 1834, IS 1838 and IS 11433.

6.0 REINFORCEMENT

Reinforcement shall comply with IS 1786 or IS 432. Different types of reinforcement may be used in the same structural member. Reinforcement shall be cut and bent in accordance with approved bar bending schedules.

CUTTING AND BENDING

Reinforcement shall be cut and/or bent in accordance with IS 2502. It is essential that reinforcement shall not be subjected to mechanical damage prior to embedment. In general, reinforcement shall be bent cold.
Bends in reinforcement shall have a substantially constant curvature.

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It is permissible to bend mild steel reinforcement projecting from concrete provided that care is taken to ensure that radius of bend is not less than that specified in IS 2502. Grade Fe.415 bars shall not be re-bent or straightened without the Engineer's approval.

FIXING

Reinforcement shall be secured against displacement outside the specified limits. Actual concrete cover shall be not less than the required nominal cover minus 5 mm or two third the nominal cover whichever is more. In slabs, the actual concrete cover shall be not more than the required nominal cover plus.
5 mm on bars up to and including 12 mm size
10 mm on bars over 12 mm and up to 25 mm
15 mm on bars over 25 mm
Spacers and chairs shall be used to maintain the specified nominal cover to the steel reinforcement. Spacers or chairs shall be placed at a maximum spacing of 1 meter. Wherever reinforcing bars are intended to be in contact, they shall be securely bound together with 18 gauge annealed soft iron wire.
The mix used for spacer blocks made from cement, sand and fine aggregates shall be comparable in strength, durability and appearance to the surrounding concrete.
The position of reinforcement shall be checked before and during concreting, particular attention being directed to ensure that the nominal cover is maintained within the limits, given, especially in the case of cantilever sections.

SURFACE CONDITIONS

Concrete shall not be placed around reinforcement unless the reinforcement is free from mud, oil, paint, loose rust, grease or any other substance which can be shown to adversely effect the steel or concrete chemically or reduce the bond.

LAPS AND JOINTS

Laps and joints shall be made only by the methods specified and at the positions shown on the drawings or as agreed by the Engineer.

WELDING

Welding on site shall be avoided if possible, but may be permitted where suitable safeguards and techniques are employed. Generally, however, all welding shall be carried out in a workshop. The competence of the welder shall be demonstrated prior to and periodically during welding operations. Welding of mild steel bars shall be carried out in accordance with IS 2751. Welding of high strength deformed bars shall be in accordance with IS 9417. The carbon content of high yield strength deformed bars conforming to IS 1786 shall not be more than 0.25%. If carbon content exceeds the limits specified herein, specifically written down welding and testing procedure shall be followed.

TOLERANCES ON PLACING

Reinforcement shall be placed within the following tolerances:
1. For effective depth 200 mm or less + 10 mm
2. For effective depth more than 200 mm + 15 mm.

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TYING OF REINFORCEMENT

Bars crossing each other, where required shall be secured by binding wire (annealed) conforming to IS 280. Every compression bar will be tied at least in two perpendicular directions.

7.0 TRANSPORTING, PLACING, COMPACTING AND CURING OF CONCRETE

TRANSPORTING

Concrete shall be transported from the mixer to the formwork as rapidly as possible by methods that will prevent the segregation, loss of any ingredients or ingress of foreign matter or water and will maintain the required workability. The concrete shall be deposited as close as possible to its final position to avoid handling or moving the concrete horizontally by vibrating. The addition of water at point of discharge is prohibited.

PLACING AND COMPACTING CONCRETE

All placing and compacting shall be carried out under suitable supervision and as soon after mixing as is practicable. Placing of concrete shall commence only after embedment in the concrete is securely fixed in position. Care shall be taken to avoid displacing reinforcement and damage to the faces of formwork, particularly when the concrete is allowed to fall freely through the depth of lift. The concrete shall not be dropped from a height of over 1.5 meters unless it is dropped by a tremie or chute. The bonding medium shall have the same cement-sand content as the concrete to be placed on it. Bonding planes shall generally be horizontal.
No concrete shall be placed in flowing water. Under water, concrete shall be placed in position by tremies or by pipeline from the mixer and never allowed to fall freely through the water.
Concrete shall be placed in successive horizontal layers in thicknesses not exceeding 500 mm. Concrete shall be thoroughly compacted by vibration or other means during placing and worked around the reinforcement, embedded fixtures and into corners of the formwork to form a solid void free mass having the required surface finish. When vibrators are used, vibration shall be applied continuously during the placing of each batch of concrete until the expulsion of air has practically ceased and in a manner that does not promote segregation. Over vibration shall be avoided to minimize the risk of forming a weak surface layer.
When internal or immersion type vibrators are used they shall have frequency of 7000 RPM. They shall be inserted in a vertical position at an interval of about 600 mm. Vibrators shall not be used to transport concrete inside the formwork. When external vibration is used, the design of formwork and disposition of vibration shall be such as to ensure efficient compaction and to avoid surface blemishes.
The Contractor shall keep a complete record of the work of concreting showing the time and date of placing. This record shall be available for inspection at any time by the Engineer. Structural concreting against open excavation will not be permitted.

CURING

Curing is the process of preventing the loss of moisture from the concrete while maintaining a satisfactory temperature. The prevention of moisture loss from the concrete is particularly important if the water/cement ratio is low.
Curing and protection shall start immediately after the compaction of the concrete to prevent it from:
Prematurely drying out, particularly by solar radiation and wind,
Leaching out by rain and flowing water.

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Where members are of considerable bulk or length, the cement content of the concrete is high, the surface finish is critical; the method of curing shall be specified in detail.

Surfaces shall normally be cured for at least for 7 days. The most common methods of curing are:

- Covering the surface with a damp absorbent material like sacking and keeping the material constantly wet.
- By ponding top surface with water (sea water not permitted) for slabs and the like.
- By continuous or frequent applications of water to the surface, avoiding alternate wetting and drying and the application of cold water to warm concrete surfaces.
- Spraying the surface with an efficient curing membrane.

The curing compound shall conform to relevant Indian Standards and shall be applied in accordance with the manufacturer's instructions to provide a water loss not greater than 0.55 kg/ m2 in 72 hours. Curing compound shall be used where conventional curing by water cannot be accomplished, following approval of construction manager.

8.0 CONCRETING IN HOT WEATHER

In hot weather (above 40 deg C) special precautions shall be necessary to avoid the loss of moisture and/or rapid stiffening of the concrete, which prevents its proper compaction, can cause thermal and plastic cracking and a reduction in strength and durability.
During hot weather, the concreting shall be done as per the procedure set out in IS 7861 Part 1. At the time of placing, no part of the concrete shall have a temperature exceeding 35 deg C. The temperature of concrete can be reduced by cooling the water and aggregate.
During hot dry weather at the point of placement the fresh concrete shall be protected from drying winds and solar radiation by the provision of PVC or similar tented shelter, which shall remain to avoid exposure to the sun. Suitable method to shelter the surface shall be adopted such that finishing operations can be carried out whilst it is in place. To prevent early drying and cracking, the relative humidity shall be kept high and the concrete surfaces kept moist by spraying with clean water and covered with wet hessian.

Note: To avoid de hydration of concrete use OPC 43 grade cement.

9.0 CONCRETING IN ADVERSE WEATHER

Concreting shall not be permitted when storm or rain appears to be imminent. In the event that the rain storms or other severe weather conditions occur unexpectedly, concreting shall be stopped and appropriate temporary stop ends, vee grooves etc., placed as necessary. To meet such circumstances the contractor shall always have in readiness on site approved framed sheeting or tarpaulins for protection of newly placed concrete. Under water concreting shall be permitted only with the approval of construction manager. Concrete placed under water may be lowered in bottom opening skips or may be fed continuously through an approved tremie pipe. Unless otherwise agreed with the construction manager, the cement content of any concrete mix to be placed under water shall be increased by 20%.

10.0 SAMPLING AND STRENGTH OF CONCRETE

Samples from fresh concrete which is to be used in the works shall be taken as per IS 1199 and cubes shall be made, cured and tested at 28 days in accordance with IS 516.

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Facilities required for testing materials and concrete in the field such as testing machine with an operator shall be made available at the Engineer's request.

Frequency of sampling and acceptance criteria for strength tests shall be as per clauses 15 and 16 of IS 456. Concrete test cubes may be cured by accelerated methods as described in IS 9013. Cubes may also be optionally tested at 7 days or at the time of striking the formwork. However, in all cases, the 28 days compressive strength specified in IS 456 shall be the criterion for acceptance or rejection of the concrete.

For pre casting work additional cubes shall be taken and tested at 3 days or prior to lifting. Higher rate of sampling will be required at the beginning of the Construction period in order to establish the level of quality control or where there are critical elements. All samples shall be clearly marked with their identification and accurate records shall be maintained.

The concrete will be deemed to comply with the specified design strength provided the acceptance criteria in IS 456 are met.

If any test results fail to comply with the above then the quantity of concrete represented by the results shall be at risk, and may be required to be removed and replaced. The 28 days cube crushing results shall be grouped consecutively in different groups and each group shall have standard deviation as specified IS 456

If the standard deviation is greater than this, the concrete production shall be reviewed. 7-Day Tests (In situ Concrete)

- Tests shall be carried out at 7 days to establish a relationship between the 7-day and 28 day strengths. The relationship shall be used to interpret further test results in order to predict the probable value of the corresponding 28-day strengths.
- Notice shall be given without delay of any 7 day test results which indicates that the corresponding 28 day test results are likely to fail to meet the specified strength, so that necessary action can be taken to minimize the effect of such possible failure.
- 3 Day Tests (Pre-cast Concrete)
- For pre-cast concrete tests shall be carried out at 3 and 7 days to establish the relationship with the 28 day results.

There shall be no production tests on blinding concrete.

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11.0 INSPECTION

All materials, workmanship and finished construction shall be subject to the continuous inspection and approval of the Engineer. All materials supplied by the Contractor and all construction performed by the Contractor, rejected as not in conformity with the specifications and drawings shall be immediately replaced by the contractor at no cost to the Owner.

12.0 CLEAN UP

Upon the completion of concrete work, all debris, scraps of wood, etc., resulting from the work shall be removed and the premises left clean.

13.0 WORKABILITY

The concrete mix shall be designed by varying the relative proportion of fine and coarse aggregates to ensure adequate workability for working it into corners and angles of the

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formwork and around the reinforcement without segregation of the materials or bleeding of the free water at the surface. On striking the formwork, the concrete shall present a face, which is uniform, free from honeycombing, surface crazing or excessive dusting. To confirm the workability of the designed mix for each grade of concrete, a series of workability tests shall be carried out on the preliminary trial mixes, unless acceptable data exists.

14.0 INITIAL SETTING TIME

The initial setting time shall be not less than ½ hour after the production concrete isdischarged into the forms and with a maximum time between mixing and completion of placingconcrete shall not exceed 1 hour. The total time between mixing and initial set shall be a minimum of 1 hour. There shall be a maximum setting time of 6 hours.
When trial mixes are made to determine the workability of the concrete, the initial setting time of the cement paste shall be determined as per IS 8142.

15.0 SLUMP

The slump of the structural concrete mixes shall be such that the concrete can be transported, placed into the forms, and compacted without segregation. Slump for pumpable concrete shall be determined by site trials and shall at least be 100 mm on site of pouring.

16.0 PRECAST CONCRETE

The requirements of this Specification relating to concrete and reinforcement shall be observed so far as they are applicable to reinforced concrete. In addition the following requirements specifically relating to pre-cast work should be met.

RECASTING YARD

The yard in which pre casting work is to be undertaken shall be cleaned and have firm level beds preferably of concrete with drainage channels between the beds. The beds shall have a surface of suitable quality to give the pre-cast units the required class of finish.
Where pre-cast units have projecting reinforcement the moulds shall, if necessary, be raised on stools above the general level of the pre casting yard.

MOULDS FOR PRE-CAST CONCRETE

The moulds shall be strongly constructed, closely jointed and true to the required shape with edges, corners and surfaces which comply with the relevant class of finish. Moulds are to be so designed that they can be readily taken apart and reassembled.

MARKING

All units shall be marked on the face which will not be exposed in the permanent works, with the date of manufacture and such distinguishing letters or numbers required for erection identification.

CURING, MATURING AND STACKING

The production schedules shall allow for proper curing and maturing of pre-cast concrete and shall be carried out as approved. The sides of the moulds may be removed after not less than

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12 hours provided that the concrete has thoroughly set. All concrete surfaces shall be kept covered with thoroughly wetted hessian for at least 7 days.
Slinging, transporting and stacking may take place when designed handling stresses have been attained, but building or setting in the works shall not be permitted until the 28 days cube strength has been reached.
The time periods required for gain of strength of concrete may be reduced where approved special techniques are adopted such as vacuum or pressed concrete, steam curing or when a rapid hardening cement is used. No methods of accelerated curing shall be used without prior approval.

CEMENT/SAND MORTAR

Cement/sand mortar for bedding and jointing pre-cast members shall be of equivalentstrength, quality and color to that of the concrete member being bedded or jointed. Cement/sand mortar shall be mixed in small quantities and used immediately. Particular attention shall be paid to compacting the cement/sand mortar to prevent the formation of voidsand air pockets. The mortar mix shall be determined from tests following the recommendations of Indian Standard, alternatively grouting may be considered.

SURFACES FOR STRUCTURAL CONNECTIONS (MARINE STRUCTURES)

The surfaces of pre-cast concrete slabs and other units, which are to be in contact with in situ concrete, shall be prepared to achieve a good bond between the concrete unit and the adjoining concrete. The CONTRACTOR shall submit to the Owner/Owner's Representative his proposals for preparation of a suitable surface.

17.0 GROUTING

Where equipment manufacturer's drawings define a grouting procedure, said procedure shall be followed, subject to the approval of Owner/Owner's Representative. All recommendation and instructions of the grout manufacturer shall be followed by contractor.No grout shall be placed when the outside temperature is below 5 °C unless special approval provisions are made against freezing. The minimum compressive strength of grout shall be at least equal to the parent concrete.

MATERIAL

Sand cement dry pack shall be proportioned at the site, but all non-shrink grouts shall consist of only pre-measured, pre-packaged material supplied by the grout manufacturer, except water. Water to be used for mixing Portland cement grout shall be clean, potable and free from all deleterious materials such as oils, acids, alkalis and organic materials.

GROUT TYPES

SAND CEMENT DRY PACK AND ORDINARY MORTAR GROUT

Cement shall be Portland cement and shall conform to the requirements of IS 269. Sand shall be mixed at two to one ratio by weight with the cement with a ramming consistency and shall have a minimum compressive strength of 15 N/mm2 at 7 days.

NON-SHRINK CEMENT BASED GROUT

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Non-shrink cement based grout must have a full range of consistencies, including dry pack, plastic and flowable state to be suitable for used in a variety of applications. Grout should be capable of being pumped flowable without segregation. Vibration only when expressly stated by manufacturer. Grout working time shall be minimum of 60 minutes regardless of application consistency used. The grout shall contain no metallic substances (catalyzed or non catalyzed), aluminum powder, water reducing agents, fluidizers, accelerators, super plasticizers, or other materials known to increase drying shrinkage and/ or compromise long term durability. Non-shrink cement based grout shall have a minimum compressive strength of50 N/mm2 at 7 days.

NON-SHRINK EPOXY GROUT

Grout shall be 100 % solids system with the ability to be placed in flowable state. Non-shrink epoxy shall have a minimum allowable compressive strength of 60 N/mm2 at 7 days.

GROUT TYPE SELECTION

When the application is an unobstructed bearing plate or void which is not subject to impact or vibrations and allows the easy placement of grout without undue man-hour expenditure, used a sand cement dry pack or an ordinary mortar grout.
If one of the criteria cited above is not met (i.e. obstructed bearing plate or void or subject to impact or vibration) then use a pre-packaged, pre-measured, non-shrink, cement based grout.

STORAGE

Non-shrink cement based grout and epoxy grout aggregates shall be prepared by contractor in sound, dry bags and epoxy grout liquid components in sealed hardener and resin containers. Contractor shall be responsible for storing the grout in a dry, weatherproof area and within a temperature range of 4 °C to 32 °C.
Any material which becomes damp or otherwise defective shall be immediately removed from the site by contractor at his own expense.

SURFACE PREPARATION

All surfaces to be grouted shall be entirely free of oil, grease, dirt, wax, laitance, curing compounds and other foreign substances that may interfere with complete bearing or bonding. When removing laitance, a hand held pneumatic chipping hammer shall be of the largest tool, contractor shall take the utmost care to prevent any possible structural damage that could be caused by improperly or negligently removing the laitance.
When any cement based grouts are used, concrete surfaces shall be saturated with water for 24 hours prior to grout placement. Excess water shall be removed just prior to grouting.
When epoxy grouts are used, all surfaces shall be made completely dry prior to grouting.

LEVELLING AND ALIGNMENT

Prior to commencing grouting equipment bases, column bases or anchor bolts, leveling and alignment shall be performed to place and maintain said items in their final position during grouting. A minimum grout space of 25 mm shall be provided unless specified otherwise on the drawing. All metal surfaces which are to be in direct contact with the grout shall be thoroughly cleaned and made free of all grease, oil, dirt, wax or other foreign substance.

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Leveling shims shall be removed when they would prevent uniform bearing under the base support such as tower bases rings. Removal of the shim shall be delayed long enough to ensure against disturbing the grout. Voids where shims have been removed shall be completely packed with grout before finishing.

MIXING

Grout types shall be mixed according to manufacturer's recommended procedures. Epoxy grout component ratio shall not be changed from that recommended by the manufacturers. No solvent or thinners shall be added to the mix. The amount of water added to a non-shrink cement based grout will determine its consistency. The lowest water/ grout ratio need to get the grout in place should be used.

PLACEMENT

Grout placement shall proceed in a manner that assures the filling of all voids and the intimate contact of grouting materials with surfaces to be grouted. The placement of grout shall be rapid and continuous so as to avoid cold joints under any base plate. All grouting shall be done in one direction only, placing grout on one side and working it to the other. Placement will be such as to provide full and uniform bearing under all foundation bearing surfaces. All exposed grout shall be provided with a 25 mm, chamfer, unless otherwise directed by purchaser's Owner/Owner's Representative.

CURING

Grout shall be cured according to manufacturer's recommendations. Forms shall remain in place with a minimum of 24 hours regardless of whether grout is cement based or epoxy. Cement based grout shall be protected from extreme drying conditions. Epoxy grout shall not be wet cured. The temperature of the base plate, concrete foundations and grout shall be maintained between 4°C and 32 °C during grouting and for a minimum of 24 hours thereafter.

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SPECIFICATION FOR
CIVL & STRUCTURAL WORKS

BRICK MASONRY WORK

ENG-STD-CV-DOC-TS-006

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1.0 INTRODUCTION

This specification deals with masonry and allied works in foundation, plinth and superstructure.

2.0 MATERIALS

Bricks for masonry in foundations, walls and other locations shall be common burnt clay building bricks having minimum crushing strength of 5 N/sq.mm. or such other strength as may be described in the Schedule of Items, when tested in accordance with IS : 1077-1992 "Common Burnt Clay Building Bricks". They shall be sound, hard and thoroughly well burnt, with uniform size having rectangular faces with parallel sides and sharp straight right angled edges and be of uniform colour with fine compact uniform texture. Bricks shall be of uniform deep red cherry or copper colour. They shall be free from flaws, cracks and nodules of free lime. Water absorption after 24 hours immersion in cold water shall be not more than 20% by weight. They shall not absorb more than 10% by weight of water after immersion for six hours. They shall emit a clear metallic ringing sound when struck by a mallet and shall not break when dropped on their face, from a height of 60 cm.

Fractured surface shall show homogeneous, fine grained uniform texture, free from cracks, air holes, laminations, grits, lumps of lime, efflorescence or any other defect which may impair their strength, durability, appearance and usefulness for the purpose intended. Underburnt or vitrified bricks shall not be used.

Samples of bricks brought to the site shall be tested periodically for compression and other tests according to IS: 3495 (Parts-1 to 4) -1992 "Method of Test for Burnt Clay Building Bricks". Where the size of bricks is not specifically mentioned, it shall be taken to mean conventional sizes as is commonly available in the area. In case modular bricks are to be used, it shall be accordingly specified in Schedule of Items. The bricks shall be classified on the basis of average compressive strength as given in Table 1 of IS: 1077-1992.

Bricks shall be unloaded by hand and carefully stacked and all broken bricks shall be removed from the site.

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3.0 SAMPLES AND INSPECTION

Representative samples shall be submitted by the contractor and approved samples retained by the Engineer for comparison and future reference. Bricks shall be obtained fromapproved manufacturer. All bricks shall be subject to inspection on the site and shall be to the approval of the Engineer who may reject such consignment as are considered by him tobe inferior to the quality specified. The Contractor shall provide all labour required for inspection and conduct such test as shall be required by the Engineer without additional charges.

4.0 SELECTION OF MORTARS

Mortar for masonry shall conform generally to IS: 2250-1981 "Code of Practice for Preparation and Use of Masonry Mortars", and proportion shall be as specified in the drawing or in the Schedule of Items.

Cement mortar shall be prepared by mixing cement and sand in specified proportion. It is convenient to take unit of measurement for cement as a bag of cement weighing 50 Kg

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equivalent to 0.035 cubic meters. Sand is measured in boxes of suitable size (say of 40 x 35 x 25 cm). It shall be measured on the basis of dry volume. In case of damp sand, the quantity shall be increased suitably to allow for bulkage in accordance with IS:2386-1963 (part-III) or by any approved method.

The mixing of the mortar shall be done preferably in a mechanical mixer. This condition may be relaxed by the engineer taking into account the nature, magnitude and location of the work. If mixed in the mixer, cement and sand in the specified proportion shall be fed in the mixer and mixed dry thoroughly, water shall be then added gradually and wet mixing continued for at least 3 minutes. In case of hand mixing also after mixing dry on a water-tight masonry platform, water shall be added and the mortar turned over and over, backward and forward several times.

Fresh mixed mortar, in case becoming stiff due to evaporation of water may be re-tempered by adding water as frequently as needed to restore the requirement of the consistency but this shall be permitted only upto a maximum of 2 hours from the time of addition of cement in the mortar.

5.0 STORAGE AND HANDLING

Bricks shall not be dumped at site. They shall be carefully handled and carefully stacked in regular tiers to avoid breakage and defacement of bricks and prevent contamination by mud or other materials. Bricks selected for different situations of work shall be stacked separately.

6.0 SOAKING & CLEANING

Bricks required for masonry shall be cleaned to be free from dirt, dust and sand and fully soaked in clean water by submerging in vats before use, till air bubbling ceases. The bricks shall not be too wet at the time of use. After soaking they shall be removed from the tank sufficiently early so that at the time of laying they are skin dry and stacked on a clean space.

7.0 LAYING

Brickwork in general shall be as per IS 2212-1991. Bricks shall be laid in English bond, unless otherwise specified, with frogs upward over a full bed of evenly laid mortar, and slightly pressed and tapped into final position to the lines levels and shape as shown in the drawing fully embedded in mortar. All joints including inside faces shall be flushed and packed. Not more than 8 courses shall generally be laid in a day. The first course itself shallbe made horizontal by providing enough mortar in the bed joint to fill up any undulations. The horizontality of courses and the verticality of wall shall be checked very often with spirit level and plumb bob respectively.

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Horizontal joints shall be truly horizontal and vertical joints shall line up in every alternate course. The joints shall not exceed 10 mm in thickness and shall be well finished and neatly struck. The joints shall be kept uniform throughout the brick work. All the brick joints of the face works shall be neatly raked out to a minimum depth of 15 mm with the help of raking tools and the faces of brick wall cleaned with wire brush to remove any splashes of mortar before the close of the day's work, while the mortar is still green and the last brick layer shall be cleaned with wire brush and the frogs free from mortar.

Walls coming in contact with R.C.C. structures shall perfectly be bonded with M.S. inserts or lugs where shown on drawings and the sides butting against the R.C.C structures neatly and efficiently flashed and packed with rich mortar & cement slurry at no extra cost. Where such lugs are not required to be provided, brick work shall be built tightly against columns, slabs or other structural parts, around door and window frames with proper distance to permit caulked joint. Where drawings indicate structural steel column or beam to be partly or wholly covered with brick work, bricks shall be built closely against all flanges and webs, with all spaces between steel and brick work filled solid with mortar not less than 10 mm thick.

Damaged or broken brick or brick bats shall not be used in brick work. Cut bricks may be used to complete bond or as closers or around irregular openings.

Bricks shall not be thrown from heights to the ground, but shall be handled carefully and put gently in position to avoid damaging the edges. Selected bricks of regular shape and dimension shall be used for face work.

Making of grooves, sleeves and chases shall be done, during the construction, to the lines, levels and position as shown in the drawing or as instructed by the Engineer. Such sleeves shall slope outward in external walls so that their surface cannot form channels for the easy passage of water inside.

Fixtures, plugs, frames, pipes, inserts etc., if any, shall be built in at the right places to the lines & levels as shown in the drawings while laying the course and not later by disturbing the brick work already laid.

Brick walls of one brick thick or less shall have one selected face in true plane and walls more than one brick thick shall have both the faces of wall in true plane.

All connected brick wo rk shall be carried out simultaneously with uniform heights throughout the work, and in exceptional cases, with the approval of the Engineer, the brick work built in any part of the work may be lower than another adjoining wall/connected wall by a maximum of one meter and the difference in height of adjoining wall/connecting wall shall be raked back according to bond by stepping at an angle not steeper than 45 degree, without sacrificing the necessary bond, horizontality of layers, verticality of joints and the wall.

8.0 PROTECTION OF BRICK WORK

The brick wall shall be protected and covered with gunny bags or water proof sheets from the effects of inclement weather, rain, frost, etc. during the construction and until the mortar sets. Care shall be taken during construction that the edges of jambs, sills and soffits of openings are not damaged.

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9.0 CURING

Masonry in cement or composite mortar shall be kept continuously moist on all faces for a minimum period of 7 days by means approved by the Engineer.

10.0 SCAFFOLDING

Necessary and suitable scaffolding shall be provided at all heights to facilitate the construction of brick wall. Scaffolding shall be sound, strong and all supports and other members shall be sufficiently strong and rigid, stiffened with necessary bracings and shall be firmly connected to the walls securing them against swing or sway. Planks shall be laid over the scaffolding at required levels. Scaffolding shall preferably be of tubular steel, although the Engineer may permit other material, depending upon the circumstances.

Scaffolding shall be double, having two sets of vertical supports, particularly for the face wall and all exposed brick work. Single scaffolding may be used for buildings upto two storeys high or at other locations, if permitted by the Engineer. In such case the inner ends of horizontal members shall rest in holes provided in header course only. Such holes shall not be allowed in pillars under one meter in width, or immediately near the skew backs or arches. The holes thus left in masonry shall be filled with bricks set in rich mortar and the surface made good on removal of scaffolding.

If for any reason the Contractor is required to erect scaffolding in property other than that belonging to the Owner, including municipal corporation or local bodies, necessary permission shall be obtained by the Contractor from the appropriate authorities and necessary licensing fees if any shall have to be borne by him.

All scaffoldings once erected shall be allowed to remain in position, efficiently maintained by the Contractor, till all the finishing works required to be done are completed and shall not be removed without the approval of the Engineer. The Contractor shall allow workmen of other trades to make reasonable use of the scaffolding without any extra cost.

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SPECIFICATION FOR
CIVIL & STRUCTURAL WORKS

PLASTERING & POINTING

ENG-STD-CV-DOC-TS-007

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1.0 INTRODUCTION

This specification covers the material and workmanship requirements for the Plastering works as applicable.

2.0 MATERIALS

CEMENT

Ordinary Portland cement / Portland slag cement complying with the requirements of IS: 269-1989 and I.S. 455-1989 respectively shall be used.

SAND

Sand for plaster and pointing shall conform to IS: 1542. Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of silt, day bails or pellets. Sand shall not contain harmful impurities such as iron pyrites, coal particles, lignite, mica shale etc.
Sand whose grading falls outside the limits of IS: 460 due to excess or deficiency of coarse or fine particles shall be processed to comply with the standards.
Fine sand shall be obtained from river beds not affected by tidal water of the sea and shall be clean, sharp and free from excessive deleterious matter. The sand shall not contain more than 8 per cent of mud and silt as determined by field test with a measuring cylinder.

WATER

Water used for mixing concrete and mortar and for curing shall be clean and free from injurious amounts of oil, acid, alkali, salts, sugar, organic materials or other substances that may be deleterious. The pH value of water shall generally be not less than '6'. Water has to meet the requirements mentioned in clause 4.3 of IS: 456-2000. Water shall be obtained from an approved source.

CEMENT MORTAR

Cement mortar shall be prepared by mixing cement and sand in specified proportion. It is convenient to take unit of measurement for cement as a bag of cement weighing 50 Kg equivalent to 0.035 cubic meters. Sand is measured in boxes of suitable size (say of 40 x 35 x 25 cm). It shall be measured on the basis of dry volume. In case of damp sand, the quantity shall be increased suitably to allow for bulkage in accordance with IS:2386-1963 (part-III) or by any approved method.

The mixing of the mortar shall be done preferably in a mechanical mixer. This condition may be relaxed by the engineer taking into account the nature, magnitude and location of the work. If mixed in the mixer, cement and sand in the specified proportion shall be fed in the mixer and mixed dry thoroughly, water shall be then added gradually and wet mixing continued for at least 3 minutes. In case of hand mixing also after mixing dry on a water-tight masonry platform, water shall be added and the mortar turned over and over, backward and forward several times.

Fresh mixed mortar, in case becoming stiff due to evaporation of water may be re-tempered by adding water as frequently as needed to restore the requirement of the consistency but this shall be permitted only up to a maximum of 2 hours from the time of addition of cement in the mortar.

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CEMENT MORTAR WITH WATERPROOFING COMPOUND

Waterproof compound shall conform to IS: 2645 of approved make. The compound shall be well mixed with dry cement in the proportion of 3% by weight or as recommended by manufacturer.

3.0 WORKMANSHIP

PREPARATION OF BACKGROUND SURFACE

The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surfaces shall be roughened by wire brushing or hacking for non-hard and hard surfaces respectively. Projections on surfaces shall be trimmed wherever necessary to get even surfaces. In case of brick/stone masonry, raking of joints shall be carried out wherever necessary. The masonry shall be allowed to dry out for sufficient period before carrying out the plaster work. The masonry shall not be soaked but only damped evenly thereafter before applying the plaster.
In case of concrete work, projecting blurs of mortar formed due to the gaps of joints in shuttering shall be removed. Such surface shall be scrubbed clean with wire brushes. The surface shall be pock marked with a pointed tool at spacing of not more than 50 mm centers, the pocks being made not less than 3 mm deep to ensure a proper key for the plaster. The surface shall be washed off and cleaned of all oil, grease etc. and well wetted before the plaster is applied.

SEQUENCE OF OPERATIONS

For external plaster, the plastering operations shall be started from the top floor level and carried downwards. For internal plaster, the plastering may be started wherever the building frame, roofing and brick work are ready.
The surfaces to be plastered shall first be prepared as described in 'Preparation of background surface. The first layer shall then be applied to ceilings. After the ceiling plaster is complete and scaffolding for the same removed, plastering on wall shall be started. After a suitable time interval as detailed under various types of plaster in subsequent paras, depending upon the type of mortar, the secondary layers if required shall be applied. After a further suitable time interval as detailed under various type of plaster in subsequent paras, the finishing coat shall be applied first to the ceiling and then to the walls.
Plastering of cornices, decorative features, etc. shall be completed before the finishing coat is applied. Unless otherwise specified corners and edges shall be rounded off to a radius of 25 mm, such rounding off shall be complete along with the finishing coat to prevent any joint marks showing out later.

SCAFFOLDING

Refer specification for structural concrete

DAMAGE RECTIFICATION

Any cracks, damages, any part of work which sound hollow when tapped or found damaged or defective otherwise shall be cut out in rectangular shape and redone as directed by Owner/Owner's Representative.

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4.0 APPLICATION OF PLASTER

ONE LAYER PLASTER WORK

To ensure even, specified thickness, plaster of 150 mm x 150 mm shall be first applied horizontally and vertically at not more than 2 meter interval over the entire surface to serve as gauges. The surface of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall be brought to true surface by working with a wooden straight edge reaching across the gauges with small upward and sideways movements at atime. Finally the surface shall be finished off true with a trowel or wooden float to obtain a smooth texture. Excessive trowelling or overworking the float shall be avoided. All corners, arises, angles and junctions shall be truly vertical/horizontal and shall be carefully finished. Rounding or chamfering of corners, arises, junctions etc. shall be carried out with proper templates to the size required.
In suspending the work, the plaster shall be left, cut clean to line, both horizontally and vertically. When recommencing the plastering the edge of the old work shall be scrapped clean and wetted before plastering the adjoining area. Plastering work shall be closed on the border of the wall and nearer than 150 mm to any corners or arises and shall not be closed on the body of the features such as plaster bands, cornices nor at the corners or arises.

TWO LAYER PLASTER WORK

FIRST OR UNDER LAYER

The first or under layer of the specified thickness shall be applied as described above or mentioned in drawing. Before the first coat hardens, surface of it shall be beaten up by edges of wooden tapers and close dents shall be made on the surface. The subsequent coatshall be applied after this coat has been allowed to set for 3 to 5 days depending upon weather conditions. The surface shall not be allowed to dry during this period.

SECOND OR FINISHING LAYER

The second layer shall be complete to the specified thickness in the same manner as for first layer.

CURING

Curing shall be started 24 hours after finishing the plaster. The plaster shall be kept wet for a period of 7 days. During this period the plaster shall be suitably protected from all damages at the Contractor's expense by such means as approved by the Owner/Owner's Representative. The date of execution of plastering shall be marked on the plastering to ensure the proper duration of curing.

5.0 POINTING

Pointing shall be of the type specified such as flush, cut or weather struck, raised and cut etc.

PREPARATION OF BASE SURFACE

The joints shall be raked to such a depth that the minimum depth of the new mortar measured from either the sunk surface of the finished pointing or from the edge of the brick shall be less than 20 mm.

MORTAR

Mortar shall be in accordance with the specifications of cement mortar as described above.

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APPLICATION OF MORTAR AND FINISHING

The mortar shall be pressed into the raked out joints with a pointing trowel according to the type of pointing specified. The mortar shall be spread over the corner edges or surfaces of the masonry. The pointing shall then be finished with the pointed tool. The superfluous mortar shall be cut off from the edges.

FLUSH POINTING

The mortar shall be pressed into joints and shall be finished off flush and leveled. The edges shall be neatly trimmed with trowel and straight edges.

CUT OR WEATHER STRUCK POINTING

The mortar shall first be pressed into joints. The top of the horizontal joints shall then be neatly pressed back by about 15 mm with the pointing tool so that the joint is sloping from top to bottom. The vertical joint shall also be similarly pointed. The junctions of vertical joints with the horizontal joints shall be at true right angles in case of brick and coursed rubble masonry.

RAISED AND CUT POINTING

This type of pointing shall project from the wall facing with its edges cut parallel so as to have a uniformly raised band about 6 mm and width 10 mm more as directed. The pointing shall be finished to a smooth but hard surface.

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SPECIFICATION FOR
CIVIL & STRUCTURAL WORKS

STRUCTURAL STEEL WORKS

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1.0 INTRODUCTION

This Specification defines the requirements for the supply, fabrication and erection of structural steel work, design of connections and preparation of fabrication drawings for buildings, plant and equipment supports, stairways, access platforms, steel flooring, ladders and the like. This Specification does not include the requirements of protective treatment like painting, fireproofing, jetty and other marine structures.

2.0 MATERIALS

All materials used in the Works shall be new, first quality steel of Indian manufacture free from laminations, seams, blisters and other harmful defects and shall comply with the appropriate Indian Standards.
Manufacturer or Laboratory test certificates in accordance with the requirements of the relevant Indian Standards shall be supplied to the Engineer-In-Charge in respect of all materials to be used in the Works, prior to commencement of fabrication.

STRUCTURAL STEEL

Unless specified otherwise, structural steel used in the Works shall comply with the requirements of IS 2062 and be of Grade Fe 410WB specified therein. Hot rolled sections shall be Indian Standard Sections in accordance with IS 808. The thickness tolerance for plates and flats shall be as specified in IS 1852. The deviation over or under the nominal thickness shall be equal to half the total thickness tolerance. Steel shall be marked in accordance with IS 2062. Members in steel grades other than Grade A shall have additional marks of a form and in positions to be agreed with the Engineer-In-Charge. When design drawing do not specify grade of steel intended for connections and fittings, IS 2062 Grade Fe410 WB or BS EN 10025 Grade 430 B shall be used. Steel for cold rolled sections shall be asper IS 801. Hollow rectangular / square sections shall conform to IS 4923. Steel Tubes shall conform to IS 1161.

BOLTS, NUTS AND WASHERS

Bolts and nuts shall comply with IS 1363, IS 1367, IS 3757 and IS 6639 as appropriate. Nuts shall be of at least the strength grade appropriate to the grade of bolts or other threaded elements with which they are used.
Plain washers for use with ordinary bolts and nuts shall comply with IS 5369. Tapered washers shall comply with IS 5372 or IS 5374 as applicable.
High tensile bolts of strength grade 8.8 shall comply with requirements of IS 3757 or BS 3692. Dimensional requirements to comply with IS 3757. Bolt shall be of product grade C to IS 1367 part 2 and mechanical properties to IS 1367 part 3.
Nuts shall be heavy hex Grade 4 conforming to IS: 1363 Part 3 and 1367 Part 2 for ordinary strength bolts and heavy hex Grade 8 conforming to IS: 6623 for high tensile bolts.
All Bolts, Nuts and Washers shall be hot-dip galvanized in accordance with IS 1367 (part 13) or in accordance with BS 4921.

WELDING CONSUMABLES

Welding consumables, used for metal arc welding of steels complying with IS 2062, shall comply with IS 814. Welding consumables and procedures shall be such that the mechanical properties of deposited weld metal are not less than the respective minimum values for the parent metal being welded.

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STEEL GRATING AND STAIR TREADS

Steel grating and stair treads shall be open grid rectangular pattern complying with Standard drawings.

3.0 CONNECTION DESIGN AND FABRICATION DRAWINGS

Before commencing of job, all related detailed engineering documents shall be approved. Structural steel work shall be designed in accordance with IS 800. The design of ladders, platforms, handrails, stairways and the like shall be in accordance with Standard Drawings.

DESIGN DETAILS

Connections made in the shop shall be either bolted or welded. Connections made on site shall generally be bolted. Welded site connections shall be permitted only when specified on design drawings or with prior permission of the Engineer-In-Charge. Bolted connections shall contain a minimum of two bolts each. Bolts smaller than M16 shall not be used without prior approval of the Engineer-In-Charge. Tapered washers shall be used for bolts passing through tapered sections.
The thickness of gusset plates and welded end plates shall be not less than 8 mm. Connections shall not generally project above the level of the top of steel work. In the case of pipe racks the top of steel work shall be free from projections within the width of the rack.
All grating floor panels shall be fixed to supporting steel work by means of positive non-slip flooring grips and all panels shall be side-bolted together with two 6 mm diameter galvanised bolts per side.
The design drawing shall show the position on the structure where temporary bracing or restraints are to be provided until walls / floors and other non steel structures are built.

4.0 FABRICATION

Fabrication shall be carried out in accordance with the requirements of IS 800. Fabricated structural steel work shall be within the tolerances specified in IS 7215. The radius of re-entrant flame cuts shall be as large as possible but not less than 20mm, except in small members where this is impracticable.
Ends of columns shall generally be gas flame cut and ground where steelwork fabrication is carried out on site. For critical and highly stressed structures fabricated in off-site workshops, ends of columns shall be sawn square and base plate surface machined prior to welding, as called for on the design drawings. Joint assembly of column and base plate shall be jigged.
Frames, platforms, stairs and handrails shall be shop assembled in the largest units suitable for handling and transportation. All fabricated frames shall be suitably braced to prevent distortion during transit.
Where fillet welds to very thick column base plates are called for on the design drawings, preheating of the plate may be required to retard cooling rate and reduce shrinkage stresses and shall be incorporated in the welding procedures.

IDENTIFICATION

At all stages of fabrication, structural steel members shall be positively identified by a suitable marking scheme.
For the purposes of marking for erection, every part shall be marked with a durable and distinguishing mark in such a way as not to damage the material. For small members which are delivered in bundles or crates, the required marking shall be done on small metal tags

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securely tied to the bundle.

STRAIGHTENING

All materials shall be straight and, if necessary before being worked shall be straightened and/or flattened (unless required to be of curvilinear form) and shall be free from twists.
Rolled Sections and plates shall be clean, free from kinks, bends or twists, and straight within the tolerances allowed by IS 1852 "Specification for Rolling and Cutting Tolerances for Hot Rolled Steel Products".
Where straightening is necessary, it may be carried out by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, measured by methods approved by the Engineer-In-Charge shall not exceed 600°C
Rolled sections and plates with major defects shall be returned to Supplier for replacement.

CLEARANCES

The erection clearance for ends of members with web cleats or end plates shall be not greaterthan 2 mm at each end. The erection clearance at ends of beams without web cleats and endplates shall be not more than 3 mm at each end but where for practical reasons, greater clearance is necessary, suitably designed seating approved by the Engineer-In-Charge shall be provided.

CUTTING

Prior to cutting, all members shall be properly marked showing the requisite cut length/width, connection provisions e.g. location and dimensions of holes, welds, cleats, etc. Marking for cutting shall be done judiciously so as to avoid wastages or joints as far as possible.
Cutting shall be by sawing, shearing, cropping or machine or hand flame cutting. Hand flame cutting shall be used only where it is impractical to use machine flame cutting and for notching, or for the completion of the formation of slotted holes. Electric metal arc cutting shallnot be permitted.
Cut edges shall be true to profile and be free from major notches and sharp edges and shall be dressed immediately by grinding.
Where members are notched to fit other members the notches shall be as small as practicable and chamfered at re-entrant corners with a minimum radius of 6 mm.

HOLES

All holes for fasteners or pins shall be drilled except as permitted otherwise herein. All matching holes for fasteners or pins shall register with each other so that fasteners can be inserted freely through the assembled members in a direction at right angles to the faces in contact.
Holes for ordinary bolts of property class below 8.8 in light roof members or other light framing and in connecting angles and plates other than splices, may be punched full size through material not thicker than the diameter of the hole, provided that the punching does not unduly distort the material.
Slotted holes shall either be punched in one operation or formed by drilling two holes and completed by cutting, grinding or filing the surface smooth.
Burrs shall be removed from holes before assembly except that where holes are drilled in one operation through parts clamped together which would not otherwise be separated after drilling, they need not be separated to remove the burrs.

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For bolts not exceeding 24 mm diameter, holes shall be not more than 1.5 mm greater in diameter than the bolt and for bolts over 24 mm diameter, holes shall be not more than 2 mm greater in diameter than the bolts, except in steel base plates and where otherwise specified on the Drawings.

All matching holes for fasteners or pins shall register with each other so that fasteners can be inserted without undue force through the assembled members in a direction at right angles to the faces in contact. Drifts may be used but holes shall not be distorted. All unused drilled holes shall be plugged by welding.

JOINTS IN COMPRESSION

Abutting surfaces dependent on contact for the transmission of load shall be within the specified tolerances.

SPLICING

Splicing of built up/compound/latticed sections shall be done in such a fashion that each component of the section is jointed in staggered manner.
Where no butt weld is used for splicing, the meeting ends of two pieces of joint/channel/built up section shall be ground flush for bearing on each other and suitable flange and web splice plates shall be designed and provided for the full strength of the flange/web of the section and bolts/welds designed accordingly.
Where full strength butt weld is used for splicing (after proper edge preparation of the web and flange plates) of members fabricated out of joist/channel/built up section, additional flange and web plates shall be provided over and above the full strength butt welds, to have 40% strength of the flange and web.
Where a cover plate is used over a joist/channel/section the splicing of the cover plate and channel/joist section shall be staggered by minimum 500 mm. Extra splice plate shall be used for the cover plate and joist/channel section.

5.0 ERECTION

Prior to erection, the Contractor shall carry out an inspection of the location and level of the prepared foundations and anchor bolts, and advise the Engineer-In-Charge of his findings.
Erection shall be carried out in accordance with the requirements of IS 800.
All components shall be erected within the specified tolerances and in such a manner so that they are not bent, twisted or otherwise damaged and the specified cambers are provided when required. Drifting to align holes shall not enlarge the holes or distort the metal. Holes which cannot be aligned without distortion shall be a cause for rejection unless enlargement by reaming is specifically approved by the Engineer-In-Charge. Holes shall not be made by gas cutting. Throughout the erection of the structure, the steel work shall be securely bolted or fastened in order to ensure that it can adequately withstand all loadings liable to be encountered during erection, including where necessary, those from erection plant and its operation. Any temporary bracing or temporary restraint shall be left in position until such time as erection is sufficiently advanced so as to allow its safe removal.
All connections for temporary bracings, members, etc. to be provided for erection purposes shall be so made that they do not weaken the permanent structure or impair serviceability.
No permanent bolting or welding shall take place until the steel work has been properly aligned and the erection has been approved by the Engineer-In-Charge.
Connected parts shall be firmly drawn together. If there is a gap remaining which may affect the integrity of the joint, the joint shall be remade after insertion of a suitable pack. Where parts cannot be brought together by drifting without distorting the steelwork, rectification may be made by reaming, provided the design of the connection will allow for larger diameter holesand bolts, and is approved by the design Engineer-In-Charge.

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WELDING

Welding of structural steel shall be in accordance with IS 9595 and IS 816.For welded parts, all mating surfaces shall be sealed by welding against the ingress of moisture. Welding shall be carried out by suitably qualified welders who have satisfactorily completed the appropriate tests laid down in IS 7310. All welding shall be carried out under the direction of a competent Welding Technologist. The minimum size of fillet weld shall be 6 mm. The Contractor shall make necessary arrangement for providing sufficient number of welding sets of the required capacity, all consumables, cutting and grinding equipment with requisite accessories/auxiliaries, equipment and materials required for carrying out various tests such as dye penetration, magnetic particle, ultrasonic and the like. Adequate protection against rain and strong winds shall be provided to the welding personnel and the structural members during welding operation. Welding shall not be carried out in the absence of such protection.
It shall be the responsibility of the Contractor to ensure that all welding is carried out in accordance with this specification and relevant IS Codes. The Contractor shall provide all the supervision to fulfill this requirement.

PREPARATION OF MEMBER FOR WELDING

EDGE PREPARATION
Edge preparation/leveling of the fusion faces for welding shall be done strictly in accordance with the dimensions shown in the drawings.
In case, the same are not indicated, edges shall be prepared (depending on the type of weld indicated in the drawing) in accordance with the details given in IS 9595. Leveling of fusion faces shall be approved by the Engineer. The tolerance on limits of gap, root face and included angle shall be as stipulated in IS 9595.

CLEANING
Welding edges and the adjacent areas of the members (extending up to 20 mm) shall be thoroughly cleaned of all oil, grease, scale and rust and made completely dry. Gaps between the members to be welded shall be kept free from all foreign matter.

PREHEATING
Preheating of members shall be carried out as per IS 9595 when the base metal temperature is below the requisite temperature for the welding process being used. Preheating shall be done in such a manner that the parts, on which the weld metal is being deposited, are above the specified minimum temperature for a distance of not less than 75 mm on each side of the weld line. The temperature shall be measured on the face opposite to that being heated. However, when there is access to only one face, the heat source shall be removed to allow the temperature equalization (1 minute for each 25 mm of plate thickness) before measuring the temperature.

GRINDING
Column splices and butt joints of struts and compression members (depending on contact for load transmission) shall be accurately ground and close-butt end over the whole section with a tolerance not exceeding 0.2 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc. shall be accurately ground so that the parts connected butt over minimum 90% surface of contact. In case of connecting

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angles or channels, care shall be taken so that these are fixed with such accuracy that they are not reduced in thickness by grinding by more than 2 mm. Ends of all bearing stiffeners shall be ground to fit tightly at both top and bottom. Similarly bottom of the knife edge supports along with the top surface of column brackets shall be accurately ground to provide effective bearing with a tolerance not exceeding 0.22 mm locally at any place.
Slab bases and caps shall be accurately ground over the bearing surfaces and shall have effective contact with the ends of stanchions. Bearing faces which are to be grouted need not be ground if such faces are true and parallel to the upper faces.

WELDING PROCESSES

Welding of various materials under this specification shall be carried out using one or more of the following processes.

- Manual Metal Arc Welding Process (MMAW)
- Submerged ARC Welding Process (SAW)
- Gas Metal Arc Welding Process (GMAW)
- Flux Cored Arc Welding Process (FCAW)

The welding procedure adopted and consumables used shall be specifically approved by the Engineer.

NON DESTRUCTIVE TESTING OF WELDS

Visual inspection shall be made in accordance with guidance given in IS 822 or BS 5289 after completion of all welding over the full length of the weld. All NDT shall be performed by personnel qualified to a recognized national or international standard (e.g. PCN, ASNT Level II, etc.) Magnetic particle inspection (MPI) shall be in accordance with the recommendations given in IS 5334 or BS 6072.Dye penetrant inspection (DPI) may be used in accordance with the recommendations given in IS 3658 or BS 6443. The test results shall be recorded and be available for inspection by the Engineer in charge. Where ultrasonic examination is required, it shall be made in accordance with IS 4260 or BS 3923 Part 1, level 2

BOLTING

Bolts of property class 4.6 shall generally be used for all connections including bracing and column splices. However, for connections resisting large moments and forces, bolts of property class 8.8 shall be used with the prior approval of the Engineer-In-Charge.
Where necessary the connected parts shall be firmly drawn together. Steel packing plates shall be provided where necessary to ensure that the total remaining gap between adjacent surfaces does not exceed 2 mm.
The length of bolt shall be such that at least one clear thread shows above the nut after tightening and at least one thread plus the thread run out is clear between the nut and the unthreaded shank of the bolt. The threaded length shall be clear of the joint mating surfaces.
Washers shall be provided under the element (nut or bolt head) turned during tightening.
Nuts used on connections subject to vibration shall be secured to prevent loosening. Self-locking nuts shall be used or else the nuts shall be secured by the use of locknuts or upsetting of the threads of the bolts after assembly and tightening.
Bolts, nuts and washers used to connect metal sprayed or galvanized steel work shall be spun galvanized.
Where slotted holes are provided for movement connections, the joint shall be free to move.
Areas of steel which will form the mating faces of a high strength friction grip joint or are to be concrete cased shall be unpainted and maintained in a clean condition and free from loose rust, oil, loose scale and other deleterious matter.

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High tensile bolts to IS 1367 property class 8.8 shall be tightened in accordance with the manufacturer's recommendations using a torque wrench which shall be calibrated at least once each working day.
The combination of bolts and nuts shall be not less than the following:
4.6 bolts with grade 4 nuts (IS-1363, IS-1367/BS 4190)
8.8 bolts with grade 8 nuts (IS-3757, IS-6623/BS 3692)
Any bolt assemblies which seize when being tightened shall be replaced.
Grade 4.6 and grade 8.8 bolts of the same diameter shall not be used in the same structure, except for holding down bolts.
The bolt length shall be chosen such that at least one thread plus the thread run-out will be clear between the nut and unthreaded shank of the bolt after tightening and at least one clear thread shall show above nut.When the members being connected have surface protective treatment, a washer shall be placed under the nut or bolt head being rotated. A suitable plate washer shall be used under the head and nut when bolts are used to assemble components with oversize or slotted holes.
When the bolt head or unit is in contact with a surface which is inclined at more than 30 from a plane at right angles to the bolt axis, a taper washer shall be placed to achieve satisfactory bearing.
Galvanized Nuts – Nuts shall be checked after being galvanized for free running on the bolt and re-tapped if necessary to ensure a satisfactory tightening performance.
Ordinarily bolts Grade 4.6 to IS1367 shall be tightened to a "snug tight" fit. "Snug tight" is defined as tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.
High tensile bolts Grade 8.8 to IS 3757 shall be tightened to a torque of approximately 85% of the proof load of the bolt, by means of a power or hand operated torque wrench. Bolts shall be tightened to the torques given in the following table.

Bolt Diameter	Torque to be Applied (Nm) For Bolt Class 8.8 of IS 3757
M20	476
M24	822
M30	1630
M35	2850

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PROTECTIVE TREATMENT

Steel shall be pre-treated and painted or galvanized .The protective treatment shall be carried out after fabrication is complete. No welding, holing or other work which may damage the protective treatment shall be carried out following painting.

EQUIPMENT

All equipment used in erection shall be provided by the Contractor, and shall be suitable for its purpose and of adequate capacity.
Equipment to be used shall include staging, ladders, and plant including temporary structures necessary to complete the erection.

ALIGNMENT

Each part of the structure shall be aligned as soon as practicable after it has been erected Packs, shims and other supporting devices shall be flat, of adequate strength and rigidity and not larger than necessary. Where packings are to be left in position and subsequently grouted, they shall be placed such that they are totally enclosed by the grout.

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CLEARANCE

The Contractor shall periodically clean up as required by the Engineer-In-Charge to maintain a safe working environment and on completion of the work remove all rubbish, plant and surplus materials from the site of work, storage areas, to the satisfaction of the Engineer-In-Charge.

SAFETY AND SECURITY DURING ERECTION

The Contractor shall comply with IS 7205 for necessary safety and adhere to safe erection practice and guard against hazardous as well as unsafe working conditions during all stages of erection.
During erection, the steel work shall be securely bolted or otherwise fastened and when necessary, temporarily braced/guyed to provide for all loads including those due to the wind, erection equipment and its operation to be carried by the structure till the completion of erection.
No permanent bolting or welding shall be done until proper alignment has been achieved.
Proper accesses, platforms and safety arrangements shall be provided for working and inspection whenever required.

6.0 INSPECTION

Prior to inspection, all slag, loose scale, dirt, grit, weld spatter, paint, oil or other foreign matter shall be removed from the steel work. Welded connections shall not be painted prior to inspection.

The Contractor shall carry out non-destructive testing of welds at his own cost in the presence of the Engineer's Inspector. All welds shall be visually inspected along 100% of their length.
NDT testing of welds for general steel structures is not required. For critical structures where connections are highly stressed, NDT inspection shall be performed.

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7.0 STORAGE AND HANDLING

Fabricated parts shall be handled and stacked in such a way that permanent damage is not caused to the components. Means shall be provided to avoid damage to the protective treatment on the steel work.
All work shall be protected from damage in transit. Particular care shall be taken to stiffen free ends, prevent permanent distortion and protect all machined surfaces adequately.

8.0 PAINTING

Steelwork shall be prepared, primed and painted in accordance with the project Specification for painting. Steelwork to be galvanized shall be in accordance with IS 4759. Paint shall be excluded from areas within 50mm of joints to be field welded. In order to minimize coating damage, all reasonable care shall be taken: 1) when handling steelwork between stages in painting, and 2) when slinging and loading steelwork which has received its final coat.
No material shall be shipped until the final shop coat of paint is thoroughly dry and clearly colour coded. Adequate packing, crating, blocking and/or bracing shall be provided to prevent damage to the fabricated material while loading, in transit and while unloading.

After complete erection, surfaces, areas damaged subsequent to shop painting shall be repaired in accordance with the Painting Specification. Any damage caused, during delivery and/or erection, to galvanized steel surfaces shall be repaired in accordance with Paint Specification.

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SPECIFICATION FOR
CIVIL & STRUCTURAL WORKS

ROAD WORK & CONCRETE PAVEMENTS

BGL/632/2024-25

ENG-STD-CV-DOC-TS-009

Rev	Date	Purpose	Prepared By	Checked By	Approved By	

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1.0 INTRODUCTION

This specification establishes the requirements of material, laying and finishing of concrete pavements.

2.0 MATERIALS

WATER

Water used for cement concrete, mortar, plaster, grout, curing etc. shall be clear and free from injurious amounts of oils, acids, alkalis, organic matters or other harmful substances. Only natural water suitable for drinking shall be used. It shall conform to IS: 456.

AGGREGATE FOR CONCRETE

The aggregate for concrete shall comply in all respects with IS: 383 and IS: 456. This should be furnished in at least two separate sizes with separation at 20mm IS sieve when combined material graded from 5 to 38 mm is specified and at 25mm IS sieve when combined material graded from 20 to 50 mm is specified. This shall be obtained from a source approved by Owner/Owner's Representative and shall be chemically inert, strong, hard, durable and of limited porosity. This shall be of the gauge specified in the schedule of rates and approximately cubical in shape. It shall be free from soft or decayed pieces, dirt, clay, leaves or any organic matter. The aggregate shall not have any injurious effect when mixed with cement nor shall it corrode the reinforcement, nor otherwise impair the strength and durability of the concrete. The size of coarse aggregate mentioned in this specification denotes maximum size of aggregate and the same shall be grade downward as per IS: 383.

SAND FOR CONCRETE AND MORTAR

Fine aggregate shall preferably be natural sands. In case of crushed sand the very fine natural sand amount passing IS: 383. Sand shall consist of clean, hard, strong, sharp, durable uncoated particles free from any mix of clay, dust, vegetable matter, mica, iron pyrites, shells, soft or flaky and elongated particles, alkali organic matter, salts, loam and other impurities which may be considered by the Owner/Owner's Representative as harmful. Sulphate content should not exceed 1%. Total content of all deleterious matter should not exceed 5%. This source of sand shall be approved by the Owner/Owner's Representative. Sand obtained from river bed subject to tidal effect will not be allowed in works. All sand shall be washed before being brought to site.

STORAGE OF AGGREGATES

The contractor shall at all time maintain at the site of work such quantities of aggregates as are considered by the Owner/Owner's Representative to be sufficient to ensure continuity of work. Each type and grade of aggregates shall be stored separately. This ground on which the aggregates are stored shall be firm and have sufficient slope to ensure adequate drainage of rain water.

Any aggregate delivered to site wet shall be placed in storage for atleast 24 hours to ensure adequate drainage before it is used for concreting.

Sand heaps shall be covered with bricks or such other materials to prevent blowing off and to assist in good house keeping.

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CEMENT

The cement used shall be ordinary Portland cement, conforming to IS: 8112, unless otherwise specified. The cement issued to the contractor shall be stored in a suitable weather tight building and in such a manner as to permit easy access for proper inspection. All cement storedat site by the contractor shall be arranged in batches and used in the same order as received from owner. Contractor shall maintain a cement register in which all entries shall be completedday-to-day showing quantities received, date of receipt and daily cement consumption.

REJECTION OF CEMENT

The Owner/Owner's Representative may reject cement which has deteriorated after issue to the contractor owing to inadequate protection against moisture or other causes or in any other case where the cement is not to his satisfaction.

ADMIXTURE

No admixture shall be normally permitted for concrete or mortar. Water proofing compound to be used in concrete, plaster, damp proof course etc. where specified, shall be of approved make. It shall be mixed as per manufacturer's specifications and as approved and directed by the Owner/Owner's Representative.
Joint sealing in pavements and around equipment's structural columns shall be approved compound conforming to IS: 1834 TYPE 'b' (SHALITEX or approved equivalent).

3.0 GRADES AND PROPORTIONING

The grades indicated in drawings and schedules shall conform to IS: 456, the strengths being indicated below.

Min. Crushing Strength of 15 cm. Cube in Kg/cm² at 28 days

Grade	Compressive Strength
M- 10	100
M-15	150
M-20	200
M-25	250
M-30	300

The water cement ratio aggregates and grading for each mix shall be predetermined from the results of cube tests of trial mixes. The mix proportions determined thus shall be followed at site and shall in no way relieve the contractor of his responsibility as regards the prescribed strength of mix. The mix proportions, however, shall be revised if the results of the cube tests during the construction show consistently lower or higher strength than the prescribed one. Noclaim to alter the rates of concrete work will be entertained due to such changes in mix designs, as the contractor will be responsible to produce the concrete of required grade. The slump of concrete mix for pavements compacted by vibrations should not be more than 25 mm and thatfor manual compaction not more than 50 mm.

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All concrete shall be controlled concrete conforming to IS: 456. For mud-mat and filling purpose ordinary concrete of 1:4:8 mix proportions may be used or as indicated in drawings.

4.0 EQUIPMENT

All equipment like weighting devices, measuring boxes, mixers, sub-grade templates, hand tempers, vibrating screens, internal vibrators, longitudinal floats, bridges, belts, push brooms, straight edges, edging tools etc. shall be on the worksite in first class working condition and shall have been inspected by the Owner/Owner's Representative before paving operations are permitted to start. Throughout the construction period the contractor shall maintain adequate equipment in first class working conditions to ensure the proper execution of the work.

5.0 PREPARATION OF SUB GRADE

The sub grade or sub base for laying of the concrete slabs shall comply with the following requirements:

I. No soft spots are present in the sub grade or sub base.
II. The uniformly compacted sub grade or sub base extends at least 300mm on either side of the width to be concreted.
III. The sub grade is properly drained.
IV. The minimum modulus of sub grade reaction obtained with a plate bearing test shall be 5.54 Kg/cm².
V. Sub grade shall be prepared to the lines and grades shown on the drawings.
VI. No concrete shall be placed around manholes or other structure until they have been brought to required grade and alignment.
VII. The sub grade shall be in moist condition at time of concrete placement.

6.0 FORMWORK

All side forms shall be of mild steel unless uses of wooden sections are specially permitted. The steel forms shall be MS channel sections and their depth shall be equal to thickness of the pavement. The sections shall have a length of atleast 3.0m except on curves, where shorter sections may be used. These forms should be provided with ample bracing and supports to prevent the springing of the forms under the concrete pressure or thrust of machinery operating nearby.

The forms should be in sufficient number and they should not be removed until concrete is hardened sufficiently.
In case wooden forms are permitted, these shall have minimum base width of 100mm for 200mm slabs and 150mm for more than 200mm thickness.

7.0 REINFORCEMENT

All reinforcement work shall confirm to IS: 456. Reinforcing steel shall be free from dirt scale or

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other foreign matter and rust. The number, size, form and position of all the reinforcement shall unless otherwise directed or authorised by Owner/Owner's Representative be strictly as per drawings. The placing of reinforcement shall be such that when properly placed into the work,

extreme longitudinal bars will be located not less than 50mm nor more than 100mm from the edges of the slab except for dummy joints, the length of reinforcement will keep clear of transverse joints by not less than 50mm nor more than 100mm as measured from the centre of the joint to the ends of longitudinal bars.

While overlapping the bars in either direction the overlap shall be atleast equal to spacing between bars in the respective direction.

To prevent displacement before or during concreting, the bars shall be secured to one another with 16 SWG black soft annealed binding wire. Wooden planks provided for labour to move shall be supported independent of reinforcement and the cage shall never be permitted to sag or get displaced during concreting. Concrete blocks shall be used to ensure correct cover of concrete over bars as shown in drawings.

Dowels if used as load transferring device shall be checked for exact position before concreting. Dowels shall be parallel to the surface and perpendicular to the joint and shall not place any restraint on the movement of the joint.

8.0 MIXING

Mixing should be carried out in mechanical mixers. Drum of the mixer shall rotate at a peripheral speed of 60RPM (Rotation per minute). Hand mixing can, however, be permitted by Owner/Owner's Representative in special cases. Water cement ratio shall be rigidly controlled during mixing. Mixers shall be fitted with automatic devices to discharge measured quantity of water directly into the mixing pan. The water shall be introduced into the drum within first 15 seconds of mixing, but not until all the cement and aggregate constituting the batch are thoroughly mixed. Mixing shall continue until the concrete is uniform in colour and for not less than 2 minutes after all the materials and water are in the drum. The entire content of the drum shall be discharged before any materials are placed therein for the succeeding batch.

Correction for Bulking- In volume batching suitable allowance shall be made for the bulking of fine aggregates due to presence of water. For this purpose the bulking shall be determined as directed by Owner/Owner's Representative.

9.0 PLACING

The place where concrete is to be poured should be clean and free from all loose dirt, standing water etc.

Walking on reinforcement layers is not permissible. Walkways of wooden planks or similar material can be placed with removable supports and should be independent of the reinforcement. The reinforcement position should not be disturbed nor should at sag during carriage and placement of concrete.

Placing and vibration should not take totally more than 20 minutes from time of mixing. Method of placing should be got approved by Owner/Owner's Representative. Segregation during carriage and placement should be avoided. If during carriage concrete segregates, it should be remixed before placement.

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Concrete should not be dropped from a height of over 1.5m.

To ensure bond and water tightness between old concrete surface and fresh concrete to be placed, the surface should be cleaned and roughened by "initial green cut" by wire brushing or chipping. The initial green may be done by wire brush after 6 hours of placing concrete in order to facilitate the work. Chipping can be done only after 48 hours. A layer of cement slurry with 1:1 mix (1 cement: 1 sand) should be poured to obtain a uniform coating on old concrete. Immediately thereafter, the fresh concrete should be poured.

Concrete shall be mixed in quantities required for immediate use and shall be deposited on the sub-grade in a single operation to the required depth and width of the pavement. Spreading shall be as uniform as possible to avoid re-handling of concrete. Where however, a certain amount of redistribution is necessary it shall be done with shovels and not with rakes. Concrete shall be vibrated with internal vibrators. Concrete shall be placed continuously until completion of the part of the work between construction joints or as directed by Owner/Owner's Representative continuously until completion of the part of the work between construction joints or as directed by Owner/Owner's Representative.

All precautions shall be taken for concreting in extreme weather in accordance with the relevant clauses of IS: 456. Due protection shall be provided to prevent cement being blown away while proportioning and mixing during windy weather. No concreting shall be carried out in continuous heavy rains. Necessary arrangements to cover the freshly poured concrete shall be provided, to protect it from the direct rays of the sun and from drying winds.

All concreting placement should be co-ordinated with placement of conduits, inserts, embedded parts etc. executed either by same agency or separately.

Concrete in standing water shall be executed strictly as per IS: 456. This shall be paid as a separate item where applicable.

The concrete shall be laid in panels not exceeding 4m x4m as shown in layout drawing or as directed by Owner/Owner's Representative.

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10.0 COMPACTION

The surface of the pavement shall be compacted either by means of power driven finish machine or a vibrating hand screed. For areas where width of the slab is very small as the corner of street junction etc. hand consolidation and finishing shall be done as follows:

I. Concrete as soon as placed, shall be struck off uniformly and screeded to the crown and cross-section shown on the plans and to such level above the base that when compacted and finished, the pavement shall conform to the grade and cross section indicated by the plans. The entire surface shall then be tamped until a close knit dense surface is obtained.

II. The tamper shall rest on the side forms and shall be drawn ahead with a swing motion in combination with a series of lifts and drops alternating with lateral shifts, theaim of this operation being compaction and screeding to the approximate level required.

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Subsequent tamping should advance 75mm at a time in the direction in which the work is proceeding and in final stages the tamping should be closer about12mm at a time until a level and dense surface is obtained.

III. If so directed by Owner/Owner's Representative, hand operated vibrating tamper consisting of normal type of hand tamper attached to a pneumatic or electric vibrating unit shall be used for compaction.

IV. Segregated particles of coarse aggregate which collect in front of the tamper shall be thrown outside the forms or thoroughly mixed by hand with a mass; of concrete already on the base.

V. Compaction by tamping shall be carried on till the mortar in the mix just works upto the surface. The surface shall be examined after compaction correction, if needed, shall be made by adding or removing concrete followed by further compaction and finishing.

11.0 FINISHING

FLOATING

As soon as practicable, after concrete has been struck off and compacted, it shall be further smoothened and compacted by means of a longitudinal float 1200 mm long and 75mm wide operated from a foot bridge.

STRAIGHT EDGING

After floating is completed and excess water removed but while concrete is still plastic the slab surface shall be tested for trueness with a straight edge and rectified, if necessary.

BELTING

Just before the concrete becomes non-plastic, the surface shall be belted with a two ply canvas belt not less than 200mm wide and atleast 1.0M longer than the width of the slab. Hand belts shall have suitable handles to permit controlled uniform manipulation. The belt shall beoperated with short strokes transverse to the carriage way centreline and a rapid advance parallel to the centre line.

BROOMING

After belting and as soon as surplus water has risen to the surface the pavement shall be given a broom finish to produce corrugations of uniform appearance of not more than 1/16 inch in depth.

EDGING

Before the concrete has its initial set the edges shall be carefully finished with an edger of the radius required and pavement edge shall be left smooth and true to line.

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12.0 CURING

INITIAL CURING

Immediately, after the completion of the finishing operations, the surface of pavement shall be entirely covered with wetted burlap, cotton or jute mats.

FINAL CURING

Upon the removal of the mats, the slab shall be thoroughly wetted and covered by the following method:
Curing with wet earth- A system of transverse and longitudinal dykes of clay about 50mm high shall be laid over the slab. These dykes shall be blanketed with sandy soils free from stones to prevent drying up. The rest of the slab shall be covered with sufficient sandy soil so as to produce a blanket of earth not less than 37mm depth after wetting. This earth shall be kept thoroughly wet till the concrete has attained the required strength but not less than 14 days.

13.0 JOINTS

Wherever called for on the drawings expansion joints, dummy joints and longitudinal joints shall be provided as per details indicated in the drawing and as directed by Owner/Owner's Representative.

After the curing, the temporary seal or other intruded materials of all expansion and contraction joints shall be removed completely and the slots filled with approved joint sealing compound.
The edges of the joints shall thoroughly cleaned and primed with a thin bituminous paint which shall be allowed to dry before the sealing compound is applied.

The primer shall be applied with a brush. The composition of primer shall be as follows:

Name of Material	Percent by weight
200 – Penetration Bitumen	66%
Light creosote oil	14%
Solvent Naphtha	20%

The bitumen shall be melted and fluxed with oil. When cold, solvent Naphtha shall be added. Bituminous emulsion shall not be used as primers. Care shall be taken to ensure that the sealing compound is not heated above 200^0C and the temperature does not exceed 180^0C forlong periods.
Sealing compound shall be poured into the joint opening in such a manner that the material will not be spilled on the exposed surface of the concrete. When required to prevent pick up under traffic, the exposed surface of the sealing compound shall be dusted with hydrated lime.

14.0 OPENING TO TRAFFIC

Traffic shall not be allowed for a period of 28 days after laying of concrete.
Before opening the roads to traffic all joints shall be filled and trimmed or topped out as required.

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SPECIFICATION FOR
CIVIL & STRUCTURAL WORKS

DISMANTLING AND DEMOLITION

ENG-STD-CV-DOC-TS-011

BGL/632/2024-25

Rev	Date	Purpose	Prepared By	Checked By	Approved By	

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BGL/632/2024-25

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1.0 INTRODUCTION

This specification deals with the procedures to be adopted while demolishing/dismantling of existing concrete, steel and masonry structures.

While the intent is not to specify each and every details of the dismantling activity, the contractor shall take every possible care while executing the works and as per directions of the Owner/Owner's Representative.

2.0 SAFETY AND SECURITY

Safety and security of the structures, site or the field personnel shall be solely the responsibility of the Contractor. The Contractor shall take all necessary safety measures to prevent mishaps or accidents during dismantling work.

For important structure/buildings as directed by the Owner/Owner's Representative, an advanced / improved demolition / dismantling technique / control demolition technique shall be adopted after carrying out collapse analysis as and when required. This shall be done such that the ground vibrations caused during demolishing/dismantling shall not unduly disturb/ damage the adjacent / neighbouring buildings/structures.

As for as possible for dismantling, core cutting techniques that uses cutting tools which produces less vibration/noise shall be used. Wherever applicable, approval of statutory body/concerned environmental agencies shall be obtained before starting of the dismantling/demolishing work.

3.0 WORKMANSHIP

Before taking up any dismantling/demolishing activity, a clear and detailed method statement indicating the detailed procedure adopted shall be prepared and submitted to the Owner/Owner's Representative for approval. The documents approved by the Owner/Owner's Representative do not absolve or dilute the Contractor's responsibilities towards safety precautions. Any liabilities/injuries/accidents arising due to defective safety practices of the Contractor shall be solely to the Contractor's accounts.

All materials obtained from dismantling/demolishing operations shall be the owner property, unless otherwise specified and shall be kept in the safe custody until handed over to the Owner/Owner's Representative

Where it becomes necessary to disconnect any existing service lines such as Electrical, Piping etc. during dismantling/demolishing operation and where so required by the Owner/Owner's Representative suitable alternate arrangement shall be made by the Contractor to maintain the continuity and proper functioning of the affected service linkage.

Dismantling activity implies carefully taking up or down and removing without damage. The articles shall be passed by hand where necessary, and lowered to the ground, and not thrown. Where nails, screws, bolts etc. fix these, these shall be taken out with proper tools and not by tearing or ripping off. Demolition activity implies taking up or down or breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown in the drawings.

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Prior to commencement of activity, the structures to be dismantled shall be studied carefully and the works procedure planned out. The permission to dismantle shall be obtained in writing from the Owner/Owner's Representative. Adequate warning/sign posts shall be provided at locations. The entire area shall be cordoned off after prior intimation. Where the plant is in operation, the operating staff of the plant shall be informed of the dismantling activity.

The demolition shall always be planned before hand and shall be done in reverse order of the one in which the structure was constructed. The scheme of demolition shall be got approved from the Owner/Owner's Representative before starting the work. Necessary propping, shoring and under pinning shall be provided for the safety of the adjoining work or property, which is to be left intact before demolition is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining properties. Necessary precaution shall be taken to keep the dust nuisance down as and where necessary. The dismantling shall be commenced in a systematic manner- Chipping of concrete shall proceed taking adequate care as not to cause damage to the existing structures. Use of sledgehammer shall be limited so as not to cause damage to adjacent structures/equipment. Floor slabs shall be chiseled around the perimeter to enable removal of slabs in units. The area identified for chiseling shall be suitably assessed so as not to cause any damage to floor below, if any. The reinforcement shall be subsequently cut and the debris shall then be moved to the location identified by the Owner/Owner's Representative and as per his instructions. Masonry units shall be dismantled in such a way so that collapse of entire units is avoided. The bricks shall be removed in units. These shall be then moved to a location us directed by Owner/Owner's Representative, Adequate supports wherever necessary shall be provided to the area adjacent to the dismantling activity so as to protect any damage or collapse, Shuttering shall be provided below the slabs where chipping is envisaged. If necessary, blinds shall be erected to avoid dust and flying of the chipped particles.

Any serviceable material obtained during dismantling or demolition shall be separated out and stacked properly as directed by Owner/Owner's Representative within a lead of 100 meters. All unserviceable materials rubbish etc. shall be disposed off as directed by Owner/Owner's Representative.

Where structural steel platforms are to be dismantled, these shall be either carefully cut or if it is a bolted structure such as platforms, be dismantled to enable reuse of these units for a different location.

After the dismantling or demolishing work is complete, all loose debris etc. shall be removed and the area swept clean or washed with water.

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SPECIFICATION FOR
CIVIL & STRUCTURAL WORKS

BARRICADES

BGL/632/2024-25

ENG-STD-CV-DOC-TS-012

0	07.03.15	Issued For Standard				
Rev	**Date**	**Purpose**	**Prepared By**	**Checked By**	**Approved By**	

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BGL/632/2024-25

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1.0 INTRODUCTION

This specification covers the requirement for site in-situ barricading where the work is commencing along the major and minor roads.

2.0 REFERENCE DOCUMENTS

Refer standard drawing no: - ENG-STD-CV-DWG-TP-011

3.0 GENERAL

- Providing and installing the barricades of size 2.5 m X 2.0 m of the design and type as shown in the standard drawing no:- ENG-STD-CV-DWG-TP-011. Installation plan of Barricades is to be approved by Owner/Owner's Representative. Barricades are to be firmly fixed to the ground and are to be maintained during the progress of work.

- Barricades are to be painted with logo initially and repainting to be done whenever required.

- Wet mopping of Barricades shall be done quarterly in a month.

- In accordance with the requirements of this specification, the contractor shall submit the details specified in the following paragraphs covered by this specification.

- Wet mopping of Barricades shall be done quarterly in a month.

- Ground Space of one-meter width outside barricades shall be cleaned everyday.

- Reflector shall be placed on the barricades.

- Barricades shall have blinking red light for night getting power through generator or electric connection.

- To avoid traffic congestion/accident a trained supervisor shall be deployed as per directions of Owner/Owner's Representative.

- Dismantling of Barricades from the site and cleaning the site as per directions of Owner/Owner's Representative.

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SPECIFICATION FOR
CIVIL & STRUCTURAL WORK

STANDARD FIELD QUALITY PLAN

BGL/632/2024-25

ENG-STD-CV-DOC-TS-013

Rev	Date	Purpose	Prepared By	Checked By	Approved By	

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STANDARD FIELD QUALITY PLAN

Sl. No	Component Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norms	Testing Agency	Remarks	Check
1	**CHECKING OF FOUNDATION MATERIALS**					
A.	**CEMENT**	One sample per lot of 100 MT or part thereof from each source for MTCs and one sample per lot of 200 MT or part thereof from each source for site testing.	IS:456, IS:269, IS:8112, IS:12269, IS: 4489 & Specification	Manufacturer approved lab	Review of manufacturers test certificates (MTCS) and laboratory test results by	β
i	Initial & final setting time					
ii	Soundness					
iii	Heat of Hydration for low heat cement (Not Applicable for OPC & PCC)					
iv	Fineness					
v	Compressive Strength					
vi	Chemical Composition of Cement	One sample per lot of 100 MT or part thereof from each source fro MTCs.	IS:456, IS:269, IS:8112, IS:12269, IS: 4489 & Specification	Manufacturer	Review of manufacturers test certificates by	β
B.	**COARSE AGGREGATES**					
i.	Determination of Particle size (Sieve Analysis)	One sample per lot of 100 cubic meter or part thereof from each source for each source for each size	IS: 383, IS: 2386 and specification	approved lab. However, Moisture content test for design mix concrete shall be done on all days of concreting at site.	Each source to be approved by . Review and acceptance of test result by	B
ii	Flakiness Index					
iii	Crushing Value					
iv	Specific Gravity					
v	Bulk Density					
vi	Absorption Valve					
vii	Moisture Content					
viii	Soundness of Aggregate					
ix	Presence of detections materials					

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Sl. No	Component Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norms	Testing Agency	Remarks	Check
C	**FINE AGGREGATE**					
i	Gradation/Determination of Particle size(Sieve Analysis)	One sample per lot of 100 cubic meter of part thereof from each source	IS:383, IS:2386, IS:456 and specification	approved lab. However, Moisture content test for design mix concrete shall be done on all days of concreting at site.	Each source to by approved by . Review and acceptance of test result by	β
ii	Specific Gravity and density.					
iii	Moisture content*					
iv	Absorption Value*					
v	Bulking					
vi	Silt Content Test					
vii	Presence of deleterious materials					
D	**BRICKS**					
i.	Dimensional tolerance	As per enclosed Annexure-II	CPWD & specification	approved Lab.	Approved by	β
ii	Compressible Strength					
iii	Water Absorption					
iv	Efflorescence					
E	**WATER**					
i	Cleanliness (Visual Check)	Random	IS: 456, IS: 3025 and specification. The water used for mixing concrete shall be fresh, clean and free from oil, acids and alkalis, organic materials, or other deleterious materials.	Contractor	Each source to be approved by	β
ii	Chemical and physical properties of water for checking its suitability for construction purposes	One sample per source	IS:456, IS:3025 and specification	Contractor/ approved lab.	Approved by	β

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Sl. No	Component Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norms	Testing Agency	Remarks	Check
2	**Reinforcement Steel**					
i.	Identification & size	Random	IS:432, IS:1139, IS:1786 & specification	Contractor	Approved by	β
ii.	Chemical Analysis Test	One sample per heat	IS:432, IS:1139, IS:1786 & specification	Manufacturer	Review of manufacturers test certificates by	β
iii	Tensile Test	One sample per lot of 40 MT or part thereof for each size of steel conforming to IS:1139 and 5 MT or part thereof for HDS wire for each size of steel as per IS:432. For steel as per IS:1786 under 10mm 1 sample for each 35 MT or part thereof. Over 16m , 1 sample for each 45 MT or part thereof.	IS:432, IS:1139, IS:1786 & specification	Manufacturers / approved Lab	Review of manufacturers test certificates as well as lab test result by	β
iv	Yield stress/ proof stress					
v	Percentage Elongation					
vi	Bend/Rebend Test	One sample per lot of 20 MT or part thereof for each size of steel as per IS:432, IS:1139. For steel as per IS:1786 under 10mm-16mm, 1 sample for each 25 MT or part thereof 10mm-16mm 1 sample for each 45 MT or part thereof.	IS:432, IS:1139, IS:1786 & specification	Manufacturers / approved Lab	Review of manufacturers test certificates as well as lab test result by	β

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Sl. No	Component Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norms	Testing Agency	Remarks	Check
vii	Reverse Bend Test for HDS wire.	One sample per lot of 5 MT or part thereof for each size	IS:432, specification	Manufacturer/ approved lab.	Review of manufacturers test certificates as well as lab test result by	β
3	**Structural Steel Used In Cable Trenches & Foundations**					
i.	Dimensional Check	Random	specification & approved drawing	Contractor	Checklist to be prepared and signed jointly.	β
ii	Visual Check for damages, resting, pitting etc.	100%	specification & approved drawing	Contractor	Checklist to be prepared and signed jointly.	Y
iii	Visual Check for welding, defects, primer coating and painting/ galvanizing as applicable	Sample per lot of 40 MT or part thereof for tensile tests and 1 sample per lot of 20 MT or part thereof for bend test for each size.	IS:2062, Specification & approved drawings	Manufacturer/ approved lab	Review of Mtgs test certificates as well as lab test results by	Y
iv	Physical properties of structural steel	One sample per lot of 40 T or part thereof for tensile tests and 1 sample per lot of 20 T or part thereof for bend test.	IS 2062 , Specifications and approved drawings	Manufacturer/ approved lab	Review of Mtgs test certificates as well as lab test results by	β
4	**EQUIPMENT FOUNDATION/ CABLE TRENCH**					
A	**BEFORE EXCAVATION**					
i	Checking of pegs condition as per line and alignment	100% on each location	IS:4091, IS:3764 & approved drawing/ specification	Contractor	Approved by	Y

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Sl. No	Component Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norms	Testing Agency	Remarks	Check
ii.	Checking of pit making as per drawing & RL.	100% on each location	IS:4091, IS:3764 & approved drawing/ specification.	Contractor	Approved by	Y
B	**EXCAVATION**					
i	Dimensional conformity	Each location	IS:4091, IS:3764 & approved drawing/ specification.	Contractor	Approved by	β
ii	Verticality/slopes & Square ness of each pit	Each location	IS:4091, IS:3764 & approved drawing/ specification.	Contractor	Approved by	β
iii	Vertification & classification of foundation wherever application.	Each location	IS:4091, IS:3764 & approved drawing/ specification.	Contractor	Approved by	β
C	**FOUNDATION BOLTS/ MATALLIC INSERTS**					
i	Check for proper identification foundation bolts w.r.t. type of foundation	100%	specification & approved drawings	Contractor	Checklist to be prepared & signed jointly.	Y
ii	Visual check for mechanical damage and galvanizing/ painting it applicable for metallic insert	100%	specification & approved drawings	Contractor	Checklist to be prepared & signed jointly.	Y
iii	Alignment & Level	100%	specification & approved drawings	Contractor	Checklist to be prepared & signed jointly.	β

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Sl. No	Component Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norms	Testing Agency	Remarks	Check
iv	Grouting/ Underpinning of foundation base plate.	100%	specification & approved drawings	Contractor	Checklist to be prepared & signed jointly.	Y
D	**P.C.C. PADDING**	For all locations	IS:456 and approved foundation drawings & Specification	Joint Inspection by and Contractor.	Approval by	β
E	**SHUTTERING (Formwork)**					
i.	Check for materials, breakage or damage.	100%	IS: 456, specification / approved drawings.	Joint Inspection by and contractor	Approval by	Y
ii	Check for plumb, alignment parallelism, squareness and equidistance from stub.	100% casting	IS:456, Specification/ approved drawings.	Joint Inspection by and contractor.	Approval by	β
iii	Dimensional check	100% before casting	Specification/ approved drawings	Joint Inspection by and contractor	Approval by	β
iv	Check for level & height.	100% before casting	Specification/ approved drawings	Joint Inspection by and contractor	Approval by	β

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Sl. No	Component Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norms	Testing Agency	Remarks	Check
v	Check for rigidity of frame/ tightness	100%	Specification/ approved drawings	Joint Inspection by and contractor	Approval by	β
vi	Cleaning and oiling	100%	Specification/ approved drawings	Joint Inspection by and contractor	Approval by	β
vii	Diagonal bracing if required as per drawings/ site conditions	100%	Specification/ approved drawings	Joint Inspection by and contractor	Approval by	Y
viii	Checking of joints to avoid undue loss of cement slurry.	100%	Specification/ approved drawings	Joint Inspection by and contractor	Approval by	Y
F	**Placement of Reinforcement Steel**					
i	Check the steel bars for rust, cracks, surface flaws, laminate etc. (Visual check)	100%	IS:456 and Specification/ approved drawings	Joint Inspection by and contractor	Approval by	Y
ii	Check as per the bar bending schedule before placement of concrete.	For all locations	IS:456 IS:2502 and Specification/ approved drawings	Joint Inspection by and contractor	Approval by	Y
iii	Checking cutting tolerance for bars as per check list/ drawings, check whether all the bent bars and lap lengths are as per	For all locations	IS:456 , IS:2502 and Specification/ approved drawings	Joint Inspection by and contractor	Approval by	β

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Sl. No	Component Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norms	Testing Agency	Remarks	Check
	approved bar bending schedule.					
iv	Check whether all joints & crossing of bars are tied properly with right guage & annealed wire as per specification	100%	IS:456 , and Specification/ approved drawings	Joint Inspection by and contractor	Approval by	Y
v	Check for proper cover distance spacing of bars, spacers & chairs after the reinforcement cage has been put inside the formwork.	100%	IS:456 , and Specification/ approved drawings	Joint Inspection by and contractor	Approval by	Y
vi	Check whether tapping of bars are tied properly with right guage and annealed wire as per specification.	100%	IS:456 , and Specification/ approved drawings	Joint Inspection by and contractor.	Approval by	β
vii	Anchor bolts if applicable					
a	Level, center-to-center distance of bolts.	100% on each location	approvedpile foundation drawings/ specification.	Joint Inspection by and contractor.	Checklist to be prepared and signed jointly.	β
b	Visual check for galvanizing.	100% on each location	approvedpile foundation drawings/ specification.	Joint Inspection by and contractor.	Checklist to be prepared and signed jointly.	β

BGL/032/2024-25

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Sl. No	Component Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norms	Testing Agency	Remarks	Check
5	**CONCRETING**					
a	APPROVAL OF MIX DESIGN	Each mix	IS: 456 & drawings/ specification.	approved by Lab	Approval by	á
b	BATCHING, MIXING & PLACING OF CONCRETE AND COMPACTING.	100%	IS:456 & approved pile foundation drawings/ specification	Joint Inspection by and contractor.	Approval by	β
c	PLACING CONCRETE AND COMPACTING.	100%	IS:456 & approved pile foundation drawings/ specification	Joint Inspection by and contractor.	Min gap between boxes and reinforcement bars should be maintained. Approved by .	β
D	**Concrete testing**					
i	Slump Test	One sample per casting	IS:456, IS 516, IS: 1199 and specification.	Contractor	Approved by	β
ii	Check for quantities for cement, fine aggregate, coarse aggregate and water while batching	100% on all locations	IS:456, IS 516, IS: 1199 and specification.	Contractor	Checklist to be prepared and signed jointly.	β
e	**Concrete Cube Testing**					
i	Compressive Strength	One sample for every 20 Cum of concreting or part thereof for each days concreting (one sample consists of min. 3 test cubes for 28 days strength)	IS:456, IS 516, IS: 1199 and specification.	approved lab	Approval by Cubes must be testedwithin a week after 28 days curing period and test resultsshould be approved.	á

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Sl. No	Component Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norms	Testing Agency	Remarks	Check
f	CHECK FINISHING, DIMENSIONAL CONFORMITY AND WORKMANSHIP BEFORE & AFTER BOX REMOVAL.	100%	IS:456, IS 516, IA: 1199 and specification.	Contractor	Approval by	β
6	**BACKFILLING**					
i	Check for thickness of layer & watering	100%	specification and approved drawings.	Contractor	Approved by	Y
ii	Visual check for correction/ ramming.	100%	specification and approved drawings.	Contractor	Approved by	Y
iii	Compaction test (percentage of max. dry density)	Samples for each pit. Equipment & other foundation 20% at random	Specification	approved lab	Review of lab test results by . Elevation for testing to be decided by .	β
6	**BRICK-WORK & TILING WORK**					
i.	Mortar mix/ proportion	Random	IS:2250, specification & CPWD specification.	Contractor	Approval by	β
ii	Plumb & Alignment	Random	specification & CPWD Specification	Contractor	Approval by	β
iii	Joints	Random	specification & CPWD Specification	Contractor	Approval by	β

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Sl. No	Component Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norms	Testing Agency	Remarks	Check
iv	Water absorption Test	Random	specification & CPWD Specification	Contractor	Approval by	β
7	**PLASTERING**					
i	Plastering thickness and evenness	Random	specification & CPWD Specification	Contractor	Approval by	β
ii	Mortar mix./ proportion	Random	specification & CPWD Specification	Contractor	Approval by	β
8	SITE SURFACING					
i	Levelling	100%	specification & CPWD Specification	Contractor	Checklist to be prepared and signed jointly	B

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Section: **GENERAL GUIDELINES FOR IMPLEMENTATION**

1. Details of categories of check codes á, β & Y including accepting and deviation dispositioning authorities are indicated at Annexure-1.

2. specification shall mean technical specification, approved drawings/ data sheets and LOA provisions applicable for the specific contract.

3. Accepting criteria and permissible limits for certain tests are indicated at Annexure-II. For balance tests, site to verify the same with respect to specification, relevant Indian Standards and/or prevalent code of practice.

4. It is clarified that the tests indicated at column 2 of this F.Q.P. i.e. against column “Component Operation & Description of Test,” are only generally required to be conducted. However, reserves the right to carryout any additional tests at any stage if the situation so warrants.

5. site representative shall witness all the tests conducted by the contractor as mentioned inthis F.Q.P. However, in case of tests conducted in the approved lab, it is preferred to witness the tests in the lab itself, if possible.

6. shall approve testing laboratory before accepting the test results from the lab.

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7. shall approve the sources for cement, coarse aggregate, fine aggregate & water before actual utilization.

8. All the testing & measuring equipment used by the contractor for testing are required to be calibrated. A copy of valid calibration report shall be retained by as records.

9. Classification of foundations shall be approved by based on the Joint Inspection Report &Soil investigation reports.

10. Curing of concrete work should be continued for a minimum period of 10 days.

11. ZONE-IV FINE AGGREGATE.

a. Zone-IV line aggregate shall be used for nominal mix. Reinforced cement concreting work.

b. Zone-IV line aggregate shall be avoided for design mix. Reinforced cement concreting work unless tests have been done to ascertain the suitability of proposed mix proportion with the prior approval site.

12. Bricks shall be free from cracks, flaws and modules of free lime. They should have smooth rectangular faces with sharp corners and should be uniform in colour.

13. CEMENT

a. In case supply of cement is in the scope of the contractor, the same shall be procured from sources approved by site and got tested at site on sample basis for specified acceptancetests as specified in the F.Q.P. at a reputed Third Party Lab approved by site.

b. The samples of cement for site testing shall be taken within three weeks of the delivery and all the tests shall be commenced within one week of sampling, if the cement remains in store for a period of more than six month. All the site tests are required to be repeated before usage.

14. REINFORCEMENT STEEL & STRUCTURAL STEEL USED IN CABLE TRENCHES AND FOUNDATIONS.

a. In case supply of steel is in the scope of the contractor, the same shall be procured from the main producers i.e. SAIL, TISCO, IISCO or Rashitriya Ispat Nigam Ltd. The steel shall be got tested at site on sample basis of specified acceptance tests as specified in this F.Q.P. at a reputed Third Party Lab approved by site.

b. The results of the testing of cement and reinforcement steel referred to in 13.a and 14.a above shall be got approved from site before cement and reinforcement steel are put to use. However, in exceptional cases due to exigencies of work. site may authorize the contractor to use Cement and Reinforcement Steel even before the test results are received. However, in all such cases, if the test results subsequently received are found to be not complying with the specified acceptance criteria, the contractor shall have to dismantle and recast all such foundations cast with such non-conforming materials at his own cost. Confirmation to this effect shall be obtained from the contractor by the Project authorities beforehand in all such cases.

15. The contractor shall submit welding procedure specification (WPS) including the type of electrode used for approval of site before starting the welding work.

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16. Approval/ acceptance of individual test results by in the course of execution of contract will not relieve the contractor of his contractual obligations and responsibilities, nor does it limitthe Owner's right under the contract.

17. In case, requirement of special items like Super Sulphated Cement, Corrosive Resistant Reinforcement Steel (CRRS) etc arise due to site conditions, the specific approved of may be obtained before using the same and all the tests as per relevant standards shall be carried out.

All the materials shall be stored by the contractor in a manner affording convenient access for identification and inspection at all times. Storage of material shall be in accordance with IS: 4032 (Latest Edition).

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FOUNDATION MATERIALS & CONCRETE

A. CEMENT

Description of the Test	**33 Grade OPC as per IS:269**	**43 Grade cement as per IS:8112**	**PPC as per IS:1489**	**Low Heat Cement**
i) Fineness (min)	225 m^2/Kg	225 m^2/Kg	300 m^2/Kg	225 m^2/Kg
ii) Compressive Strength (min) 72 ± 1 hours 168 ± 2 hours 672 ± 4 hours	 160 kgf/cm^2 220 kgf/cm^2 -	 23 MPa 33 MPa 43 MPa	 16 Mpa 22 Mpa 33 Mpa	 100 kgf/cm^2 160 kgf/cm^2 350 kgf/cm^2
iii) Initial Setting Time (Min)	30 Minutes	30 Minutes	30 Minutes	30 Minutes
iv) Final Setting Time (Max.)	600 Minutes	600 Minutes	600 Minutes	600 Minutes
v) Soundness (Le chatelier Method)	Max 10 mm expansion	Max 10 mm expansion	Max 10 mm expansion	Max 10 mm expansion
vi) Heat of hydration (Max.)	-	-	-	Max. 65 cal/gm for 7 days cal/gm for 28 days
vii) Chemical Composition	As per IS	As per IS	As per IS	As per IS

B. COARSE AGGREGATE

(i) Sieve Analysis

IS SIEVE Designation	**Percentage passing for Graded aggregate of nominal size**		**Percentage passing for single sized aggregate of nominal size**	
	40 mm	20 mm	40 mm	20 mm
63 mm	-	-	100	-
40 mm	95 to 100	100	85-100	100

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IS SIEVE Designation	Percentage passing for Graded aggregate of nominal size		Percentage passing for single sized aggregate of nominal size	
20 mm	30 to 70	95 to 100	0-20	85-100
10 mm	10 to 35	25 to 55	0-5	0-20
4.75 mm	0 to 5	0 to 10	-	0-5

(ii) Flakiness Index — Not to exceed 25%

(iii) Crushing Value — Not exceed 45%

(vi) Soundness of aggregate applicable for concrete works subject to froast action — Loss of weight after 5 cycle to exceed 12% when tested with Sodium sulphate and 18% when tested with magnesium sulphate.

(v) Deleterious material — Not to exceed 5% of the weight of aggregate when tested as per IS:2386 Part-II (1963)

C. FINE AGGREGATE

(i) Sieve Analysis — Shall confirm to Zone II or Zone III.

IS Sieve designation	Percentage Passing for			
	Grading zone-I	Grading zone-II	Grading zone-III	Grading zone-IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100
2.35 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55 – 90	75 – 100	90- 100
600 Micron	15-34	35-59	60-79	60-100
300 Micron	15-20	8-30	12-40	15-50
150 Micron	0-10	0-10	0-10	0-15

(ii) For guidance of adjusting sound in mix of concrete, the following table may be used.

Moisture Content %	Building % by volume
2	15
3	20
4	25
5	30

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(iii) Silt Content Test: Shall not exceed 4% when tested for building work and shall not exceed 10% as per procedure specified CPWD specification when tested.

(iv) Deleterious Materials: Total deleterious material shall not be more than 5% by weight.

(D) REINFORCEMENT STEEL: As per relevant Indian Standards.

(E) CONCRETE CUBE TEST

For nominal (volumetric) concrete mixes, compressive strength for M20 (1:1½:3 (cement: sand: Coarse aggregate) concrete shall be 265 kg/ cm^2 for 28 days.

(F) ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTH FOR NOMINAL MIX CONCRETE.

(a) The average of the strength of three specimen be accepted as the compressive strength of the concrete, provided the strength of any individual cube shall neither be less than 70%, nor higher than 130% of the specified strength.

(b) If the actual average strength of accepted sample exceeds specified strength by more than 30%, the Owner/Owner's Representative, if he so desires, may further investigate the matter. However, if the strength of any individual cube exceeds more than 30% of specified strength, it will be restricted to 30% only for computation of strength.

(c) If the actual average strength of accepted sample is equal to or higher than specified strength upto 30%, than strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.

(d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate at the discretion of Owner/Owner's Representative.

(e) If the actual average strength of accepted sample is less than 70% of specified strength, the Owner/Owner's Representative shall reject the defective portion of work represented by sample and nothing shall be paid for the rejected work. Remedial measures necessary to retain the structure shall be taken at the risk and cost of contractor. If, however, the Owner/Owner's Representative so desires, he may order addition to tests to be carried out to ascertain if the structure can be retained. Al the charges in connection with these additional tests shall be borne by the Contractor.

(G) ACCEPTANCE CRITERIA FOR DESIGN MIX CONCRETE SHALL BE AS PER IS: 456.

(H) SAMPLING PLAN FOR BRICK- WORK

Scale of sampling and permissible number of defectives for visual and dimensional characteristics.

No of bricks in the lot	**For Characteristics specified for individual bricks**		**For dimensional characteristics for group of 20 bricks. No. of bricks to be selected.**
2001-10000	20	1	40
1001-35000	32	2	60
35001-50000	50	3	60

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Note: In case the lot contains 2000 or less bricks the sampling shall be as per decision of the Owner/Owner's Representative.

ii) Scale of sampling for physical characteristics

Lot size	Sampling size for compressive strength water absorption and efflorescence	Permissible No. of defectives for efflorescence
2001-10000	5	0
10001-35000	10	0
35001-50000	15	1

Note: In case the lot contains 2000 or less bricks, the sampling shall be as per decision of Owner/Owner's Representative.

iii) Water absorption Test.
Water absorption after 24 hours immersion shall not exceed more than 22 percent by weight.

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SPECIFICATION FOR
CIVIL & STRUCTURAL WORKS

TOPOGRAPHICAL SURVEY

BCL/632/2024-25

ENG-STD-CV-DOC-TS-014

Rev	Date	Purpose	Prepared By	Checked By	Approved By	

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1.0 INTRODUCTION

This specification deals with the Topographical Survey work for development of terminals. The intent of the survey for the proposed sites is to obtain sufficient topographical data for finalizing all engineering works and establishment of Reference levels and plot extremities forreference during construction of the project.

2.0 SCOPE OF WORK

The terminals/plots along with approaches to the plots which are to be surveyed shall be clarified by the Engineer in charge during execution of work.

The Survey agency shall carry out detail survey of the area along with showing:-

- Physical features, spot levels, invert levels of existing drains and culverts in terms of RL with their cross sections, transmission/telephone lines, service lines etc. land survey by triangulation or other suitable method.
- Topographical survey indicating existing permanent and temporary structures including levels & limits.
- Drawing of terrain.
- Detailed levels and coordinates of existing roads and other units.
- Preparation of survey drawings with descriptive note on terrain.
- Setting of reference grid lines and temporary bench marks.
- True North
- Grids at 5m internal shall be established parallel to true north. Working reference point "A" to be fixed at site with reference to some permanent bench mark.
- Check the co-ordinations of existing roads and other units with reference to the details
- Survey of 5m length beyond the periphery of the proposed plot all around the proposed site.
- Establish the HFL while indicating its source of information.
- To identify storm water disposal point with it's levels as per existing site condition.
- Plot plan to show all test locations w.r.to plot corner pegs as well as their Reduced Level.

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3.0 LEVELING WORK

The leveling work shall be based on the bench marks available in the vicinity or any permanent existing features. Vertical control based on existing bench marks shall be established based on closed level network.

Suitable instruments shall be used for establishing the bench marks and for doing the general leveling work. All survey points, reference grid /corner pillars (of wooden pegs), shall be protected in such a way so that they are not disturbed during the construction period. The size of pegs shall be minimum 100mm diameter of Wooden balli which shall be embedded in ground. Reference point for the grid system shall be nearest to the existing permanent features.

4.0 SURVEY DETAILS

It shall be general survey work to be used for engineering purposes. The survey shall be oriented towards furnishing information for project planning and detailed engineering work. The survey shall show all the existing features along with levels and important dimensions. Existing features such as roads, railway tracks, buildings, drains, manholes, overhead & underground service lines, communication and supply lines, and similar permanent and temporary structures shall be shown. Each survey drawing shall show sets of perpendicular grid lines parallel to actual North, South and East, West with reference to reference point. These are needed for the purpose of orienting and matching the survey drawings with layout of the unit. Ground levels shall be shown on rectangular grid pattern at intervals of 10 meters. Additional levels to show sudden change of levels shall also be indicated. Contours are to be drawn at 0.20 m intervals. Inverts levels of existing drains at regular intervals shall be taken. Top levels of man-holes shall also be taken. Existing levels at regular intervals and at all junctions for roads, top levels, width, curvature at turning points shall be shown. Any other important detail shall also be shown. Bench marks, reference points, triangulation stations, any existing boreholes, oil wells trial pits etc. used shall be clearly identified in the drawing indicating their values/co-ordinates. Co-ordinates mentioned above shall be surveyed with respect to the reference axes N-S and E-W.

All survey data collected during the day shall be plotted on the drawing sheet on the same day. These drawings shall be used for following, day to-day progress of work and for quick reference, if needed.

5.0 SURVEY DRAWING AND SCALE

All survey drawings shall be made in metric units.

Survey drawings that are to be submitted to the Owner shall be in colour on white paper.

Four copies each of drawings shall be submitted to the Owner along with 2 editable copy on a

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DVD. .

A descriptive note regarding the site conditions and special features shall also be submitted in field reports. These notes will compliment the drawing and will contain information which could not be covered in the survey drawings. The entire survey report shall also be submitted in soft copy on DVD in 2 sets.

The scale of the drawings shall be 1:100. Generally, A-1 size sheets shall be used for drawings.

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6.0 INSTRUMENTS, TOOLS AND TACKLES

The use of proper instruments is an important factor in survey work. The Contractor shall arrange his own instruments, accessories, tools and tackles, camping equipment and transport necessary for conducting the survey as per precision required.

Experienced and qualified engineers, surveyors and draughtsmen shall be engaged to carry out the work.

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Survey team shall have at least the following survey instruments and accessories.

- Total Station
- Precision Automatic levels with precision leveling staff
- Precision Measuring Tapes

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SPECIFICATION FOR
CIVIL & STRUCTURAL WORKS

GEOTECHNICAL SURVEY

BGL/632/2024-25

ENG-STD-CV-DOC-TS-015

Rev	Date	Purpose	Prepared By	Checked By	Approved By	

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1.0 INTRODUCTION

This specification deals with the Geotechnical Survey work for development of terminals. The plan for Geo-technical Survey is drawn with a view to obtain sufficient data regarding the engineering properties of soil supporting the foundation for equipment and structures and to plan the various facilities.

2.0 SCOPE OF WORK

The scope of services of the contractor for undertaking soil investigation work shall cover all the work connected with soil exploration program at the proposed terminal including the setting out of locations of the various exploration points from reference point, conducting all field investigations at site, collection of soil and water samples, field and laboratory tests and submission of final reports. All field investigation, laboratory tests and reports etc. shall be done in accordance with the latest relevant Indian Standard Codes.

3.0 FIELD INVESTIGATION

This specification deals with Field Investigation/ tests and laboratory tests involved in ascertaining soil stratification & engineering properties of the soil at proposed project site. The field investigations/ tests comprise of the following:-

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EXPLORATORY BORE HOLES

There shall be one borehole at specified Terminal / plot. The location of these shall be indicated by Engineer before commencement of field activities. The location and number of these boreholes can be altered at site, if found necessary. All boreholes shall be of 150 mm diameter and shall be sunk into soil to a depth of 10m or up to refusal strata, whichever is earlier. The exploratory work at site shall be carried out by using shell and auger equipment. Disturbed samples for boring shall be collected every 1.5m or change in stratum and representative samples placed systematically for proper logging of the strata. The existing ground level shall be marked in terms of RL. Proper logging shall be done with description of different strata encountered with their reduced levels. All boreholes after completion of work shall immediately be filled in with a mixture of bentonite slurry and clay-sand mixture.

UNDISTURBED SAMPLING

In cohesive and semi-cohesive soils, undisturbed samples conforming to IS:2132 shall be taken using open tube samples with an area ratio of less than 15% so as to obtain a core of samples of 100mm diameters and 450mm long at every change in stratum or at intervals of 1.5m whichever is less. The tubes shall be marked and the ends of the sample tube shall be sealed properly with wax of thickness not less than 25mm and capped properly immediately after the sample is recovered from the boreholes to ensure no loss of moisture with time while retained in the tube. Sample tubes shall be immediately shifted to the laboratory for testing.

STANDARD PENETRATION TEST (SPT)

Standard Penetration Test shall be performed at the base of boreholes as per IS: 2131 with the first test at a depth of 0.5 m and thereafter at every change in stratum or at intervals of 1.5

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meter whichever is less in both cohesive and non-cohesive soil. The S.P.T. shall also be conducted at termination depth of Borehole. Test may also be required to be carried out in compact sand which in normal terminology will be refusal strata. No. of blows required to penetrate every 150mm shall be recorded in case of normal sand, silt or clay as per IS:2131.

In case of dense/ hard stratum, the penetration (in mm) for every 20 blows per test shall be recorded. All these field records are to be submitted along with bore logs. Bent rods and damaged/ defective nipples shall not be used for the test and shall be replaced immediately by proper ones. Centering spacers shall be used at every 6 meters or at smaller intervals in depths to reduce the effect of whipping of rods. Samples collected in process of conducting S.P.T. shall be preserved as disturbed sample. Graphs shall be drawn for each penetration test. Collection of undisturbed samples and conducting S.P.T. tests will be done alternatively.

DISTURBED SAMPLES

Representative disturbed samples obtained from boring at every 1.5 meter interval in depth or change in stratum shall be placed in suitable jars labeled properly for onward transmission to the laboratory. These samples shall be sent to the laboratory immediately after the boring is complete. All S.P.T. samples shall also be similarly preserved.

STANDING GROUND WATER LEVEL

Records shall be maintained of the level at which water is struck and the level of any rapid in flow shall also be recorded. On reaching such level the borehole shall be left open for a period of two hours to observe the rise of water in the casing. Boreholes can be continued thereafter, upto the end of the day. The level of the water in the casing at the end of the day and at the beginning of the next day shall be recorded properly. For studying the ground water table no drilling mud will be permitted for stabilizing the hole.

4.0 LABORATORY TESTS

Laboratory tests shall be conducted on selected samples collected from site to establish the physical and chemical properties of soil. Following tests shall be done as appropriate in accordance with latest relevant Indian code of Practice.

(i) Natural moisture content
(ii) Void ratio
(iii) Liquid plastic and shrinkage limits
(iv) Specific gravity
(v) Dry density and bulk density
(vi) Direct Shear test
(vii) Consolidation/ swelling test
(viii) Particle size analysis
(ix) Chemical properties of the soil

ATTERBERG LIMITS

Liquid and plastic limit tests shall be conducted on all cohesive soils for classificationpurposes

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and for predicting engineering properties. The results of limit tests shall be plotted on the plasticity chart of A. Cassagrande. Shrinkage limit shall also be determined for a few soil samples.

PARTICLE SIZE ANALYSIS

Particle size analysis shall be done on all clayey and sandy samples. Both sieve and hydrometric analysis shall be conducted and gradation curves shall be plotted to show the particle size distribution.

SHEAR TESTS

Shear tests shall be conducted on the undisturbed samples. A few unconfined compression tests shall be conducted on clayey samples but the majority of clayey samples in un-drained condition shall be subjected to tri-axial tests. The cohesion values and angle of internal friction are to be determined either by Mohr's circle or by any other method. Particular attention shall be paid for conducting tri-axial tests, each of which shall be done on a minimum of 3 specimens. Specimens shall be prepared by trimming and not by pushing small tube in a large tube.

CONSOLIDATION TESTS

A few consolidation tests shall be carried out on undisturbed samples of clayey soil, to estimate the settlement of foundation from "e-log p" curves, compression index - Cc and co- efficient of consolidation – Cu. Consolidation test shall be done in manner that will not allow the sample to swell.

SWELLING TEST

For soils of expansive nature, swelling tests on a few samples shall be selected for conducting swelling test to determine swelling pressure and magnitude.

SPECIFIC GRAVITY AND BULK DENSITY

These shall be determined as per the standard procedures.

CHEMICAL ANALYSIS OF SOIL

Water samples from a few bore holes shall be taken and chemical analysis shall be done for sulphate, chloride content and pH value, particularly to determine the aggressiveness to concrete, steel and GI pipes. Care shall be taken to ensure that they are not diluted with rain or surface water during recovery from the boreholes. Similarly, a few soil samples shall be chemically tested to determine the sulphate contents, chloride content and pH values and other aggressive components as per IS - 2720.

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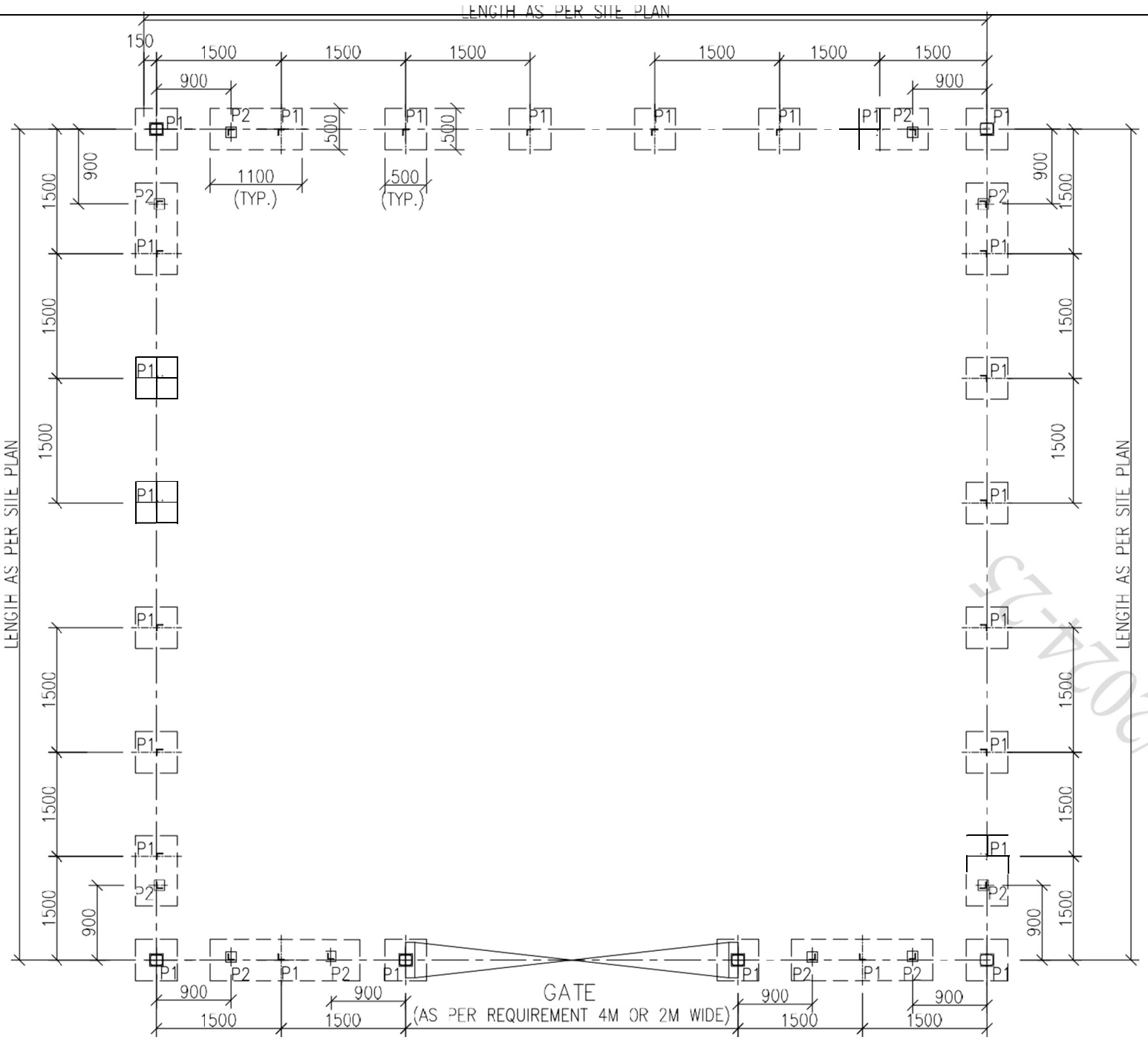
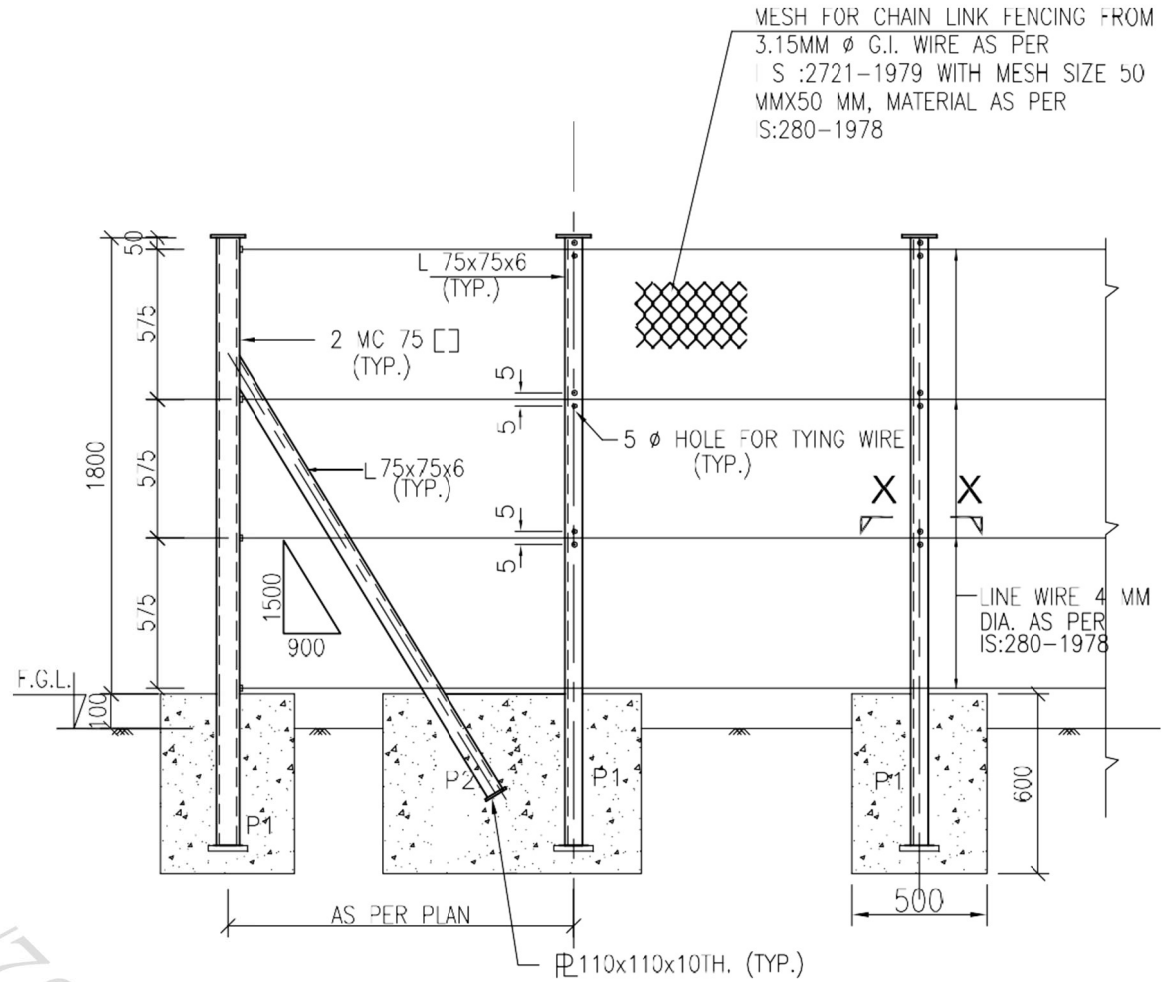


PLAN

(AS PER SITE)



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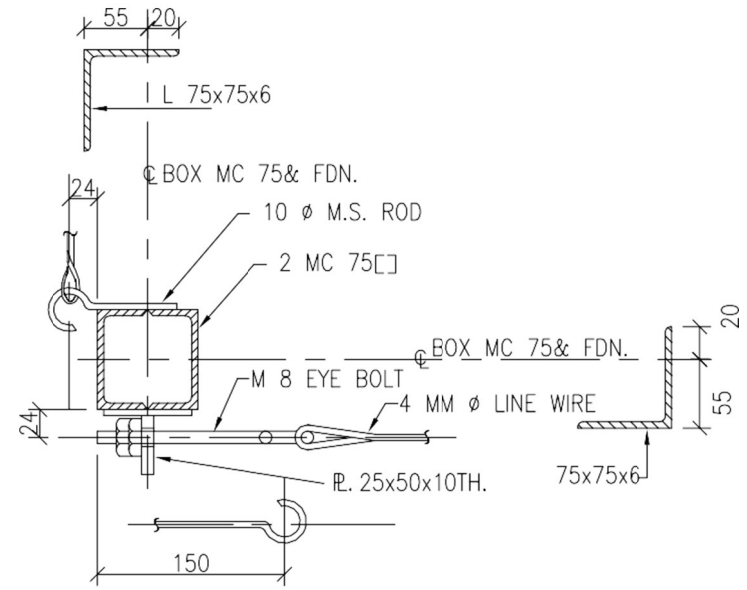
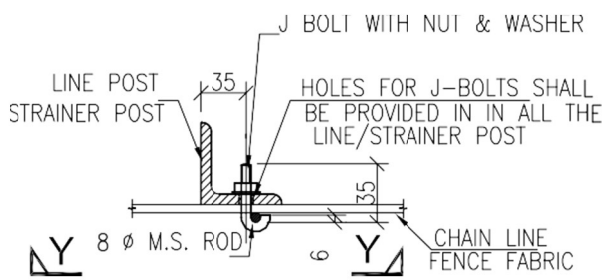
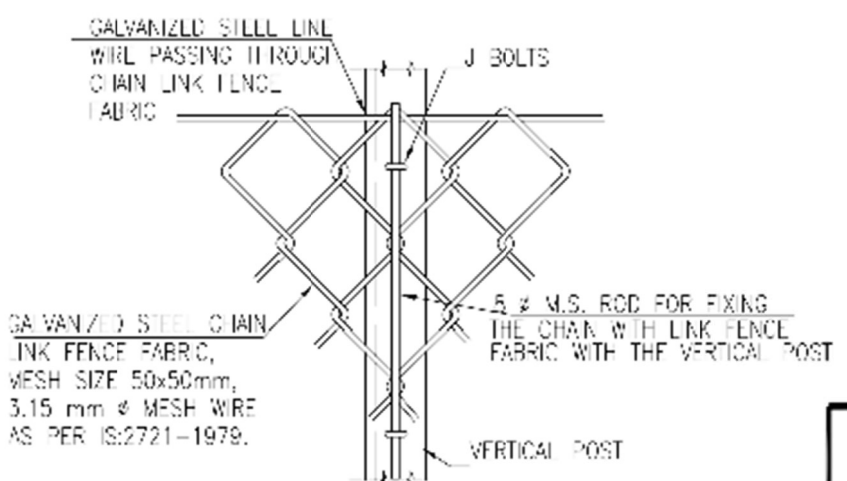


CORNER DETAIL

(ALL LINE WIRE TO BE STRAINED)



SECTION X-X



VIEW Y-Y

	STANDARD FOR CHAIN LINK FENCING	DRAWING NUMBER	REV
		ENG-STD-CV-DWG-TP-001	1
		SHEET 1 OF 1	

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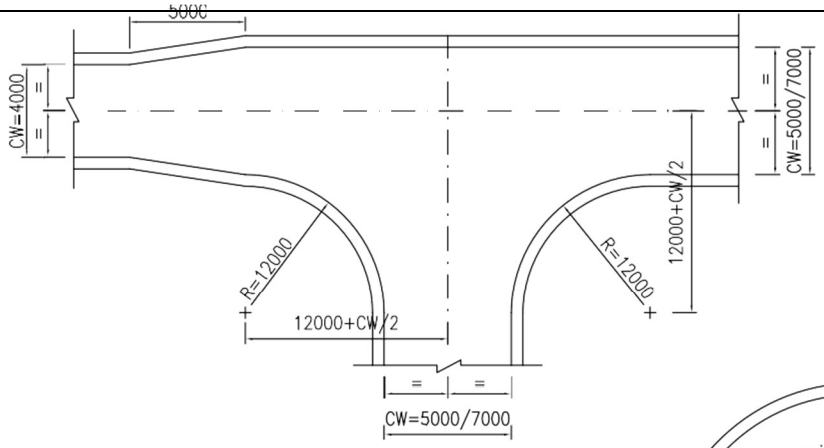
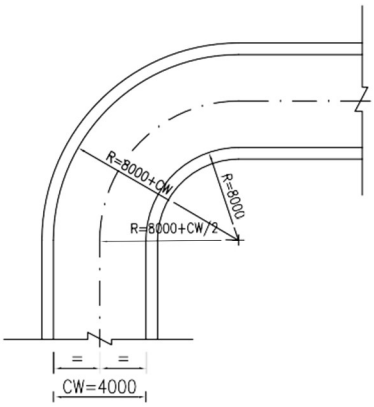


CASE – I



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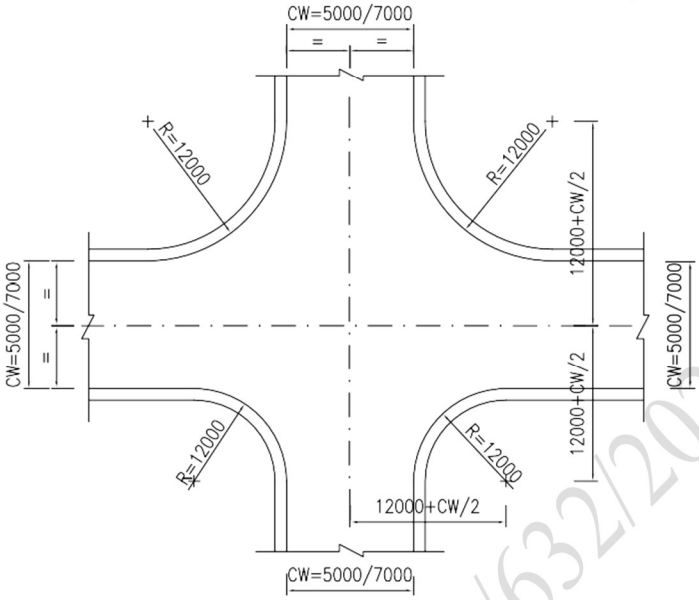
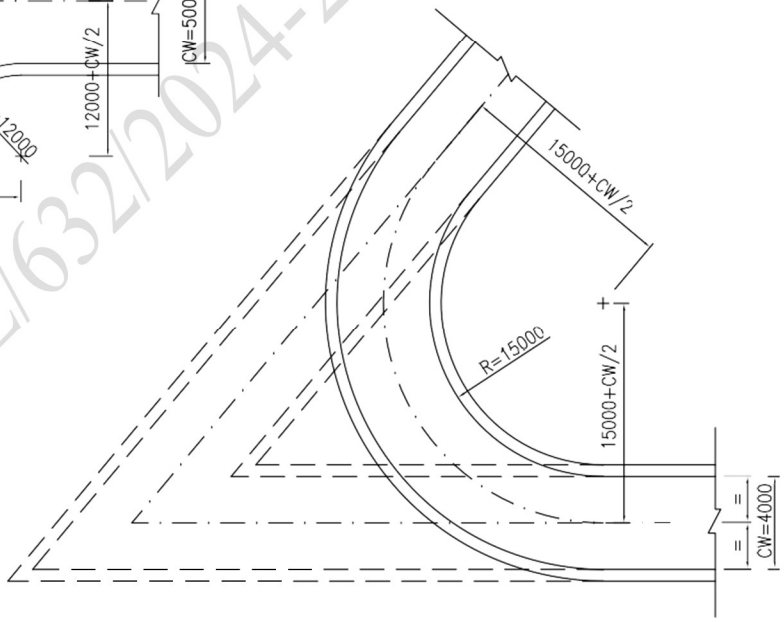


CASE – II



CASE – IV

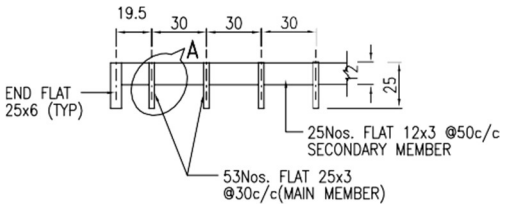
BGL/632/2024-25

NOTES:–

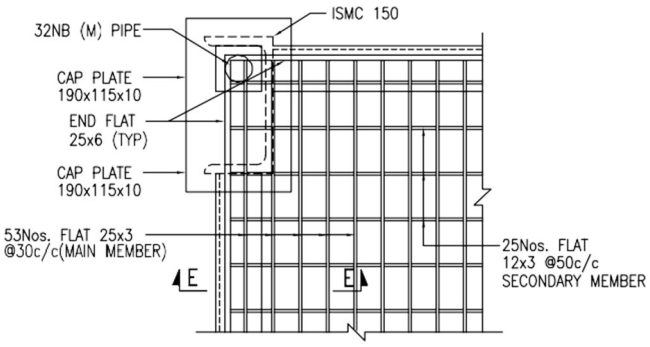
1. ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE MENTIONED.
2. MINIMUM RADIUS OF CURVES FOR ROADS WITH CW=4.0m
3. MINIMUM RADIUS OF CURVES FOR ROADS WITH CW>4.0m SHALL BE 12m.
4. RADIUS OF CURVES FOR APPROACH ROADS TO BUILDINGS AND OTHERS AREAS MAY BE REDUCED AS PER SERVICES REQUIRMENTS.
5. FOR ROAD CURVES WITH ACUTE ANGLE TURNING, THE MINIMUM RADIUS SHALL BE 15m AND ANGLE NOT LESS THAN 50°.
6. RADIUS OF CURVES AND CROSSING WHEN DIFFERENT FROM THOSE GIVEN IN THIS STANDARD TO MEET ANY SPECIAL REQUIRMENT SHALL BE SO MARKED IN THE AREA DRAWINGS.

	STANDARD FOR DETAIL OF ROAD CURVES AND CROSSINGS	DRAWING NUMBER	REV
		ENG-STD-CV-DWG-TP-002	0
		SHEET 1 OF 1	

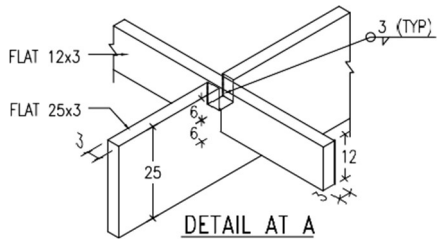
Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST



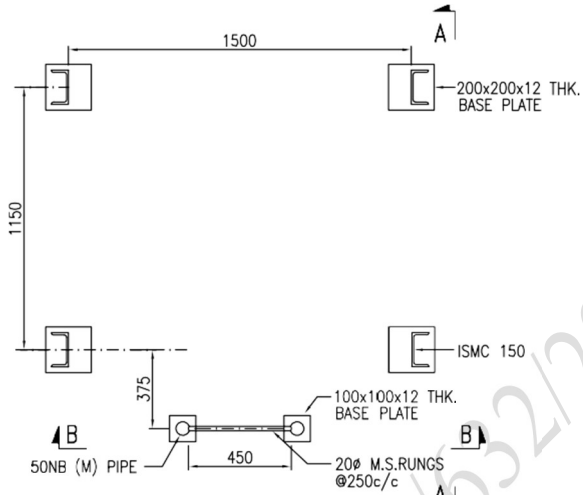
SECTION E – E



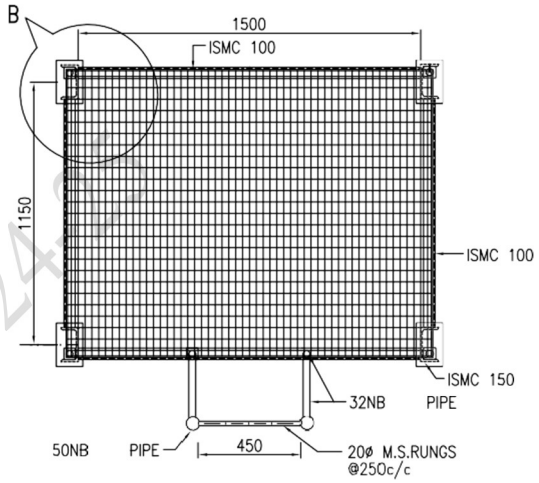
DETAIL AT B



DETAIL AT A



SECTION C – C
(P L A N)



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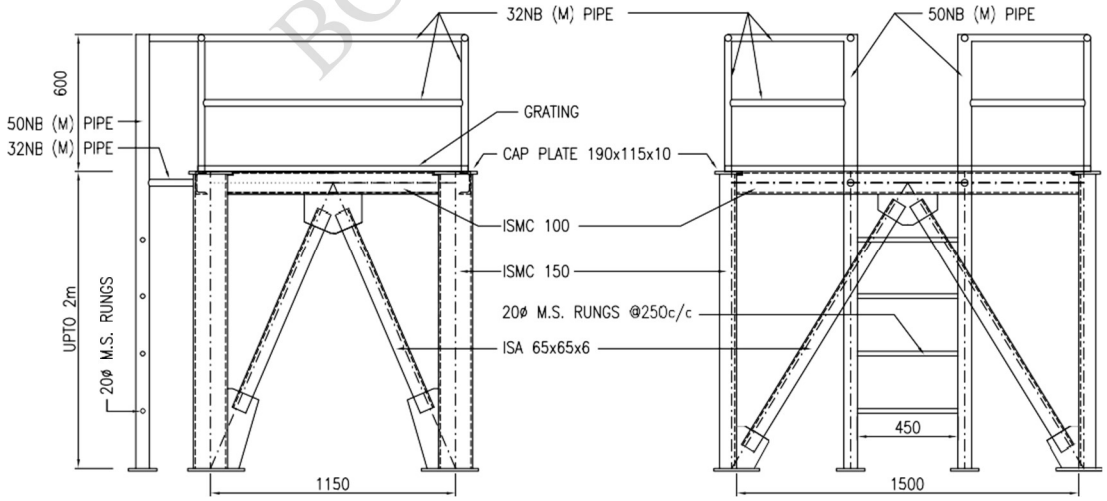
(P L A N)



VIEW A – A

VIEW B – B

BGL/632/2024

	STANDARD FOR PLATFORM DETAILS	DRAWING NUMBER	REV
		ENG-STD-CV-DWG-TP-003	0
		SHEET 1 OF 1	

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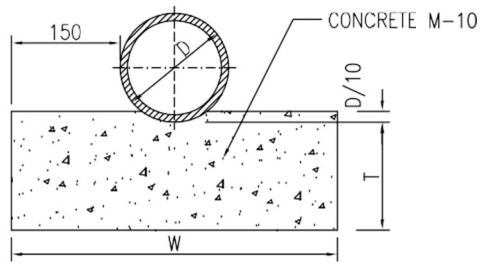
Date: 2024.09.16 18:15:02 IST

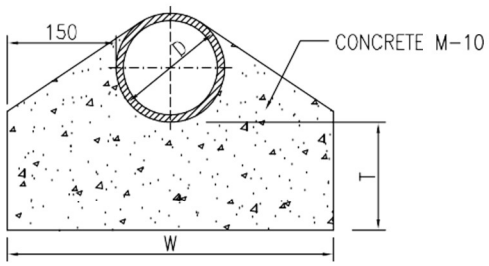
TYPE-I



SECTION ELEVATION OF BEDDING

(FOR C.S PIPE SEWER WHERE SUPPORT IS REQUIRED)

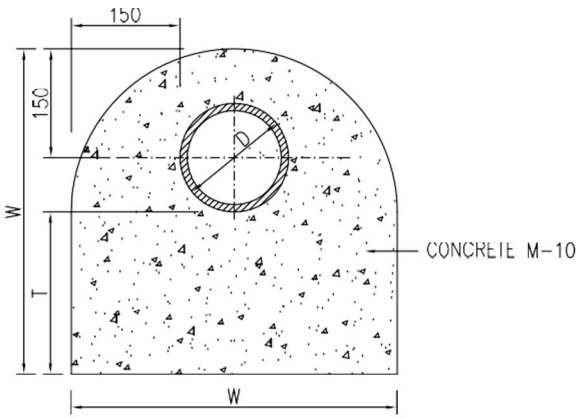
TYPE-II



SECTION ELEVATION OF HAUNCHING

(FOR HDPE, SW PIPE SEWERS)

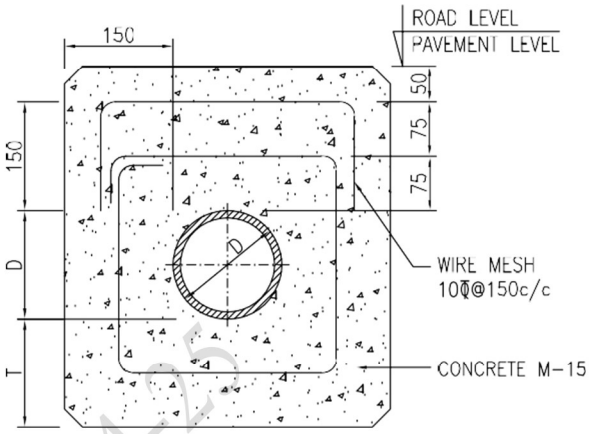
TYPE-IIIA



SECTION ELEVATION SURROUND OR ENCASING

(FOR SEWERS UNDER ROADS COVER>600mm)

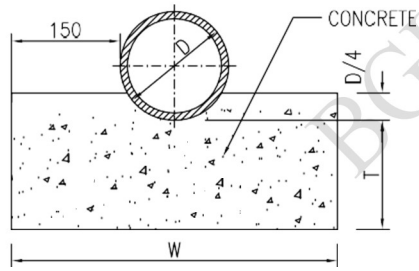
TYPE-IIIB



SECTION ELEVATION SURROUND OR ENCASING

(FOR SLEEVES/PIPES CULVERTS UNDER ROADS FOR COVER<600mm)

TYPE-IV



SECTION ELEVATION CONCRETE GRADE BEDDING

(FOR SEWERS - CONCRETE PIPE)

LEGEND

D = EXTERNAL DIA OF PIPE
W = D+300
T = 100 FOR PIPES UNDER 150 NOMINAL DIA.
T = 150 FOR PIPES OF 150 NOMINAL DIA AND ABOVE.

NOTES:-

1. BEDDING:- WHERE BEDDING IS USED, THE CONCRETE SHALL BE BROUGHT UP TO ATLEAST TO THE INVERT LEVEL OF THE PIPE TO FORM A CRADLE & TO AVOID LINE CONTACT BETWEEN THE PIPE AND BED.
2. HAUNCHING:- THE FULL WIDTH OF THE BED SHALL BE CARRIED TO THE LEVEL OF THE HORIZONTAL DIAMETER OF THE PIPE AND SPLAYS FROM THIS LEVEL CARRIED ON BOTH SIDES OF THE PIPE TO MEET THE PIPE BARREL TANGENTIALLY.
3. SURROUNDED OR ENCASING TYPE-IIIA:- THE SURROUND OR ENCASING SHALL BE SIMILAR TO HAUNCHING UP TO THE HORIZONTAL , DIA OF THE PIPE & THE PORTION OVER THIS SHALL BE FINISHED IN A SEMI-CIRCULAR FORM TO GIVE A UNIFORM ENCASING FOR THE TOP HALF OF THE PIPE.

   TYPE-IIIB:- IT IS SIMILAR TO TYPE-IIIA ABOVE EXCEPT THAT THE TOP PORTION OVER THIS SHALL BE FINISHED RECTANGULAR AS SHOWN AND THE SECTION PROVIDED WITH REINFORCEMENT AS PER REQUIRMENTS.
4. CONCRETE CRADLE BEDDING:- IS THE METHOD OF BEDDING PIPES IN WHICH THE LOWER PART OF THE PIPE EXTERIOR IS BEDDED IN CRADLE CONSTRUCTION OF CONCRETE WITH DIMENSION AS SHOWN.
5. CONCRETE WORK SHALL BE CONFORM TO IS: 456.

BGL/632/2024-25

	STANDARD FOR CONCRETE BEDDING AND ENCASEMENT FOR PIPES	**DRAWING NUMBER**	**REV**
		ENG-STD-CV-DWG-TP-004	**0**
		SHEET 1 OF 1	

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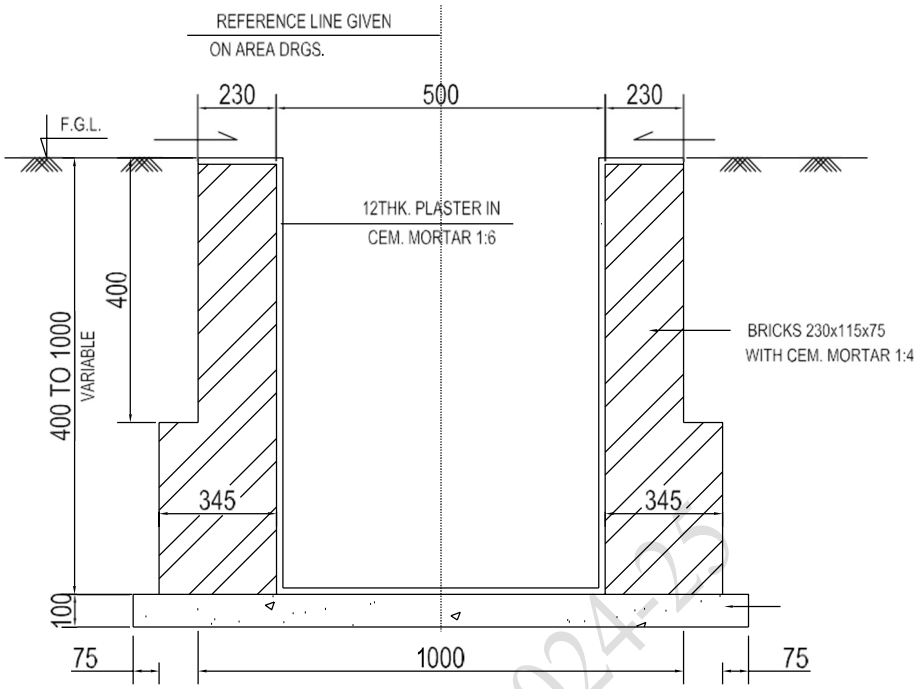
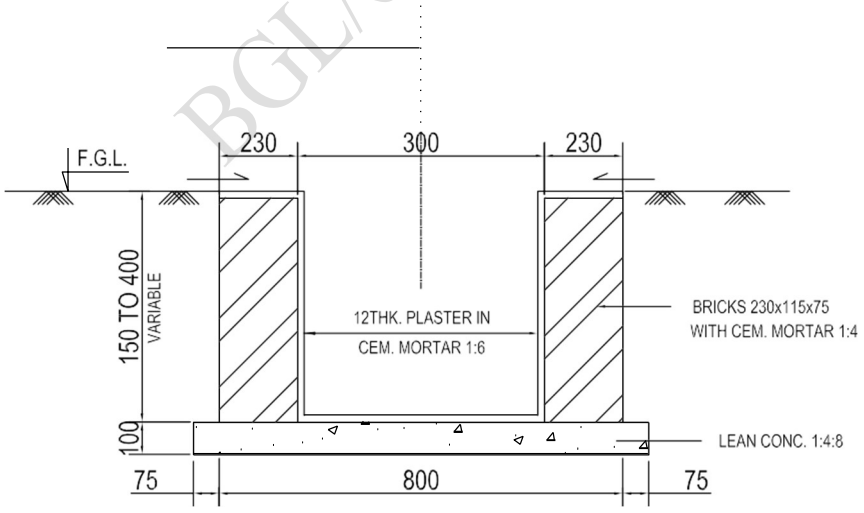
Date: 2024.09.16 18:15:02 IST



RECTANGULAR DRAIN
(TYPE-1)



RECTANGULAR DRAIN
(TYPE-2)

BGL/632/2024-25

	STANDARD FOR STORM WATER DRAIN (OPEN)	DRAWING NUMBER	REV
		ENG-STD-CV-DWG-TP-005	0
		SHEET 1 OF 1	

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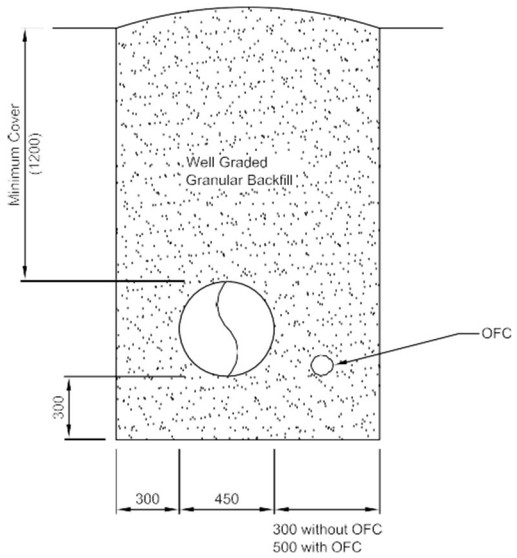
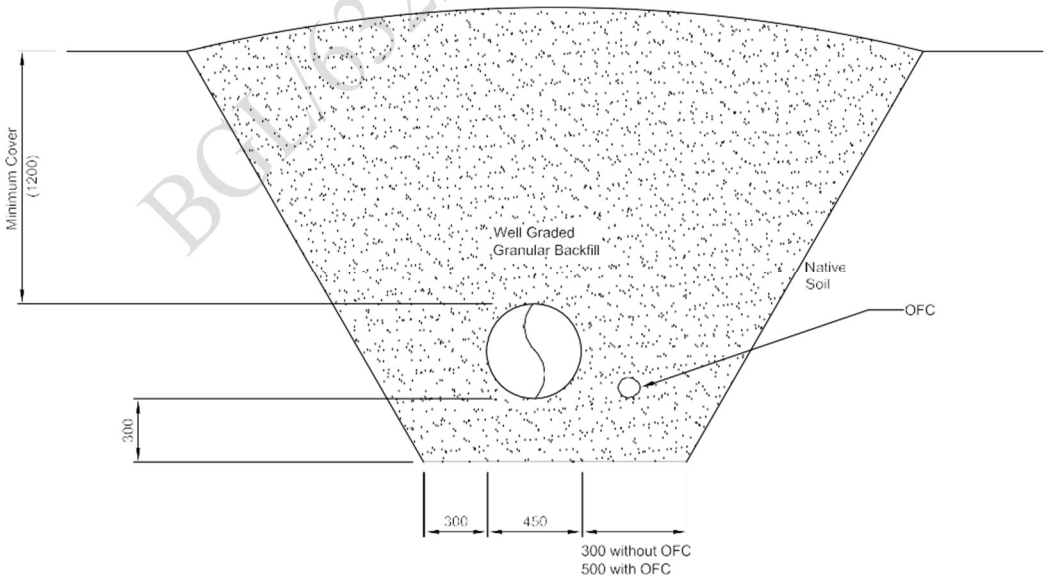
Date: 2024.09.16 18:15:02 IST

For Rocky Strata / Gravel Area :



For Clay Soil :



BGL/82/2024-25

	STANDARD FOR TRENCH SAND BEDDING	DRAWING NUMBER	REV
		ENG-STD-CV-DWG-TP-006	0
		SHEET 1 OF 1	

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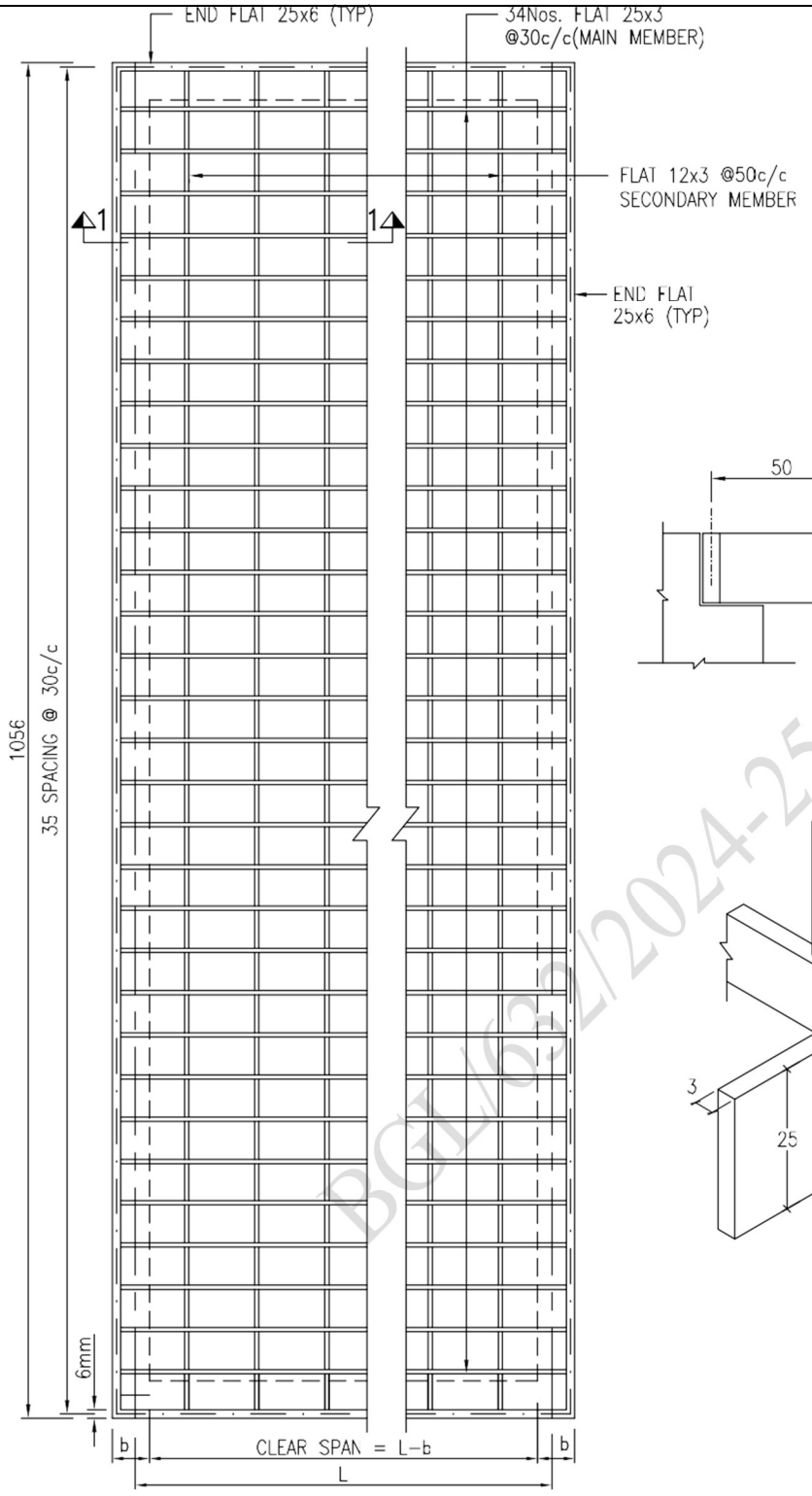
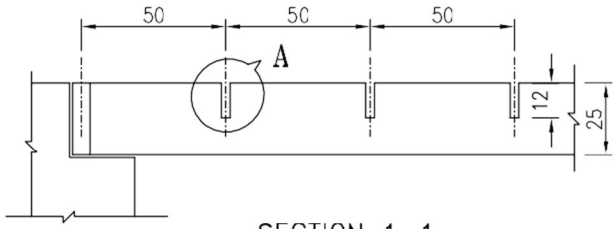
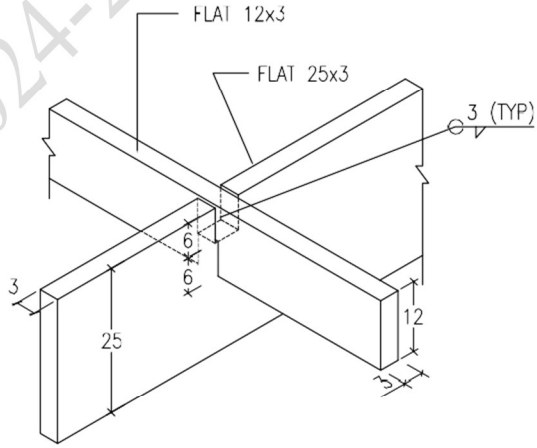
Date: 2024.09.16 18:15:02 IST



P L A N



SECTION 1-1



DETAIL AT A

BGL/632/2024-25

NET SAFE WORKING LOADS FOR GRATING

PROPERTIES			TYPE-I	L	500	600	700	800	900	1000	1100	1250	1400
Lxx(cm4)	Zxx(cm 3)	MR(kgm)		Δd	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.0
14.84	11.87	195.94		W	> 2000				1515	1105	830	540	345
				P	1475	1225	1050	915	810	670	550	400	275

	STANDARD FOR GRATING DETAIL	DRAWING NUMBER	REV
		ENG-STD-CV-DWG-TP-007	0
		SHEET 1 OF 1	

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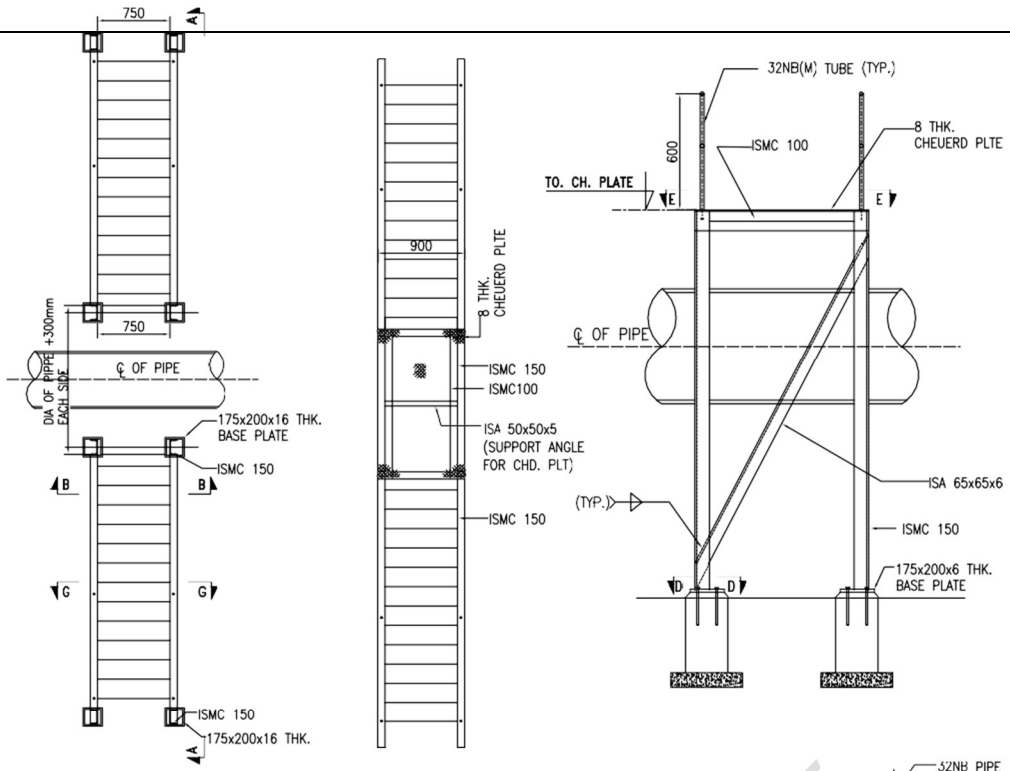
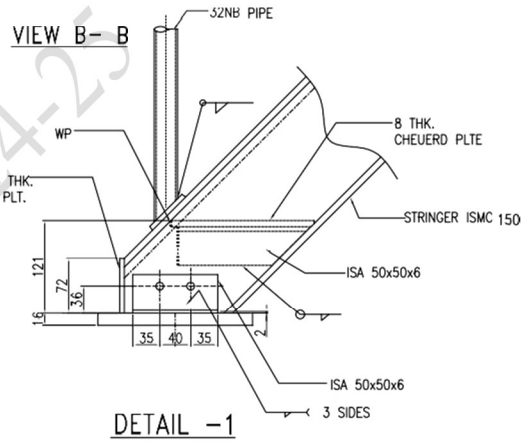
Date: 2024.09.16 18:15:02 IST

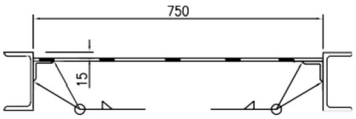


PLAN AT FOUNDATION LEVEL

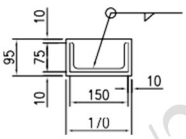
VIEW E-E



VIEW B- B

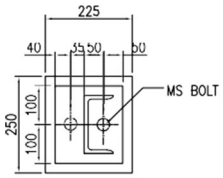


SECTION G-G
(BOTTOM PLATE)

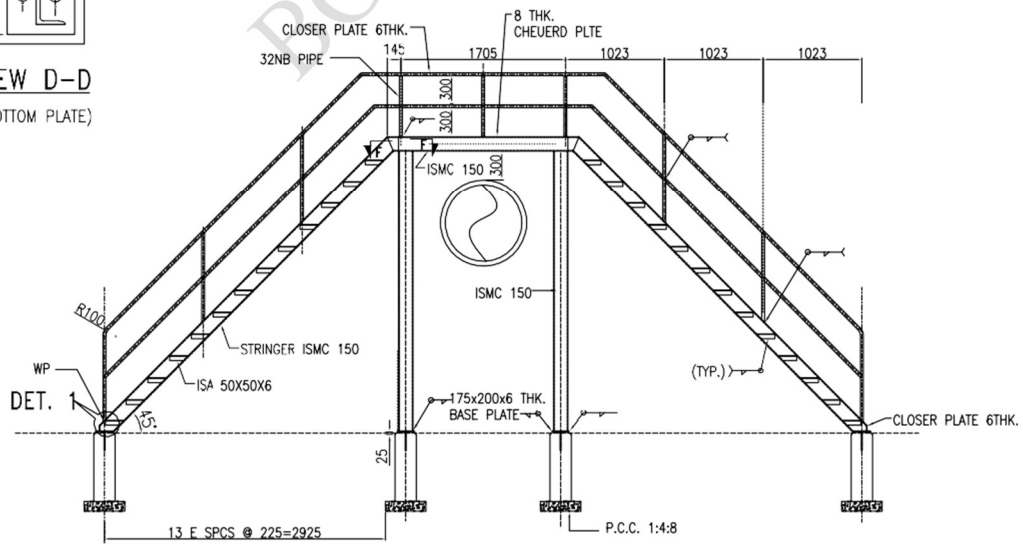


VIEW F-F
TOP PLATE

DETAIL -1



VIEW D-D
(BOTTOM PLATE)

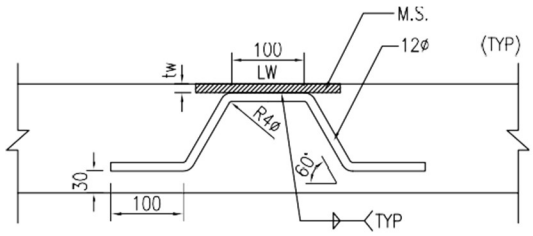


VIEW A-A

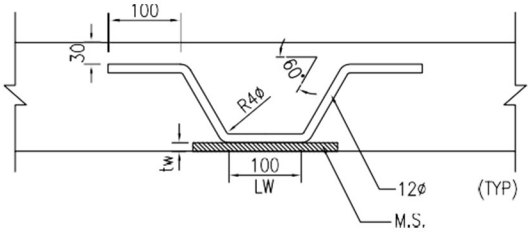
RGL/632/2024-25

	STANDARD FOR TYPICAL DETAIL OF CROSS-OVER	**DRAWING NUMBER**	**REV**
		ENG-STD-CV-DWG-TP-008	**0**
		SHEET 1 OF 1	

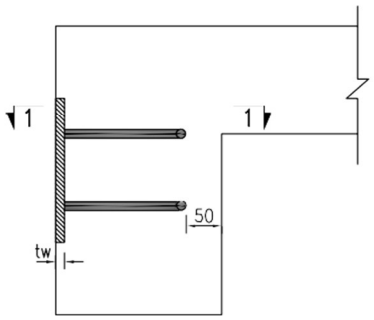
Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST



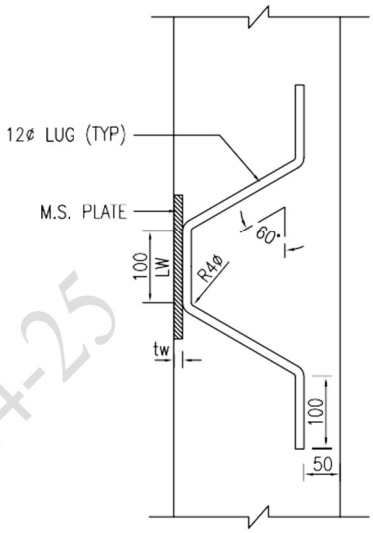
INSERT PLATE DETAIL ON TOP OF SLAB



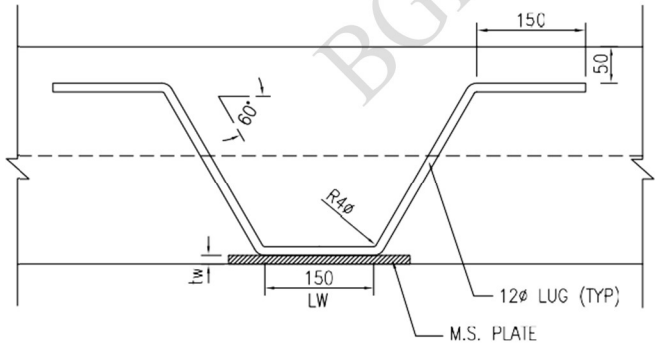
INSERT PLATE DETAIL ON BOTTOM OF SLAB



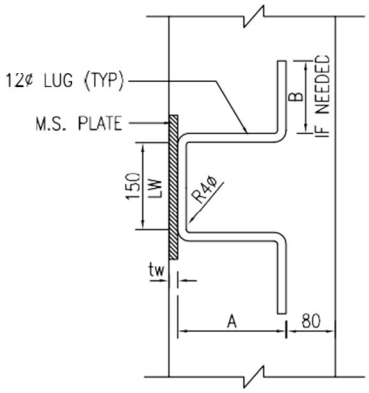
INSERT PLATE DETAIL ON SIDE OF BEAM



PLAN AT 1–1



INSERT PLATE DETAIL ON BOTTOM OF BEAM



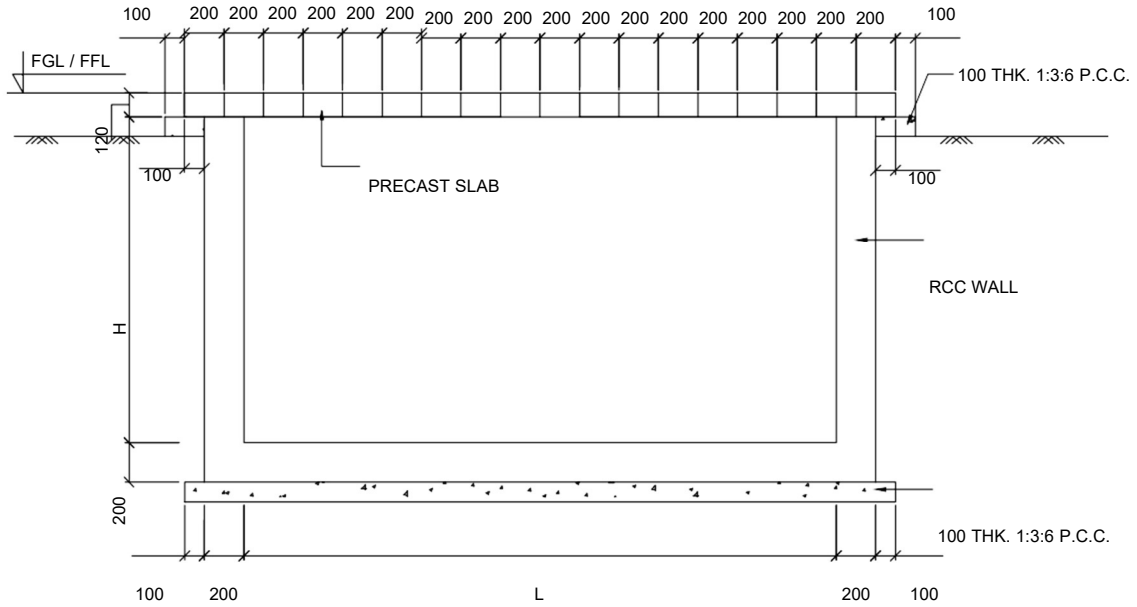
INSERT PLATE DETAIL ON COLUMNS

LW = WELD LENGTH AVAILABLE
tw = THICKNESS OF M.S. PLATE
A+B = LUG EMBEDMENT REQUIRED

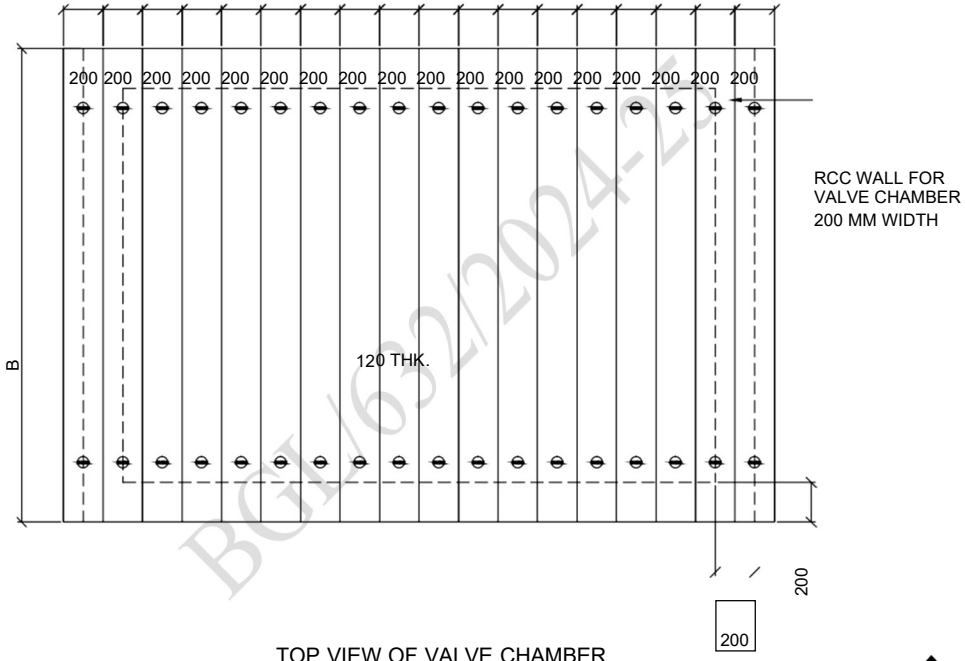
BGL/632/2024-25

	STANDARD FOR INSERT PLATE DETAILS (LUG BENDING DETAILS)	DRAWING NUMBER	REV
		ENG-STD-CV-DWG-009	0
		SHEET 1 OF 1	

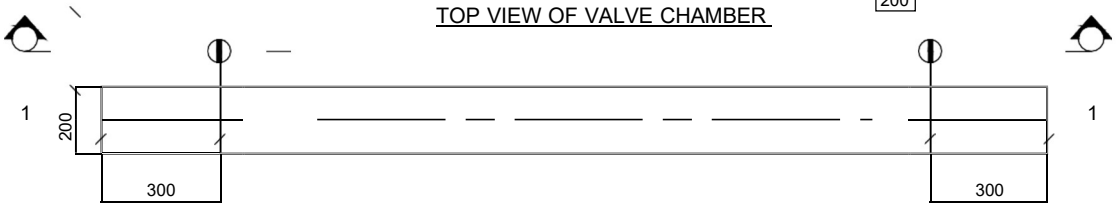
Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST



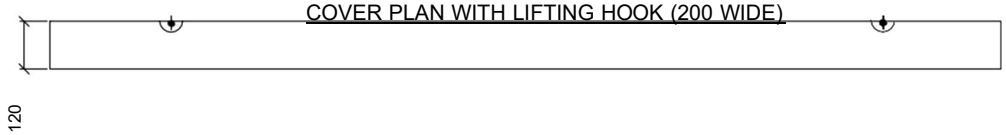
DETAIL OF VALVE CHAMBER



TOP VIEW OF VALVE CHAMBER



COVER PLAN WITH LIFTING HOOK (200 WIDE)

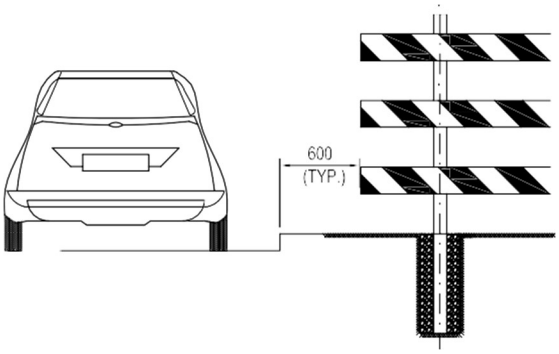


SECTION 1-1

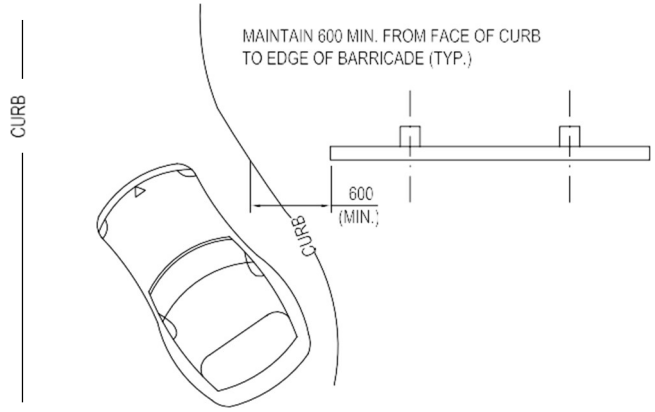
	STANDARD FOR G.A. OF VALVE PIT	**DRAWING NUMBER**	**REV**
		ENG-STD-CV-DWG-TP-010	**0**
		SHEET 1 OF 1	

BGL/632/2024-25

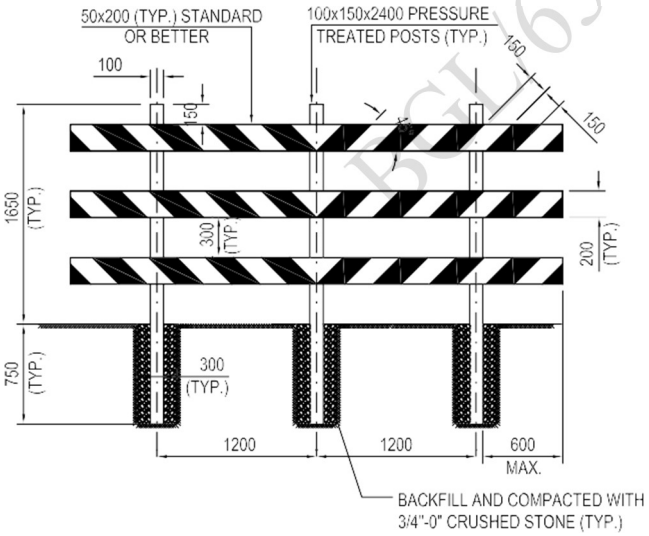
Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST



TYPICAL NARROWING OF DRIVING AREA BARRICADE (USW DIMENSIONS BELOW)
ORIENT DIAGOINAL BARS TO CHANNEL TRAFIC AS SHOWN

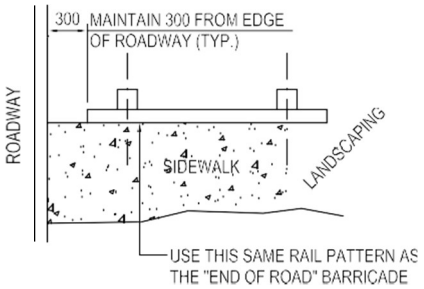


NARROWING OF DRIVING AREA

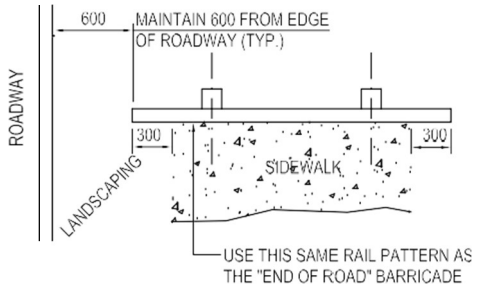


END OF ROAD BARRICADE

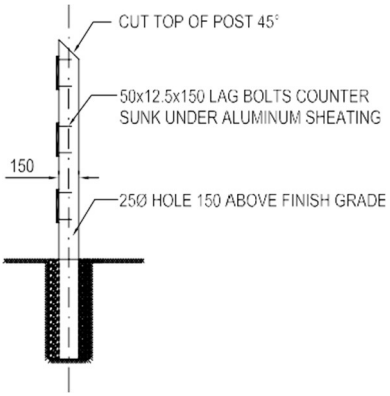
(TYPICAL DIMENSIONS AND LAYOUT)



END OF SIDEWALK ('TYPE B')



END OF SIDEWALK ('TYPE A')



SECTION

NOTES:-

ALL WOOD SHALL BE PAINTED WHITE.

ALTERNATING RED & WHITE HIGH INTENSITY PRISMATIC 0.80. ALUMINUM SHEATING SHALL BE SCREWED TO THE HORIZONTAL RAILS

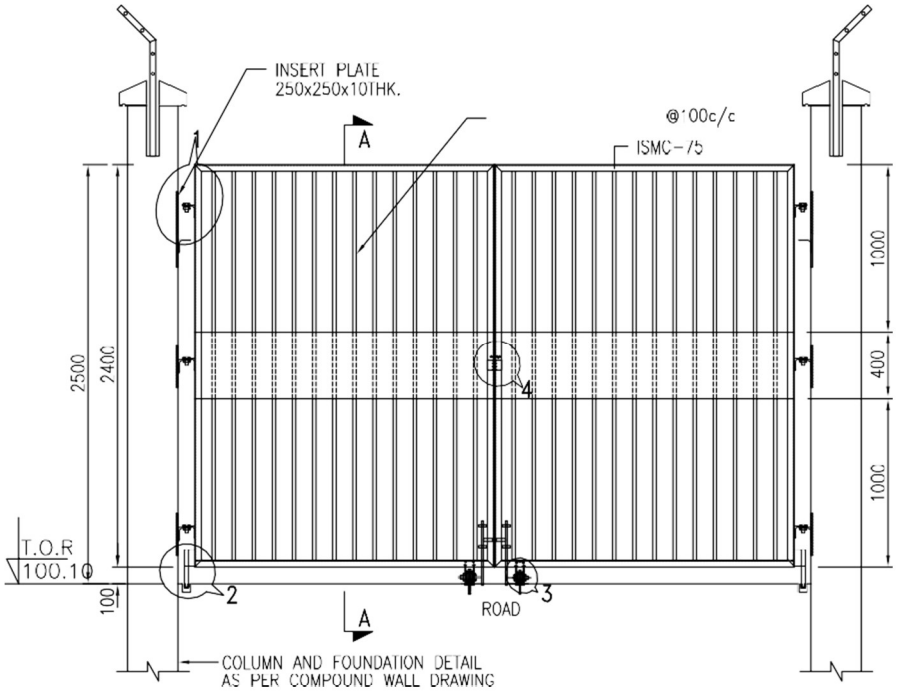
ALL FASTENERS TO BE STAINLESS STEEL OR RUST PROOF HEAVT GALVANIZED

FOR STREET BARRICADES HORIZONTAL RAIL LENGTH SHALL EQUAL THE DISTANCE BETWEEN THE FACE OF CURB PLUS 600. (EG. 1000 CURB 1600 RAILS).

BGL/632/2024-25

	STANDARD FOR BARRICADES	DRAWING NUMBER	REV
		ENG-STD-CV-DWG-011	0
		SHEET 1 OF 1	

Digitally signed by PRADEEP KUMAR YADAV
Date: 2024.09.16 18:15:02 IST



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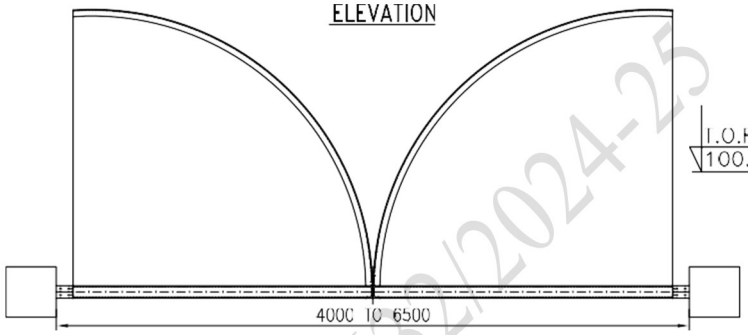

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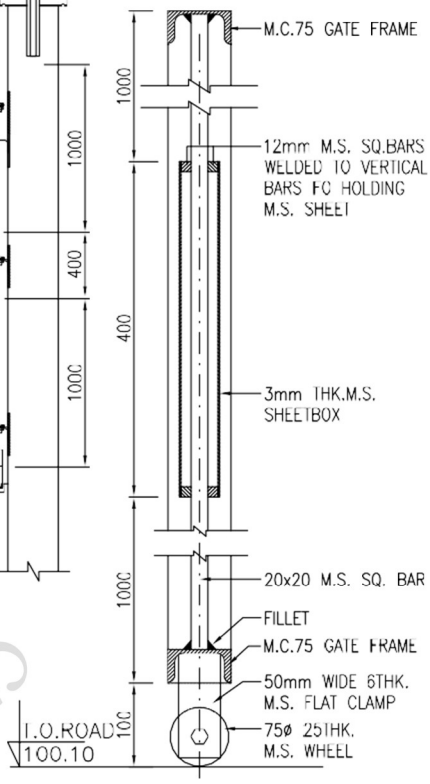
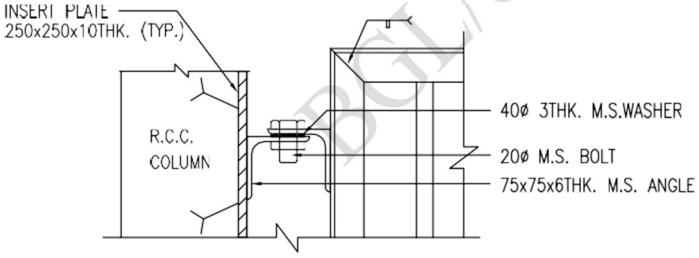


SECTION A-A



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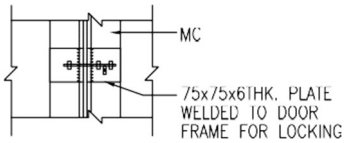

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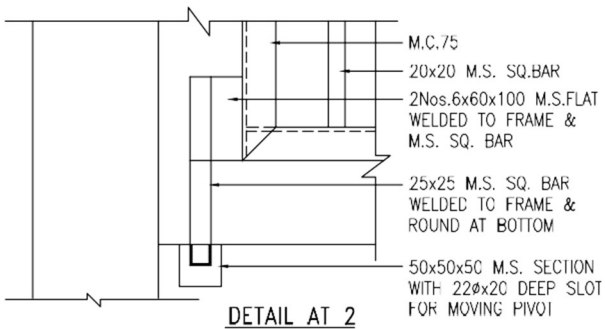

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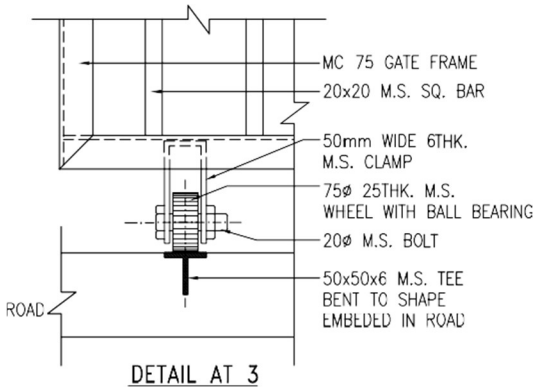

DETAIL AT 3

	STANDARD FOR GATE	DRAWING NUMBER	REV
		ENG-STD-CV-DWG-TP-012	0
		SHEET 1 OF 2	

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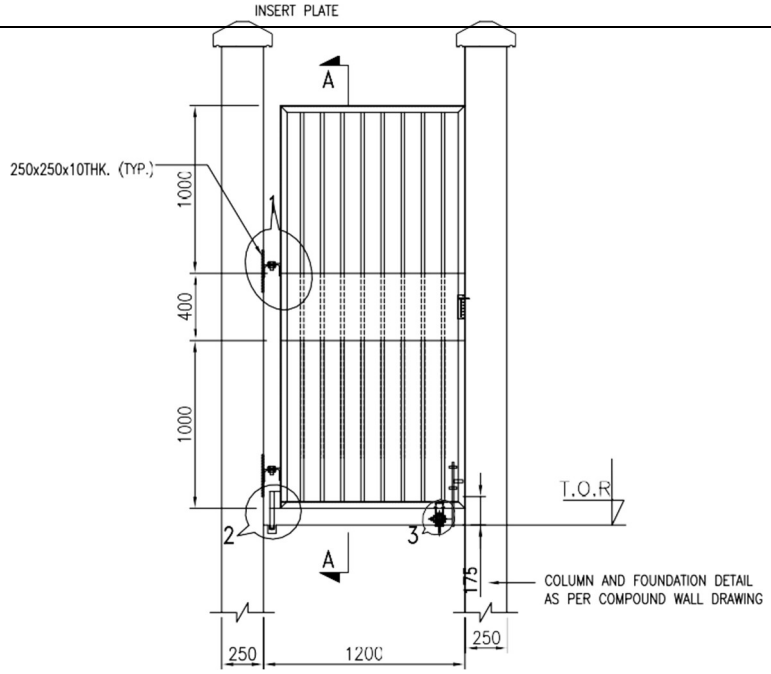

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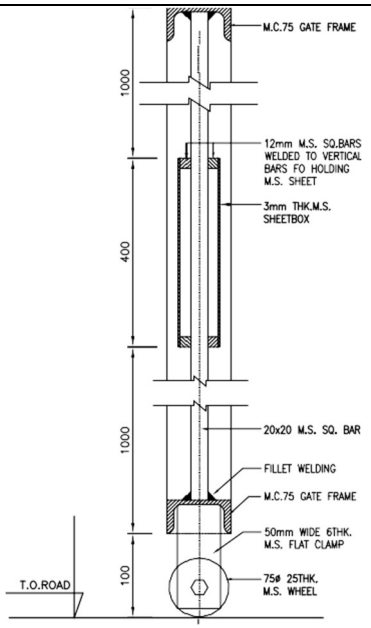

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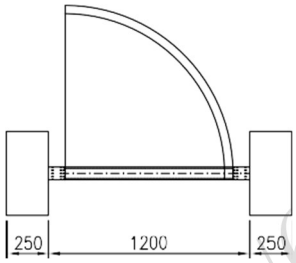

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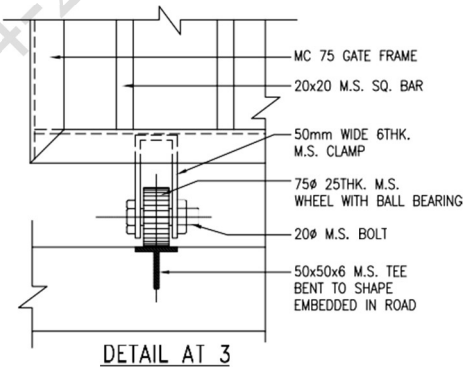

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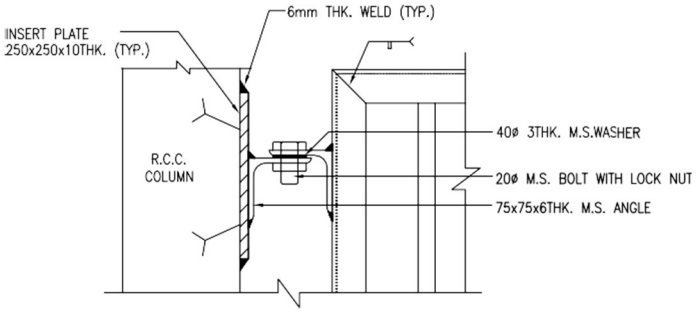

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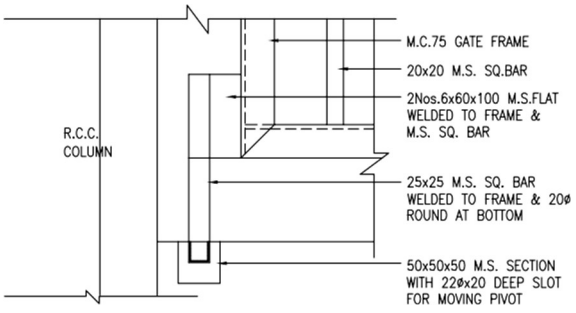

DETAIL AT 2

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	STANDARD FOR GATE	DRAWING NUMBER	REV
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		SHEET 2 OF 2	

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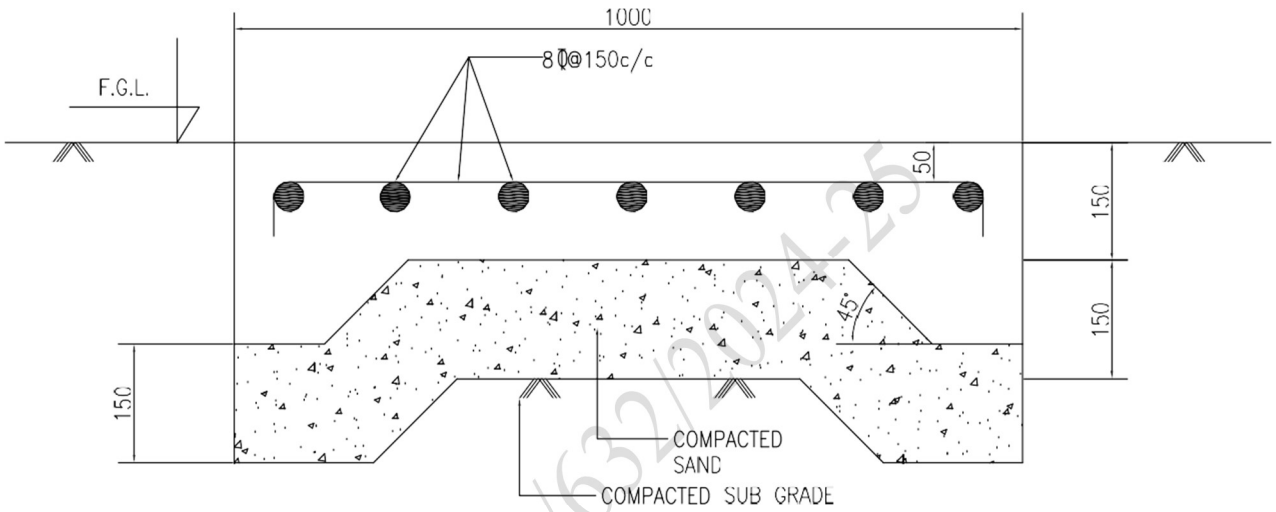

TYPICAL DETAIL OF FOOTPATH

BGL/632/2024-25

	STANDARD FOR TYPICAL DETAIL OF FOOTPATH	DRAWING NUMBER	REV
		ENG-STD-CV-DWG-TP-013	0
		SHEET 1 OF 1	

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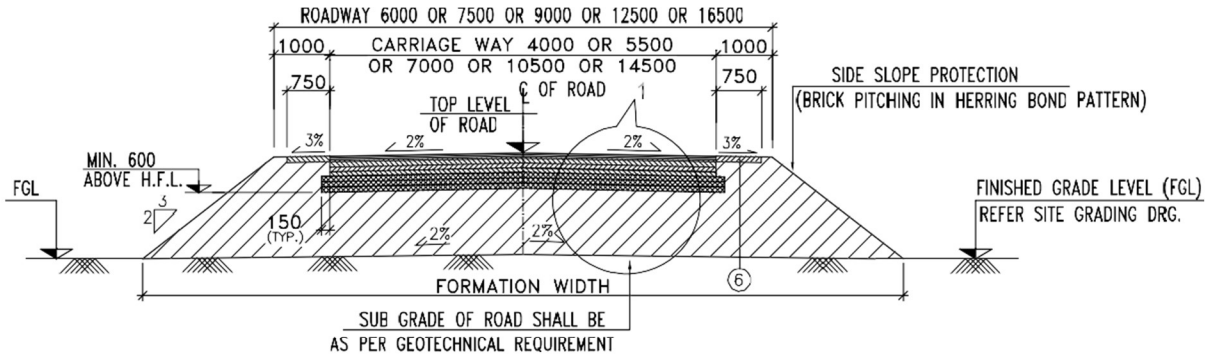
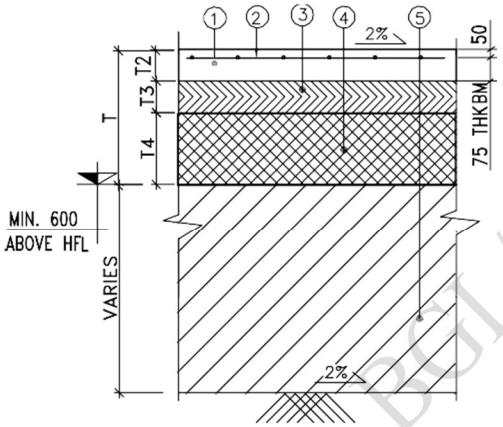


CROSS SECTION OF ROAD



DETAIL – 1

LEGEND :–

① R.C.C. M–25 150 MM THK. (T2)

② 8 Φ 150

BASE COURSE (T3)
MINIMUM 2 LAYERS (EACH 75mm THICK) OF WATER BOUND (WBM) WITH GRADE–II (63mm TO 45mm) REFER

SUB BASE COURSE (T4)
MINIMUM 2 LAYERS (EACH 100mm THICK)
(WBM) WITH GRADE–I AGGREGATE TO 45mm) REFER

RECOMMENDATION.

(TOTAL CRUST THICKNESS) T = T2+T3+T4
(T1– PREMIX CARPET IS ONLY A WEARING COURSE AND IS NOT CONSIDERED IN TOTAL CRUST THICKNESS)

GEOTECHNICAL RECOMMENDATION SHALL BE FOLLOWED FOR ROAD SUBGRADE AND EMBANKMENT PREPARATION.

NOTES:–

1. ALL DIMENSIONS ARE IN MM, UNLESS MENTIONED OTHERWISE.
2. THE CROSS–SECTION OF CRUST SHOWN HERE ARE MINIMUM & INDICATIVE ONLY AND PREPARE FOR BID PURPOSE ONLY HOWEVER, THE CONSTRUCTION SHALL BE EXECUTED AS PER APPROVED FOR CONSTRUCTION DRG.
3. FOR SUBGRADE & EMBANKMENT PREPARATION OF ROAD, GEOTECHNICAL'S RECOMMENDATION SHALL BE FOLLOWED.

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	STANDARD FOR CROSS SECTION OF ROAD (RCC)	DRAWING NUMBER	REV
		ENG-STD-CV-DWG-014	0
		SHEET 1 OF 1	

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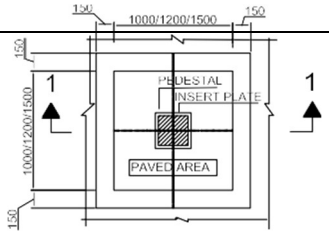
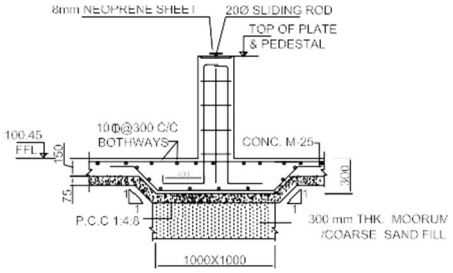


FOUNDATION PLAN
(FOUNDATION LOAD LESS THAN 8 KN/M2)



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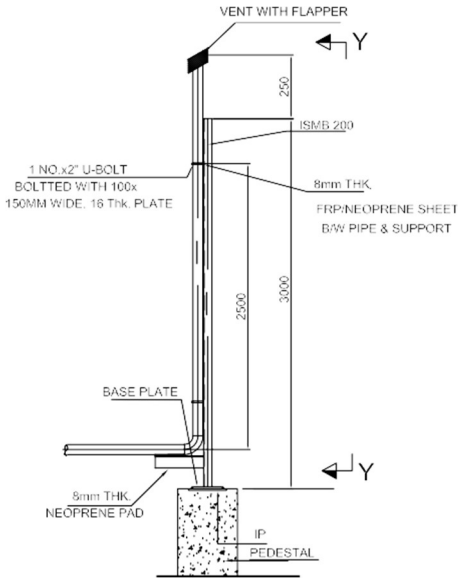
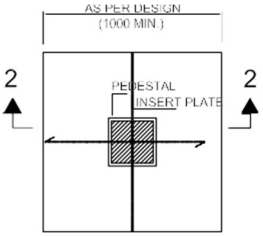
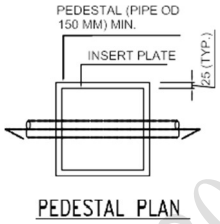


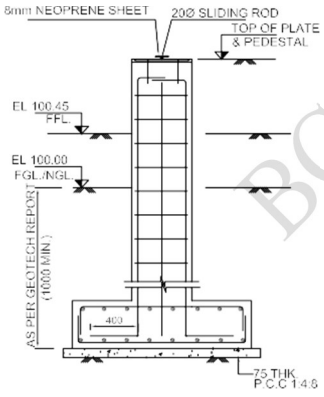
DETAIL OF VENT SUPPORT



FOUNDATION PLAN
(FOUNDATION LOAD GREATER THAN 8 KN/M2)



PEDESTAL PLAN



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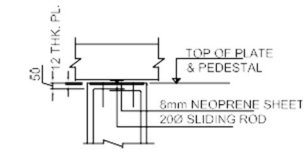
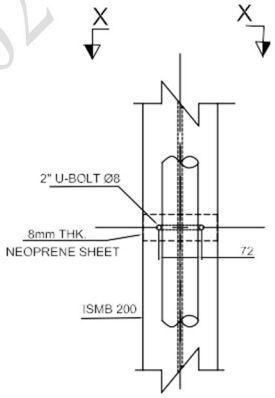
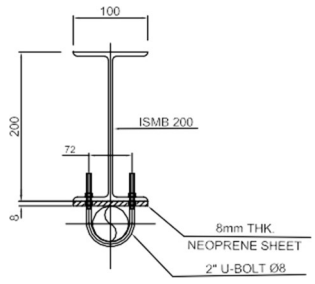


TYP. DETAIL OF PIPE SUPPORT



VIEW Y-Y



VIEW X-X

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	STANDARD FOR RCC PIPE SUPPORT	DRAWING NUMBER	REV
		ENG-STD-CV-DWG-TP-015	0
		SHEET 1 OF 1	

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6. INSTRUMENTATION

BGL/632/2024-25

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Sr. No.	Description	Document / Drawing No.	Rev. No.
6	**Instrumentation**		
1	Technical Specification for Pressure Gauge	ENG-STD-IN-DOC-TS-001	Rev. 1
2	Data Sheet for Pressure Gauge	ENG-STD-IN-DOC-DS-001	Rev. 0
3	QAP for Pressure Gauge	ENG-STD-IN-DOC-QP-001	Rev. 0
	Index - Instrumentation		**CLIENT:**

BGL/632/2024-25

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ENGINEERING STANDARD

TECHNICAL SPECIFICATION FOR PRESSURE GAUGES

ENG-STD-IN-DOC-TS-001

BGL/632/2024-25

Rev	Date	Purpose	Prepared By	Checked By	Approved By
1	22.01.16	Issued for Bid			
0	11.12.15	First Issue			

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1.0 GENERAL

The technical requirements for Pressure Gauges, Differential pressure gauges and Vacuum gauges are specified in this document. This is to be read together with corresponding datasheet(s).

1.1 Codes And Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry:

ASME B 1.20.1	Pipe Threads General Purpose (Inch)
ASME B 16.5	Pipe Flanges and Flanged Fittings NPS'A through NPS24
ASME B 16.20	Metallic Gaskets for Pipe Flanges, Ring Joint, Spiral wound and Jacketed.
EN10204	Inspection Documents For Metallic Products
IEC-60529	Degree of Protection Provided by Enclosures (IP Code)
IS-13947	Specification for Low Voltage Switchgears and Control gears.
IS-3624	Specification for Pressure and Vacuum Gauges.

1.2 Conflicting Requirement

In the event of any conflict between this standard specification, job specification, datasheets, statutory regulations, related standards, codes etc. the following order of priority shall govern:

i) Statutory Regulations
ii) Data Sheets
iii) Standard Specification
iv) Codes and Standards

1.3 Additional Responsibility of Vendor

In addition to compliance to purchaser's specifications in totality, vendor's extent of responsibility shall include the following:

a) Data sheets indicate the minimum acceptable material of construction for pressure element, movement etc. Alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.

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b) Data sheets specify the type of pressure element. Unless specifically indicated otherwise, alternate type of pressure elements shall also be acceptable provided all the functional and performance requirements specified in the respective data sheets are guaranteed by the vendor.

1.4 Drawing and Data

1.4.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducible, prints and soft copies shall be dispatched to the address mentioned, adhering to the time limits indicated.

1.4.2 Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase, order shall include the following, as a minimum:

a) Specification sheet

b) Certified drawings sheets for each equipment and accessories, which shall provide dimensional details, internal constructional details, end connection details and materials of construction.

c) Copy of type test certificates.

d) Installation procedure for each gauge and its accessories.

e) Calibration and maintenance procedures including replacement of internal parts wherever applicable.

2.0 GENERAL TECHNICAL REQUIREMENTS

2.1 Performance Requirements

Unless otherwise specified, the accuracy which is inclusive of repeatability and hysteresis of pressure gauges / differential pressure gauges shall meet the following performance requirements:

a) Direct pressure gauge : ±1% of full scale

b) Chemical seal type pressure gauge : ±2% of full scale

c) Differential pressure gauges : ±2% of full scale

2.2 Cases and Dials

2.2.1 Unless specified otherwise, the gauges shall be weather proof to IP 65 as per IEC 60529 / IS 13947, as a minimum.

2.2.2 In general, dial markings and dial colour shall be as per IS 3624.

2.2.3 The gauge dial shall be made of a suitable metallic materials so that the finished dial shall be capable of withstanding a dry heat of 85°C for 10 hours and immersion in water-at 85°C for 1 hour without cracking, blistering, warping or discoloring of the dial or paint on the dial.

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2.2.4 The pointer stops shall be provided at both ends of the scale to restrict the pointer motion beyond 5% above the maximum of scale and less than 5% below the minimum of the scale.

2.2.5 The dial cover shall be made out of shatter proof glass sheet of thickness 1.5 to 3mm for gauges with dial size less than 100mm while minimum 3.0mm for gauges with dial size 100mm or greater.

2.2.6 All gauges shall be provided with a blow-out device i.e. blow out disc of aperture not less than 25mm for gauges with dial size 100mm and above, while 20mm for gauges with dial size less than 100mm.

2.2.7 When safety type solid front type of gauges is specified, they shall consist of a solid partition isolating the pressure element from the dial. In such gauges the total solid partition disc area shall not be less than 75% of the cross sectional area of the inside of the case surrounding the pressure element.

2.2.8 The bezel ring shall be screwed or Bayonet type made out of SS316 material.

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2.3 Pressure Elements, Gauge Movement and Socket

2.3.1 The pressure element shall be an elastic element like bourdon tube made from stainless steel (SS316L) and the gauge socket shall be made out of stainless steel (SS316) unless specified otherwise.

2.3.2 In case of bourdon type of gauges, the size of the bourdon tube shall not be less than 75% of the nominal diameter of the dial size.

2.3.3 Gauge construction shall ensure no leakage of process fluid from the sensor elements to atmosphere and between the high pressure and low-pressure side (in case of differential pressure gauges) under normal condition.

2.3.4 The gauge socket shall be in one piece and shall also serve as element anchorage in case of bourdon tube type element, which shall be directly connected to the socket, without any capillary or tube in between.

2.3.5 Any joint in the process wetted system including joint between the element and the anchorage/socket shall be welded type only.

2.3.6 Unless specified otherwise, the pressure gauges shall have an over-range protection of at least 130% of maximum working pressure, as a minimum.

2.3.7 Data sheet indicates the minimum requirement of material of construction. Alternate materials as specified in Annexure 1 to this specification shall also be acceptable subject to meeting process conditions.

2.3.8 The gauge movement material shall be of stainless steel unless specified otherwise in the data sheet. It shall be adjustable for calibration without dismantling the sensor unit. The use of'S' link for calibration of span is not permitted.

2.3.9 Vendor shall ensure that the operating pressure falls in the middle 30% of the full working range i.e. operating pressure shall fall between 35% and 65% of the range offered.

2.3.10 Pressure gauges with range as 0 to 100 kg/cm^{2}g and above shall have safety type solid front case. All gauges in oxygen and chlorine service shall be thoroughly degreased using reagents like tri-chloro-ethylene or carbon tetrachloride. All connections shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.

2.3.11 The casing of the pressure gauge shall be filled with suitable fluid to provide better protection and dampen the effect of pulsation and pressure spikes.

2.4 End Connection

Unless specified otherwise, the following shall govern-

a) Threaded end connections shall be NPT as per ANSI / ASME B. 1.20.1.
b) Flanged end connection shall be as per ANSI / ASME B. 16.5
c) Ring joint flanges shall have octagonal grooves as per ANSI / ASME B16.20.
d) Flange face shall be as per clauses 6.4.4.1, 6.4.4.2 and 6.4.4.3 of ANSI / ASME B16.5. The face finish as specified in the data sheet shall be as follows;

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125AARH : 125 to 250 AARH
63 AARH : 32 to 63 AARH

2.5 Accessories

2.5.1 Gauges shall be supplied with all accessories as specified in the data sheets pre-installed.

2.5.2 Over Range Protector (OPV):

a) Whenever the maximum pressure specified in the data sheet exceeds the over range protection pressure, over range protector shall be supplied.
b) In case of pressure gauges with diaphragm seal, the over-range protector shall be installed between the seal and the gauge.
c) The material of construction of over range protector shall be same as socket material, as a material.

2.5.3 Snubber:

a) Whenever the service specified is pulsating type, snubber shall be supplied.
b) The material of construction of snubber shall be same as socket material, as a minimum.

3.0 NAME PLATE

Each gauge shall have a stainless steel nameplate attached firmly to it at a visible place either by riveting or screwed to the case, furnishing the following information:

a) Tag number as per data sheets.
b) Vendor's name
c) Model number and manufacturer's serial number.
d) Range of the instrument.
e) MAWP and maximum vacuum rating of element

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4.0 INSPECTION AND TESTING

Unless otherwise specified, purchaser reserves the right to test and inspect all the items at the vendor's workshop in line with the inspection test plan for pressure, differential pressure and vacuum gauges.

4.1 Test reports

Vendor shall submit following test certificates and test reports for purchaser's review:

a) Material test report as per EN10204 clause 2.2 for wetted parts like gauge socket and sensing element and as per clause 3.IB for flanges and spacer rings of diaphragm seal type pressure gauges.

b) Type test report for enclosure.

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c) Dimensional test report for all gauges.

d) Performance test reports for all gauges including accuracy, repeatability, over pressure and vacuum test (as applicable)

e) Type test reports for shock test and endurance test as per IS-3624 for each type / model.

f) Type test report for influence of temperature for each type/model.

4.2 Witness Inspection

4.2.1 All pressure, differential pressure and vacuum gauges shall be offered for pre dispatch inspection for following as a minimum:

a) Physical dimensions verification and workmanship.

b) Performance test including accuracy and repeatability, on representative samples of each type/model number before and after over-pressure and vacuum test.

c) Over-pressure and vacuum test (as applicable) shall be carried out on representative samples of each type / model number without loss of their elastic characteristics.

d) Review of all certificates and test reports as indicated in clause 4.1 of this specification.

4.2.2 In the event when the witness inspection is not carried out by purchaser, vendor shall anyway complete the tests and the test documents for the same shall be submitted to purchaser for scrutiny.

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ANNEXURE-I

Material of Construction

Sr. No.	Item	Specified Material of Construction	Alternate Material of Construction
1.	Sensing Element	SS316	SS316L, SS316Ti
2.	Socket	SS316	SS316L, SS316Ti
		SS304	SS304L, SS316
3.	Case	SS 316	SS316Ti, SS316L,SS
4.	Capillary	SS	SS304, SS316, SS304L, SS316L, SS316Ti
. 5.	Diaphragm	SS316	SS316L, SS316Ti
		SS	SS 302, SS 304, SS 304L, SS316, SS316L, SS316Ti

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ENGINEERING STANDARD

TECHNICAL DATASHEET: INSTRUMENTS

ENG-STD-IN-DOC-DS-001

BGL/632/2024-25

0	11.12.2015	Issued for Approval	SC	KG	SK
REV	**Date**	**Purpose of Issue**	**Prepared By**	**Checked By**	**Approved By**

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Date: 2024.09.16 18:15:02 IST

CONTENTS

Sl. No.	Instrument	Sheet No.
1	PRESSURE GAUGE	3

BGL/632/2024-25

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ENGINEERING STANDARD QUANTITY: AS PER P&ID	TECHNICAL DATA SHEET - PRESSURE GAUGE

1	Type	Direct		Wetted Parts Material			(*)
2	Mounting	Local		Other Material			(*)
3	Dial Size	150 mm		Process Connection			1/2"
4	Colour	White with black inscription			Size & rating		(*)
5	Case Material	SS 316		Facing & finish			(*)
6	Bezel Ring	Beyonnet type SS 316		Capillary Material			(*)
7	Window Material	Shatterproof glass		Armour Flexible Material			(*)
8	Enclosure	WP to IP 65 as per IEC 60529/IS 2147		Capillary Length			(*)
9	Pressure Element	Bourdon		Flushing/filling connection with			(*)
10	Element Material	SS 316	17	Over range protection		130 % of FSD	
11	Socket Material	SS 316	18	Blow out protection		Yes	
12	Accuracy	"+/-" 1% of FSD	19	Options			
13	Zero Adjustment	Micropointer - External Type		a)	Scrubber	b)	Syphon
14	Connection	1/2" NPT(M)		c)	Gauge Saver	d)	Liquid filled casing
	Connection location	Bottom		e)	Vaccum protection	f)	Solid front
15	Movement	SS 316		g)	Three valve manifold		Yes (*)
16	Diaphagram Seat	Rigid					
	Type	(*)					

S.NO.	TAG NO.	RANGE	PRESSURE			TEMPERATURE			SERVICE	OPTIONS
			OP.	MAX.	DES.	OP.	MAX.	DES.		
									Natural gas	f,g

NOTES:-		
		* Vendor to furnish
	1)	Process data shall be as per Design Basis

DATASHEET- PRESSURE GAUGE	DOCUMENT NO.	Rev.
	ENG-STD-IN-DOC-DS-001	0
	SHEET 3 of 7	

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ENGINEERING STANDARD

QAP FOR PG, OFC, HDPE DUCT

ENG-STD-IN-DOC-QP-001

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Sl. No.	Instrument	Sheet No.
1	PRESSURE GAUGE	3
2	OPTICAL FIBRE CABLE	4 & 5
3	HDPE DUCT	6 & 7

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VENDOR LOGO

VENDOR NAME AND ADDRESS

STANDARD QUALITY ASSURANCE PLAN FOR PRESSURE GUAGE - MODEL NO

CUSTOMER:- **QAP NO.:-** **REV.:-**

SO NO:- **DATE:-**

PO NO.:-

PROJECT:-

REF DOCUMENT:-

Sr. No.	Component Operation	Characterstics	Category	Type of Check	Quantum of Check	Referrence Document	Acceptance Norm	Format of Plan	Agency			Remarks
									Vendor	TPI	Client	
1	Raw Material	a) Dimensions b) Chemical Analysis c) Marking, Tagging, Unique, Srl. No.	MA MA MA	Mechanical Chemical Visual	100% Sample 100%	PO approved Spec/Drg. Approved Spec/PO	PO approved Spec/Drg. Approved Spec/PO	Test Certificate Material Test Certificate Test Certificate	P P P	R R R	R R R	
2	Routine test	Accuracy Hystresis Repeatability Over range protection	CR CR	Measurement Visual	100% 100%	EN 837-1 EN 837-1	EN 837-1 EN 837-1	Calibration Report Test Report	P P	W W	W / R W / R	5 Point
	Accessories Guage Saver in SS 316	1) Chemical Analysis 2) Dimensions 3) Leak Tightness	MA MA CR	Chemical Measurement Hydrotest	Sample 100% 100%	Approved Datasheet/ Drawing/Job Specification Approved Datasheet/ Drawing/Job Specification Approved Datasheet/ Drawing/Job Specification	Approved Datasheet/ Drawing/Job Specification Approved Datasheet/ Drawing/Job Specification Approved Datasheet/ Drawing/Job Specification	Material Test Certificate Test Reports/ Certificates Test Reports/ Certificates	P P P	R W W	R W / R W/ R	
3	IRN	TPI Inspection Reports & Inspection Release Note								P	R	

Note:

1) Material and Type shall be as per tender specification / datasheet.

P - Performance, R - Review, W - Witness, COC - Certificate of Conformance, T&C - Test & Calibration Report, H - Hold

Category: CR - Characteristics affecting safety of equipment and personnel

MA - Characteristics affecting safety of Performance

MT – Characteristics affecting safety of Appearance

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SR. NO.	EQUIPMENT	TO BE MANDATORILY DEPLOYED (Refer Note 1) (Qty in Nos.)
	MECHANICAL	
1	Dozers (Plot Development)	1
2	Back Hoe	2
3	JCB	2
4	Rock Breakers	As required
5	Side booms (10T) /Hydra (10T)	2
6	Cranes(15 – 20T)	2
7	Pipe Trailers with Prime movers	As required
8	Truck Trailers	As required
9	Pipe Bending Machines	1
10	Air Compressor with min. 300 CFM	2
11	Diesel Generators	As required
12	Welding Machines	4
13	Water Tanker	As required
14	UT Machines	As required
15	Radiography unit (Crawlers, External Unit, Dark Room and Associated Facilities)	1
16	Sand Blasting Units with Compressor	1
17	Pipeline Locators (Automatic)	As required
18	Holiday Detectors	2
19	Thrust Boring Machines	1
20	External Clamps	4
21	HDD Equipment of minimum Capacity (50 T)	1
22	Hydro testing Equipment with Test Cabin as per Spec.	As required
23	Filling pumps 100m/min	As required
24	High pressure Test Pump with Stroke	As required
25	Dozing Pump	As required
26	Mobile Workshop	As required
27	Beveling Machine	As required
28	Blowing Machine	As required
29	Splicing Unit	As required
30	OTDR Equipment	As required

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SR. NO.	EQUIPMENT	TO BE MANDATORILY DEPLOYED (Refer Note 1) (Qty in Nos.)
	CIVIL	
31	Full-Fledged Civil Lab	As required
32	Plate Compactor	As required
33	Concrete Mixer	1
34	Vibrator Machine	1
35	Road Rollers	As required
36	Cube Testing Set (6nos. Mould)	1
	ELECTRICAL	
37	Earth Resistance Tester with all Accessories	1
Notes:-		

1. All the equipment listed as above are mandatory equipment's for this projects and shall be deployed within 15 days from the date of LOA or as per direction of Owner / Owner Representative and the same cannot be de-mobilised from the site unless or until written petition from the owner is granted.

2. The equipment's indicated above are the minimum critical equipment's , which are required to be deployed by the contractor. Any additional equipment/resources required to complete the project as per schedule shall be mobilized based on the project execution plan/project schedule.

	Minimum Equipment List	**Doc No.**	
		BGL-HYD-GN-DOC-EL-001	
		Rev. 0	

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SPECIFICATION FOR HEALTH, SAFETY AND ENVIRONMENT (HSE) MANAGEMENT AT CONSTRUCTION SITES

BGL-HYD-GN-DOC-HS-001

BGL/632/2024-25

0	24.03.2024	Issued for Review				
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1.0 SCOPE

This specification establishes the health, Safety and environment (HSE) management requirement to be complied by Contractors during construction.

Requirements stipulated in this specification shall supplement the requirements of HSE management given in relevant Act (s)/legislations, General Conditions of Contract (GCC), Special Conditions of Contract (SCC) and Job (Technical) Specifications. Where different documents stipulate different requirements, the most stringent shall apply.

2.0 REFERENCES

The document should be read in conjunction with following:

- General Conditions of Contract (GCC)
  Special Conditions of Contract (SCC)
  Building and other construction workers (regulation of employment and condition of service) Act,1996
  Job (Technical) specifications
  Relevant IS Codes
  Statutory requirements

3.0 REQUIREMENTS OF HEALTH, SAFETY & ENVIRONMENT (HSE) MANAGEMENT SYSTEM TO BE COMPLIED BY BIDDERS

3.1 MANAGEMENT RESPONSIBILITY

3.1.1 HSE Policy & Objectives

The Contractor should have a documented HSE policy & objectives to demonstrate commitment of their organization to ensure health, safety and environment aspects in their line of operations.

3.1.2 Management System

The HSE management system of the Contractor shall cover the HSE requirements including but not limited to what is specified under para 1.0 and para 2.0 above.

3.1.3 Indemnification

Contractor shall indemnify & hold harmless Owner/Consultant & their representatives free from any and all liabilities arising out of non-fulfilment of HSE requirements.

3.1.4 Personnel deployment

Contractor as a minimum requirement shall designate/deploy the following persons at site:

a) Up to 250 persons - Designate one safety supervisor

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deployed by him at site

b)	For 251 to 500 persons	-	Deploy one qualified & \Experienced safety Engineer/Office in addition to Deployed by him at site the Safety Supervisor as described in (a) above.
c)	For more than 500 persons	-	Deploy an additional Safety Engineer/ Officer for every 500 Persons or part deployed by him at site thereof, in addition to (b) above.

No work will be started at site until above safety personnel are mobilized at site. The contractor shall submit a safety organogram clearly indicating the lines of responsibility, reporting system and furnish Bio-Data/Resume/Curriculum Vitae with contact details of the safety personnel he intends to mobilize, at least 1 moth before the intended mobilization.

3.1.5 Implementation & Monitoring

Contactor shall be fully responsible for planning, implementing and monitoring all HSE requirements and compliance of all laws & statutory requirements. The Contractor shall also ensure that the HSE requirements are clearly understood & faithfully implemented at all levels at site.

3.1.6 Awareness

The Contractor shall promote and develop consciousness about Health, Safety and Environment among all personnel working for the Contractor. Regular awareness programs and fabrication shop/work site meetings shall be arranged on HSE activities to cover hazards involved in various operations during construction.

3.1.7 Fire prevention & First-aid

The contractor shall arrange suitable first aid measures such as First Aid Box, trained personnel to administer First Aid, stand-by ambulance or vehicle and install fire protection measures such as: adequate number of steel buckets with sand & water and adequate number of appropriate fire extinguishers to the satisfaction of OWNER/CONSULTANT.

3.1.8 Documentation

The contractor shall evolve a comprehensive, planned and documented system for implementation and monitoring of the HSE requirements. This shall be submitted to OWNER/CONSULTANT for approval. The monitoring for implementation shall be done by regular inspections and compliance to the observations thereof. The Contractor shall get similar HSE requirements implemented at his sub-contractor(s) work site/office. However, compliance

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of HSE requirements shall be the responsibility of the Contractor. Any review/approval by OWNER/CONSULTANT shall not absolve contractor of his responsibility/liability in relation to all HSE requirements.

3.1.9 Audit

Non-Conformances on HSE by Contractor (including his sub-contractors) as brought out during review/audit by his internal audit team as well as OWNER/Consultant's representative shall be resolved forthwith by Contractor. Compliance report shall be submitted to OWNER/CONSULTANT.

3.1.10 Meetings

The Contractor shall ensure participation of his top most executive at site (viz. Resident Engineer/Site-in-Charge) in Safety committee/HSE Committee meetings arranged by OWNER/CONSULTANT. The compliance of any observations during the meeting shall be arranged urgently. He shall assist OWNER/CONSULTANT to achieve the targets set by them on HSE during the project implementation.

3.1.11 The Contractor shall adhere consistently to all provisions of HSE requirements. In case of non-compliance or repeated failure in implementation of any of the HSE provisions; OWNER/CONSULTANT may impose stoppage of work without any cost & time implication to the Owner and/or impose a suitable penalty, up to a cumulative limit of 1.0% (one percent) of the contract value with a ceiling of Rs.10 lacs (Rupees Ten Lacs only). This penalty shall be in addition to all other penalties specified elsewhere in the contract. The decision of imposing stoppage work, its extent and penalty shall rest with OWNER/CONSULTANT. The same shall be binding on the Contractor. The penalty does not make the contractor eligible to continue the work in unsafe manner.

3.2 HOUSE KEEPING

3.2.1 Contractor shall ensure that a high degree of house keeping is maintained and shall ensure interalia; the following:

All surplus earth and debris are removed/disposed off from the working areas to identified location(s). Unused/surplus cables, steel items and steel scrap lying scattered at different places within the working areas are removed to identified location(s).
All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from work place to identified location(s).
Roads shall be kept clear and materials like pipes, steel, sand, boulders, concrete, chips and bricks etc. shall not be allowed on the roads to obstruct free movement of men & machines.
Fabricated steel structural, pipes & piping materials shall be stacked properly for erection.Water logging on roads shall not be allowed.
No parking of trucks/trolleys, cranes and trailors etc. shall be allowed on roads, which may obstruct the traffic movement.
Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas.
Trucks carrying sand, earth and pulverized materials etc. shall be covered while moving within the plant area/or these materials shall be transported with top surface wet.
The contractor shall ensure that the atmosphere in plant area and on roads is free fromparticulate

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matter like dust, sand, etc. by keeping the top surface wet for ease in breathing.
At least two exits for any unit area shall be assured at all times.

3.3 HSE MEASURES

3.3.1 Construction Hazards

Contractor shall ensure that during the performance of the work, all hazards have been identified, assessed and eliminated.

A list of construction hazards along with their effects & preventive measures is given in the Annexure-V.

3.3.2 Accessibility

The Contractor shall provide safe means of access to any working place including provisions of suitable and sufficient scaffolding at various stages during all operations of the work for the safety of his workmen and OWNER/CONSULTANT.

3.3.3 Personal Protective equipment's (PPEs)

The contractor shall ensure that all their staff and workers including their sub-contractor(s)'s have been issued & wear appropriate PPEs like safety helmets, safety shoes, safety belt, full body harness, protective goggles, gloves etc. All these gadgets shall conform to applicable IS Specifications/CE or other applicable international standards.

For shot blasting, the usage of protective helmets (approved by the competent authority), gauntlet and protective clothing is mandatory.

For offshore contracts, contractor shall provide PPEs (new) to CONSULTANT & Owner's personnel at his (contractor's) cost. All personnel shall wear life jacket at all time.

3.3.4 Working at height

The contractor shall issue height permit for working above 3 meters height after verifying and certifying the checkpoints as specified in the attached permit. He shall also undertake to ensure compliance to the conditions of the permit during the currency of the permit including adherence to personal protective equipment's .

The permit shall be issued initially for one week or expected duration of an activity and extended further for the balance duration. This permit shall be applicable in areas where specific clearance from Owner's operation Department/Safety Department is not applicable. CONSULTANT field Engineers/Safety Officers/Area Coordinators may verify and sign this permit during the execution of the job.

In case work is undertaken without taking sufficient precautions as given in the permit, CONSULTANT Engineers may cancel the permit and strop the work till satisfactory compliance is arranged. Contractors are expected to maintain a register for issuance of permit and extensions thereof including preserving the used permits for verification during audits etc.

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Contractor shall arrange (at his cost) and ensure sue of Fall Arrester Systems by his workers. Fall arresters are to be used while climbing tall structures. These arresters should lock automatically against the anchorage line, restricting free fall of the user. The device is to be provided with a double security opening system to ensure safe attachment or release of the userat any point of rope. In order to avoid shock, the system should be capable of keeping the person in vertical position in case of a fall.

Contractor shall ensure that Life Lines are used by all personnel while working at height. One end of the life line shall be firmly tied with the worker and the other end with a fixed and rigid structure. The life line should be strong enough to take the load of the worker in case of a fall.

Contractor shall provide Roof Top Walk ladders for carrying out activities on sloping roofs in order to reduce the changes of slippages.

Contractor shall ensure that a proper Safety Net System is used wherever the hazard of fallfrom height is present. The safety net shall be located not more than 9.0 meters below the working surface extending on either side up to sufficient margin to arrest or to reduce the consequences of a possible fall of persons working at different heights.

3.3.5 Electrical installations

The contractor shall ensure that electrical systems and equipment including tools and tackles are properly selected, installed, used and maintained.

The contractor shall deploy qualified and licensed electricians for proper and safe installation and for regular inspection of construction power distribution lines/points including their earthing. A copy of the license shall be submitted to CONSULTANT for records.

3.3.6 Welding/Gas cutting

Contractor shall ensure that flash back arresters conforming to BS: 6158 or equivalent are installed on all gas cylinders while in use. All cylinders shall be mounted on trolleys. All welding machines shall have effective earthing. To eliminate radiation hazard, Tungsten electrodes used for Gas Tungsten Arc Welding shall not contain Thorium.

3.3.7 Ergonomics and tools & tackles

The Contractor shall assign to his workmen, tasks commensurate with their qualification, experience and state of health. All lifting tools, tackles, equipment, accessories including cranes shall be tested periodically by statutory/competent authority for their condition and load carrying capacity. Valid test and fitness certificates from the authority shall be submitted to Owner/CONSULTANT for their review/acceptance before the lifting tools, tackles, equipment, accessories and cranes are used.

Contractor shall ensure installation of Safe Load Indicator (SLI) on all cranes (while in use) to minimize overload risk. SLI shall have capability to continuously monitor and display the load on the hook, and automatically compare it with the rated crane capacity at the operating condition

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of the crane. The system shall also provide visual and audible warnings at set capacity levels to alert the operator in case of violations.

3.3.8 Occupational Health

The contractor shall identify all operations that can adversely affect the health of its workers and issue and implement mitigation measures. For surface cleaning operations, sand blasting shall not be permitted even if not explicitly stated elsewhere in the contract.

3.3.9 Hazardous substances

Hazardous and/or toxic materials such as solvent coating or thinners shall be stored in appropriate containers, which shall be labeled with the name of the materials, the hazards associated with its use and necessary precautions to be taken.

Where contact or exposure of hazardous materials/Noise pollution exceeds the specified limit or otherwise have harmful affects, appropriate personal protective equipment's such as gloves, earmuffs, goggles, aprons, chemical resistant clothing, respirator, etc. shall be used.

3.3.10 Spills

Chemical and other spills shall be contained and cleaned up immediately to prevent further contamination.

3.3.11 Radiation exposure

a) All personnel exposed to physical agents such as non-ionizing radiation, ultraviolet rays or similar other physical agents shall be provided with adequate shielding or protection commensurate with the type of exposure involved.

b) For ionizing radiation, requirements of Bhabha Atomic Research Centre (BARC) shall be followed.

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3.3.12 Road Safety

The contractor shall ensure adequately planned road transport safety management system. The vehicles shall be fitted with reverse warning alarms. The contractor shall also ensure a separate pedestrian route for safety of the workers and comply with all traffic rules and regulations.

For pipeline jobs, the contractor shall submit a comprehensive plan covering transportation of pipes, movement of side booms, movement of vehicles on the ROW, etc.

3.3.13 Welfare measures

Contractor shall at the minimum, ensure the following facilities at work sites :

A crèche where 10 or more female workers are having children below the age of 6 years.

Reasonable canteen facilities at appropriate location depending upon site conditions.

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Rest rooms (separate for male workers and female workers)
Toilets, drinking water, adequate lighting at site and labour camps, commensurate with applicable Laws/Legislation.

3.3.14 Environment Protection

Contractor shall ensure proper storage and utilization methodology of materials that are detrimental to the environment. Where required, contractor shall ensure that only the environment friendly materials are selected and emphasize on recycling of waste materials such as metals, plastics, glass, paper, oil and solvents.

For pipeline jobs, top soil shall be stacked separately while making ROW through fields. This fertile soil shall be placed back on top after backfilling.

3.3.15 Rules & Regulations

All persons deployed at site shall be knowledgeable of and comply with the environmental laws, rules and regulations relating to the hazardous materials, substances and wastes.

Contractor shall not dump, release or otherwise discharge or dispose off any such materials without the express authorization of OWNER/CONSULTANT.

3.4 TOOL BOX MEETING (TBM)

Contractor shall conduct daily TBM with workers prior to start of work and shall maintain proper record of the meeting. A suggested format is given below. The TBM is to be conducted by the immediate supervisor of the workers.

TOOL BOX MEETING RECORDING SHEET		
Date & Time		
Subject		
Presenter		
Hazards Involved		
Precautions to be taken		
Worker's Name	Signature	Section
Remarks, if any		

The topics during TBM shall include:

Hazards related to work assigned on that day and precautions to be taken.
Any forthcoming HSE hazards/events/instruction/orders, etc.

The above record can be kept in local language, which workers can read. These records shallbe made available to OWNER/CONSULTANT whenever demanded.

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3.5 TRAINING

Contractor shall ensure that all his personnel possess appropriate training to carryout the assigned job safely. The training should be imparted in a language understood by them and should specifically be trained about.

Potential hazards to which hey may be exposed at their workplace
Measures available for prevention, recurrence and elimination of these hazards

The topics during training shall cover, at the minimum:

Education about hazardous jobs and precautions required
Emergency and evacuation plan
HSE requirements
Fire fighting and First-Aid
Use of PPEs

Records of the training shall be kept and submitted to OWNER/CONSULTANT whenever demanded.

For off-shore and jetty jobs, contractor shall ensure that all personnel deployed have undergone structured training on swimming, use of lifeboats, basket landing, etc.

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3.6 INSPECTION/AUDIT

The contractor shall carry out daily HSE inspection and record observations at a centrallocation. These inspection records shall be freely accessible to Owner/CONSULTANT representatives. He shall also carry out internal HSE audits as well as cooperate during HSE audits by Owner/CONSULTANT, which will be at least two times during the project executionperiod.

4.0 DETAILS OF HSE MANAGEMENT SYSTEM BY CONTRACTOR

4.1 ON AWARD OF CONTRACT

The Contractor shall submit a comprehensive Health, Safety and Environment manual or procedure and HSE Plans for approval by OWNER/CONSULTANT prior to start of work. The Contractor shall participate in the pre-start meeting with OWNER/CONSULTANT to finalize HSE Plans including the following:

Job procedure to be followed by Contractor for activities covering handling of equipment's , scaffolding, electric installations, etc. describing the risks involved, actions to be taken and methodology for monitoring each activity.
OWNER/CONSULTANT review/audit requirement.
Organization structure along with responsibility and authority, records/reports etc. on HSE activities.
Procedures for reporting and investigation of accidents and near misses
HSE Training programmes.
Reference to Rules, Regulations and Statutory requirements.
HSE reports.

4.2 DURING JOB EXECUTION

4.2.1 Contractor shall implement approved Health, Safety and Environment management procedure/plan/manual including but not limited to as brought out under Para 3.0. Contractor shall also ensure :

to arrange workmen compensation insurance, registration under ESI Act, third party liability insurance etc., as applicable

to arrange all HSE permits before start of activities (as applicable), like permits for hot work, confined space, working at heights, storage of chemical/explosive materials and its use and implement all precautions mentioned therein. In this regard, requirements of Oil industry Safety Directorate Standard No. Std-105 "Work Permit Systems" shall be complied with while working in existing plants.

to submit, timely, the completed checklist on HSE activities Monthly HSE report, accident reports, investigation reports etc. as per OWNER/CONSULTANT requirements. Compliance of instructions on HSE shall be done by Contractor and informed urgently to OWNER/CONSULTANT.

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That his top most executive at site attends all the Safety Committee/HSE meetings arranged by OWNER/CONSULTANT. Only in case of his absence from site that a second senior most

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person shall be nominated by him, in advance, and communicated to OWNER/CONSULTANT.

Display at site office and work locations caution boards, list of hospitals, emergency services available, etc.

Provide posters, banners for safe working to promote safety consciousness.
Assess, analyze and mitigate the construction hazards.
Carryout audits/inspection at his works as well as sub contractor works as per approved HSE document and submit the reports for OWNER/CONSULTANT review.
Assistance and cooperation during HSE audits by OWNER/CONSULTANT, and submit compliance report.
Generation and submission of HSE records/report as per HSE Plan. And this specification.
Apprise OWNER/CONSULTANT on HSE activities at site.
Carryout all dismantling activities safely, with prior approval of OWNER/CONSULTANT representative.

1.0 RECORDS

The contractor shall maintain/submit HSE records in the following reporting formats:

1. Monthly HSE checklist cum compliance report Accident/Fire report
   Supplementary Accident & Investigation report
2. Monthly HSE report
3. Permit for working above 3 mete height
4. HSE Plan

IS – CODES FOR HSE

SP:53	Safety code for the use, Care and protection of hand operated tools.
IS: 816	Code of practice for safety and health requirements in electric and gas welding and cutting operations
IS: 1179	Eye and Face precautions during welding, equipment etc.
IS: 1860	Safety requirements for use, care and protection of abrasive grinding wheels.
IS: 1989(Part–I & II)	Leather safety boots and shoes
IS: 2925	Industrial Safety Helmets
IS: 3016	Code of practice for fire safety precautions in welding and cutting operations.
IS: 3043	Code of practice for earthing.
IS: 3521	Industrial Safety belts and harness.
IS: 3738	Rubber boots.
IS: 3996	Safety Code of scaffolds and ladders.
IS: 4770	Rubber gloves for electrical purposes
IS: 5216 (Part-I	Recommendations on Safety procedures and practices in electrical works
IS: 5557	Industrial and Safety rubber lined boots.

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IS: 5983	Eye protectors
IS:6519	Selection, care and repair of Safety footwear
IS: 6994 (Part-I)	Industrial Safety Gloves (Leather & Cotton Gloves)

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IS: 7293	Safety Code for working with construction Machinery
IS: 9167	Ear protectors
IS: 11006	Flash back arrestor (Flame arrestor)
IS:11016	General and safety requirements for machine tools and their operation
IS: 11226	Leather safety footwear having direct moulded rubber sole
IS: 11972	Code of practice for safety precaution to be taken when entering a sewerage system
IS: 13367	Code of practice-safe use of cranes
IS: 13416	Recommendations for preventive measures against hazards at working place

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ANNEXURE - II

DETAILS OF FIRST AID BOX

SL.NO.	DESCRIPTION	*QUANTITY*
1.	Small size Roller Bandages, 1 inch wide (Finger Dressing small)	6 Pcs.
2.	Medium size Roller Bandages, 2 inch wide (Hand and Foot Dressing)	6 Pcs.
3.	Large size Roller Bandages, 4 inch wide (Body Dressing Large)	6 Pcs.
4.	Large size Burn Dressing (Bun Dressing Large)	4 Pkts.
5.	Cotton wool (20 gms packing)	4 Pkts.
6.	Antiseptic Solution Dettol (100 ml.) or Savalon	1 Bottle
7.	Mercurochrome Solution (100 ml.) 2% in water	1 Bottle
8.	Sal-volatile (20 ml. Ammonia)	1 Bottle
9.	A Pair of Scissor	1 Piece
10.	Adhesive Plaster (1.25 cm x 5 m)	1Spool
11.	Eye pads in Separate Sealed Packet	4 Pcs.
12.	Tourniquet	1 No.
13.	Safety Pins	1 Dozen
14.	Tine IODINE (100 ml.)	1 Bottles
15.	Ointment for burns (Burnol 20 gms.)	1 Bottole
16.	Polythene Wash cup for washing eyes	1 No.
17.	Potassium Permanganate (20 gms.)	1 Pkt.
18.	Tinc. Benzoine (100 ml.)	1 Bottole
19.	Triangular Bandages	2 Nos.
20.	Band Aid Dressing	5 Pcs.
21.	Iodex (25 gms.)	1 Bottole
22.	Tongue Depressor	1 No.
23.	Boric Acid Powder (20 gms.)	2 Pkt.
24.	Sodium Bicarbonate (20 gms.)	1 Pkt.
25.	Dressing Powder (Nebasulf) (10 gms.)	1 Bottole
26.	Medicinal Glass	1 No.
27.	Duster	1 No.
28.	Booklet (English & Local Language)	1 No. each
29.	Soap	1 No.
30.	Toothache Solution	1 No.
31.	Eye Ointment	1 Bottle
32.	Vicks (22 gms.)	1 Bottle
33.	Forceps	1 No.
34.	Cottom Buds (5 nos.)	1 Pkt.
35.	Note Book	1 No.
36.	Splints	4 Nos.
37.	Lock	1 Piece
38.	Life Saving/Emergency/Over-the Counter Drugs	As decided at site
	NOTE : Type of Box Size	Aluminum 14" x 12" x 4"

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Annexure-III

TYPES OF FIRE EXTINGUISHERS AND THEIR APPLICATION

	CARBON DIOXIDE	DRY CHEMICAL				WATER TYPE				FOAM
		SODIUM POTASSIUM BICARBONATE		MULTI PURPOSE A B C						
	CO2	CARTRIDGE OPERATED	STORED PRESURE	STORED PRESSURE	CARTRIDGE OPERATED	STORED PRESSURE	CARTRIDGE OPERATED	WATER PUMP TANK	SODA ACID	FOAM
CLASS A FIRES WOOD PAPER TRASH HAVING GLOWING EMBERS	x	X	x	_/	_/	_/	_/	_/	_/	_/
	(BUT CAN CONTROL MINOR SURFACE FIRES)									
CLASS B FIRES FLAMMABLE LIQUIDS GASOLINE OIL PAIN GRASE ETC.	_/	_/	_/	_/	_/	X	X	X	X	_/
CLASS C FIRES ELECTRICAL EQUIPMENT	_/	_/	_/	_/	_/	X	X	X	X	X

LEGEND : _/ : CAN BE USED
X : NOT TO BE USED

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ANNEXURE-19

INDICATIVE LIST OF STATUTORY ACTS & RULES

Indian Explosives Act, 1984
The Motor Vehicles Act, 1988
The Factories Act, 1949
The Petroleum Act, 2002
Workmen Compensation 'act
Static/Mobile Pressure Vessel Act
Indian Electricity Act
Indian Boiler Act, 1923
Water (Prevention & Control Pollution) Act, 1974
Water (Prevention & Control of Pollution) Cess Act-1977
The Mines & Minerals (Regulation & Development) Act-1947
The Air (Prevention & control of Pollution) Act-1981
The Atomic Energy Act-1962
The Radiation Protection Rules-1971
The Indian Fisheries Act-1954
The Indian Forest Act-1927
The Wild Life (Protection) Act-1972
The Environment (Protection) Act-1986
The Environment (Protection) Rules-1986
The Hazardous Wastes (Management & Handling) Rules-1989
The Manufacture, Storage & Import of Hazardous Chemicals Rules-1989
The Central Motor Vehicles Rules-1989
The Building and Other Construction Workers (Regulation of Employment and Condition of Service) Act, 1996

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ANNEXURE-V

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES

ACTIVITY	*TYPE OF HAZARD*	EFFECT OF HAZARD	PREVENTIVE MEASURES
(A) EXCAVATION • Pif Excavation up to 3.0m	➢ Falling into pit	➢ Personal injury	➢ Provide guard rails/barricade with warning signal. ➢ Provide at least two entries/exits. ➢ Provide escape ladders.
	➢ Earth Collapse	➢ Suffocation/ Breathlessness ➢ Buried	➢ Provide suitable size of shoring and strutting, if required. ➢ Keep soil heaps away from the edge equivalent to 1.5m or depth of pit whichever is more. ➢ Don't allow vehicles to operate too close to excavated areas. Maintain at least 2m distance from edge of cut. ➢ Maintain sufficient angle of repose. Provide slope not less than 1:1 and suitable bench of 0.5m width at every 1.5m depth of excavation in all soils except hard rock. ➢ Battering/benching the sides.
	➢ Contact with buried electric cables ➢ Gas/Oil Pipelines	➢ Electrocution ➢ Explosion	➢ Obtain permission from competent authorities, prior to excavation, if required. ➢ Locate the position of buried utilities by referring to plant drawings. ➢ Start digging manually to locate the exact position of buried utilities and thereafter use mechanical means.
• Pit Excavation beyond 3.0m	➢ Same as above plus ➢ Flooding due to excessive	➢ Can cause drowning situation	➢ Prevent ingress of water ➢ Provide ring buoys ➢ Identify and provide suitable size dewatering pump or well point system

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ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	rain/ underground water		
	➢ Digging in the vicinity of existing Building/ Structure	➢ Building/Structure may collapse ➢ Loss of health & wealth	➢ Obtain prior approval of excavation method from local authorities ➢ Use under-piping method ➢ Construct retaining wall side by side
	➢ Movement of vehicles/ equipments close to the edge of cut.	➢ May cause cave-in or slides ➢ Persons may get buried	➢ Barricade the excavated area with proper lighting arrangements ➢ Maintain at least 2m distance from edge of cut ➢ Strengthen shoring and strutting
• Narrow deep excavations for pipelines, etc.	➢ Same as above plus ➢ Frequent cave-in or slides	➢ May cause severe injuriesor prove fatal	➢ Battering/benching of sides ➢ Provide escape ladders
	➢ Flooding due to Hydro testing	➢ May arise drowning situation	➢ Same as above plus ➢ Bail out accumulated water ➢ Maintain adequate ventilation
• Rock excavation by blasting	➢ Improper handling of explosives	➢ May prove fatal	➢ Ensure proper storage, handling & carrying of explosives by trained personnel. ➢ Comply with the applicable explosive acts & rules.
	➢ Uncontrolled explosion	➢ May cause severe injuriesor prove fatal	➢ Allow only authorized persons to perform blasting operations. ➢ Smoking and open flames are to be strictly prohibited.
	➢ Scattering of stone pieces in atmosphere	➢ Can hurt people	➢ Use PPE like goggles, face mask, helmets etc.
• Rock excavating by blasting (Contd)	➢ Entrapping of persons/animals.	➢ May cause severe injuriesor prove fatal	➢ Barricade the area with red flags and blow siren before blasting.
	➢ Misfire	➢ May explode suddenly	➢ Do not return to site for at least 20 minutes or unless announced safe by

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ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			designated person.
• Piling Work	➢ Failure of pile-driving equipment	➢ Can hurt people	➢ Inspect Piling rigs and pulley blocks before the beginning of each shift.
	➢ Noise pollution	➢ Can cause deafness and psychological imbalance.	➢ Use personal protective equipment's like ear plugs, muffs, etc.
	➢ Extruding rods/casing	➢ Can hurt people	➢ Barricade the area an install sign boards ➢ Provide first-aid
	➢ Working in the vicinity of 'Live-Electricity'	➢ Can cause electrocution / asphyxiation	➢ Keep sufficient distance from Live-Electricity as per IS code. ➢ Shut off the supply, if possible ➢ Provide artificial/rescue breathing to he injured.
(B) CONCRETING	➢ Air pollution by cement	➢ May affect Respiratory System	➢ Wear respirators or cover mouth and nose with wet cloth.
	➢ Handling of ingredients	➢ Hands may get injured	➢ Use gloves and other PPE.
	➢ Protruding reinforcement rods.	➢ Feet may get injured	➢ Use Safety shoes. ➢ Provide platform above reinforcement for movement of workers.
	➢ Earthing of electrical mixers, vibrators, etc. not done	➢ Can cause electrocution / asphyxiation	➢ Ensure earthing of equipment's and proper functioning of electrical circuit before commencement of work.
	➢ Falling of materials from height	➢ Persons may get injured	➢ Use hard hats ➢ Remove surplus material immediately from workplace ➢ Ensure lighting arrangements during night hours.
	➢ Continuous pouring by same gang	➢ Cause tiredness of workers and may lead to	➢ Insist on shift pattern ➢ Provide adequate rest to workers between subsequent pours.

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ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
		accident.	
	➢ Revolving or concrete mixer/ vibrators	➢ Parts of body or clothes may get entrapped.	➢ Allow only mixers with hopper ➢ Provide safety cages around moving motors ➢ Ensure proper mechanical locking of vibrator
• Super-structure	➢ Same as above plus ➢ Deflection in props or shuttering material	➢ Shuttering/p rops ma collapse and prove fatal	➢ Avoid excessive stacking on shuttering material ➢ Check the design and strength of shuttering material before commencement of work ➢ Rectify immediately the deflection noted during concreting
	➢ Passage to work place	➢ Improperly tied and designed props/planks may collapse	➢ Ensure the stability and strength of passage before commencement of work ➢ Do not overload and stand under the passage
(C) REINFORCEMENT	➢ Curtailment and binding of rods	➢ Persons may get injured	➢ Use PPE like gloves, shoes, helmets, etc. ➢ Avoid usage of shift tools
	➢ Carrying of rods for short distance/at heights	➢ Workers may get injured their hands and shoulders.	➢ Provide suitable pads on shoulders and use safety gloves ➢ Tie up rods in easily liftable bundles ➢ Ensure proper staging.
	➢ Checking of clear distance/c over with hands	➢ Rods maycut or injure the finger	➢ Use measuring devices like tape, measuring rods, etc.
	➢ Hitting projected rods and standing on cantilever rods	➢ Persons may get injured and fell down	➢ Use safety shoes and avoid standing unnecessarily on cantilever rods ➢ Avoid wearing of loose clothes
	➢ Falling of material from height	➢ May prove fatal	➢ Use helmets ➢ Provide safety nets
	➢ Transport	➢ Protruded	➢ Use red flags/lights at the

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ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	ation of rods by trucks	rods may hit the persons	ends ➢ Do not protrude the rods in front of or by the side of driver's cabin. ➢ Do not extend the rods 1/rd of deck length or 1.5 m which is less
(D) WELDING AND GAS CUTTING	➢ Welding radiates invisible ultraviolet and infrared rays	➢ Radiation can damage eyes and skin.	➢ Use specified shielding devices and other PPE of correct specifications ➢ Avoid throated tungsten electrodes for GTAW
	➢ Improper placement of oxygen and acetylene cylinders	➢ Explosion may occur	➢ Move out any leaking cylinder ➢ Keep cylinder in vertical position ➢ Use trolley for transportation of cylinders and chain them ➢ Use flash back arrestors
	➢ Leakage/cuts in hoses	➢ May cause fire	➢ Purge regulators immediately and then turn off ➢ Never use grease or oil on oxygen line connections and copper fittings on acetylene lines ➢ Inspect regularly gas carrying hoses ➢ Use the current for which the cable is designed ➢ Always use red hose for acetylene and other fuel gases and black for oxygen
	➢ Opening-up of cylinder	➢ Cylinder may burst	➢ Always stand back from the regulator while opening the cylinder ➢ Turn valve slowly to avoid bursting ➢ Cover the lug terminals to prevent short circuiting.
	➢ Welding of tanks, container or pipes storing	➢ Explosion may occur	➢ Empty them before welding ➢ Never attach the ground cable to tanks, container or pipe storing flammable liquids

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ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	flammable liquids		➢ Never use LPG for gas cutting
(E) RADIOGRAPHY	➢ Ionizing radiation	➢ Radiations may react with the skin and can cause cancer, skin irritation, dermatitis, etc.	➢ Ensure safety regulations as per BARC before commencement of job. ➢ Cordon off the area and install Radiation warning symbols ➢ Restrict the entry of unauthorized persons ➢ Wear appropriate PPE and film bagdges issued by BARC
	➢ Transportation and Storage of Radiography source	➢ Same as above	➢ Never touch or handle radiography source with hands ➢ Store radiography source inside a pit in an exclusive isolated storage room with lock and key arrangement. The pit should be approved by BARC ➢ Radiography source should never be carried either in passenger bus or in a passenger compartment of trains. ➢ BARC have to be informed before source movement. ➢ Permission from Director General of Civil Aviation is required for booking radio isotopes with airlines.
	➢ Loss of Radio isotope	➢ Same as above	➢ Try to locate with the help of Survey Meter ➢ Inform BARC(*)
(F) ELECTRICAL INSTALLATION AND USAGE	➢ Short circuiting	➢ Can Cause Electrocution or Fire	➢ Use rubberized hand gloves and other PPE ➢ Don't lay wires under carpets, mats or door ways. ➢ Allow only licensed electricians to perform on electrical facilities ➢ Use one socket for one appliance ➢ Ensure usage of only fully insulated wires or cables ➢ Don't place bare wire ends in a socket

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ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			➢ Ensure earthing of machineries and equipment's ➢ Do not use damaged cords and avoid temporary connections ➢ Use spark-proof/flame proof type field distribution boxes. ➢ Do not allow open/bare connections ➢ Provide all connections through ELCB ➢ Protect electrical cables/equipment's from water and naked flames ➢ Check all connections before energizing
	➢ Overloading of Electrical System	➢ Bursting of system can occur which leads to fire	➢ Display voltage and current ratings prominently with 'Danger' sings. ➢ Ensure approved cable size, voltage grade and type ➢ Switch off the electrical utilities when not in use ➢ Do not allow an unauthorized connections ➢ Ensure proper grid wise distribution of Power.
	➢ Improper laying of overhead and underground transmission lines/cables	➢ Can cause electrocution and prove fatal	➢ Do not lay unarmored cable directly on ground, wall,roof of trees ➢ Maintain at least 3m distance from HT cables ➢ All temporary cables should be laid at least 750 mm below ground on 100 mm fine sand overlying by brick soling ➢ Provide proper sleeves at crossings/intersections ➢ Provide cable route markers indicating the type anddepth of cables at intervals not exceeding 30m and at the diversions/termination.
(G) FIRE PREVENTION AND PROTECTION	➢ Small fires can become big ones	➢ Cause burn injuries and may prove fatal	➢ In case a fire breaks out, press fire alarm system and shout "Fire, Fire" ➢ Keep buckets full of sand &

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ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	and may spread to the surroundi ng areas		water/fire extinguishing equipment near hazardous locations ➢ Confine smoking to 'Smoking Zones' only ➢ Train people for using specific type of fire equipment's under different classes of fire ➢ Keep fire doors/ shutters, passages and exit doors unobstructed ➢ Maintain good housekeeping and first-aid boxes (for detail refer Annex-2) ➢ Don't obstruct assess to f ➢ Fire extinguishers ➢ Do not use elevators for evacuation during fire ➢ Maintain lightening arrestors for elevated structures
	➢ Improper selection of Fire extinguish ers	➢ It may not extinguish the fire	➢ Ensure usage of correct fire extinguisher meant for the specified fire (for details refer Annexure-III) ➢ Do not attempt to extinguish Oil and electric fires with water. Use foam cylinders/CO2/sand or earth.
	➢ Improper storage of highly inflamma ble substances	➢ Same as above	➢ Maintain safe distance of flammable substances from source of ignition ➢ Restrict the distribution of flammable materials to only min. necessary amount ➢ Construct specifically designed fuel storage facilities ➢ Keep chemicals in cool and dry place away from hat. Ensure adequate ventilation ➢ Before welding operation, remove or shield the flammable material properly ➢ Store flammable materials in stable racks, correctly labelled

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ACTIVITY	***TYPE OF HAZARD***	**EFFECT OF HAZARD**	**PREVENTIVE MEASURES**
			➢ Wipe off the spills immediately
	➢ Short circuiting of electrical system	➢ Same as above ➢ Can cause Electrocution	➢ Don't lay wires under carpets, mats or door ways ➢ Use one socket for one appliance ➢ Use only fully insulated wires or cables ➢ Do not allow open/bare connections ➢ Provide all connections through ELCB ➢ Ensure earthing of machineries and equipment's
(H) VEHICULAR MOVEMENT	➢ Crossing the Speed Limits (Rash driving)	➢ Personal injury	➢ Obey speed limits and traffic rules strictly ➢ Always expect the unexpected and be a defensive drive ➢ Use sat belts/helmets ➢ Blow horn at intersections and during overtaking operations. ➢ Maintain the vehicle in good condition ➢ Do not overtake on curves, bridges and slopes
	➢ Adverse weather condition	➢ Same as above	➢ Read the road ahead and ride to the left ➢ Keep the wind screen and lights clean ➢ Do not turn at speed ➢ Recognize the hazard, understand the defense and act correctly in time.
	➢ Consuming alcohol before and during the driving operation	➢ Same as above	➢ Alcohol and driving do not mix well. Either choose alcohol or driving. ➢ If you have a choice between hitting a fixedobject or an on-coming vehicle, hit the fixed object ➢ Quit the steering at once and become a passenger. Otherwise take sufficient rest and then drive. ➢ Do not force the driver to drive fast and round theclock

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ACTIVITY	***TYPE OF HAZARD***	**EFFECT OF HAZARD**	**PREVENTIVE MEASURES**
			➢ Do not day dram while driving
	➢ Falling objects/ Mechanical failure	➢ May prove fatal	➢ Ensure effective braking system, adequate visibility for the drives, reverse warning alarm ➢ Proper maintenance of the vehicle as per manufacturer instructions
(I) PROOF TESTING (HYDROSTATIC/ PNEUMATIC TESTING	➢ Bursting of piping ➢ Collapse of tanks ➢ Tanks flying off	➢ May cause injury and prove fatal	➢ Prepare test procedure & obtain CONSULTANT/ Owner's approval ➢ Provide separate gauge for pressurizing pump and piping/equipment ➢ Check the calibration status of all pressure gauges, dead weight testers and temperature recorders ➢ Take dial readings atsuitable defined intervals and ensure most of them fall between 40-60% of the gauge scale range ➢ Provide safety relief valve (set at pressure slightly higher than test pressure) while testing with air/nitrogen ➢ Ensure necessary precautions, stepwise increase in pressure, tightening of bolts/ nuts, grouting, etc. before and during testing ➢ Keep the vents open before opening any valve while draining out of water usedfor hydro testing of tanks ➢ Pneumatic testing involves the hazard of released energy shored in compressed gas. Specific care must therefore be taken to minimize the chance of brittle failure during a pneumatic leak test. Test temperature is important in this regard and must be

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ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			considered when the designer chooses thematerial of construction ➢ A pressure relief device shall be provided, having a set pressure not higher than the test pressure plus the lesser of 345 KPa (50 psi) or 10% of he test pressure.
(J) WORKING AT HEIGHTS	➢ Person can fall down	➢ May sustain severe injuries or prove fatal	➢ Provide guard rails/barricade at the work place ➢ Use PPE like safety belts,full body harness, life line, helmets, safety shoes, etc. ➢ Obtain a permit before starting the work at height above 3 meters ➢ Fall arrest systems likesafety nets, etc. must be installed ➢ Provide adequate working space (min. 0.6 m) ➢ Tie/weld working platform with fixed support ➢ Use roof top walk ladder while working on a slopping roofs ➢ Avoid movement on beams
	➢	➢ May hit the scrap/ material stacked at the ground or in between	➢ Keep the work place neat and clean ➢ Remove the scrap immediately
	➢ Material can fall down	➢ May hit the workers working at lower levels and provide fatal	➢ Same as above plus ➢ Do not throw or drop material or equipment from height ➢ All tools to be carried in a tool-kit bags or on working uniform ➢ Remove scrap from the planks ➢ Ensure wearing of helmet by the workers at low level
(K) CONFINED	➢ Suffocatio n/	➢ Unconscious ness, death	➢ Use respiratory devices, if required

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ACTIVITY	***TYPE OF HAZARD***	**EFFECT OF HAZARD**	**PREVENTIVE MEASURES**
SPACES	drowning		➢ Avoid over crowding inside a confined space ➢ Provide Exhaust Fans for ventilation ➢ Do not weal loose clothes, neck ties, etc. ➢ Check for presence of hydrocarbons, O2 level ➢ Obtain work permit before entering a confined space ➢ Ensure that the connected piping of the equipment which is to be opened is pressure free, fluid has been drained, vents are open and piping is positively isolated by a blind flange
	➢ Presence of foul smell and toxic substances	➢ Inhalation can pose threat to life	➢ Same as above plus ➢ Check for hydrocarbon and Aromatic compounds before entering a confined space ➢ Depute one person outside the confined space for continuous monitoring and for extending help in case of an emergency
	➢ Ignition/flame can cause fire	➢ Person may sustain burn injuries or explosion may occur	➢ Keep fire extinguishers at a hand distance ➢ Remove surplus material and scrap immediately ➢ Do not smoke inside a confined space ➢ Do not allow gas cylinders inside a confined space ➢ Use low voltage (24V)lamps for lighting ➢ Use tools with air motors or electric tools with max. voltage of 24V ➢ Remove all equipment's at the end of the day
(L) HANDLING AND LIFTING EQUPMENTS	➢ Failure of load lifting and moving equipments	➢ Can cause accident and prove fatal	➢ Avoid standing under the lifted load and within the operating radius of cranes ➢ Check periodically oil, brakes, gears, horns and tyre pressure of all moving machinery ➢ Check quality, size and

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ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			condition of all chain pulley blocks, slings, U-clamps, D-shackles, wire ropes, etc. ➢ Allow crane to move onlyon hard, firm and levelled ground ➢ Allow lifting slings as short as possible and check gunny packing at the friction points ➢ Do not allow crane to tilt its boom while moving ➢ Install Safe Load Indicator
	➢ Overloading of lifting equipments	➢ Same as above	➢ Safe lifting capacity of derricks and wincheswritten on them shall be got verified. ➢ The max safe working load shall be marked on all lifting equipment's ➢ Check the weight of columns and other heavy items painted on them and accordingly decide about eh crane capacity, boom and angle of erection ➢ Allow only trained operators and riggers during crane operation
	➢ Overhead electrical wires	➢ Can cause electrocution and fire	➢ Do not allow boom or other parts of crane to come within 3 m reach of overhead HT cables ➢ Hook and load being lifted shall preferably remain in full visibility of crane operator.
(M) SCAFFOLDING, FORMWORK AND LADDERS	➢ Person can fall down	➢ Person may sustain severe injuries and prove fatal	➢ Provide guard rails for working at height ➢ Face ladder while climbing and use both hands ➢ Ladders shall extend about 1m above landing for easy access and tying up purpose ➢ Do not place ladders against movable objects and maintain base at ¼ unit of the working length of the ladder

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ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			➢ Suspended scaffolds shallnot be less than 500 mm wide and tied properly with ropes ➢ No loose planks shall be allowed ➢ Use PPE, like helmets,safety shoes, etc.
	➢ Failure of scaffoldin g material	➢ Same as above	➢ Inspect visually all scaffolding materials for stability and anchoring with permanent structures. ➢ Design scaffolding for max. load carrying capacity ➢ Scaffolding planks shall not be less than 50x250 mm full thickness lumber or equivalent. These shall be cleared or secured and must extend over the end supports by at least 150mm and not more that 300 mm ➢ Don't overload the scaffolds ➢ Do not splice short ladders to make a longer one. Vertical ladders shall not exceed 6m.
	➢ Material can fall down	➢ Persons working at lower level gets injured	➢ Remove excess material and scrap immediately ➢ Carry the tools in a tool-kit bag only ➢ Provide safety nets
(N) STRUCTURAL WORKS	➢ Personal Negligence and danger of fall	➢ Can cause injury or casualty	➢ Do not take rest inside rooms built for welding machines or electrical distribution system ➢ Avoid walking on beams at height ➢ Wear helmet with chin strap and safety belts when working at height ➢ Use hand gloves andgoggles during grinding operations ➢ Cover or mark the sharp and projected edges ➢ Do not stand within the operating radius of cranes
	➢ Lifting/sli-	➢ Same as	➢ Do not stand under the lifted

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ACTIVITY	***TYPE OF HAZARD***	**EFFECT OF HAZARD**	**PREVENTIVE MEASURES**
	pping of material	above	load ➢ Stack properly all the materials. Avoid slippage during handling ➢ Control longer pieces lifted up by cranes from both ends ➢ Remove loose materials from height ➢ Ensure tightening of all nuts and bolts
(O) PIPELINE WORKS	➢ Erection/ lowering failure	➢ Can cause injury	➢ Do not stand under the lifted load ➢ Do not allow any person to come within the radii of the side boom handling pipes ➢ Check the load carrying capacity of the lifting tools and tackles ➢ Use safe Load Indicators ➢ Use appropriate PPEs
	➢ Other	➢ Same as above	➢ Wear gum boots in marshy areas ➢ Allow only one person to perform signalling operations while loweringof pipes ➢ Provide night caps on pipes ➢ Provide end covers on pipes for stoppage of pigs while testing/cleaning operations

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MONTHLY HSE CHECKLIST CUM COMPLIANCE REPORT

PROJECT : ……. CONTRCTOR: ……..…….

DATE : ……. OWNER : ……...

INSPECTED BY: …….

Note: Write 'NA' wherever the item is not applicable.

MONTHLY HSE CHECKLIST CUM COMPLIANCE REPORT

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
1	**HOUSEKEEPING**				
a)	Waste containers provided and used				
b)	Sanitary facilities adequate and clean				
c)	Passageways and Walkways clear				
d)	General neatness of working areas				
e)	Others				
2	**PERSONNEL PROTECTIVE EQUIPMENT**				
a)	Goggles; Shields				
b)	Face protection				
c)	Hearing protection				
d)	Safety shoes				
e)	Hand protection				
f)	Respiratory Masks etc.				
g)	Safety Belts				
h)	Safety Helmet/Hard Hat				
I)	Others				
3	**EXCAVATIONS/OPENINGS**				
a0	Openings properly covered or barricaded				
b)	Excavations shored				
c)	Excavations barricaded				
d)	Overnight lighting provided				
e)	Others				
4	**WELDING & GAS CUTTING**				
a)	Gas cylinders chained upright				
b)	Cables and hoses not obstructing				
c)	Screens or shields used				
d)	Flammable materials protected				
e)	Fire extinguisher(s) accessible				
f)	Others				
5	**SCAFFOLDING**				
a)	Fully decked platforms				
b)	Guard and intermediate rails in place				
c)	Toe boards in place				

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MONTHLY HSE CHECKLIST CUM COMPLIANCE REPORT

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
d)	Adequate shoring				
e)	Adequate access				
f)	Others				
6	**LADDERS**				
a)	Extension side rails 1m above				
b)	Top of landing				
c)	Properly secured				
d)	Angle $\pm$ 70 from horizontal				
e)	Others				
7	**HOISTS, CRANES AND DERRICKS**				
a)	Condition of cables and sheaves OK				
b)	Condition of slings, chains, hooks and eyes OK				
c)	Inspection and maintenance logs maintained				
d)	Outriggers used				
e)	Signs/barricades provided				
f)	Signals observed and understood				
g)	Qualified operators				
h)	Others				
8	**MACHINERY, TOOLS AND EQUIPMENT**				
a)	Proper instruction				
b)	Safety devices				
c)	Proper cords				
d)	Inspection and maintenance				
e)	Others				
9	**VEHICLE AND TRAFFIC**				
a)	Rules and regulations observed				
b)	Inspection and maintenance				
c)	Licensed drivers				
d)	Others				
10	**TEMPORARY FACILITIES**				
a)	Emergency instructions posted				
b)	Fire extinguishers provided				
c)	Fire-aid equipment available				
d)	Secured against storm damage				
e)	General neatness				
f)	In accordance with electrical requirements				
g)	Others				
11	**FIRE PREVENTION**				
a)	Personnel instructed				
b)	Fire extinguishers checked				
c)	No smoking in Prohibited Areas				
d)	Hydrants Clear				
e)	Others				
12	**ELECTRICAL**				
a)	Use of 3-core armoured cables				

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MONTHLY HSE CHECKLIST CUM COMPLIANCE REPORT

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
b)	Usage of 'All insulated' or 'double insulated' electrical tools				
c)	All electrical connection are routed through ELCB				
d)	Natural Earthing.				

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MONTHLY HSE CHECKLIST CUM COMPLIANCE REPORT

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
	at the source of power (main DB)				
e)	Continuity and tightness of earth conductor				
f)	Covering of junction boxes, panels and other energized wiring places				
g)	Ground fault circuit interrupters provided				
h)	Prevention of tripping hazards				
I)	Others				
13	**HANDLING AND STORAGE OF MATERIALS**				
a)	Properly stored or stacked				
b)	Passageways clear				
c)	Others				
14	**FLAMMABLE GASES AND LIQUIDS**				
a)	Containers clearly identified				
b)	Proper storage				
c)	Fire extinguishers nearby				
d)	Others				
15	**WORKING AT HEIGHT**				
a)	Erection plan and work permit obtained				
b)	Safety nets				
c)	Safety belts, full body harness and lanyards; chute lines				
d)	Others				
16	**CONFINED SPACE**				
a)	Work permit obtained				
b)	Test for toxic gas and sufficient availability of oxygen conducted				
c)	At least one person outside the confined space for monitoring deputed				
d)	Availability of sufficient means of entry, exit and ventilation				
e)	Fire extinguishers and first-aid facility ensured				
f)	Lighting provision made by using 24V lamps				
g)	Proper usage of PPEs ensured				
17	**RADIOGRAPHY**				
a)	Proper storage and handling of source as per BARC guidelines				
b)	Working permit obtained				
c)	Cordoning of the area done				
d)	Use of appropriate PPE's ensured				
e)	Proper training to workers/supervisors imparted				

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MONTHLY HSE CHECKLIST CUM COMPLIANCE REPORT

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
f)	Minimum occupancy of workplace ensured				
18	**HEALTH CHECKS**				
a)	Hygienic conditions at labour camps OK?				
b)	Availability of First-aid facilities				
c)	Proper sanitation at site, office and labour camps				
d)	Arrangement of medical facilities				
e)	Measures for dealing with illness				
f)	Availability of Portable drinking water for workmen & staff				
g)	Provision of crèches for children				
19	**ENVIRONMENT**				
a)	Chemical and other effluents properly disposed				
b)	Cleaning liquid of pipes disposed off properly				
c)	Seawater used for hydro-testing disposed off as per agreed procedure				
d)	Lubricant Waste/Engine oils properly disposed				
e)	Waste from Canteen, offices, sanitation etc. disposed properly				
f)	Disposal of surplus earth, stripping materials, oily rags and combustible materials done properly				
g)	Green belt protection				

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ACCIDENT / FIRE REPORT

(To be submitted by Contractor after every accident within 24 hours of accident)

Report: …….

Name of Site Date: …….

NAME OF THE INJURED
FATHER'S NAME
SUB-CONTRACTOR M/S.
DATE & TIME OF ACCIDENT
LOCATION

BRIEF DESCRIPTION OF ACCIDENT

CAUSE OF ACCIDENT

NATURE OF INJURY/DAMAGE

MEDICAL AID PROVIDED/ACTIONS TAKEN

INTIMATION TO LOCAL AUTHORITIES

DATE: **SIGNATURE OF CONTRACTOR**
WITH SEAL

CONSULTANT HO Constn. Through RCM 3 COIES
Proj.Mgr. CONSULTANT, Through RCM 1 COPY

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TO : OWNER 1 COPY
RCM/SITE-IN-CHARGE CONSULTANT 1 COPY

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CONSULTANT HO Constn. Through RCM 3 COIES
Proj.Mgr. CONSULTANT, Through RCM 1 COPY

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SUPPLEMENTARY ACIDENT & INVESTIGATION REPORT

Project: ……

Supplementary to Report No. ..... (Copy enclosed)

Site: .....Date:

Contractor:
……

NAME OF INJURED
FATHER'S NAME
SUB-CONTRACTOR M/S.
DATE & TIME OF ACCIDENT
LOCATION

BRIEF DESCRIPTION & CAUSE OF ACCIDENT

NATURE OF INJURY/DAMAGE

COMMENTS FROM MEDICAL PRACTITIONER, WHO ATTENDED THE VICTIM/INJURED

SUGGESTED IMPROVEMENT IN THE WORKING CONDITION, IF ANY

LOSS OF MAN HOURS AND IMPACT ON SITE WORKS

ANY OTHER COMMENT BY SAFETY OFFICER

DATE :

SIGNATURE OF CONTRACTOR
WITH SEAL

TO	:	OWNER	1 COPY
		CONSULTANT HO Constn. Through RCM	3 COIES
		Proj.Mgr. CONSULTANT, Through RCM	1 COPY

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RCM/SITE-IN-CHARGE CONSULTANT 1 COPY

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CONSULTANT HO Constn. Through RCM 3 COIES
Proj.Mgr. CONSULTANT, Through RCM 1 COPY

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MONTHLY Health, Safety & Environment (HSE) REPORT
(To be submitted by each Contractor)

Actual work start Date: …… For the month of : ……

Project : ……. Report No. : ……

Name of the Contractor : …….. Status as on : ……

Name of work : ……. Name of Safety Officer : ……

ITEM	***THIS MONTH***	***CUMULTIVE***
Total strength (Staff + Workmen)		
Number of HSE meetings organized at site		
Number of HSE awareness programmes conducted at site		
Whether workmen compensation policy taken	Y/N	--
Whether workmen compensation policy is valid	Y/N	--
Whether workmen registered under ESI Act	Y/N	--
Number of Fatal Accidents		
Number of Loss Time Accidents (Other than Fatal)		
Other accidents (Non Loss Time)		
Total number of accidents		
Total man-hours worked		
Man-hour loss due to fire and accidents		
Compensation cases raised with Insurance		
Compensation cases resolved and paid to workmen		
Remarks, if any :		

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DATE : **SIGNATURE OF CONTRACTOR**
WITH SEAL

TO : OWNER 1 COPY
RCM/SITE-IN-CHARGE CONSULTANT 1 COPY

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PERMIT FOR WORKING ABOVE 3 METER HIGHT

(Strike out whichever is not applicable)

Project Site : …… Sr. No.: ……
Name of the work: ……. Date: ……
Name of Contractor : …….. Nature of Work : ……
Total No.of Workers: …….. Exact location of work : ……
Duration of work: from..... to

The following items have been checked and compliance shall be ensured during the currency of the permit:

Sl.	ITEM	DONE	NOT REQD.
1.	Equipment/Work Area inspected	☐	
2.	Considered hazard from other routine/non-routine operations and concerned person alerted	☐	
3.	ELCB provided	☐	
4.	Proper lighting provided	☐	
5.	Area cordoned off.	☐	
6.	Precautions against public traffic taken	☐	
7.	Sound Scaffolding provided	☐	
8.	Adequate protected Platform provided	☐	
9.	Access and Exit to the area (Ladder properly fixed)	☐	
10.	Floor Openings covered	☐	
11.	Safety Net provided	☐	

A. Following personal protective equipment are provided (√ mark) and used as relevant Safety helmet/Gloves/Goggles/Shoes/Face Shield/Life Line/Safety Belt/Safety Harness.
B. This permit shall be available at the work site at all times.
C. Permit shall be issued for maximum one week only (Monday to Sunday).
D. This permit shall be applicable in non-operational areas.
E. After completion of the work, used permits shall be preserved for record purposes.
F. Additional precautions, if any …….

Permission is granted to work (See overleaf) = Yes/No.

Name of Contractor's Supervisor (Initiator)

Name of Contractor's Safety Officer (Issuing Authority)

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GRANT OF PERMIT AND EXTENSIONS

Sl. No.	Validity Period From …… To ……	Work time From …..Hrs. To …….Hrs.	Initiator (Supervisor of Contractor)	Issuing Authority (Safety Officer) of Contractor	Verification by CONSULTANT with date

Additional safety instructions, if any.

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HEALTH, SAFETY & ENVIRONMENT (HSE) PLAN

Division/Department :				Project Name :				
Activity/Process Description	Procedure Number	Code of Conformance	Performer	Checker Reviewer	Appr over	Sampling Plan		Owner's/ PMC's Audit Requirements
						Reviewer	Approver	

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ELECTRICAL

Electrical power is the mainstay of any construction activity, at the same time it requires utmost care in it's utilization to avoid accidents due to electrical shock, fire incidents or electric short circuits. Exposure of electrical installation to adverse environmental conditions increase the risk of such accidents. Hence it is necessary to take extra precautions for such installations to ensure safety of personnel and equipment. This standard addresses the safety measures required to be adopted for the electrical installations by all contractors during construction phase.

All electrical connections/work for electrical installations shall be carried out as per provisions of the latest revision of the following codes and standards in addition to the requirements of statutory authorities and ie rules :
Oisd-std-173 : fire prevention and protection system for electrical installations.
Sp-30 (bis) : national electric code.
The installation shall have approval from concerned statutory authorities.

1. All electrical connections shall be done by an electrician with valid licence and to the satisfaction of engineer-in-charge.
2. One competent licenced electrician shall be made available by contractor at site round the clock to attend to the normal/emergency jobs.
3. All switch boards/welding machines shall be kept in well ventilated and covered shed. The shed shall be elevated to avoid water logging. No flammable materials shall be used for constructing the shed. Also flammable materials shall not be stored in and around electrical equipment/switchboard. Adequate clearances and operational space shall be provided around the equipment.
4. Fire extinguishers and insulting mats shall be provided in all power distribution centres.
5. Temporary electrical equipment shall not be employed in hazardous areas without obtaining safety permit.
6. Proper housekeeping shall be done around the electrical installations.
7. All temporary installations shall be tested before engineering, to ensure proper earthing, bonding, suitability of protection system, adequacy of feeders/cables etc.
8. All welders shall use hand gloves irrespective or holder voltage.
9. Multilingual (English, Hindi and local language) caution boards, shock treatment charts and instruction plate containing location of isolation point for incoming supply, name and telephone number(s) of contact person in emergency shall be provided in substations and near all distribution boards/local panels.
10. Operation of earth leakage device shall be checked regularly by temporarily connecting series test lamp (2 bulbs of equal rating connected in series) between phase and earth.
11. The following design features shall be ensured for all electrical installations during construction phase.

12.1 Each installation shall have a main switch with a protective device, installed in an enclosure adjacent to the metering point. The operating height of the main switch shall not exceed 1.5 m. The main switch shall be connected to the point of supply by means of armoured cable.

12.2 The outgoing feeders shall be double or triple pole switches with fuses/mcbs. Loads in a three phase circuit shall be balanced as far as possible and load on neutral should not exceed 20% of load in the phase.

12.3 The installation shall be adequately protected against overload, short circuit and earth leakage by the use of suitable protective devices. Fuses wherever used shall be hrc type. Use of rewirable fuses shall be strictly prohibited. The earth leakage device shall have an operating current not

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exceeding 30 ma.

12.4 All connections to the handtools/welding receptacles shall be taken through proper switches, sockets and plugs.

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12.5 All single phase sockets shall be 3 pin type only. All unused sockets shall be provided with socket caps.

12.6 Only 3 core (p+n+e) overall sheathed flexible cables with minimum conductor size of 1.5 mm2 copper shall be used for all hand tools.

12.7 Only metallic distribution boxes with double earthing shall be used at site. No wooden boxes shall be used.

12.8 All power cables shall be terminated with compression type cable glands. Tinned copper lugs shall be used for multistrand wires/cables.

12.9 Cables shall be free from any insulation damage.

12.10 Cables shall be laid underground at a minimum depth of 900 mm, covered with sand, brick and soil for ensuring mechanical protection. Cables shall not be laid in water logged area as far as practicable. Cable route markers shall be provided at every 25 m of buried trench route. When laid above ground, cables shall be properly cleated or supported on rigid poles of at least 2 m high. Minimum head clearance of 6 meters shall be provided at road crossings.

12.11 Under ground road crossings for cables shall be avoided to the extent feasible. In any case no under ground power cable shall be allowed to cross the roads without pipe sleeve.

12.12 All cable joints shall be done with proper jointing kit. No taped/temporary joints shall be used.

12.13 An independent earthing facility should preferably be established within the temporary installation premises. All appliances and equipment shall be adequately earthed. In case armoured cables are used, the armour shall be bonded to the earthing system.

12.14 All cables and wire rope used for earth connections shall be terminated through tinned copper lugs.

12.15 In case of local earthing, earth electrodes shall be buried near the supply point and earth continuity wire shall be connected to local earth plate for further distribution to various appliances. All insulated wires for earth connection shall have insulation of green colour.

12.16 Separate core shall be provided for neutral earth/structures shall not be used as a neutral in any case.

12.17 On/off position of all switches shall be clearly designated/ painted for easy isolation in emergency.

12.18 All insulations shall be inspected by engineer-in-charge atleast once in a month.

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BHAGYANAGAR GAS LIMITED

CNG & CITY GAS DISTRIBUTION

BGL/632/2024-25

LIST OF RECOMMENDED PARTIES FOR BOUGHT OUT ITEMS

BGL-ENG-GN-DOC-VL-001

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LIST OF SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS

1. (MECHANICAL & FIRE FIGHTING EQUIPMENT)

A). MAINLINE & MECHANICAL

i) Pipe Carbon Steel To Indian Standards

1. A.S.T. Pipes Pvt. Ltd. (AST Group)
2. Advance Steel Tube Ltd.
3. Apl Apollo Tubes Ltd. (Er. Bihar Tubes Ltd.)
4. Asian Mills Pvt. Ltd.
5. Asrani Tubes Limited
6. Dadu Pipes (P) Ltd.
7. Essar Steel Limited(Er Hazira Pipes Mill)
8. Gaurang Products Pvt Ltd. (Ast Group)
9. Goodluck Steel Tubes Ltd.
10. HiǦTech Pipes Limited
11. Indus Tube Limited
12. Jindal Industries Ltd
13. Jindal Pipes Ltd.
14. Jindal Saw Ltd (Kosi Works)
15. Jotindra Steel & Tube Ltd
16. ALLit Pipes and Pipes Ltd.
17. Maharashtra Seamless Ltd.
18. Man Industries (India) Ltd. – Pithampur
19. Man Industries (India) Ltd. Anjar
20. Mukat Tanks & Vessels Ltd.
21. Nezone Tubes Limited
22. North Eastern Tubes Limited
23. Pratibha Industries Limited
24. Pratibha Pipes & Structural Ltd.
25. Psl Ltd (Chennai)
26. Psl Ltd (V1, V2 & Nc)
27. Rama Steel Tubes Ltd.
28. Ratnamani Metals and Tubes Ltd.
29. Ravindra Tubes Limited

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30. Samshi Pipe Industries Limited
31. Surya Roshni Ltd.
32. Swastik Pipes Ltd.
33. Utkarsh Tubes & Pipes Ltd. (Formly Bmw)
34. Welspun Corp. Limited (Dahej)
35. Zenith Birla (India) Limited

ii) Pipe & Tubulars To A.P.I. Standards

1. Arcelormittal Tubular Products Roman Sa, Romania
2. Bhel (Trichy),India
3. Dalmine Spa (Enquiry To Tenaris),UAE
4. Eewkorea Co. Ltd (Germany), Korea
5. Eew Korea Co. Ltd. (Korea), Korea
6. Eisenbau Kramer Gmbh, Germany
7. Hyundai Rb Co. Ltd. South Korea
8. Ilva Lamiere E Tubi Srl (Enq To Ilva Spa, Italy
9. Inox Tech. Spa, Italy
10. Ismt Ltd. Ahmedngr, India
11. Ismt Ltd. Baramati, India
12. Jindal Pipes Ltd., India
13. Jindal Saw Ltd. (Kosi Works), India
14. Jindal Saw Ltd. (Nashik Works), India
15. ALLit Pipes and Pipes Ltd. India
16. Maharashtra Seamless Ltd., India
17. Man Industries (I) Ltd. (Pithampur), India
18. Mukat Tanks & Vessels Ltd., India
19. Pratibha Industries Limited, India
20. Ratnamani Metals and Tubes Ltd., India
21. Siderca S.A.I.C (Enquiry Totenaris), UAE
22. Sumitomo Metal Ind. Ltd., India
23. Surya Roshni Ltd., India
24. Swastik Pipes Ltd, India
25. Tata Steel Uk Limited (Formerly C702)
26. Tubos De Acero De Mexico Sa (Enq. Tenaris), UAE
27. Tubos Reunidos Sa Spain
28. Umran Steel Pipe Inc (Turkey), Turkey
29. Valcovny Trub Chomutov, Czech Republic

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30. Valloure c and Mannesmann Tubes, France
31. Welspun Corp Limited (Dahej), India

iii) Pipe/Tube CS (Seamless) To ASTM STDs

1. Arcelormittal Tubular Products Roman Sa, Romania
2. Bhel (Trichy), India
3. Changshu Seamless Steel Tube Co. Ltd., China
4. Dalmine Spa (Enquiry To Tenaris, UAE
5. Heavy Metals & Tubes Limited (Mehsana), India
6. Ismt Ltd. Ahmedngr, India
7. Ismt Ltd. Baramati India
8. Jfe Steel Corporation, UAE
9. Jindal Sdaw Ltd (Nashik Works) India
10. Klt Automotive and Tubular Products Ltd., India
11. Mahalaxmi Seamless Limited, India
12. Maharashtra Seamless Ltd, India
13. Products Tubulares S.A.U, Spain
14. Ratnadeep Metal Tubes Ltd., India
15. Staineest Tubes Pvt Ltd., India
16. Sumitomo Metal Ind. Ltd., India
17. Tubos Reunidos Sa Spain
18. Valcovny Trub Chomutov, Czech Republic
19. Vallourec Andmannesmann Tubes France
20. Yangzhou Chengde Steel Pipe Co. Ltd Dubai (UAE)

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iv) Pipe Carbon Steel (Welded) To ASTM STDs

1. Eew Korea Co. Ltd. (Germany), Korea
2. Eew Korea Co. Ltd. (Korea), Korea
3. Eisenbau Kramer Gmbh, Germany
4. Hyundai Rb Co. Ltd., South Korea
5. Inox Tech. Spa, Italy
6. Jindal Saw Ltd (Kosi Works), India
7. ALLit Pipes and Pipes Ltd., India
8. Man Industeries (I) Ltd.(Pithampur), India
9. Man Industries (India) Ltd. Anjar, India
10. Mukat Tanks & Vessels Ltd., India

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11. Ratnamani Metals And Tubes Ltd., India
12. Sumitomo Metal India Ltd., India
13. Tata Steel Uk Limited

v) Valve

a) Globe Valves

1) M/S BDK (New Delhi)
2) M/S Datre Corpn (Calcutta)
3) M/S KSB Pumps (New Delhi)
4) M/S L&T (New Delhi)
5) M/S Neco Schuber & Salzer Ltd. (New Delhi)
6) M/S Niton Valve (Mumbai)
7) M/S Ornate Valves (Mumbai)
8) M/S Panchavati Valves (Mumbai)
9) AV Valves Ltd.
10) BHEL (Trichy), India
11) Econo Valves Pvt Ltd, India
12) Fouress Engg (I) Ltd (Aurangabad)
13) Guru Industrial Valves Pvt Ltd
14) Leader Valves Ltd, India
15) NSSL Ltd. (Neco Schubert & Salzerltd)
16) Oswal Industries Ltd, India
17) Petrochemical Engineering Enterprises, India
18) Sakhi Engineers Pvt Ltd
19) Shalimar Valves Pvt Ltd
20) Steel Strong Valves India Pvt Ltd, India
21) Petro Valves Pvt. Limited, Ahmedabad

b) Check Valves

1. M/s Advance Valves Pvt. Ltd., Noida
2. M/s Aksons & Mechanical Enterprises, Mumbai
3. M/s Larsen & Toubro Limited (M/s Audco India Limited, Chennai)
4. M/s AV valves Ltd., Agra
5. M/s BDK engineering India Ltd., Hubli

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6. M/s BHEL,OFE &OE Group, New Delhi
7. M/s Datre Coroportion Limited, Calcutta
8. M/s Leader Valves Ltd., Jalandhar
9. M/s Neco schubert &Salzer Ltd., New Delhi
10. M/s Niton Valves Industries (P) Ltd., Mumbai
11. M/s Precision Engg.Co., Mumbai
12. Econo Valves Pvt Ltd, India
13. Fouress Engg (I) Ltd (Aurangabad)
14. KSB Pumps Ltd (Coimbatore), India
15. NSSL Ltd. (Neco Schubert & Salzerltd)
16. Oswal Industries Ltd, India
17. Panchvati Valves & Flanges Pvt Ltd, India
18. Petrochemical Engineering Enterprises, India
19. Sakhi Engineers Pvt Ltd
20. Shalimar Valves Pvt Ltd
21. Steel Strong Valves India Pvt Ltd, India

c) Plug Valves

1. M/s Breda Energia Sesto Industrial Spa, Italy
2. M/s Fisher Sanmar Ltd., Chennai
3. M/s Larsen & Toubro Ltd., New Delhi
4. M/s Nordstrom Valves, USA
5. M/s Serck Audco Valves, UK
6. M/s Sumitomo Corporation India Pvt. Ltd., New Delhi
7. M/s Z Corporation, Korea
8. M/s Hawa Valves (India) Pvt. Ltd., Mumbai
9. M/s Steel Strong Valves India Pvt. Ltd., Navi Mumbai
10. M/s Econo Valves
11. M/s Flow-Serve PTE (Mfr. SERCK), India

d) Ball Valves

1. M/s Hawa Valves (India) Pvt. Ltd, Navi Mumbai
2. M/s Larsen & Toubro, Delhi
3. M/s Microfinish Valves Pvt. Ltd., Noida
4. M/s Oswal Industries Ltd., Gandhi nagar

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5. M/s Virgo Engineers Ltd., Delhi
6. M/s Boteli Valve Group Co. Ltd., China
7. M/s Cameron (Malaysia) SDN BHD, Malaysia
8. M/s Dafram S.P.A., Italy
9. M/s Fangyuan Valve Group Co. Ltd., China
10. M/s Franz Schuck GmbH, Germany
11. O.M.S. Saleri (Italy)
12. Pibi Viesse S.P.A (Italy)
13. Nuovo Pignone (Italy)
14. Perar S.P.A (Italy)
15. Pietro Fiorentini (Italy)
16. Cooper Cameron Valv Italy SRL-FRM, Itly
17. Petrol Valves SRL
18. Tormene Gas Technology S.P.A (VALVITALIA)
19. AB Industries, Ahmedabad
20. Norflow Controls, Ahmedabad,
21. Niton Valves Inds. Pvt. Ltd., Mumbai
22. Steel Strong Valves (I) Pvt Ltd., Navi Mumbai,
23. Dembla Valves Ltd, Gurugram
24. Hawa Engineers Ltd, Ahmedabad
25. Micon Engineers(hubli) Pvt Ltd, Dharwad
26. V A Valves, Jalandhar,
27. PHBB Valves Pvt Ltd, Maharashtra
28. * Or as per attached Technical Criteria.

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vi) Split Tee

1) M/s Ipsco, Canada

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2) M/s TD Willamsons, USA

3) M/s Pipefit Engineers

4) M/s Sawan Engineers

5) M/s Furmanite International Ltd.

6) M/s VKVC

7) M/s Bhotika

8) M/s Huwelco Inc.

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9) M/s Plant-Tech

vii) Flow Tee

1) M/s Coprosider SPA, Italy
2) M/s GEA Energy System India Limited, Chennai
3) M/s Multitex Filteration
4) M/s Pipeline Engineering, UK
5) M/s Scomark Engg. Limited (U.K.)
6) M/s Skeltonhall Limited, Engaland(U.K.)
7) M/s Technospecial SPA, Italy
8) M/s Tectubi SPA, Italy
9) M/s RMA Germany
10) M/s Pipefit Engineers Pvt. Ltd
11) M/s Sawan Engineers Pvt Ltd
12) M/s United Forge Industries
13) * Or as per attached Technical Criteria.

viii) Flanges

1. M/s Aditya Forge Ltd., Vadodara
2. M/s Amforge Industries Ltd., Mumbai
3. M/s CD Engineering Co., Ghaziabad
4. M/s Echjay Forgings Pvt. Ltd. (Bombay), Mumbai
5. M/s Echjay Industries Ltd., Rajkot
6. M/s Forge & Forge Pvt. Ltd., Rajkot
7. M/s Golden Iron & Steel Works, New Delhi
8. M/s JK Forgings, New Delhi

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9. M/s Metal Forgings Pvt. Ltd., Mumbai
10. M/s Perfect Marketings Pvt. Ltd., New Delhi
11. M/s Sky Forge, Faridabad
12. M/s S&G, Faridabad
13. Chaudhry Hammer Works Ltd, India
14. JAV Forgings (P) Ltd, India
15. Kunj Forgings Pvt Ltd, India
16. MS Fittings
17. R.N. Gupta & Co. Ltd, India
18. R.P. Engineering Pvt Ltd, India
19. Sanghvi Forgings & Engineering Ltd
20. Shri Ganesh Forgings Ltd., India
21. Uma Shankar Khandelwal & Co., India
22. Sawan Engineers, Baroda
23. Stewarts & Lloyds of India Ltd., Kolkata
24. Engineering Services Enterprises
25. Pipefit Engineers Pvt. Ltd.
26. Utsah Engineering Pvt Ltd
27. Vivial Forge Pvt Ltd
28. Norma (India) Ltd
29. United Forge Industries
30. * Or as per attached Technical Criteria.

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ix) Fittings

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1. M/s Commercial Supplying Agency, Mumbai
2. M/s Dee Development Engineers Ltd.
3. M/s Eby Industries, Mumbai
4. M/s Flash Forge Pvt. Ltd., Vishakhapatnam
5. M/s Gujarat Infra Pipes Pvt. Ltd., Vadodara
6. M/s M.S. Fittings Mfg. Co. Pvt. Ltd., Kolkata
7. M/s Stewarts & Lloyds of India Ltd., Kolkata
8. M/s Teekay Tubes Pvt. Ltd., Mumbai
9. M/s Pipe Fit, Baroda
10. M/s Sky Forge, Faridabad
11. M/s S&G, Faridabad
12. M/s Sawan Engineers, Baroda
13. Eby Fasteners, India
14. Leader Valves Ltd, India
15. R.N. Gupta & Co. Ltd, India
16. Exten Engg Pvt Ltd
17. Sivananda Pipe & Fittings Ltd
18. Vivial Forge Pvt Ltd
19. Janta Engineers & Company (Iron)
20. United Forge Industries
21. * Or as per attached Technical Criteria.

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x) Gaskets

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1. IGP Engineers (P) Ltd., Madras
2. Madras Industrial Products, Madras
3. Dikson & Company, Bombay
4. Banco Products (P) Ltd., Vadodara
5. Goodrich Gaskets Pvt Ltd
6. Starflex Sealing India Pvt Ltd, India
7. Teekay Meta Flex Pvt Ltd
8. UNIKLINGER Ltd
9. HEM Engg. Corp.
10. Unique Industrial Packing Pvt. Ltd.

xi) Fasteners

1. Nireka Engg. Co. (P) Ltd., Calcutta
2. Precision Taps & Dies, Bombay
3. AEP Company, Vithal Udyog Nagar
4. Fix Fit Fasteners, Calcutta
5. Precision Engg. Industries, Baroda
6. Echjay Forgings Pvt. Ltd., Bombay
7. Capital Industries, Bombay
8. Boltmaster India Pvt Ltd, India
9. Deepak Fasteners Limited, India
10. Fasteners & Allied Products Pvt Ltd, India
11. Hardwin Fasteners Pvt Ltd, India
12. J.J. Industries, India
13. Multi Fasteners Pvt Ltd, India
14. Nexo Industries, India
15. Pacific Forging & Fasteners Pvt Ltd, India
16. Pioneer Nuts & Bolts Pvt Ltd, India
17. Precision Auto Engineers, India
18. President Engineering Works, India
19. Sandeep Engineering Works, India
20. Syndicate Engineering Industries, India

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xii) Welding Electrodes

For Mainline - Root: Lincoln, and Other passes: Lincoln.
For Piping- Root: Lincoln, Other passes: Lincoln, D&H or equivalent make.

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xiii) Fire Fighting equipment's

a) Fire Extinguishes

1. Avon Services (Production & Agencies) Pvt. Ltd., Bombay
2. Kooverji Devshi & Co., Bombay
3. Zenith Fire Services, Bombay
4. Safex Fire Services, Bombay
5. Reliable (Fire Protection) India Ltd., Bombay
6. Brij Basi Hi
7. Tech Udyog
8. Bharat Engg Works, India
9. Gunnebo India Ltd
10. Nitin Fire Protection Industries Ltd, India
11. Supremex equipment's , India
12. Vimal Fire Controls Pvt Ltd., India

b) Fire Hydrants, Monitors, Deluge Valve, Nozzles

1. Zenith
2. Minimax
3. Newage
4. HD Fire
5. Vijay Fire
6. Asco Strumech Pvt Ltd, India
7. Brij Basi Hi
8. Tech Udyog
9. Gunnebo India Ltd
10. Nitin Fire Protection Pvt Ltd
11. Shah BhogiALL Jethamal & Brothers
12. Venus Pumps & Engineering Works

c) RRL Hose

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1. Jayshree
2. Newage

d) Hoses

1. Ashit Sales Corporation, Bombay
2. Royal India Corporation, Bombay
3. Gayatri Industrial Corporation
4. Simplex Rubber Products Ltd., Ahmedabad
5. Zaverchand Marketing Pvt. Ltd., Baroda
6. Presidency Rubber Mill, Calcutta
7. The Cosmopolite, Calcutta
8. Simplex Rubber Products, Thane

e) Hose Delivery

1. Chhatarya Rubber & Chemical Industries,
2. Nitin Fire Protection Industries Ltd, India

f) Fire Hose Accessories

1. Asco Strumech Pvt Ltd
2. Brij Basi Hi-tech Udyog
3. Gunnebo India Ltd
4. Shah BhogiALL Jethamal & Brothers
5. Vimal Fire Controls Pvt Ltd., India

g) Heat Shrinkable Sleeves

1. Covalence Raychem (Berry Plastics Corporation)
2. Canussa – CPS
3. CYJ Changtong New Material company

h) Cold Applied Tapes

1. Denso GmBH
2. Polyken (Berry Plastics Corporation)

i) PUR Coating

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1. Powercrete (Berry Plastics Corporation)

j) Casing End Closure

1. Raci, Italy
2. Raychem RPG Limited

k) Casing Insulators

1. Raci, Italy
2. Raychem RPG Limited

l) Rockshield

1. Raychem RPG Limited

m) Warning Tape /Mesh

1. Sparco Multiplast Pvt. Ltd., Ahmedabad
2. M/s Raychem RPG Limited
3. Singhal Industries Private Limited

n) High Build Epoxy Coating

1. Berry Plastics – Powercrete
2. Specialty Polymer Canada
3. Denso Protal, Canada

o) Casing Insulators

1. Raci, Italy
2. Raychem RPG Limited
3. Veekay Vikram

xiv) DRY GAS FILTER & FILTER SEPERATOR

1. Grand Prix Fab (Pvt.) Ltd.(New Delhi)
2. Perry Equipment, USA
3. Faudi Filter, Germany

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4. Forain S.r.l., Italy
5. ABB, Faridabad
6. Burgess Manning, USA
7. Multitex Filtration Engineers India
8. Triveni Plenty Engg. Ltd. (New Delhi)
9. Siirtec International Contractor S.P.A (Italy)
10. Flashpoint, Pune india
11. Filteration Engineers (I) Pvt Ltd, India
12. Gujarat Otofilt, India
13. Tormene Gas Technology
14. Ultrafilter (India) Pvt Ltd, India
15. Ravi Techno Systems Pvt Ltd, India
16. Siirtec Nigi S.P.A
17. Filtan Filter Anlagenbau Gmbh
18. Fairley Arlon BV
19. PECO Facet
20. EPE Epenstenner GMBH
21. Filtrex srl
22. Petromar Engineered Soln
23. Plenty Filter
24. Eurofiltec
25. PTI Technologies Inc

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xv) FILTER ELEMENT

1. Peco – Facet
2. Velcon
3. Pall – Filterite
4. Burgress Manning

xvi) NDT Agency

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1. NDT Services, Ahmedabad
2. GEECY Industrial Services Pvt. Ltd., Mumbai
3. Corrosion Control Services, Mumbai
4. Perfect Metal Testing & Inspection Agency, Calcutta
5. Inter Ocean Shipping Co., New Delhi
6. RTD, Mumbai
7. Sievert, Mumbai
8. X-Tech, Vizag

#Note:– If NDT services not provided by above recommended agency, Thencontractor will engage the other NDT agency shall be accepted subjected to the valid applicable license (BARC) and Satisfactory performance.

xvii) Long Radius Bends

1. M/s BHEL, Trichy, Tamilnadu
2. M/s Jindal SAW Limited, (Koshi Works), U.P.
3. M/s PSL Limited, Gandhidham, Gujarat
4. M/s Welspun, Gujarat
5. M/s Fabricon, Belgium
6. M/s Sawan Engineers Pvt Ltd
7. M/s Gujarat Infra

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8. M/s P K Tubes
9. M/s DEE Development
10. Pipefit Engineers Pvt. Ltd.
11. United Forge Industries
12. * Or as per attached Technical Criteria.

xviii) PIG LAUNCHERS/ RECEIVERS/ PIG SIGNALERS

1. Bassi Luigi Fittings B.V., Holland
2. BRAUN STAHL PIPE TEC, GERMANY
3. FORAIN, ITALY
4. Fluidel SRL, ITALY
5. RMA Maschinen- und, GERMANY
6. Siiritec Nigi, Itlay
7. SCHUCK ARMATUREN, GERMANY
8. T.D. Williamson Inc., USA
9. Tectubi SPA, Italy
10. Taylor Forge Engineering System INC, USA
11. Tormene Americana S.A. (Argentina)
12. Tormene Gas Technology S.p.A., Italy
13. PIPELINE ENGINEERING, UNITED KINGDOM
14. Krohne, Oil & Gas BV, Drive Houston,
15. Multitex Filtration Engrs. Ltd, New Delhi
16. BGR ENERGY SYSTEMS LIMITED New Delhi
17. Glapwell Contracting Services Ltd. UK
18. FULGOSI GIOVANNI S.n.c di Corrado & C, ITALY
19. VEEKAY VIKRAM & CO, GUJARAT
20. GBM S.R.L, ITALY
21. Multitex Filtration Engineers Ltd., India

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22. Cardew Ltd., Alexeander
23. Forain S.R.L.
24. GD Engineering, India
25. Pipeline Engineering, UK
26. Bliss Anand Pvt Ltd
27. Control Plus Oil and Gas Solutions Pvt Ltd
28. Grand Prix Engineering Pvt Ltd
29. VEE Kay Vikram & Co. LLP
30. Oswal Infrastructure Pvt Ltd
31. * Or as per attached Technical Criteria.

xix) HOT TAPPING VENDERS

1. Furmanite International Ltd.
2. Huwelco Inc.
3. Unique Hydrographics
4. Conmate Energy
5. Propipe SL
6. Plant-Tech
7. TDW

xx) INSULATING JOINTS

1. IGP Engineers Pvt Ltd
2. Advance Electronic Systems
3. * Or as per attached Technical Criteria.

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2. LIST OF MATERIALS OF RECOMMENDED BRAND AND/ OR MANUFACTURE

B. (CIVIL & STRUCTURE)

Unless otherwise specifically mentioned in the Schedule of Items, Contractor has to use materials as listed below, of only these brand names/Company's names, which are mentioned in the approved list for civil,water supply and sanitary items thereon.

CIVIL

Sr. No.	Items/ Name of Products	Make/ Brands/ Manufactures
1.	Reinforcement Steel	TATA,SAIL,RINL,IISCO,RATHI
2.	Cement	Ambuja, ACC, JK, Grasim, Ultratech, Birla, L&T, Or Approved Equivalent Cement make
3.	Structural Steel	TATA,SAIL,RINL,IISCO,ESSAR, ISPAT
4.	Pre- engineered building (PEB) firms	Kirby Building system India ltd ,Interach Building Product limited, Tata blue scope steel ,Lloyd Insulation India ltd, Everest Industries. Ltd. Modern Prefab System Pvt Ltd,Aster Building Solution Pvt.Ltd, Octamec Engineering Ltd,Jindal Mectec Pvt Ltd,Fedders Lioyd Corporation Ltd.
5.	Structural Steel Tubes ISI Marked	TATA, JINDAL , SURYA , SWASTIK
6.	(a) Zincalume colour coated steel sheet(COIL) (b) Profile of Sheet(as per tender specification)	(a)Tata Blue scope, Dongbu Steel ,Union Steel,JSW STEEL Ltd. Kirby Building system India ltd ,Interach Building Product limited, Tata blue scope steel ,Lloyd Insulation India ltd, Everest Industries. Ltd. ModernPrefab System Pvt Ltd,Aster Building Solution Pvt.Ltd, Octamec Engineering Ltd,Jindal Mectec
7.	Polycarbonate Sheet	Sabic Innovative Plastic , Everest
8.	Mineral wool for thermal insulation of ceilings (Under deck insulation)	Rock wool (india) Ltd. Minwool Rock Fibres Ltd., Lloyd Insulation,

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9.	Rolling shutters(ISI marked)	Swastic, Hercules, Shubdwar, M/s Bharat Rolling Shutters Industries Agra, Bengal RollingShutter Rama Rolling Shutter Works, Gandhi Entrance Automations Private

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10.	Wind driven air Ventilators	Apurva Enterprises (Mumbai), SVS Wind Driven Turbo Ventilator(Ahmadnagar),Real Green Engineers Pvt.Ltd. Bangalore;Sun Green Ventilation system
		Mumbai, Multi colour, Anchit Ispat PvtLtd. (Faridabad),
11.	Synthetic Enamel Paint (1st quality only)	ICI Paint (Dulux), Asian Paint (Apcolite), Berger Paints (Luxol). Goodlass Nerolac Paints (Nerolac), Jenson & Nicholson Paints Ltd (Borolac), Shalimar,
12.	G.I SHEET	ESSAR,JSW,,SAIL
13.	Sheeting Screw	Corroshield, Buildex,
14.	Chemical for Antitermite treatment	DE- NOCIL Bombay, Pest Control of India, Trishul
15.	Factory made Panelled Door shutter	M/s Goel Brothers Raipur New Industrial Area Raipur (CG) M/s Hindustan Housing factory Ltd- New Delhi M/s Delhi Construction Eqpt Sadar Bazar DelhiM/s Joinery manufacturing Co Calcutta M/s Goyal Industries Faridabad M/s Surbhi Metal (India) Ltd, Jodhpur
16.	Flush doors IS-2191, 2202	M/s Mysore Wood Products M/s Laxmi Doors, Faizabad Road, Chinhat, Lucknow M/s Merino flush doors M/s Poineer Timber Products, Chandigarh, M/S Goyal Industries Faridabad
17.	Fly proof doors (Made out of solid block marine grade)	M/S Laxmi Doors, Faizabad Road, Chinhat, Lucknow, Northern doors Kanpur
18.	Natural Fibre Thermo Composite door/window shutter & frames, roofing sheets etc	Durosam
19.	PVC Panel Door (Solid Core)	Rajshri Plastiwood Limited, Sintex, Hindopan, Marino
20.	Pressed steel door frames/ cupboard and window frames (manufacturers)	M/s SAIL, M/s TATA

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21.	Pressed steel door frames/ cupboard and window frames (fabricators)	M/s Loyal safe works Mayapuri, N/DelhiM/s Multiwyn Industrial Corpn Calcutta M/s Metal Window Corpn N/Delhi M/s Chhabra Steel Udyog, 260 Sadar Bazar, MeerutCantt M/s Delite safe works, Rani Jhansi Road, N/Delhi M/sIshwar Industries, 175/A Bombay Bazar, Meerut CanttM/s Chandni Industries, J-142, Patel Nagar 1st, Ghaziabad.
22.	Steel Windows, Ventilators(as per IS- 1038 of 1983) & frames pressed steel door/window	M/S Multiwyn Industrial Corpn Calcutta M/S Metal Window Corp N/ Delhi Govind Enterprises, Delhi M/S Chhabra Steel Udyog 260, Sadar Bazar, Meerut Cantt, Agent steel MFG Pvt Ltd, Ahmedabad, Godrej, M/SChandni Industries, J-142, Patel
23.	Al Section for Al Door/ Window/ Partitions	Hindalco, Indal, Ajit India, Jindal
24.	AluminumI Door/ Window/ Glazing Fabricated and Anodized	M/s Ahlcon M/s Alumilite Pvt Ltd, M/s Ajit India Pvt Ltd, M/s RamnikALL S Raste Agra, Argent Industries, M/s Aluminium Tech Industries, I-2249 DSIDC Narela, Delhi,
25.	Aluminium door and windows Fittings	M/s Elite Enterprises C/6 Shalimar Hardware 133, Jarg Mahal, Dhobitalao Mumbai 400002. M/s MohanMetal Industries 178/2-A, Bhole Nath Nagar, Shahadara, Delhi 110032.
26.	Automatic Glass Door	Ditec (Gandhi)
27.	Aluminium Grill	Alu Grill, Arihant Aluminium Corporation, Decogrille
28.	Door Closer	Everite, Golden, Gandhi
29.	Floor Spring	Prabhat,Everite
30.	Builders Hardware	M/s Golden Industries Pvt. Ltd., Everite, Solo, Hardwyn
31.	Plywood for general purpose (IS-303)	National Plywood Inds Pvt Ltd, S Fancy lane, 8th floor Calcutta-700001,
32.	Pre laminated Particle board	Kitply, Bhutan board, Ecoboard, Novapan, Archidply, Merinova, Merino
33.	Laminated Sheets	Formica, Merino Lam, Greenlam, National
34.	Modular Partitions	Godrej, Blowplast
35.	False Ceiling (Mineral Fibre Board)	Armstrong, , Daiken, Luxalon, Llyods, Gypboard,Trac,Aerolite

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36.	False Ceiling (POP/ Gypsum Board)	Gypboard, Anchor ceiling tiles, LA

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37.	Aluminium False Ceiling	Lloyds,Armstrong,Luxlon,Trac
38.	Flooring Tiles (Mosaic / Terrazzo / PCC) (1st quality only)	M/S Mehtab Tiles, NITCO, Royal Tiles, Gem Tiles, Hindustan Tiles, M/S National Tiles & Industries,Ultra Tiles
39.	Glazed Ceramic Tiles, Non-Skid (Floor/Wall), (1stquality only)	Kajaria, Somany, NITCO. Murudeshwar Ceramic Ltd (Navin Diamond tile), Johnson (Marbonite), Marbito, Somany, Orient, Asian
40.	Vitrified/ Designer Vitrified Tiles (1st quality only)	Asian, Marbonite (Johnson), Kerrogres (Kajaria), NITCO, Orient
41.	PVC Tiles/Flooring (IS 3461) (1st quality only)	Marblex Tiles, Krishna Tiles, Polyfin, Armstrong, Wonder floor.
42.	False Flooring	Godrej or equivalent
43.	Glass Mosaic Tiles (1st quality only)	Paladio, Coral, Accura, Bisazza, Italia, Mridul.
44.	Designer Paver Tiles/ Interlocking tiles ISI marked/ Grass-jointed Tiles	Pavit, Ultra, Hindustan, Eurocon, Vyara, NationalTiles, Gem, Unistone, Konkrete, Unitile
45.	Glass reinforced Paver block	Unistone or equivalent
46.	Wall care Putty for Base preparation (1st quality only)	Birla Wall care putty, Berger, Jenson & Nicholson, JK White
47.	White Cement (1st quality only)	Birla, JK
48.	Cement based Paints (1st quality only)	Super Snowcem, Duracem, Super Acrocem.
49.	Dry Distemper / Oil bound Distemper (1st quality only)	Goodlass Nerolac Paint, Shalimar Paint, Jenson & Nicholson, Asian Paint, Berger. ICI
50.	Acrylic Washable Distemper (1st quality only)	Asian, Berger, ICI Dulux, Jenson & Nicholson, Nerolac,Shalimar,Garware& Goodlass
51.	Plastic Emulsion Paint (1st quality only)	Asian, Berger, ICI, Nerolac, Jenson & Nicholson, Shalimar,Garware & Goodlass
52.	Exterior Acrylic Emulsion (1st quality only)	ICI (Weathercoat), Excel (Nerolac), Apex (Asian), Berger, Jenson & Nicholson, Shalimar,Garware & Goodlass

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53.	Polymer based Paint	STP,CICO
54.	Textured Paint / Wall Tile (1st quality only)	Unitile, Heritage, Spectrum, Iokos, Acropaints, Asian

55.	Flexible board for Expansion joint	STP or equivalent
56.	Grout	Shrinkomp,Fosroc,Fairmate
57.	Integral water proofing compound	STP, Pidilite, Fosroc, CICO, Sika.
58.	Concrete Admixture	Pidilite, Fosroc, CICO, Sika.
59.	Water proofing for cementitions surface IS-2645	Acrocrete & Acrocote, CICO, Fosroc, STP
60.	Bituminous Product	M/s Faridabad Spinning & Woolen Mills PvtLtd, 837, SP Mukherjee Marg Delhi, M/s STP Ltd (Formerly Shalimar Tar Products) M/s Bitufelt Pvt Ltd 123/377 Fazalm Ganj Kanpur 208012, Texas, Texas India Ltd,
61.	Hardeners	Ironite, Ferrok, Hardonate
62.	Construction Chemicals	Choksey, CICO, Forsroc, Sika
63.	Non Metalic Surface Hardners	CICO, Fosroc, STP, Sika
64.	Corrugated, Semi Corrugated & AC Sheets (IS-459-1970,IS-2098)	M/s Everest Bldg Products Ltd Jata Sankar Bosa Marg Muland (west) Bombay 400080, M/s Ramco AC Sheets "SWASTIK", M/s Eternit Everest Ltd, UP Asbestos Ltd
65.	GI Sheet ISI Marked	Multicolor, TATA, Bluescope, JSW, Colour Plus, Interarch, Lloyds, Jindal,
66.	Sheet Glass /Structural Glazing	Hindustan Pilkington Glass Works, Saint Gobain, Modi
67.	Multiell / Multiwall Polycarbonates Panel	M/s Coxwell Domes Engineering , Delhi, M/s Lexan , M/s Gallina India Pvt. Ltd.
68.	Stainless Steel Cladding	Jindal
69.	Punch Tape Concertina Coil	Global Technocrat, S.G.Engineers Delhi
70.	Punch Tape In Plastic Spool	Global Technocrat, S.G.Engineers Delhi
71.	Stainless Steel Railing	Jindal

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72.	FRP/ HDPE Garbage Bins	Sintex, Swift, Nutech, Sheetal
73.	Thermoplastic Road Marking Paint	Shalimark (STP)
74.	Bollard	STP
75.	Cateye	TATA, STP
	Readymade Speed	STP
77.	Fountain	Ripples, Green Evolutions, Agritech Services, Premier
78.	Multi-Vent	Multicolor

79.	Sanitary ware	Neycer Kermag (standard), Hindustan Sanitary Ware (Ist quality), Parryware (superfine), Cera (Ist quality), Classica (Ist /
80.	WC seat cover ISI Marked	Parryware, Neycer Kermag (standard), Hindustan Sanitary Ware (Ist quality), Cera (Ist quality), Classica (Ist / standard)
81.	PVC Flushing Cistern IS: 774-1984 (ISI Certified)	Parryware, Hindustan Sanitary Wares, Cera.
82.	Faucets & Taps, Stop Valves & Pillar Taps, Surgical basin mixer, Shower rose etc.	Gem, Parko, Parryware, HSW, Jaquar,Orient
83.	Kitchen Stainless Steel Sink	Diamond, Nirali, Neel Kanth, Jayna
84.	Looking Mirror	Saint Gobain, Modi Float, Triveni Float Glass, Crown, Atul,Ashai
85.	Ready-made Bathroom Cabinets	Commander Gratings (I) Pvt Ltd, Gratolite Cabinet, A-4 Sector Viii Noida-202701, Alpina, Cera.
86.	Float Valve	Leader, Bombay Metal & Alloy Co, Bombay superflow.
87.	SGSW Pipes (IS-651) ISI Marked	Perfect Agra, Devraj Ind Gaziabad, Buran, RK, Prince,
88.	CI (Centrifugally Cast) Pipes for sewage disposalISI marked	NICCO, SRIF, A-1 Singhal Casting Co Agra, JindalSaw, Kesoram, NECO
89.	PVC rain water/sewage pipes (IS-4985)	Reliance, Finolex, Supreme, Kisan, Prince,Hindustan Plastic & machine corporation,Polypack industries (P) Ltd.
90.	HDPE Water storage Tanks (Rotational Moulded)	Sintex, Swift, Nutech, Sheetal

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91.	Cast Iron Pipes and Fittings	Hindustan Engineering Products Company Calcutta, S..L.C., Standard approved manufacturers ofany other brand of fittings
92.	RCC Pipes	Indian Hume Pipe Company, Delhi / Allahabad / Chandigarh / Lucknow; Hindustan PressurePipes, Kolhapur; Dhere Concrete Products, Pune or any other approved manufacturer conforming B.I.S.
93.	Brass Fittings	Leader Engineering Works, Jalandhar; L & K Mathura; Luster Sanitary, Jalandhar; Annapurna Metal Works, Calcutta; Neta Metal Works, Jalandhar; Honey Industrial
94.	C.P. Fittings	Ego Metal Works, Ballabhgarh; Jaquar Industries, Delhi; Soma Plumbing Fixtures Limited, Calcutta; Gem Sanitary Appliances Pvt. Ltd.,Delhi; EsscoSanitations, Delhi; Bilmet,
95.	Stone Ware (Salt-Glazed) Pipes	Hind Ceramics Limited, Orissa; Ceramic Industries Limited, Sambalpur; Shrikamakshi Agencies, Madras; Binary Udyog Pvt. Limited, Howrah; Tirumati Moulds Limited, Nagpur; Kiran Potteries, Hyderabad;Perfect Sanitary
96.	Asbestos Cement Pipes and Fittings	Ganga Asbestos Limited, U.P.; Hyderabad Asbestos Cement Products Limited; J.K. Super PipeIndustries, Nanded; Konark Cement and Asbestos Limited, Orissa; Maharashtra Asbestos Limited, Bombay; Poddar Industrial Corporation, Patna;
97.	HDPE pipes and fittings	ORI-PLAST,HASTI

STRUCTURE

Sl. No.	Items/Name of Products	Makes/Brands/Manufactures
1	Structural Steel	SAIL / TATA / RINL / IISCO / ESSAR / ISPAT
2	Structural Steel Tubes ISI Marked	TATA / JINDAL / SURYA / SWASTIK
3	Synthetic Enamel Paint Ist Quality only	ICI Paint (Deluxe), Asian Paint (Apcolite), Shalimar Paint (Superlac), Goodlass,Nerolac Paint(Nerolac), Berger Paints

Any materials not fully specified in these specification and which may be offered for use in the works shall be subject to approval of Engineer, without which it shall not be used anywhere in the construction works.

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3. LIST OF RECOMMENDED SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS

C. (ELECTRICAL)

i) Air Conditioner

1. O General
2. Daikin
3. Hitachi

ii) Batteries (Lead Acid)

1. Amco Batteries Ltd.
2. Exide Industries Ltd.
3. HBLNIFE Power System Ltd.
4. Amara Raja Batteries Ltd.

iii) Batteries (Nickel Cadmium)

1. Amco Batteries Ltd.
2. HBLNIFE Power Systems Ltd.

iv) Batteries Charger/DC-DC Converter

1. Amara Raja Power System (P) Ltd.
2. BCH.
3. Chhabi Electricals Pvt. Ltd.
4. Caldyne Automatics Limited
5. Dubas
6. HBL Nife Power Systems Ltd.
7. Universal Industries Products

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8. Universal Instrument Mfg Co Pvt Ltd

v) Cable – Fire Alarm & Communication Cables

1. Cords Cable Industries Ltd.
2. CMI
3. Delton cables Ltd.
4. ELKAY Telelinks
5. KEI Industries Ltd.
6. Reliance Engineers Ltd.

vi) Cable – HT (XLPE)

1. Universal Cable Ltd.
2. KEI Industries Ltd.
3. Industrial Cables
4. NICCO Corporation Ltd.
5. Uniflex
6. Polycab.
7. Torrent cables Ltd.

vii) Cable – LT Power and Control

1. Cords Cable Industries Ltd.
2. Universal Cable Ltd.
3. KEI Industries Ltd.
4. Havells.
5. Delton
6. Elkay Telelinks
7. Evershine Electricals
8. Ecko
9. Ravin
10. Rallison.
11. Suyog
12. Netco
13. Uniflex

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14. Paramount
15. Gloster
16. Associated cables Pvt Ltd.
17. CMI
18. Gemscab
19. Industrial cables
20. NICCO
21. Polycab
22. Torrent

viii) Cable – Gland

1. .Baliga
2. .Comet
3. Flexpro
4. Flameproof
5. FCG
6. Electro Werke
7. Dowels
8. CCI

ix) Cable – Lugs

1. Dowels
2. Jainson
3. Ismal

x) Cable – Tray

1. Ercon Composites
2. Yamuna Power & Infrastructure Ltd.

xi) Cable Termination and Jointing Kit

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1. CCI
2. Raychem
3. M-Seal

xii) Ceiling/Exhaust/Pedestal Fans & Circulators

1. Bajaj Electricals Ltd.
2. Crompton Greaves Ltd.
3. Khaitan Electricals Ltd.
4. Havell's

xiii) Contractors – AC Power

1. Andrew Yule
2. ABB
3. BHEL
4. C&S
5. Havell's
6. L&T
7. Schneider
8. Siemens Ltd.
9. Telemechanique

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xiv) Control Transformer

1. AE
2. Indushree
3. Intra Vidyut
4. Kalpa Electricals
5. Transpower Industries Ltd.
6. Siemens

xv) DG Set

1. Sterling and Wilson.

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2. GD ankalesaria.
3. Deev Genset.
4. Jackson
5. Sudheer Gensets.
6. Power Engineering(India) Pvt Ltd.

xvi) Earthing Materials

1. Rukmani Electrical & Components Pvt Ltd.
2. Indiana Grating Pvt Ltd.
3. Jef Techno Solutions Pvt Ltd

Flame proof LDB's/ JB,s/Control Station/ switches

7. FCG
8. Sudhir
9. Prompt Engineering Works
10. Flame Proof equipment's pvt. Ltd.
11. Baliga Lighting equipment's Pvt. Ltd.
12. Flexpro Electricals Pvt. Ltd.

#Note:- If material is not supplied by above recommended manufacture list, Then material of other make shall be accepted on MTC basis.

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xvii) High Mast

1. Bajaj Electricals Limited
2. Crompton Greaves Limited.
3. Philips India Limited
4. Surya Roshani

xviii) High Voltage PCC/ MCC panels

1. BHEL
2. Control and Switchgear
3. Siemens
4. Tricolite Electrical Industries
5. Schneider

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6. CGL
7. L&T

xix) Indicating Lamps

1. Alstom Ltd.
2. BCH
3. L&T Ltd.
4. Siemens Ltd.
5. Vaishno Electricals

xx) Indicating Meters

1. ABB
2. AMCO
3. AE
4. Alstom Ltd. (EE)
5. Conzerv/Schneider
6. Elecon Measurement Pvt. Ltd.
7. HPL Electric & Power Pvt. Ltd.
8. MECO Instruments Ltd.
9. Minilec
10. Rishabh Instruments Pvt. Ltd.
11. Trinity energy system
12. kaycee
13. Salzer

xxi) Lighting Fixtures

1. GE Lighting Pvt. Ltd.
2. Bajaj Electricals Ltd.
3. Crompton Greaves Ltd.
4. Philips India Ltd.

xxii) Lighting Fixtures – Flameproof

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1. Bajaj Electricals Ltd.
2. Baliga Lighting Equipment Pvt. Ltd.
3. Crompton Greaves Ltd.
4. CEAG Flameproof Controlgear Pvt. Ltd.
5. Flexpro Electricals Pvt. Ltd.
6. Philips India Ltd.
7. Sudhir Switchgears Pvt. Ltd.
8. FCG.

xxiii) Miniature Circuit Breakers (MCBs) and Lighting DB

1. ABB
2. Hagger
3. Havell's India Ltd.
4. Indo Asian Fusegear Ltd.
5. Legrand
6. MDS Switchgear Ltd.
7. Schneider
8. Siemens Ltd.
9. HPL

xxiv) Moulded Case Circuit Breaker (MCCBs)

1. ABB
2. Andrew yule
3. Larsen & Toubro
4. Schneider
5. Siemens
6. Control and Switchgear

xxv) Protection Relays – Thermal

1. BCH
2. L&T Ltd.
3. Siemens Ltd.
4. Telemenchanique & Controls (India) Ltd.

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xxvi) Low Voltage Power Control Center (PCC)/ MCC/ PDB/ MLDB/ LDB

1. ABB
2. BCH
3. C & S
4. Elecmech Switchgear & Instrumentation
5. KMG ATOZ
6. L&T
7. Pyrotech Electronics Pvt. Ltd.
8. Risha control Engineers Pvt. Ltd.
9. Siemens
10. Tricolite Electrical Industries
11. Unilec Engineers ltd.
12. Vidyut Control India Pvt. Ltd.
13. Control and Schematic
14. Zenith Engineering

xxvii) Push Buttons

1. BCH
2. Alstom Ltd.
3. L&T
4. Siemens Ltd.
5. Telemenchanique & Controls (India) Ltd.
6. Vaishno Electricals

xxviii) Switches - Control

1. BCH
2. Easum Reyrolle Relays & Devices Ltd.
3. Alstom
4. Kaycee Industries Ltd.
5. L&T
6. Siemens Ltd.

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xxix) Switches – 5/15A Piano/ Plate, Switch Socket

1. Anchor Electronics & Electricals Pvt. Ltd.
2. Kingal Electricals Pvt. Ltd.
3. North-West Switchgear Ltd.

xxx) Switch Socket Outlets (Industrial)

1. Alstom Ltd.
2. Best & Cromption Engineering Ltd.
3. BCH
4. Crompton Greaves Ltd.
5. Essen Engineering Company Pvt. Ltd.

xxxi) Solar Modules

1. Tata BP Solar (I) Ltd.
2. REIL, Jaipur.
3. CEIL, Sahibabad.
4. HBL Power

xxxii) Solar Street Lighting

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1. Tata BP Solar (I) Ltd.
2. REIL, Jaipur.
3. CEIL, Sahibabad.
4. HBL.

xxxiii) Terminals Blocks

1. Connectwell
2. Controls & Switchgear Co. Ltd.
3. Elmex Controls Pvt. Ltd.
4. Essen Engineering Co. Pvt. Ltd.

xxxiv) Tranformers

1. ABB
2. Andrew Yule
3. Areva
4. BHEL
5. Bharat Bijlee
6. Crompton Greaves
7. EMCO Ltd.
8. Intra Vidyut
9. Indushree
10. Indcoil
11. Kirloskar
12. Skippers Electricals
13. Transformers & Rectifiers (I) Ltd.
14. Voltamp

xxxv) UPS System and Inverter

1. DB Power
2. Aplab
3. Keltron

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4. Hi-Rel
5. Dubas
6. Toshiba Corporation
7. Fuzi Electric Co Ltd

xxxvi) GI-Octogonal Pole

1. Bajaj
2. Transrail
3. Wipro

xxxvii) List Of Recommended Manufacturers for Heater

1. Escorts Limited, Faridabad, Haryana
2. Spherehot / Kanti ALL Chuni ALL & Sons Appliances Pvt Ltd.Surat
3. Kerone, Bhayander(E), Thane - 401105
4. Excel Heaters, Andheri (West), Mumbai - 400 053, India
5. Nirmal Industrial Controls Pvt. Ltd. , Mulund(W), Mumbai - 400 080

NOTE: - Item/Vendor, which are not listed above, shall be subject to prior approval from Client/Consultant.

4. LIST OF MATERIALS OF RECOMMENDED BRAND AND/ OR MANUFACTURE

D. (INSTRUMENTATION)

I. OFC JOINT CLOSURE

Manufacture/Procurement, Testing and supply of suitable OFC Joint closures including all necessary accessories of any of the following make:

1. Raychem
2. 3M
3. Siemens
4. Any other make from the approved vendor list of client with supporting paper

II. PRESSURE GAUGES

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1. AN Instruments Pvt Ltd
2. Badotherm Process Instruments
3. Baumer Bourdon Haenni S.A.S
4. British Rototherm Co Ltd
5. Budenberg Gauge Co Ltd
6. Dresser Inc
7. Forbes Marshall (Hyd) Pvt Ltd
8. General Instrument Consortium
9. H. Guru Instruments (South India) Pvt Ltd
10. Manometer (India) Pvt Ltd
11. Nagano Keiki Seisakusho Ltd
12. Hirlekar Precision, India
13. Waaree Instruments Ltd
14. Walchandnagar Industries Ltd (Tiwac Divn)
15. Wika Alexander Wiegand & Co GmbH
16. Wika Instruments India Pvt Ltd
17. Ashcroft India Pvt Ltd.

III. TEMPERATURE GAUGES

1. AN Instruments Pvt Ltd.
2. Badotherm Process Instruments B.V.
3. Bourdon Haenni S.A.
4. Dresser Inc.
5. General Instruments Consortium
6. H. Guru Instruments (South India) Pvt. Ltd
7. Nagano Keiki Seisakusho Ltd

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6. Sbeletro Mechanicals

8. TRAC

IV. FIELD INSTRUMENTS (P, DP, F, L, T)

1. ABB Ltd
2. Honeywell
3. Fuji Electric Instruments Co Ltd
4. Yokogawa
5. Invensys India Pvt.Ltd

V. FLOW COMPUTERS

1. Emerson
2. Instromet International (Belgium)
3. FMC Measurement Solutions (UK)
4. RMG (Germany)
5. OMNI Flow Computers Inc.
6. Thermo Fisher, USA

VI. PRESSURE REGULATOR AND SLAM SHUT VALVE

1. Pietro Fiorentini S.P.A. (Italy)
2. Emerson
3. RMG-Regel Messtechnik (Germany
4. Mokveld Valves BV (Netherlands)
5. Schlumberger (USA)
6. Gorter Controls B V (Netherlands)
7. Instromet International NV
8. Nirmal Industrial Controls Pvt Ltd. (up to 6" size only)
9. ESME Valves Ltd

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10. Kaye & Macdonald Inc.
11. Nuovo Pignone S.P.A (Italy) (GE Oil Co.)
12. Richards Industries (Formerly Treloar)
13. Samson AG Mess-und Regeltechnik
14. Tormene Gas Technology
15. Dresser Inc, USA (upto 8" size, 300# class only)

VII. PRESSURE SAFETY VALVES

1. Keystone Valves (India) Pvt. Ltd.
2. Larson & Toubro Ltd.
3. Lesser GmbH & Co KG
4. Mekaster Engg Ltd..
5. Tyco Sanmar Ltd. (New Delhi)
6. Anderson Greenwood Crosby
7. BHEL (Trichy)
8. Curtiss Wright Flow Control Corporation
9. Dresser Inc.
10. Fukui Seisakusho Co. Ltd
11. Nakakita Seisakusho Co Ltd
12. Nuovo Pignone S.P.A (Italy) (GE Oil co)
13. Parcol S.P.A
14. Safety Systems UK Ltd
15. Tai Milano S.P.A
16. Weir Valves & Controls France
17. Bliss Anand Pvt Ltd.

VIII. FLOW CONTROL VALVES

1. Fouress Engg. (New Delhi)

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2. Fisher Xomox (New Delhi)
3. MIL Control Ltd. (Noida)
4. KOSO India Pvt ltd
5. Samson Control (Thane)
6. Dresser Valves India Pvt Ltd.
7. Fisher Controls
8. Valvitalia Italy
9. CCI Valve technology
10. Flowserve Pvt Ltd.
11. Metso Singapore Pvt Ltd.
12. Instrumentation Ltd Palghat
13. Dresser Inc. USA

IX. CONTROL PANEL & ACCESSORIES

1. Keltron Controls Ltd., Kerala
2. Elechmec Corporation Ltd., Mumbai
3. Industrial Controls & Appliances Pvt. Ltd.,
4. Alstom System Ltd., Noida
5. Emerson Process Management (I) Pvt. Ltd.
6. ABB Instruments Ltd., New Delhi
7. Larsen & Toubro Ltd.
8. Control & Automation, New Delhi
9. GE Fanuc Systems Pvt. Ltd., New Delhi
10. Rockwell Automation (I) Ltd., Ghaziabad
11. Honeywell Automation Ltd.
12. Rittal
13. Pyrotech Elcronics Pvt Ltd.
14. Positronics Pvt Ltd.

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15. Electronics Corporation of India Ltd.

X. JUNCTION BOXES AND CABLES GLANDS

1. Ex-Protecta
2. Flameproof Control Gears
3. Baliga
4. Flexpro Electricals

XI. CONTROL AND SIGNAL CABLES

1. Associated Cables
2. Brook
3. Associated Flexibles & Wires (Pvt) Ltd
4. Universal Cables Ltd,India
5. Delton Cables Ltd, India
6. KEI Industries Ltd INDIA
7. CMI Limited
8. Cords Cable Industries Ltd, India
9. Elkay Telelinks (P) Ltd., India

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10. Udey Pyrocables Pvt Ltd, India
11. Goyolene Fibres (I) Pvt Ltd, India
12. Netco Cable Industries Pvt Ltd, India
13. Nicco Corporation Ltd, India
14. Paramount Communications Ltd, India
15. Polycab Wires Pvt Ltd, India
16. Radiant Cables Pvt Ltd, India
17. Reliance Engineers Ltd., India
18. Suyog Electricals Ltd, India
19. Thermo Cables Ltd

XII. INDICATORS & CONTROLLERS

1. Yokogawa
2. Eurotherm Chessel
3. Honeywell
4. Emerson

XIII. BARRIERS

1. MTL
2. STHAL
3. P&F
4. Phoenix

XIV. GAS CHROMATOGRAPH

1. ABB
2. Emerson
3. Instromet International, NV
4. RMG Regal+Messtechnik GmbH

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5. Yokogawa

XV. I/P CONVERTERS

1. ABB
2. Emerson
3. IMI Watson Smith Ltd.
4. Moore Controls Ltd
5. Shreyas Instruments Pvt Ltd, India
6. Thermo Brandt Instruments

XVI. SS FITTINGS, INSTRUMENT VALVES & MANIFOLDS

1. Aura Inc.
2. Hoke
3. Excelsior Engg Works, India
4. Parker
5. Swagelok Co.
6. Swastic Engineering Works, India
7. Comfit & Valves Pvt.Ltd
8. Arya Crafts & Engg.Pvt. Ltd

XVII. SS TUBES

1. Sandvik
2. Hoke
3. Parker
4. Swagelok Co.
5. Heavy metal & tubes LTD
6. Nuclear Fuel Complex .India
7. Ratnamani Metal & Tube Ltd

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8. Jindal Saw

XVIII. GAS DETECTION SYSTEM

1. Crowcon Detection Instruments Ltd
2. Detection Instruments (I) Pvt Ltd
3. Detector Electronics Corporation
4. Drager Safety AG & Co. KGAA
5. General Monitors Ireland Ltd
6. Mine Safety Appliances Company
7. MSA – Mines Safety Appliances (India) Ltd
8. Industrial Scientific Oldham France S.A.
9. Riken Keiki Co Ltd
10. Simrad Optronics Icare
11. Honeywell Analytics
12. Net Safety Monitoring Inc.
13. Simtronics SAS

5. LIST OF RECOMMENDED MANUFACTURERS

E. (SHOP & FIELD PAINTING)

I. Indian Vendors

1. Asian Paints(I) Ltd.
2. Berger Paints Ltd.
3. Goodlass Nerlolac Paints Ltd.
4. Jenson And Nicholson Paint Ltd & chokuGu Jenson & Nicholson Ltd.
5. Shalimar Paints Ltd.
6. Sigma Coating, Mumabai
7. CDC Carboline Ltd.

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8. Premier Products Ltd.
9. Coromandel Paints & Chemicals Ltd.
10. Anupam Enterprises
11. Grand Polycoats
12. Bombay Paints Ltd.
13. Vanaprabha Esters & Glycer, Mumbai
14. Sunil Paints and Varnishes Pvt. Ltd.
15. Courtaulds Coating & Sealants India (Pvt.) Ltd.
16. Mark-chem Incorporated, Mumbai (for phosphating chemicals only)
17. VCM Polyurethane Paint (for polyurethane Paint only)

II. Foreign Vendors for Overseas Products

1. Sigma Coating, Singapore
2. Ameron, USA
3. Kansai Paint, Japan
4. Hempel Paint, USA
5. Valspar Corporation, USA
6. Courtaulds Coating, UK.

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6. RECOMMENDED MANUFACTURE LIST FOR TELECOM BOUGHT OUT ITEMS

Fiber Optic Cable and Accessories

Vendor Details

1. Aksh Optifibre Limited
2. Vindhya Telelink Limited
3. Finolex Cables Ltd
4. RPG Cables Limited

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5. Tamilnadu telecommunication Limited
6. UM Cables Limited
7. Himachal Futuristic Communications Limited
8. Birla Ericsson Optical Limited
9. Uniflex Cables Ltd
10. Sterlite Optical technologies Limited

HDPE Duct (For OFC) and Accessories

Manufacture/Procurement, Testing and supply of suitable HDPE duct pipe including all necessary accessories of any of the following make:

1. Raychem
2. 3M
3. Siemens
4. Sangir
5. Duraline
6. Any other make from the approved vendor list of client with supporting paper.

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INSULATION JOINTS

4.1 TECHNICAL CRITERIA:

4.1.1 The bidder shall be a manufacturer of Monolithic Insulating Joints.

4.1.2 Bidder should have designed, manufactured, tested and supplied atleast one (1) number of Monolithic Insulating Joint that are of same type, equal or higher in terms of size and pressure rating as quoted for, in the last (7) years reckoned from the bid due date.

Note:

1. Experience of only the bidding entity shall be considered. A Job executed by a Bidder for its own plant/ project cannot be considered as experience for the purpose of meeting of this Tender Document. However, jobs executed for Subsidiary/Fellow subsidiary / Holding company will be considered as experience for the purpose of meeting Subject to submission of tax paid invoice (s) duly certified by Statutory Auditor of the Bidder towards payments of statutory tax in support of the job executed for Subsidiary/Fellow subsidiary/ Holding company. Such Bidders to submit these documents in addition to the documents specified to meet of this Tender Document.

2. Bids from Consortium/Joint bids/multiple bids/alternative bids shall not be accepted in the instant tender.

3. Bidder shall not be affiliated with a firm or entity, (i) that has provided consulting services related to works to employer during preparatory stages of works or of the period of which the work form a part, or (ii) that has been hired (or proposed to be hired) by the employer as Engineer/Consultant for the contract.

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PIG TRAPS

4.1 **TECHNICAL CRITERIA**

(i) Bidder shall be a manufacturer of Pig Launcher / Receiver.

(ii) The Bidder should have designed, manufactured, tested and supplied at least one (01) number Pig Launcher / Receiver that are of equal or higher in terms of size & pressure rating as quoted for, in last seven (07) years reckoned from the bid due date.

(iii) The Bidder or its proposed supplier of Quick Opening End Closure (QOEC) to be installed on Pig Launcher/ Receiver should have designed, manufactured, tested and supplied at least one (01) number Quick Opening End Closure (QOEC) that are equal or higher in terms of size and pressure rating as quoted for in last seven (07) years reckoned from the bid due date.

Note:

(i) A job executed by a bidder for its own Plant/Projects will not be considered as experience for the purpose of meeting of the Tender. However, jobs executed for Subsidiary / Fellow Subsidiary / Holding company will be considered as experience for the purpose of meeting subject to submission of tax-paid invoice(s) duly certified by Statutory Auditor of the bidder towards payments of statutory tax in support of the job executed for Subsidiary/ Fellow Subsidiary / Holding Company. Such bidders to submit these documents in addition to the documents specified in the Bid Document to meet of the tender documents.

(ii) Bidder shall not be affiliated with a firm or entity, (i) that has provided consulting services related to works to employer during preparatory stages of works or of the period of which the work form a part, or (ii) that has been hired (or proposed to be hired) by the employer as Engineer / Consultant for the contract

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FLANGE & FITTINGS

4.1 TECHNICAL CRITERIA:

4.1.1 FOR – FLANGES, SPECTACLE BLIND

4.1.1.1 The bidder shall be a manufacturer of items as quoted.

4.1.1.2 The bidder, in last seven (7) seven years reckoned form the bid due date, should have designed, manufactured, tested and supplied from the proposed manufacturing plant at least one (1) number of Flange/Spectacle Blind equal or higher in terms of size & Pressure rating specified in the group as quoted for.

4.1.2 FOR – EQUAL TEE, UNEQUAL TEE, CONCENTRIC REDUCER, WELDOLET, SOCKOLET, ELBOW

4.1.2.1 The bidder shall be a manufacturer of items as quoted.
4.1.2.2 The bidder, in last seven (7) seven years reckoned form the bid due date, should have designed, manufactured, tested and supplied from the proposed manufacturing plant at least one (1) number of Equal Tee/Unequal Tee/Concentric Reducer/ Weldolet/Sockolet /Elbow of atleast equal or higher in terms of size & pressure rating specified in the group as quoted for.

4.1.3 FOR – FLOW TEE

4.1.3.1 The Bidder shall be a manufacturer of items as quoted.

4.1.3.2 Bidder should have designed, manufactured, tested and supplied at least one (1) number of Flow Tee, that are of same type, equal or higher in terms of size & pressure rating as quoted for, in the last seven (7) years reckoned from the bid due date.

4.1.4 FOR – BEND

4.1.4.1 The bidder shall be a manufacturer of items as quoted.

4.1.4.2 The bidder, in last seven (7) seven years reckoned form the bid due date, should have designed, manufactured, tested and supplied from the proposed manufacturing plant at least one (1) number of Bend which is at least equal or higher in terms of size &pressure rating specified in the group as quoted for.

Note:

1. Experience of only the bidding entity shall be considered. A Job executed by a Bidder for its own plant/ project cannot be considered as experience for the purpose of meeting of this Tender Document. However, jobs executed for Subsidiary/Fellow subsidiary / Holding company will be considered as experience for the purpose of meeting

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subject to submission of tax paid invoice (s) duly certified by Statutory Auditor of the Bidder towards payments of statutory tax in support of the job executed for Subsidiary/Fellow subsidiary/ Holding company. Such Bidders to submit these documents in addition to the documents specified to meet of this tender.

2. Bids from Consortium/Joint bids/multiple bids/alternative bids shall not be accepted in the instant tender.

3. Bidder shall not be affiliated with a firm or entity, (i) that has provided consulting services related to works to employer during preparatory stages of works or of the period of which the work form a part, or (ii) that has been hired (or proposed to be hired) by the employer as Engineer/Consultant for the contract.

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BALL VALVE

4.1 TECHNICAL CRITERIA

(i) Bidder shall be a manufacturer of Ball Valves as per API 6D Specification and shall have a valid license to use API monogram for the proposed manufacturing Plant(s).

(ii) Bidder shall have designed, manufactured, tested and supplied from the proposed manufacturing plant at least one (1) number Ball Valve as per API 6D, specifications, identical in terms of design and equal or higher in terms of size and rating, as quoted for, in the last seven (7) years reckoned from the bid due date.

(iii) The bidder or his proposed supplier of Gas powered / Gas over oil actuator(s) shall have designed, manufactured, tested and supplied at least one (1) number valve actuator of similar type / model, as being offered, within the last seven (7) years reckoned from the bid due date. Documents submitted for qualification should clearly specify the actuation medium as natural gas.

Note:

(i) A job executed by a bidder for its own Plant/Projects will not be considered as experience for the purpose of meeting of the Tender. However, jobs executed for Subsidiary / Fellow Subsidiary / Holding company will be considered as experience for the purpose of meeting subject to submission of tax-paid invoice(s) duly certified by Statutory Auditor of the bidder towards payments of statutory tax in support of the job executed for Subsidiary/ Fellow Subsidiary / Holding Company. Such bidders to submit these documents in addition to the
documents specified in the Bid Document to meet of the tender documents.

(ii) Bidder shall not be affiliated with a firm or entity, (i) that has provided consulting services related to works to employer during preparatory stages of works or of the period of which the work form a part, or (ii) that has been hired (or proposed to be hired) by the employer as Engineer / Consultant for the contract.

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Notes:

1. Bidder can select vendor from this VENDOR LIST and mention the same in the checklist for technical evaluation attached with the tender. The offered bid must include filled datasheet indicating make, model, size, rating of offered instrument/ equipment duly supported by sizing calculation of offered equipment (wherever applicable).

2. Vendors who have already supplied above equipment in other terminals of BGL, shall also be considered qualified for this tender provided the supplier equipment are commissioned and running successfully and they have not been put on holiday in list of Client/BGL/ Other PSU

3. Equipment / Instruments of any make which is offered by one bidder and acceptable to BGL shall be accepted for other bidder also. After placement of order, on request of the successful bidder list of other qualified makes for a particular item (for which successful bidder wants to change the vendor) shall be provided.

4. Bidder shall take prior approval of the make / model no of the offered item and it shall be from the list given above. However additional vendors will be considered in exceptional cases,provided they have supplied for similar application to reputed gas transmission/distribution companies, in quantities at least half the numbers being supplied for this tender, and working satisfactorily for minimum 6 months. Documentary evidence substantiating above shall be submitted for taking approval.

5 For procuring bought out items from vendors other than thoselisted above, the same may be acceptable subject to the following:
-

   a) The vendor/ supplier of bought out item(s) is a manufacturer/ supplier of said item(s) for intended services and the sizes being offered is in their regular manufacturing supply range.

   b) Should have supplied at least one single random length (i.e. 5.5 meters to 6.5 meters) for item assorted pipes / tubes and for other items, which are to be supplied in quantity on number-basis (other than assorted pipes / tubes) minimum
   01 (One) number of same or higher in terms of size and rating as required for intended services. The bidder should enclose documentary evidences i.e. PO copies, Inspection Certificate etc. for the above, along with their bids.

6 For any other item(s) for which the vendor list is not provided, bidders can supply those item(s) from vendors/ suppliers who have earlier

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supplied same item(s) for the intended services in earlier projects and the item(s) offered is in their regular manufacturing/ supply range. The bidder is not required to enclose documentary evidences (PO copies, Inspection Certificate etc.) along with their offer, however in case of successful bidder, these documents shall require to be submitted by them within 30 days from date of Placement of Order for approval to CLIENT .

7 The details of vendors indicated in this list are based on the information available with BGL, Contractor shall verify capabilitiesof each vendor for producing the required quantity with. PMC does not guarantee any responsibility on the performance of the vendor. It is the contractor's responsibility to verify the correct status of vendor and quality control of each parties and also to expedite the material in time.

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SECTION 8: SPECIAL CONDITIONS OF CONTRACT AND AENNEXURE TO SCC

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SPECIAL CONDITIONS OF CONTRACT

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1.0 GENERAL

1.1 Special Conditions of Contract shall be read in Conjunction with the General conditions of Contract, specification of work, Drawings and any other documents forming part of this Contract wherever the context so requires.

1.2 Notwithstanding the sub-division of the documents into these separate sections and volumes, every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and into the Contract so far as it may be practicable to do so.

1.3 Where any portion of the General Condition of Contract is repugnant to or at variance with any provisions of the Special Conditions of Contract, unless a different intention appears, the provisions of the special Conditions of Contract shall be deemed to over- ride the provisions of the General Conditions of Contract and shall to the extent of such repugnancy, or variations, prevail.

1.4 Wherever it is mentioned in the specifications that the Contractor shall perform certain work or provide certain facilities, it is understood that the Contractor shall do so at his own cost and the value of contract shall be deemed to have included cost of such performance and provisions, so mentioned.

1.5 The materials, design, and workmanship shall satisfy the relevant Indian Standards, the Job Specifications contained herein and Codes referred to. Where the job specification stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied.

1.6 In case of an irreconcilable conflict between Indian or other applicable standards, General Conditions of Contract, Special Conditions of Contract, Specifications, Drawings or Schedule of Rates, the following shall prevail to the extent of such irreconcilable conflict in order of precedence :

i) Letter of Acceptance along with Statement of Agreed Variations.
ii) Fax / Letter of Intent / Fax of Acceptance.
iii) Schedule of Rates as enclosures to Letter of Acceptance.
iv) Job / Particular Specifications.
v) Drawings
vi) Technical / Material Specifications.
vii) Instruction to Bidders
viii) Special Conditions of Contract.
ix) General Conditions of Contract.
x) Indian Standards
xi) Other applicable Standards

1.7 It will be the Contractor's responsibility to bring to the notice of Engineer-in-Charge any irreconcilable conflict in the contract documents before starting the

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work (s) or making the supply with reference which the conflict exists.

1.8 In the absence of any Specifications covering any material, design of work (s) the same shall be performed / supplies / executed in accordance with Standard Engineering Practice as per the instructions / directions of the Engineer-in-Charge, which will be binding on the Contractor.

2.0 SCOPE OF WORK & SCOPE OF SUPPLY

The scope of work covered in this Contract will be as described in **Annexure-1**, Particularjob specifications, Standard Specifications, Schedule of Rates etc. The scope of supply covered in this Contract will be as described in **Annexure-2**, Particular Job Specifications, Standard Specifications, Schedule of Rates etc. It is however, explicitly understood that scope described is not limiting, in far as the responsibilities of the contractor are concerned and shall include, interaiia, carrying out any and all works and providing any and all facilities as are required to complete the works in all respect.

3.0 SUPPLY OF WATER, POWER & OTHER UTILITIES

3.1 The Clause No. 2.3 to 2.5 given in General Conditions of Contract is modified to following extent:

3.2 The Contractor shall be responsible at his own cost for arranging and providing all the required Water, Power, land required for temporary site office , fabrication yard and other utilities, in the quantities and at the times required for performance of work under the contract. The contract price shall be deemed to include all costs towards the same. The Employer/Consultant shall not supply water, power and other utilities.

3.3 Contractor shall, if required by him, for the entire duration of the execution of the work make available near the site, land for construction of Contractor's office, Warehouse, Workshops and for any purpose in connection with providing infrastructure required for the execution of the Contract. The Contractor shall at his own cost construct all temporarybuildings and provide suitable water supply and sanitary arrangement as required. On completion of the work undertaken by the Contractor, he shall remove all temporary works erected by him and have the site cleared as directed by Engineer-in- Charge. If the Contractor shall fail to comply with these requirements, the Engineer-in- Charge may at the expense of the Contractor remove such surplus and rubbish materials and dispose off the same as he deems fit and get the site cleared as aforesaid, and the Contractor shall forthwith pay the amount of all expenses so incurred and shall have no claims in respect of any such surplus material disposed of as aforesaid.

3.4 Cutting of trees shall not be permitted except in the case that tree is falling on the line of Pipe line alignment. In such circumstances, details of such tree being cut shall be prepared and forest/ municipal authorities be informed and necessary approval be obtained by contractor. However, after backfilling of trench & restoration, contractor should plant equal number of saplings in that area, cutting

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of tree for any purposes (fuel etc.) by workers are strictly prohibited.

4.0 TIME OF COMPLETION

4.1 The work shall be executed strictly as per Time schedule given in **Annexure-3** in the bidding document. The period of completion given includes the time required for mobilization [15 (Fifteen) Days] as well as testing, rectifications, if any, retesting and completion in all respects to the entire satisfaction of the Engineer-in-Charge.

4.1.1 The time of completion is applicable for complete work.

4.2 A joint programme of execution of work will be prepared by the Engineer-in-Charge and Contractor. This programme will take into account the time of completion mentioned above.

4.3 Monthly/ weekly construction programme will be drawn up by Engineer-in-Charge jointly with the contractor based on availability of work fronts and the joint construction programmes as above clause. The Contractor shall scrupulously adhere to these Targets/ Programme by deploying adequate personnel, construction tools & tackles and he shall also supply himself all materials of his scope of supply in good time to achieve the targets set out in the weekly and monthly programme. In all matters concerning the extent of targets set out in the weekly and achievements, the decision of the Engineer-in-Charge shall be final and binding on the contractor.

4.4 If the Contractor fails to achieve the targeted progress schedule of each month, the Employer/Consultant at its option, may terminate the contract as contractor's default and get the work completed from other sources at contractor's risk & cost.

4.5 Contractor shall give every day report on category wise labour and equipment deployed along with the progress of work done on previous day in the proforma prescribed by the Engineer-in-Charge.

4.6 The contractor shall submit fortnightly report covering all major activities indicating schedule / actual progress, slippages & its reasons and catch up plan.

4.7 No waiver shall be attributable to the stoppage due to union activities & due to the influence of trade unionism and adverse weather conditions.

5.0 DRAWINGS AND DOCUMENTS

5.1 The drawings accompanying the bid document (if any) are of indicative nature and issued for bidding purpose only. Purpose of these drawing is to enable the bidder to make an offer in line with the requirements of the Employer/Consultant. However no extra claim whatsoever, shall be entertained for variation in the "Approved for Construction" and "Bid document drawings" regarding any changes/units. Construction shall be as per drawings/specifications.

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issued/approved by the Engineer-in-Charge during the course of execution of work. Detailed construction drawings (wherever required) on the basis of which actual execution of work is to proceed will be prepared by the contractor.

5.2 The drawings and documents to be submitted by the Contractor to Employer/Consultant after award of the work as per the requirements enlisted in the bidding document shall be for Employer/Consultant's review, information and record. The Contractor shall ensure that drawings and documents submitted to Employer/Consultant are accompanied by relevant calculations, data as required and essential for review of the document/ drawings. BGL/PMC shall review the drawings/ documents within two weeks from the date of submission provided the same are accompanied by relevant calculations, data as required and essential for review.

5.3 All documents and drawings including those of Contractors sub-vendor's manufacturer's etc. shall be submitted to Employer/Consultant after having been fully vetted in detail, approved and co-opted by the Contractor & shall bear Contractor seal/certifications to this effect. All documents/drawings & submissions made to Employer/Consultant without compliance to this requirement will not be acceptable andthe delay & liability owing to this shall be to the Contractor's account.

5.4 The review of documents and drawings by Employer/Consultant shall not absolve Contractor from his responsibility to meet the requirements of specifications, drawings etc. and liabilities for mistakes and deviations. Upon receiving the comments on the drawing/documents reviewed by Employer/Consultant, Contractor shall incorporate the comments as required and ensure their compliance.

5.5 Copies of all detailed working drawing relating to the works shall be kept at the contractors' office at the site and shall be made available to the Engineer-in-charge/ Employer/Consultant at any time during execution of the contract. However no extra claim what so ever shall be entertained for any variation in the "approved/issued for construction drawings" and "tender drawings" regarding any changes/units unless otherwise agreed.

5.6 The Contractor shall rectify any inaccuracies, errors and non-compliance to contractual requirements. Any delay occurring on this shall not construe a reason for delay/ extension.

6.0 COMPLIANCE WITH LAWS

6.1 The Contractor shall abide by all applicable rules, regulations, statutes, laws governing the performance of works in India, including but not limited to the following:

i) Contract Labour (Regulation & Abolition) Act 1970 & the centre rules, 1971framed there under.
ii) Payment of Wages Act.

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iii) Minimum Wages Act.
iv) Employer's Liability Act.
v) Factory Act.
vi) Apprentices Act.
vii) Workman's Compensation Act.
viii) Industrial Dispute Act.
ix) Environment Protection Act.
x) Wild life Act.
xi) Maritime Act.
xii) Any other Statute, Act, Law as may be applicable.
xiii) PNGRB Act.

7.0 GOVERNMENT OF INDIA NOT LIABLE

7.1 It is expressly understood and agreed by and between the Contractor and the Employer/Consultant that the Employer/Consultant is entering into this agreement solely on its own behalf and not on behalf of any other person or entity. In particular, itis expressly understood and agreed that the Government of India is not a party to this agreement and has no liabilities, obligations or rights there under. It is expressly understood and agreed that the Employer/Consultant is an independent legal entity applicable laws of India and general principal of Contract Law. The Contractor expressly agrees, acknowledges and understands that the Employer/Consultant is not an agent, representative or delegate of Govt. of India. It is further understood and agreed that the Govt. of India is not and shall not be liable for any acts, omissions, commissions, breaches or other wrongs arising out of the contract. Accordingly, contractor hereby expressly waives, releases and foregoes any and all actions or claims, including cross claims, impleader claims or counter claims against the Govt. of India arising out of this contract and covenants not to sue to Govt. of India as to any manner, claim, cause of action or thing whatsoever arising of or under this agreement.

8.0 Deleted

9.0 LIMITATION OF LIABILITY

9.1 The final payment by the Employer/Consultant in pursuance of the Contract terms shall not mean release of the Contractor from all of his liabilities under the Contract. The Contractor shall be liable and committed under this contract to fulfil all his liabilities and responsibilities, till the time of release of contract performance guarantee by the Employer/Consultant.

9.2 Notwithstanding anything contrary contained herein, the aggregate total liability of Contractor under the Contract or otherwise shall be limited to 100% of Contract value. However, neither party shall be liable to the other party for any indirect and consequential damages, loss of profit or loss of production.

10.0 Deleted

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11.0 **Deleted**

12.0 Deleted

13.0 Deleted

14.0 DELETED

15.0 **DELETED**

16.0 INCOME TAX & CORPORATE TAX

16.1 Income Tax deductions shall be made from all payments made to the Contractor as per the rules and regulations in force in accordance with the Income Tax Act prevailing from time to time.

16.2 Corporate Tax liability, if any, shall be to the contractor's account.

17.0 CUSTOM DUTY

17.1 The Contract Price shall include the following duties i.e. Custom Duties, CVD, additional CVD for all materials and consumables envisaged to be imported for incorporation in the permanent works. It shall be clearly understood by the Contractor

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that custom duty shall neither be paid nor reimbursed by Employer/Consultant. Contractor shall be fully responsible for port clearance including stevedoring, handling, unloading, loading, storage, inland transportation and receipt of materials at site etc. and cost thereof shall be included in the contract price. The contractor shall also be fully responsible for any delays, penalties, demurrages, shortages and other charges and losses, if any, in this regard.

17.2 DELETED

18.0 **CUSTOM DUTY ON CONSTRUCTION EQUIPMENTS**

18.1 Contractor is liable to pay custom duty on the equipments brought into India for executing the project. The Contractor shall be fully liable for observing all the formalities in this regard as well as to pay the custom duty chargeable on the equipments,including any deposit payable for such purposes. No adjustment in contracted rates shallbe permissible for any change in duty drawback applicable in respect of equipment & machinery brought in India for the use of the project and for re-export of equipment and machinery, on completion of the project.

18.2 If the Custom Authorities require the Contractor to furnish a bond to secure payment of any custom duty in respect of any import and that such Bond shall be furnished by the Employer/Consultant, the Employer/Consultant may at the request of the Contractor furnish the said Bond against the Contractor furnishing a Bank Guarantee to the Employer/Consultant, of the like amount in the form and from a Bank in India approved by the Employer/Consultant.

18.3 If for any reason the Employer/Consultant is required by the Customs Authorities during pendency of Contract to pay any customs duty due to the importation or retention by the Contractor of any imports, the Contractor shall forthwith on demand by the Employer/Consultant pay the same to the Employer/Consultant, with the right in the Employer/Consultant (without prejudice to any other mode of recovery or right of the Employer/Consultant) to deduct the same from the on account and other payments due and/or becoming due or payable to the Contractor from time to time. The payments under such a case shall be subject to submission of Bank Guarantee from a Bank approved by Employer/Consultant, by the Contractor in favour of the Employer/Consultant for an amount equivalent to amount of custom duty.

18.4 The obligations undertaken and/or any bond or facility provided by the Employer/Consultant to the Contractor shall be based on the clear understanding that the said equipment shall be utilised by the Contractor only for the performance of the work covered under this contract and that the Employer/Consultant shall be discharged forthwith from all said obligations and shall be entitled forthwith to discontinue and recall any bond or other facility to the Contractor if the Contractor shall utilise or permit to be utilised the said equipment(s) or any of them for the performance of any work other than the work covered by the Contract in which event any amount due from Contractor in this connection shall also carry interest

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@22% (Twenty two percent) per annum from the date of relative payment by Employer/Consultant up to the date of recovery in full.

19.0 ISSUE OF ESSENTIALITY CERTIFICATE

BGL shall not provide any kind of certificate.

20.0 IMPORT LICENCE

20.1 Contractor shall arrange import of all materials required for permanent incorporation in the works as well as construction equipment as per the guidelines laid down by the Government of India. Employer shall not provide import licence.

21.0 WITHHOLDING, ACCOUNTING AND TAX REQUIREMENTS

21.1 Contractor agrees for withholding from wages and salaries of its agents, servants or employees all sums, required to be withheld by the laws of the Republic of India or any other agency having jurisdiction over the area where Contractor is conducting operations,and to pay the same promptly and directly when due to the proper authority. Contractor further agrees to comply with all accounting and reporting requirements of any Nation having jurisdiction over the subject matter hereof and to conform to such laws and regulations and to pay the cost of such compliance. If requested, Contractor will furnish the evidence of payment of applicable taxes, in the country(ies) of the Contractor's and his sub-contractor(s) and expatriate employees.

22.0 INTELLECTUAL PROPERTY

22.1 Neither Employer/Consultant nor Contractor nor their personnel, agents nor any sub- contractor shall divulge to any one (other than persons designated by the party disclosing the information) any information designated in writing as confidential and obtained from the disclosing party during the course of execution of the works so long as and to the extent that the information has not become part of the public domain. This obligation does not apply to information furnished or made known to the recipient of the information without restriction as to its use by third parties or which was in recipient's possession at the time of disclosure by the disclosing party. Upon completion of the works or in the event of termination pursuant to the provisions of the contract, Contractor shall immediately return to Employer/Consultant all drawings, plans, specifications and other documents supplied to the Contractor by or on behalf of Employer/Consultant or prepared by the Contractor solely for the purpose of the performance of the works, including all copies made thereof by the Contractor.

23.0 FIRM PRICE

23.1 The quoted prices shall be firm and shall not subjected to price escalation till the workis completed in all respects.

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24.0 WORKS CONTRACT

24.1 The work covered under this contract shall be treated as "Works Contract".

25.0 PROVIDENT FUND ACT

25.1 The Contractor shall strictly comply with the provisions of Employees Provident Fund Act and register themselves with RPFC before commencing work. The Contractor shall deposit Employees and Employers contributions to the RPFC every month. The Contractor shall furnish along with each running bill, the challan/ receipt for thepayment made to the RPFC for the preceding months.

26.0 MOBILIZATION ADVANCE

26.1 NO Mobilization Advance will be given for this Tender.

27.0 CHANGE ORDERS/ EXTRA WORKS/ DEVIATIONS

27.1 A change order will be initiated in case:

i) The Employer/Consultant directs the Contractor to include any addition to the scope of work not covered under this contract or delete any Section of the scope of the work under the contract.

ii) Contractor requests to delete any part of the work which will not adversely affect the operational capabilities of the project and if agreed by the Employer/Consultant and for which cost and time benefits shall be passed on to the Employer/Consultant.

27.2 Any changes required by the Employer/Consultant before giving their approval to detailed procedure or any other document relating to material procurement, layout plans etc for complying with the requirements of bidding document shall not be construed to be a change in the scope of work under the contract.

27.3 Any change order as above comprising an alteration which involves a change in the cost of the works (which sort of alteration is hereinafter called a "Variation") shall have impact on the contract value that shall be dealt towards end of contract. All change orders shall be approved by the EIC.

27.4 If the contract provides applicable rates for the valuation of the variation in question the contract price shall be increased or decreased in accordance with those rates. If the parties agree that the contract does not contain applicable rates then the parties shall negotiate a revision of the contract price which shall represent the change in cost of the works caused by the variations. Any change order must be duly approved by the Employer/Consultant in writing.

27.5 If there is a difference of opinion between Contractor and Employer/Consultant

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whether a particular work constitutes a change order or not, the matter shall be handled in accordance with the procedures set forth in para 27.7.8 and 27.7.9 here below.

27.6 Within 10(Ten) working days of receiving the comments from the Employer/Consultant on the documents submitted by the Contractor for approval, the Contractor's response in writing stating which item(s) is/are potential change (s), if applicable, will be submitted to the Employer/Consultant.

27.7 Procedure

27.7.1 During execution of work if the Contractor observes that any new requirements which is not specific or intended in the bidding document has been indicated by Employer/Consultant, they shall discuss the matter with Employer/Consultant's representatives.

27.7.2 In case such requirement arises from the side of the Contractor they would also discuss the matter with Employer/Consultant's Representative.

27.7.3 In either of the two cases above, the representatives of both the parties shall discuss the project requirement and mutually decide whether the project requirement constitutes a change order.

27.7.4 If it is mutually agreed that the project requirement/Inquiry constitutes a "Change Order" then a joint memorandum will be prepared to confirm a "Change Order" and basic ideas of necessary agreed modifications.

27.7.5 Contractor will study the work required in accordance with the Joint memorandum and assess subsequent schedule and cost effect if any.

27.7.6 The results of this study would be discussed mutually to enable Employer/Consultant to give a final decision whether Contractor should proceed with the Change Order or not, in the best interest of the Project.

27.7.7 If Employer/Consultant's representative accepts the change order in writing then Contractor shall proceed with the work stipulated in the Change order. Time worked by all workmen employed and a statement showing the description and quantity of all materials and plant utilised for extra work shall be submitted to Employer/Consultant. The Employer/Consultant's representative shall sign and return to the Contractor the statement, as agreed. At the end of each month the Contractor shall deliver to the Employer/Consultant's representative a priced statement of the labour, materials and plant used. Whenever any dispute arises as to cost allocation between the Contractor and the Employer/Consultant, the voucher shall nevertheless be signed by the Employer/Consultant as a record of time worked and materials used. List and vouchers so signed will be the subject of negotiations between the Employer/Consultant and the Contractor regarding their costs allocation.

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27.7.8 In case, mutual agreement as above that is whether Project Requirement constitutesa Change order or not, is not reached, then Contractor, in the interest of the project, shall take up the implementation of the work, if advised in writing to do so by Employer/Consultant's representative pending settlement between the two parties to the effect whether the Project Requirement constitutes a change order or not as per the terms and conditions of Contract Documents.

27.7.9 The time and cost effect in such a case shall be mutually verified for the purpose of record. Should it be established that the said work is constituting a Change Order, the same shall be compensated taking into account the records kept and in accordance with the contract.

27.7.10 Should the amount of Extra Work/ Change Order, if any, which the Contractor may be required to perform by the Employer/Consultant, fairly entitles the Contractor to extensions of time beyond the scheduled completion date for completion of either the whole of the works or for such Extra Work only, the Employer/Consultant and the Contractor shall mutually discuss and decide the extension of time, if any to be granted to the Contractor.

28.0 CONSTRUCTION OF PIPE LINE ALIGNMENT AND PERMITS:

28.1 Contractor shall carry out construction work with in the width as made available to him. Where the pipeline route passes through forest/plantation areas contractor shall clearonly the minimum width required for laying the pipeline as per Company's approvedprocedure for pipeline construction. Felling of trees/plants shall be minimized. Damageto any obstruction, temporary/permanent structure, boundary walls etc. within pipe linealignment shall be repaired and restored and cost of repairs/restoration shall be toContractor's account.

28.2 The Contractor must ensure that during laying of the pipeline minimum damage occurs to the land. The land has to be restored to original condition. All construction activities shall be in accordance with the local Government regulations and shall be performed by the competent and qualified persons for providing adequate protection to the general public, livestock, wild life, forest, power lines, buildings etc. in the vicinity of the pipeline.

28.3 Due measures for working within deep trench must be taken including necessary safety precautions for the workers.

During pipeline construction, measures shall be adopted in order to minimize the impact of pipeline construction activities on the environment. During ROU clearance, the vegetation shall be cut off at ground level leaving the roots intact. Only stumps and roots directly over the trench shall be removed for pipeline Installation.

28.4 In case of any detour from the acquired ROU due to constructability problems or

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otherwise, contractor may be permitted to do so after approval from CA / Company. All immediate measures for taking the land and compensations to land owner(s) shall be to Contractor's account. All statutory payments shall be paid/ reimbursed by Company. However, such activity shall not affect the construction schedule and overall completion period. In case of local detour due to non availability of Legal ROU, contractor has to negotiate and arrange the ROU for laying of pipe line without affecting the schedule. Compensation payable under P&MP act shall be paid by BGL. All other costs if any shall be to the contractors account. Company shall proceed with regular notifications etc. in due course for the detoured portion.

28.5 Clean-up and restoration of ROU and other conveniences like road, rail, canals, cultivable land, water facilities, irrigation facilities, boundary wall/fence etc. to original condition as per specification and drawings to the entire satisfaction of Company and/or Landowner/Cultivator/ Authorities having jurisdiction over the same, including disposal of surplus excavated soil and other construction materials to a location identified by Contractor approved by local authority without causing any disturbance to environment and to the entire satisfaction of Company.

28.6 Contractor shall arrange necessary clearance from the concerned authorities/land owners to the effect that ROU/ ROW has been restored back to original condition. Contractor shall carry out joint survey with representative of Competent Authority (CA) and will obtain clearance in writing from CA that ROU has been restored to original condition. Necessary clearance from statutory authority / NOC for restoring the ROU to original condition shall be in Contractor's scope. However, if the owner does not give the NOC, payment may be released to the contractor if the restoration is done by Engineer-in-charge as per the tender specifications.

28.7 Local state Government may impose Taxes/ Duties/ royalty etc. towards the excavation and filling of earth for the pipe line and terminals works. It is the responsibility of contractor to make such payments without any cost implications to BGL.

28.8 Contractor is required to maintain a hindrance register. All hindrances encountered in the execution needs to be logged in this register and shall be jointly signed.

29.0 CONSTRUCTION EQUIPMENT AND ORGANIZATION

29.1 CONSTRUCTION EQUIPMENT

29.1.1 Bidder shall meet the requirement regarding deployment of minimum construction equipments as specified in the Bidding Document at **Annexure-9**. Bidder shall also submit their compliance for deployment of equipments as above along with the bid.

29.1.2 Deleted.

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29.1.3 The Employer/Consultant shall not supply any Construction Equipment.

29.2 MANPOWER DEPLOYMENT

29.2.1 Bidder shall meet the requirement regarding deployment of minimum construction manpower for individual Section as specified in the bidding document at **Annexure-10**. Bidders who intend to quote for more than one Section shall meet the requirement equal to the sum of the construction manpower specified for individual Section. Bidder shall also submit their compliance for deployment of manpower along with the bid.

29.2.2 Schedule of Labor & Equipment Rates

Hiring / Recovery Rate for Deployment of Manpower attached as **Annexure-11** to SCC shall be used for analyzing rates for extra items and recovery for non-deployment of manpower.

29.2.3 Equipment Hiring / Recovery Rates attached as **Annexure-12** to SCC shall be used for analysing rates for extra items and recovery for non-deployment of equipment.

30.0 MECHANISED CONSTRUCTION

30.1 Contractor shall without prejudice to his overall responsibility to execute and complete the work as per specifications and time schedule adopt as far as practicable, mechanized construction techniques for major site activities. Contractor agrees that he will deploy therequired numbers and types of the plant & machinery applicable for different activitiesin consultation with the Engineer-in-charge during execution of works.

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30.2 Contractor further agrees that Contract price is inclusive of all the associated costs, which he may incur for actual mobilization, required in respect of use of mechanised construction techniques and that the Employer/Consultant/Consultant in this regard shall entertain no claim whatsoever.

31.0 GENERAL GUIDELINES DURING AND BEFORE ERECTION

31.1 Contractor shall be responsible for organising the lifting of the equipment in the proper sequence, that orderly progress of the work is ensured and access routes for erecting the other equipments are kept open.

31.2 Orientation of all foundation, elevations, lengths and disposition of anchor bolts and diameter of holes in the supports saddles shall be checked by contractor, well in advance.Minor rectifications including chipping of foundations as the case may be shall be carried out at no extra cost by the contractor after obtaining prior approval of the Engineer-in-Charge. The Contractor shall also be provided with the necessary structural drawings and piping layouts etc., wherever required for reference. During the structural member need to be dismantled, to facilitate the equipment erection, same shall be done by the contractor after ensuring proper stability of main structure with prior permission of Engineer-in-Charge. All such dismantled members shall be put in position back after the completion of equipment erection to satisfaction of Engineer-in- Charge.

31.3 During the performance of the work the Contractor at his own cost, shall keep structures, materials and equipment adequately braced by guys, struts or otherwise approved means which shall be supplied and installed by the Contractor as required till the installation work is satisfactorily completed. Such guys, shoring, bracing, strutting, planking supports etc. shall not interfere with the work of other agencies and shall not damage or cause distortion to other works executed by him or other agencies.

31.4 Manufacturer's recommendations and detailed specifications for the installation of the various equipment and machines will be passed on to the contractor to the extent available during the performance of work. The requirements stipulated in these clauses shall be fulfilled by the Contractor.

31.5 Various tolerances required as marked on the drawings and as per specifications and instructions of the Engineer-in-Charge, shall be maintained. Verticality shall be maintained. Verticality shall be verified with the Theodolite.

31.6 ERECTION OF EQUIPMENTS

31.6.1 All the erection shall be carried out by Cranes of suitable capacity. Erection by derrick shall not be permissible. The contractor shall arrange the crane of suitable capacity required for erection and include cost for same in respective items.

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without any liability on the part of Employer/Consultant.

31.6.2 Bidder shall submit the indicative erection scheme for compressor/equipment and shall undertake the erection only after obtaining approval of erection scheme by Engineer- in-charge.

31.6.3 Grouting of equipments, anchor bolts, pockets and under base plates shall be carriedout as per technical specifications.

32.0 Deleted

33.0 MEASUREMENT OF WORKS

33.1 In addition to the provisions of relevant clause of GCC and associated provisionsthereof, the provisions of **Annexure-4** shall also apply.

34.0 TERMS OF PAYMENT

34.1 Basis and terms of payment for making "On Account Payment" shall be as set out in **Annexure-5**.

35.0 REPAIR OF PIPE DEFECTS

35.1 Immediately prior to aligning pipe for welding, the bevelled ends of each joint of pipe and the area immediately adjacent thereto (at least 25mm from the edge on the inside and outside of the pipe) shall be thoroughly cleaned of paint, rust, mill scale, dirty or other foreign matter by use of power drive wire buffing wheels, disc sanders, or by other methods approved by Employer/Consultant. This shall be done at no extra cost to Employer/Consultant.

35.2 All damaged ends of pipe that are bent, cut or otherwise mutilated to such an extent that in the opinion of the Employer/Consultant, faulty alignment or unacceptable welding would result, shall be repaired or cut-off and rebevelled to the correct angle with a bevelling machine of a type approved by Employer/Consultant. No compensation shall be allowed by reason of such recutting or bevelling, except when required because of the original bevel being damaged before the pipe is "taken over"by Contractor.

35.3 Dents in bevels with a depth of less than 1 mm shall be removed by Contractor during cleaning and grinding, ahead of the welding in the field. Contractor shall rebevel dented bevel ends with a depth between 1 and 3 mm. Dents over 3mm depth shall be repaired by cutting and rebevelling.

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36.0 ISSUE OF EMPLOYER/CONSULTANT SUPPLIED MATERIAL

36.1 The conditions for issue of material and reconciliation refer enclosed **Annexure-8.**

36.2 The reconciliation of material shall be applicable only for the material issued by Employer/Consultant as free issue to the contractor.

37.0 LOCATION OF DUMPYARD / WAREHOUSE / STORAGE YARD

37.1 The Dumpyard / Warehouse / Storage Yard is situated at the locations as mentionedin the scope of work.

37.2 The Contractor shall collect the line pipes from the above dump yard(s) and arrange handling of pipes including crane etc. for unloading, transportation of pipes to required location or pipeline ROU shall be the responsibility of contractor.

37.3 Similarly other items issued as Free Issue Material (FIM) shall be collected by the Contractor from Employer/Consultant's designated storage yard(s) as directed by Engineer-in-Charge. Contractor shall arrange for handling of FIM including crane etc for loading/unloading, transportation of FIM to required site location free of cost.

37.4 Contractor shall lift the entire quantity envisaged for the section (inclusive of 10% extra pipe quantity) to cater to the wastage, re-routing etc., encountered during the construction; store it properly in the pipe yard maintained by the contractor.

38.0 STATUTORY APPROVALS

38.1 All associated activities required for obtaining necessary clearances, permissions, approvals, all licenses from all concerned authorities in respect of pipeline crossing & all pipeline related works shall be the responsibility of the Contractor and the cost of the same shall be deemed to have been included in the quoted prices.

38.2 The approval from any authority required as per statutory rules and regulations of river authority and any Central / State Government authority shall be the Contractor's responsibility unless otherwise specified in the Bidding Document. The application on behalf of the Owner for submission to relevant authorities alongwith copies of required certificate complete in all respects shall be prepared and submitted by the Contractor well ahead of time so that the actual construction of the work is not delayed for want of the approval/inspection by concerned authorities. The inspection of the works by the authorities shall be arranged by the Contractor and necessary coordination and liason work in this respect shall be the responsibility of the Contractor. However statutory fees paid, if any, for all inspections and approvals by such authorities shall be reimbursedat actual by the Owner to the Contractor on production of documentary evidence.

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38.3 Any change/addition required to be made to meet the requirements of the statutory authorities shall be carried out by the Contractor free of charge. The inspection and acceptance of the work by statutory authorities shall however, not absolve the Contract from any of his responsibilities under this Contract.

38.4 **Notice and Licences :** The Contractor shall at his costs and expenses give to the Municipal or Panchayat, Police and any other private or public authoriities all notices etc., that may be required in law to be given and obtain all necessary permissions and licences etc., for temporary obstructions, enclosures and pay all fees, taxes charges etc. which may be leviable by such authorities for that purpose. The Contractor shall make good any damage to the adjoining property whether public or private.

39.0 TESTS AND INSPECTION

39.1 The Contractor shall carry out the various tests as enumerated in the technical specifications of this bid document and the technical documents that will be furnished to him during the performance of the work.

the work and supply of materials by the Contractor shall be carried out by Contractorat his own cost.

39.3 The work is subject to inspection at all times by the Engineer-in-Charge. The contractor shall carry out all instructions given during inspection and shall ensure that the work is being carried out according to the technical specifications of this bid document, the technical documents and the relevant codes of practice will be furnished to him during the performance of the work.

39.4 The Contractor shall provide for purposes of inspection access ladders, lighting and necessary instruments at his own cost.

39.5 Any work not conforming to execution drawings, specifications or codes and approved methodology / scheme shall be rejected forthwith and the Contractor shall carryout the rectifications at his own cost.

39.6 All results of inspection and tests will be recorded in the inspection reports, proforma of which will be approved by the Engineer-in-Charge. These reports shall form part of the completion documents.

39.7 For materials supplied by Employer/Consultant, Contractor shall carryout the tests, if required by the Engineer-in-Charge, and the Employer/Consultant shall reimburse the cost of such tests at actual to the Contractor on production of documentary evidence.

39.8 Statutory fees paid to IBR authorities and for repeat tests and inspection due to failures, repairs etc. such reasons attributable to the Contractor shall be borne by the Contractor.

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39.9 Inspection and acceptance of work shall not relieve the Contractor from any of his responsibilities under this Contract.

40.0 INSPECTION OF SUPPLY ITEMS

40.1 All inspection and tests on bought out items shall be made as per the specifications forming part of this contract. Various stages of inspection and testing shall be identified after receipt of Quality Assurance Programme from the Contractor/ Manufacturer.

40.2 Inspection calls shall be given for associations of Employer/Consultant's representative as per mutually agreed programme in prescribed proforma with 15 days margin, giving details of equipment and attaching relevant test certificates and internal inspection report of the Contractor. All drawings, General Arrangement and other contract drawings, specifications, catalogues etc. pertaining to equipment offered for inspection shall be got approved from Employer/Consultant and copies shall be made available to Employer/Consultant before hand for undertaking inspection.

40.3 The contractor shall ensure full and free access to the inspection Engineer of Employer/Consultant at the Contractor's or their sub-contractor's premises at any time during contract period to facilitate him to carry out inspection and testing assignments.

40.4 The contractor/ sub-contractor shall provide all instruments, tools, necessary testing cost for carrying out inspection.

40.5 Where facilities for testing do not exist in the Contractor's/ sub-contractor's laboratories, samples and test pieces shall be drawn by the Contractor/ Sub-Contractor in presence of Inspection Engineer of a Employer/Consultant and duly sealed by the later and sent for testing in Government approved Test House or any other testing laboratories approved by the Inspection Engineer at the Contractor's cost.

41.0 FINAL INSPECTION

41.1 After completion of all tests as per specification the whole work will be subject to a final inspection to ensure that job has been completed as per requirement. If any defects noticed in the work attributable to Contractor, the Contractor at his own cost shall attend these, as and when the Employer/Consultant brings them to his notice. The Employer/Consultant shall have the right to have these defects rectified at the risk and cost of the contractor if he fails to attend to these defects immediately

42.0 COMPENSATION FOR EXTENDED STAY

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42.1 The clause no. 87 (vi) of GCC is modified to the following extent: Bidder to note thatextended stay compensation is NOT APPLICABLE.

43.0 COMPUTERIZED CONTRACTORS BILLING SYSTEM

43.1 Without prejudice to stipulation in General Conditions of Contract, Contractor should follow following billing system.

43.2 The bills will be prepared by the contractors on their own PCs as per the standard formats and codification scheme proposed by BGL / BGL/PMC. The contractors will be provided with data entry software to capture the relevant billing data for subsequent processing. Contractors will submit these data to BGL / BGL/PMC in an electronic media along with the hard copy of the bill, necessary enclosures and documents. The contractor will also ensure the correctness and consistency of data so entered with the hard copy of the bill submitted for payment.

43.3 Employer/Consultant will utilize these data for processing and verification of the Contractor's bill and payment."

44.0 TEMPORARY WORKS

44.1 All Temporary and ancillary works including enabling works connected with the work shall be responsibility of the Contractor and the price quoted by them shall be deemed to have included the cost of such works which shall be removed by the contractor at his cost, immediately after completion of his work.

45.0 DISTINCTION BETWEEN FOUNDATION AND SUPERSTRUCTURE

45.1 To distinguish between work in foundations and superstructures, the following criteriashall apply:

45.1.1 For all Equipment pedestals, pipe racks, other foundation and R.C.C. Structures, work done upto 300 mm level above finished grade level will be taken as work in foundations and work above this level will be treated as work in superstructures and payments would be made accordingly.

45.1.2 For Buildings only, all works upto level corresponding to finished floor level shall be treated as `Work in foundation' and all works above the finished floor level shall be treated as "Work in superstructure".

45.1.3 Irrespective of what has been stated above, all pavements, R.C.C. Retaining wall, all pipe sleepers and any similar item would be taken as work done in foundations irrespective of locations, nomenclature and levels given anywhere.

45.1.4 Where not specifically pointed out all works in Cellars/ sumps, Tank Pads, Cable trenches,or such similar item would be taken as work in foundation.

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46.0 QUALITY ASSURANCE/ QUALITY CONTROL

46.1 Bidder shall include in his offer the Quality Assurance Programme containing the overall quality management and procedures, which is required to be adhered to during the execution of contract. After the award of the contract detailed quality assurance programme shall be prepared by the contractor for the execution of contract for various works, which will be mutually discussed and agreed to.

46.2 The Contractor shall establish document and maintain an effective quality assurance system outlined in recognised codes.

46.3 Quality Assurance System plans/procedures of the Contractor shall be furnished in the form of a QA manual. This document should cover details of the personnel responsible for the Quality Assurance, plans or procedures to be followed for quality control in respect of Engineering, Procurement, Supply, Installation, Testing and Commissioning.

The quality assurance system should indicate organizational approach for quality control and quality assurance of the construction activities, at all stages of work at site as well as at manufacture's works and dispatch of materials.

46.4 The Employer/Consultant/Consultant or their representative shall reserve the right to inspect/witness, review any or all stages of work at shop/site as deemed necessary for quality assurance.

46.5 The contractor has to ensure the deployment of Quality Assurance and Quality Control Engineer(s) depending upon the quantum of work. This QA/QC group shall be fully responsible to carryout the work as per standards and all code requirements. In case Engineer-in-Charge feels that Contractor's QA/QC Engineer(s) are incompetent or insufficient, contractor has to deploy other experienced Engineer(s) as per site requirement and to the full satisfaction of Engineer-In-Charge.

46.6 In case contractor fails to follow the instructions of Engineer-in-charge with respect to above clauses, next payment due to him shall not be released unless until he complies with the instructions to the full satisfaction of Engineer-in-charge.

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46.7 The Contractor shall adhere to the quality assurance system as per BGL/PMCSpecification enclosed in the Bidding Document as **Annexure-6**.

47.0 HEALTH SAFETY AND ENVIRONMENT (HSE) MANAGEMENT

47.1 The Contractor, during entire duration of the Contract, shall adhere to HSE requirementas per spec. enclosed in the bidding document as **Annexure-7**.

48.0 SITE CLEANING

48.1 The Contractor shall clean and keep clean the work site from time to time to the satisfaction of the Engineer-in-Charge for easy access to work site and to ensure safe passage, movement and working.

48.2 If the work involves dismantling of any existing structure in whole or part, care shall be taken to limit the dismantling up to the exact point and/or lines as directed by the Engineer-in-Charge and any damage caused to the existing structure beyond the said line or point shall be repaired and restored to the original condition at the Contractor's cost and risks to the satisfaction of the Engineer-in-Charge, whose decision shall be final and binding upon the Contractor.

48.3 The Contractor shall be the custodian of the dismantled materials till the Engineer-in- Charge takes charge thereof.

48.4 The Contractor shall dispose off the unserviceable materials, debris etc. to any area as decided by the Engineer-in-Charge.

48.5 The Contractor shall sort out, clear and stack the serviceable materials obtained from the dismantling/renewal at places as directed by the Engineer-in-Charge.

48.6 No extra payment shall be paid on this account.

49.0 COMPLETION DOCUMENTS

49.1 As Built" Drawings

Notwithstanding the provisions contained in standard specifications, upon completion of WORK, the CONTRACTOR shall complete all of the related drawings to the "AS BUILT" stage and provide the OWNER, the following: -

a) Three complete bound sets of Contractor's specifications including design calculations and GIS data

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b) Three complete sets, in the form of hand bound volumes, of the manufacturer's data book for all the equipments, instruments etc. including certified prints and data. Data books shall be completed with index as to tag numbers associated with manufacturer's data shown, Equipment data shall include as a minimum requirement the principle anddescriptions of operations, installation and maintenance instructions, drawings and dimensions, parts list and priced purchase orders including those of major sub-vendors and suppliers. Requirements pertaining to "VENDOR DATA REQUIREMENT" attached with standard specifications for the documents to be included in the Data Book for each equipment, instruments etc. shall also be complied with.

c) Three bound copies each of the Spare Parts Data Books and the Lubricants Inventory Schedule.

d) Soft copy of all the as built drawings prepared in AutoCAD in two sets of re-writable compact Disc and photographs covering measure activities at site.

e) The Contractor shall submit coloured photographs covering all the activities of pipeline constructions highlighting the progress or other areasof work in 2 sets to Engineer-in-charge at site office alongwith monthly progress report. Similarly photographs for problem areas should be submitted well in advance with a proposed methodology to execute the works and meet the construction schedule. The cost of same shall be deemed to be inclusive in the rates and no separate payment shall be made.

f) All as-built drawings as mentioned in specification for documentation enclosed elsewhere in the tender.

9.2 Completion Document

The following documents shall be submitted in hard binder by the CONTRACTORin THREE sets, as a part of completion documents: -

a) Welding Procedure Qualification Report.
b) Welder Qualification Report.
c) Radiographic Procedure Qualification.
d) Radiographic Report alongwith radiographs (Radiographs only with theoriginal).
e) Batch Test Certificate from manufacturers for electrodes.
f) Pretesting and final Hydrostatic and other Test results and reports.
g) All other requirements as specified in the respective specifications.
h) Test results and reports.

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i) Pre-commissioning/commissioning checklist.

j) Completion Certificate issued by Owner's Site Engineer.

k) No claim certificate by the Contractor.

l) Consumption statements of steel and cement certified by Owner's SiteEngineer.

m) Completion certificate for embedded and covered up works whereverapplicable.

n) Recovery statement, if any.

o) Statement for reconciliation of all the payments and recoveries made in the progress bills.

p) Copies of deviation statement and order of extension of time, if granted.

50.0 COORDINATION WITH OTHER AGENCIES

50.1 Work shall be carried out in such a manner that the work of other agencies operatingat the site is not hampered due to any action of the Contractor. Proper coordination with other agencies will be Contractor's responsibility. In case of any dispute, the decisionof Engineer-in-Charge shall be final and binding on the Contractor.

51.0 SETTLEMENT OF DISPUTE BETWEEN TWO PSU's

51.1 In the event of any disputes or difference relating to the interpretation and application of the provisions of the contracts, such disputes or differences shall be referred by either party to the Arbitration in the Department of Public Enterprises nominated by the Secretary to the Govt. of India in charge of the Board of Public Enterprises, Govt. of India. The Arbitration and Conciliation of shall not be applicable to such arbitration. The award of the Arbitrator shall be binding upon the parties to the dispute, provided, however,any party aggrieved by such award may make a further reference for setting aside or revision of the award to the Law Secretary, Ministry of Law and Justice, Government of India. Upon such reference the dispute shall be decided by the Law Secretary or the Special/ Additional Secretary when so authorized by the Law Secretary whose decision shall bind the parties finally and conclusively. The parties to the dispute will share equally the cost of arbitration as intimated by the Arbitrator.

52.0 UNDERGROUND AND OVERHEAD STRUCTURES

52.1 The information to possible extent regarding existing structures/overhead lines, existing pipelines and utilities are already indicated on alignment sheets. Over and above contractor may encounter other structure/pipelines/ OFC etc. which may not be appearing on alignment sheet, the contractor is required to collect such information on his own before commencing the work. Contractor must intimate the Local Officer concerned of the utility about the pipeline construction activities and take necessary steps to ensure safety and protection to men, materials and

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utility provided. The Contractor shall execute the work in such a manner that the said structures, utilities, pipelines etc. are not disturbed or damaged, and shall indemnify and keep indemnified the Employer/Consultant from and against any destruction thereof or damages thereto.

53.0 TEST CERTIFICATES

53.1 Bidder shall be required to submit recent test certificates for the material being used in works from the recognized laboratories. These certificates should indicate all properties of the materials as required in relevant IS Standards or International Standards.

53.2 Contractor shall also submit the test certificate with every batch of material supplied which will be approved by Engineer-in-Charge. No secured advance will be given for the materials not having test certificate. In case any test is to be carried out, the same shall be got done in the approved laboratory at the cost of contractor.

54.0 ROYALTY

54.1 Contractor's quoted rate should include the royalty on different applicable items as per the prevailing Government rates. In case, Employer/Consultant is able to obtain the exemption of Royalty from the State Government, the contractor shall pass on the same to Employer/Consultant for all the items involving Royalty.

55.0 EXCAVATION BY BLASTING

55.1 Excavation by blasting is prohibited. Trenching in all types of rocks using mechanicalmeans such as rock breakers / excavators etc.

56.0 SITE FACILITIES FOR WORKMEN

56.1 Following facilities are to be ensured at all work places where workmen are deployed/engaged by Contractor.

i) Arrangement of first aid
ii) Arrangement for clean drinking water.
iii) Toilets
iv) Canteen where tea & snacks are available
v) A creche where 10 or more women workmen are having children below the ageof 6 years.

57.0 EXECUTION OF ELECTRICAL WORKS

57.1 The Contractor shall engage an approved electrical agency for execution of electrical works, holding valid electrical contractor licence. In case contractor

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himself executes electrical works then he shall arrange valid electrical contractor licence before start of electrical works at site. Not withstanding, contractor shall adhere to all the safety standardas included in bidding document.

58.0 HYDROSTATIC TESTING

58.1 The bidder as per the Technical specification along with their offer taking into account the completion schedule shall furnish the detailed procedure proposed for the hydrostatic testing of pipeline. The necessary piping, pumps etc. shall be provided by the contractor. The final disposal of water after testing shall be contractor's responsibility and should be in such a way that neither the traffic movement even pedestrians nor the standing crop in nearby fields gets affected. Suitable drains shall be provided for this purpose as directed by the Engineer-in-Charge within the contracted prices.

58.2 The Contractor shall propose and obtain approval of Engineer-in-Charge for exact number of test sections, based on drawings, availability of water for hydro testing and keeping in view other exigencies, if any before starting hydro testing work. The Contractorwill carryout the hydrostatic test for approved number of test section including preparation for test and tie-ins, without any time and cost implication on this account to Employer/Consultant. Any increase or decrease in number of test sections will not have any cost implication to Owner / Consultant / Contractor.

59.0 DELETED

60.0 MAKE OF MATERIALS

60.1 The materials required to be supplied by the contractor under this contract shall be procured only from Employer/Consultant approved vendors or preferred makes indicated in the tender. Where the makes of materials are not indicated in the Bidding document contractor shall furnish the details of makes and shall obtain prior approval of Engineer-in-Charge of vendors/sub-vendors before placing order.

61.0 ADDITIONAL WORKS/ EXTRA WORKS

61.1 Employer/Consultant reserves their right to execute any additional works/ extra works, during the execution of work, either by themselves or by appointing any other agency, even though such works are incidental to and necessary for the completion of works awarded to the Contractor. In the event of such decisions taken by Employer/Consultant Contractor is required to extend necessary cooperation, and act as per the instructions of Engineer-in-Charge.

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62.0 COMPENSATION FOR DELAY (L.D) / PRICE REDUCTION SCHEDULE FOR ANY DELAY

62.1 Clause No: 27.0 of GCC, pertaining to Compensation for Delay (Liquidated Damages)stands modified to the following extent:

62.1.1 The contractual completion period is as given in the Invitation for Bids and subdividedinto two parts :

A) Mechanical Completion including Mobilization Period and Completion of TCPWorks
B) Commissioning & Gas-In and TCP Commissioning

62.1.2 In case of delay in works related to clause 62.1.1 for the following sections :

In case of delay in works in any of the parts against any of the activities stated hereinabove at Clause No. 62.1.1 A), & B), L.D / PRS shall be applicable @ ½% of the contract value of respective section(s).

The maximum L.D / PRS shall be limited to 5% of contract

value .The contract value for L.D / PRS purpose shall be

excluding GST.

62.1.3 The total liability of the Contractor to Employer/ Consultant under sub clause no. 62.1.1& 62.1.2 on Compensation for Delay/Price Reduction Schedule (PRS) shall not exceedthe limit as stated above at 62.1.2 i). The compensation on account of any liability (ies)other than above shall be as per provisions of Bidding Documents. from the date of intimation to the contractor other-wise recovery shall be made at therate of Rs. 3000/- per day of delay. This will be applicable in addition to PRS.

63.0 PROJECT PLANNING, SCHEDULING AND MONITORING SYSTEM

The following schedules/documents/reports shall be prepared and submitted by the Bidder/Contractor for review/approval at various stages of the contract.

i) Along with Bid

a) Time Schedule
The Completion Time Schedule for the work (including mobilization period) as per Appendix-I to Invitation for bid, PART-A of Tender in all respect, from the date of issue of telex/telegram/letter/Fax of Intent.

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The Bidder is required to submit a Project Time Schedule in Bar Chart Form, alongwith the Bid. The Schedule shall cover all aspects like sub-ordering, manufacturing and delivery, indicated in the Bid Document. The Owner interface activities shall be clearly identified with their latest required dates. Owner reserves the right to disqualify the Bidder if the above Schedule submitted by the Bidder is not in line with the over all Project requirement.

b) Scheduling & Monitoring System

The Bidders should describe their system of Project Scheduling and monitoring, the extent of computerization, level of detailing, tracing methodology etc. with the name of computer package and sample outputs.

63.1 After the Award of Contract

a) Time Schedule

The Completion Time Schedule for the work (including mobilization period) as perAnnexure-3 to SCC of Tender in all respect, from the date of issue of Fax of Acceptance.

The Bidder is required to submit a Project Time Schedule in Primavera. The Schedule shall cover all aspects like sub-ordering, manufacturing and delivery, indicated in the Bid Document. The Owner interface activities shall be clearly identified with their latest required dates. Owner reserves the right to disqualify the Bidder if the above Schedule submitted by the Bidder is not in line with the over all Project requirement.

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b) Scheduling & Monitoring System

the extent of computerization, level of detailing, tracing methodology etc. with thename of computer package and sample outputs.

c) Overall Project Schedule

The Contractor shall submit within 1 week of Fax of Acceptance, a sufficiently detailed over all Project Schedule in the activity network form, clearly indicating the major milestones, interrelationship/ interdependence between various activities together with analysis of critical path and floats.

The network will be reviewed and approved by Engineer- in-Charge and the comments if any shall be incorporated in the network before issuing the same for implementation. The network thus finalised shall form part of the contract document and the same shall not be revised without the prior permission from Engineer-in- Charge during the entire period of contract.

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d) Progress Measurement Methodology

The contractor is required to submit within 1 week of award of work, the methodology of progress measurement of sub-ordering, manufacturing/ delivery, sub- contracting construction and commissioning works and the basis of computation of overall services/physical progress informed. Owner reserves the right to modify the methodology in part or in full.

e) Functional Schedules

The contractor should prepare detailed functional schedules in line with network for functional monitoring and control and submit scheduled progress covers for each function viz. ordering, delivery and construction.

63.2 **Project Review Meetings**

The Contractor shall present the programme and status at various reviewmeetings as required.

a) Weekly Review Meeting

Level of Participation	:	Contractor's/Consultant's RCM/Site Incharge & Job Engineers.
Agenda	:	a) Weekly programme v/s actual achieved in the past week & programme for next week. b) Remedial Actions and hold up analysis. c) Client query/ approval.
Venue	:	Site Office

b) Monthly Review Meeting

Level of Participation	:	Senior Officers of BGL and Contractors.
Agenda	:	a) Progress Status/ Statistics b) Completion Outlook c) Major hold ups/slippages d) Assistance required e) Critical issues f) Client query/ approval
Venue	:	BGL Office/ Site at the discretion of BGL

63.3 **Progress Reporting Proforma**

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A) Monthly Progress Report

This report shall be submitted on a monthly basis within 10 (ten) calendar days from cut-off date, as agreed upon covering overall scenarios of the work. The report shall include, but not limited to the following :

a) Brief Introduction of the work.
b) Activities executed/ achievements during the month.
c) Schedule versus actual percentage progress and progress curves for Detail Engg. Sub-ordering, Manufacturing/ Delivery, Sub-contracting, Construction, Commissioning and Overall and quantum wise status & purchase orders against schedule.
d) Area of concern/ problem/ hold-ups, impacts and action plans.
e) Resources deployment status.
f) Annexures giving status summary for drawings, MRs, deliveries, sub- contracting and construction.
g) Procurement status for items to be supplied by Contractor.

B) Weekly Reports

The report will be prepared and submitted by the Contractor on weekly basisand will cover following items :

a) Activities programmed and completed during the week.
b) Resource deployed men and machines.
c) Quantities achieved against target in construction
d) Record of Mandays lost.
e) Construction percentage progress schedule and actual.

C) Daily Repots

a) Activity programme for the day
b) Progress of the previous day and commutative progress.
c) Manpower & machinery deployed.

D) Any other additional reports/ information as may be required by E.I.C.

63.4 Progress Reports

63.4.1 CONTRACTOR shall make every effort to keep the OWNER adequately informed as to the progress of the WORK throughout the CONTRACT period.

CONTRACTOR shall keep the OWNER informed well in advance of the construction schedule so as to permit the OWNER to arrange for requisite inspection to be carried outin such a manner as to minimize interference with progress of WORK. It is imperative that close coordination be maintained with the OWNER during all phases of WORK.

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63.4.2 By the 10th (tenth) of each month, CONTRACTOR shall furnish the OWNER a detailed report covering the progress as of the last day of the previous month. These reports will indicate actual and scheduled percentage of completion of construction as well as generalcomments of interest or the progress of various phases of the WORK. The frequency of progress reporting by the CONTRACTOR shall be weekly.

63.4.3 Once a week, CONTRACTOR shall submit a summary of the WORK accomplished during the preceding week in form of percentage completion of the various phases of theWORK, to the OWNER.

63.4.4 Progress reports shall be supplied by CONTRACTOR with documents such as chart, networks, photographs, test certificate etc. Such progress reports shall be in the form and size as may be required by the OWNER and shall be submitted in at least 3 (three) copies.

63.4.5 Contractor shall prepare daily progress report (DPR) in the desired format and submit it to Engineer-in-charge along with schedule of next day to Engineer-in-charge.

64.0 RESPONSIBILITY OF CONTRACTOR

64.1 It shall be the responsibility of the Contractor to obtain the approval for any revision and/or modifications decided by the Contractor from the Employer/Consultant/ Engineer-in-charge before implementation. Also such revisions and/or modifications if accepted/ approved by the Employer/Consultant/Engineer-in-charge shall be carried out at no extra cost to the Employer/Consultant. Any changes required during and/or after approval for detailed construction drawings due to functional requirements or for efficient running of system keeping the basic parameters unchanged and which has not been indicated by the Contractor in the data/drawings furnished along with the offer will be carried out by the Contractor at no extra cost to the Employer/Consultant.

64.2 All expenses towards mobilisation at site and demobilisation including bringing in equipment, clearing the site etc. shall be deemed to be included in the prices quoted and no separate payments on account of such expenses shall be entertained.

64.3 It shall be entirely the Contractor's responsibility to provide, operate and maintain all necessary construction equipments, scaffoldings and safety gadgets, cranes and other lifting tackles, tools and appliances to perform the work in a workman like and efficient manner and complete all the jobs as per time schedules.

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64.4 Preparing approaches and working areas for the movement and operation of the cranes, levelling the areas for assembly and erection shall also be the responsibility of the Contractor. The Contractor shall acquaint himself with access availability, facilities such as railway siding, local labour etc. to provide suitable allowances in his quotation. The Contractor may have to build temporary access roads to aid his own work, which shall also be taken care while quoting for the work.

64.5 The procurement and supply in sequence and at the appropriate time of all materials and consumables shall be entirely the Contractor's responsibility and his rates for execution of work will be inclusive of supply of all these items.

65.0 CHECKING OF LEVELS

65.1 The Contractor shall be responsible for checking levels, orientation plan of all foundations, foundation bolts, etc., well in advance of taking up the actual erection work and bring to the notice of Engineer-in-Charge discrepancies, if any. In case of minor variations in levels etc. the Contractor shall carry out the necessary rectifications to the foundations within his quoted price.

65.2 The Contractor shall also be responsible for checking with templates, wherever necessary, the disposition of foundation bolts with the corresponding bases of structure and shall effect rectifications, as directed, within his quoted rate.

66.0 STORAGE FACILITIES

66.1 The Contractor shall maintain wherever required an air-conditioned room for the storage of the instruments as well as for calibration and testing of the instruments at his own cost. The contractor shall provide these facilities with in the quoted price.

67.0 DELETED

68.0 INSURANCE FOR FREE ISSUE MATERIAL

68.1 Contractor shall at his own expense arrange, secure and maintain insurance cover for Employer/Consultant's supplied free issue materials as defined in Bidding Document. Contractor's quoted price shall be inclusive of all costs on account of insurance liabilities covered under the Contract. Contractor to note that the beneficiary of insurance cover shall be BGL. The insurance cover of the free issue material shall be for the period from the date of handing over the material to Contractor from Employer/Consultant's designated place of issue/ dumpsite to date of handing over the completed work to Employer/Consultant.

68.2 The schedule of insurance cover for free issue materials given above shall be as follows:

Upto 2 Months - 25% of value

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Beyond 2 Months - 100% of value

The value of free issue material supplied by BGL the will be intimated to the successful bidder after placement of order.

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69.0 INSURANCES IN INDIA

69.1 In addition to the insurance covers specified in the General Conditions of Contract to be obtained and maintained by the Contractor, Contractor shall at his own expense arrange, secure and maintain insurance with reputable insurance companies to the satisfaction of the Employer/Consultant as may be necessary and to its full value for all such amounts to protect the works in progress from time to time and the interest of Employer/Consultant against all risks as detailed herein. The form and the limit of such insurance as defined herein together with the under writer works thereof in each case should be as acceptable to the Employer/Consultant. However, irrespective of work acceptance, the responsibility to maintain adequate insurance coverage at all times during the period of Contract shall be that of Contractor alone. Contractor's failure in this regard shall not relieve him of any of his responsibilities and obligations under Contractor.

69.2 Any loss or damage to the equipment during ocean transportation, port/custom clearance, inland and port handling, inland transportation, storage, erection and commissioning till such time the Work is taken over by Employer/Consultant, shall be to the account of Contractor. Contractor shall be responsible for preferring of all claims and make good for the damage or loss by way of repairs and/or replacement of the parts of the Work damaged or lost. Contractor shall provide the Employer/Consultant with a copy of all insurance policies and documents taken out by him in pursuance of the Contract. Such copies of documents shall be submitted to the Employer/Consultant immediately upon the Contractor having taken such insurance coverage. Contractor shall also inform the Employer/Consultant at least 60 (Sixty) days in advance regarding the expiry cancellation and/or changes in any of such documents and ensure revalidation/renewal etc., as may be necessary well in time.

69.3 Statutory clearances, if any, in respect of foreign supply required for the purpose of replacement of equipment lost in transit and/or during erection, shall be made available by the Employer/Consultant. Contractor shall, however, be responsible for obtaining requisite licenses, port clearances and other formalities relating to such import. The risks that are to be covered under the insurance shall include, but not be limited to the loss or damage in handling, transit, theft, pilferage, riot, civil commotion, weather conditions, accidents of all kinds, fire, war risk (during ocean transportation only) etc. The scope of such insurance shall cover the entire value of supplies of equipments, plants and materials to be imported from time to time.

69.4 All costs on account of insurance liabilities covered under this Contract will be to Contractor's account and will be included in Contract Price. However, the Employer/Consultant may from time to time, during the currency of the Contract, ask the Contractor in writing to limit the insurance coverage risk and in such a case, the parties to the Contract will agree for a mutual settlement, for reduction in Value Of Contract to the extent of reduced premium amounts.

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69.5 Contractor as far as possible shall cover insurance with Indian Insurance Companies, including marine Insurance during ocean transportation.

70.0 **Deleted**

71.0 **Deleted**

72.0 **SUBMISSION OF COLOURED PHOTOGRAPHS**

72.1 The Contractor shall shoot, prepare and submission coloured photographs in 2 sets alongwith softcopies to BGL/PMC site office along with monthly progress report covering all the activities of pipeline constructions highlighting the progress or other areas of work. Similarly photographs for problem areas should be submitted well in advance with a proposed methodology to execute the works and meet the construction schedule. The cost of same shall be deemed to be inclusive in the rates and no separate payment shall be made.

73.0 **Deleted**

74.0 **Deleted**

75.0 **Deleted**

76.0 **SPARES**

76.1 Contractor shall procure and supply all spare parts required during commissioning ofthe various items / materials supplied by him as enumerated in the Bidding Document.The quoted lumpsum prices shall be deemed to have been inclusive of all suchprovision of commissioning spares, required till commissioning of such items.Contractor shall make available all the commissioning spares required at site at least 4 (four) weeks before start of commissioning. However, listed spares not used during commissioning shall be handed over to Employer at their designated place. Contractorshall also supply commissioning spares not listed but required during commissioningwithin the contracted price.

76.2 In addition to above, special tools & tackles required, if any, for operation & maintenance shall also be supplied by the Contractor and the quoted prices shall be deemed to have been inclusive of all such provisions.

77.0 **BUILDING AND OTHER CONSTRUCTION WORKER'S ACT**

77.1 In order to govern welfare and working conditions of labourers engaged in construction activities, the Building and other Construction Workers' (Regulation of Employment and Conditions of Service "RE &CS") Act, 1996 came into force. RE&CS Act'1996 is applicable in respect of building and other construction work. Wherever applicable, The SUB-CONTRACTOR shall strictly comply with the following provisions pertaining to RE &CS Act'1996.

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a. The SUB-CONTRACTOR must be registered with the concerned authorities under the Building and Other Construction Workers' (RE&CS) Act, 1996 or in case of non- registration; the SUB-CONTRACTOR should obtain registration within one month of the award of contract.

b. The SUB-CONTRACTOR shall be responsible to comply with all provisions of the Building and Other Construction Workers' (RE&CS) Act, 1996, the Building and Other Construction Workers' Welfare Cess Act, 1996, the Building and other Construction

Workers' (RE&CS) Rules, 1998 and the Building and Other Construction WorkersWelfare Cess Rules, 1998.

c. Cess as per the prevailing rate, shall be deducted at source from bills of the SUB-CONTRACTOR by the engineer-in-Charge of the contract and remitted to the "Secretary, Building and Other Construction Workers Welfare Board" of the concerned State. The SUB-CONTRACTOR shall be responsible to submit final assessment return of the cess amount to the assessing officer after adjusting the cess deducted at source.

78.0 Deleted

79.0 SINGLE POINT RESPONSIBILITY

79.1 The entire work as per scope of work covered under this contract shall be awarded onsingle point responsibility basis.

80.0 BONUS FOR EARLY COMPLETION

80.1 The Clause 27.3 of GCC for Bonus for early completion shall not be applicable in thisContract.

81.0 Deleted

82.0 Deleted

83.0 DOCUMENTS TO BE SUBMITTED/ PRODUCED ALONGWITH R.A. BILLS

i) Computerized R.A. Bill/ Manual Bill, with IT No./ ST No./ Labour LicenseNo. Printed thereon.

ii) ESI/ EPF clearance certificates for the last month alongwith R.A. Bills.

iii) Insurance Policy as per relevant clauses of Contract Agreement.

iv) Attendance Register and Salary Records.

v) Photocopy of the measurement book to be attached with R.A. Bills.

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vi) Any other document required for the purpose of processing the bills.

vii) Registration Certificate with Sales tax authorities of state concerned.

NOTE to BIDDERS:

1. Laying of steel pipeline, with or without casing, in case of existing RCC/BW trench etc is provided with top RCC cover, then scope included removal of prevailing RCC cover from channel, laying of pipeline, testing and sand filling (including supply) refixing the top cover of pipe trench.

2. Moiling: Survey of underground utilities, execution of the work as per specification, including excavation of adequate size pits at both the sides, manual or machine moling with the hole size not exceeding 20% of the pipe dia, insertion of steel pipe, testing & commissioning and restoration of the pits to original condition, submission of As-Built Graph as per specifications and the instruction of Engineer-in-charge. It should be ensured that no asphalt or concrete road surface damaged during moiling

3. Liasioning with state authorities / local offices / society association/ traffic police / public representatives etc. is the one of the important activity for smooth laying of the pipeline. Preferably a local person having experience for co-ordination to be deployed separately.

4. All PCC/RCC items of the SOR are having volumetric mix. Hence, No design mix is required but testing of the materials such as sand, aggregate and reinforcement etc shall be required as per CPWD specification and testing norms.

5. Since Hyderabad is traffic congested city, it shall be required to carry out the trenching, laying and other related works in night time also. There shall not be any additional payment paid separately for working at night. All arrangements such as caution light / diversion sign boards, PPE to work at night for carrying out the work should be arranged by the contractor

6. It may be required to commission the network partially as per requirement. Contractor should able to commission with requisite equipment, tools, tackles & manpower without any additional implication.

7. There are some conditions stipulated by the Government agencies for laying the pipeline at GHMC / HMDA / HMWSSB jurisdiction. The General conditions stipulated by GHMC / HMDA / HMWSSB / NHAI / IR is as below: However the conditions may vary while issuing permissions:

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General conditions for Permission for laying of Gas Pipelines by Open Trench Method is accorded subject to adhering to the following conditions by GHMC / HMDA / HMWSSB / NHAI / IR /other state authorities:-

1. The concerned ward engineer shall supervise the work and ensure that the conditions imposed are complied with.

2. Before commencement of the work, the Agency must give prior written intimation to the Jurisdictional /Zonal and Road Infrastructure Engineers of GHMC / HMDA and also keep the GHMC / HMDA Engineers informed during erection of work.

3. As far as newly asphalted roads, are concerned, work should be carried out strictly by intimating and in co-ordination with Major Road/Road Infrastructure division.

4. At start, during and after the execution of work, the Agency must inform office of the Chief Engineer OFC-Ce11.

5. HDD Pits must be restored on the same day itself. Any delay is liable for penalty.

6. Excavation must be as per the instructions of the concerned GHMC Zonal /Road Infrastructure Engineers.

7. Any over burden debris/earth should be removed immediately and conveyed to the designated dumping yards failing which, a penalty will be levied by the concerned ward engineer.

8. Strictly follow the procedure laid down in road opening and restoration protocol.

9. Barricading sign boards and other precautionary signage, name and telephone numbers of the executing Agency, opening and closing dates should be displayed, also warning lights should be displayed for the road users and for easy flow of traffic during execution of work, failing which it would attract heavy penalty and cancellation of permission, etc and also entail blacklisting of the executor

10. During execution of work, care must be taken not to cause any damages to GHMC property like drains, Name boards, etc. In case of such damage, commensurate penalty to be paid.

11. Absolutely no deviations from the permitted route is allowed. If deviation is found, not only penalty would be levied, the cable on the deviation portion would be confiscated /destroyed.

12. After completion of the work, as per specification given by GHMC, the Agency must get a Satisfactory Work done Certificate from the jurisdictional GHMC Engineers along with 3rd Party Inspection Reports.

13. During execution, any damage caused to the limb or life of public, damage caused

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to any Government / ESCOM / BSNL / HMWSSB / TSPTCL / BhagyanagarGas Limited etc, property, the responsibility lies solely with the executing Agency and any claims/compensation should be borne by the executing Agency alone.

14. Redoing of Road cut portion to be carried out as per the MORTH Specification, procedure for Redoing of Road cut portion, specification detailsenclosed.

15. If the restoration of pits is not done as per MORTH Specification, the cost of Same will be recovered by forfeiting the Security Deposit.

16. During Rainy season, extra care should be taken to ensure that the pits are properly barricaded keeping in mind the safety of pedestrian and vehicular traffic.

17. At the site of construction of HMDA flyover &underpass prior approval of the undersigned is essential before the start of the work

18. The proposed gas pipe line should be laid with top of both steel and PE pipes at 1 m depth from the top of undisturbed soil. However if required by authorities specifically for any additional cover due to site requirement the same needs to be done.

19. **Damage to utilities & restoration**: Any utilities damaged during execution to be restored with out loss of time. In case if not done by the contractor, the same shall be restored through the other agencies at the contractor's risk & cost.

20. **MONITORING / EXECUTION METHODOLOGY**:

- The contractor has to submit the schedule with bar chart for the area allotted to the contractor for execution. Weekly schedule / plan is also to be submitted in accordance with the plan.

- If the progress is not as per the schedule / plan, he has to submit the catch up plan to achieve the target with additional deployment of manpower / machinery.

- In case of failure to achieve the catch up plan & schedule, BGL / BGL/PMC shall allot the work to the other party who is working in the same part after issuing the notice.

21. All the supply items of bidders scope includes manufacturing, factory testing, inspection, packaging, forwarding, transportation, insurance, receipt and storage at site.

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NETWORK & ASSOCIATED WORKS AT HYDERABAD

Bid Document No.

BGL/632/2024-25

2.0 ANNEXURES TO SCC

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ANNEXURES TO SCC

C O N T E N T S

Annexure-1 : Scope of Work

Annexure-2 : Scope of Supply

Annexure-3 : Time Schedule

Annexure-4 : Measurement of Work

Annexure-5 : Terms of Payment

Annexure-6 : Specification for Quality Assurance System requirements from Bidders

Annexure-7 : Specification for Health, Safety and Environment (HSE) Management

Annexure-8 : Conditions for issue & reconciliation of material

Annexure-9 : List of minimum nos. of construction equipment to be deployed. Annexure-9A : List of Minimum Equipments required to be owned by the bidder.Annexure-10 : Minimum no. of skilled labour to be deployed

Annexure-11 : Hiring / Recovery Rate for Deployment of ManpowerAnnexure-12 : Equipment Hiring / Recovery Rate

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SCOPE OF WORK
(ANNEXURE-1 TO SPECIAL CONDITIONS OF CONTRACT)

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ANNEXURE-1 TO SCC

1.0 SCOPE OF WORK

Scope of work shall be as detailed in Particular Job Specification, TechnicalSpecifications, Schedule of Rates & various other parts of this Bidding Document.

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SCOPE OF SUPPLY
(ANNEXURE-2 TO SPECIAL CONDITIONS OF CONTRACT)

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ANNEXURE-2 TO SCC

1.0 SCOPE OF SUPPLY

1.1 Owner's Scope of Supply

Owner's scope of supply shall be as specified in Particular Job Specification, Technical Specifications, Schedule of Rates & various other parts of the Bidding Document.

Free Issue Materials shall be issued to the Contractor from the designated store(s) of Owner. Contractor shall be responsible for lifting the free issue materials from Owner's storage point(s) and transporting the same to work site(s) at his own cost within Hyderabad GA limits but maximum 60 km to Contractor's stock yard/work shop/work site.

Conditions for Issue and Reconciliation of Materials shall be as per Document enclosed as Annexure-8 to Special Conditions of Contract.

1.2 Contractor's Scope of Supply

All materials except what is under Owner's scope of supply as mentioned in Clause No. 1.1 above, and required for successful completion of works in all respects shall be supplied by the Contractor and the cost of such supply shall be deemed to have been includedin the quoted price without any additional liability on the part of Owner.

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TIME SCHEDULE
(ANNEXURE-3 TO SPECIAL CONDITIONS OF CONTRACT)

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ANNEXURE-3 TO SCC

TIME SCHEDULE

Name of Work	Time of Completion
LAYING & CONSTRUCTION OF 6" & 4" steel P/L NETWORK & ASSOCIATED FACILITIES INCLUDING LAST MILE CONNECTIVITY FOR CNG STATIONS, DRS/MRS, COMMERCIAL & INDUSTRIALCONUSMERS FOR CITY GAS DISTRIBUTION PROJECT FOR BGL HYDERABAD	MECHANICAL COMPLETION INCLUDING MOBILIZATION PERIOD AND COMPLETION OF TCP WORKS INCLUDING COMMISSIONING AND GAS IN FOR THE AWARDED SOR QUANTITIES – **6 (six) MONTHS FROM DATE OF FAX OF ACCEPTANCE**. The contract shall be valid for a period of 06 months from the date of issue of Work Order / Letter of Intent. BGL at its discretion can extend the contract by another six months considering factors such as monsoon ban, ROU permission issues, any other reasons, etc., based on the satisfactory performance of the contractor on same rates and terms and conditions.

Note:

1) The time of completion as mentioned above is for the total scope of work including closure of contract (work order) as mentioned in the bidding document and includes the 15 (Fifteen) Days mobilization period.

2) Effective Date shall mean the date on which Contractor's obligations will commence and that will be date of issuance of Fax of Acceptance.

3) **a) Mechanical Completion shall mean completion of all works related to buried pipeline system, Cathodic protection, aboveground piping and associated civil, structural & instrumentation works including pre-commissioning and making the system ready to start commissioning activities.**

b.) Commissioning shall mean activities including final drying, filling nitrogen (as required) and Gas-in. In-case of non-clearance of Gas – in due to reasons attributable to owner/ non availability of gas source, the completion period shall be considered as Pre- commissioning (Filling the Nitrogen) & TCP Commissioning.

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4) It should be noted that the period of completion given above also includes preparation of drawings (if required), procurement and supply of materials including their inspection & testing, mobilization at site, construction, laying, fabrication, erection inspection, testing, rectification (if any), pre-commissioning, commissioning and demobilization works etc. complete in all respects to the entire satisfaction of Owner/ Engineer-in-charge.

_____

(STAMP & SIGNATURE OF BIDDER)

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MEASUREMENT OF WORK
(ANNEXURE- 4 TO SPECIAL CONDITIONS OF CONTRACT)

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MEASUREMENT OF WORK

1.0 GENERAL

1.1 The mode of measurement shall be as mentioned in relevant standard specification incorporated in the Bidding Document. Any other mode of measurements not covered in above specifications shall be followed in accordance with relevant BIS codes/ Schedule of Rates/ Specifications etc. and/ or as decided by Engineer-in-charge.

1.2 Payment will be made on the basis of joint measurements taken by Contractor and certified by Engineer-in-charge. Measurement shall be based on "Approved for Construction" drawings, to be the extent that the work conforms to the drawings and details are adequate.

1.3 Wherever work is executed based on instructions of Engineer-in-charge or details are not adequate in the drawings, physical measurements shall be taken by Contractor in the presence of Engineer-in-charge.

1.4 Measurements of weights shall be in metric tonnes corrected to the nearest Kilogram. Linear measurements shall be in meters corrected to the nearest centimeters.

1.5 The weights mentioned in the drawing or shipping list shall be the basis for payment. If mountings for panels etc. are packed separately, their erection weights shall include all mountings.

1.6 Welds, bolts, nuts, washers etc. shall not be measured. Rates for structural steel work shall be deemed to include the same.

1.7 No other payment either for temporary works connected with this Contractor for any other item such as weld, shims, packing plates etc. shall be made. Such items shall be deemed to have been included for in the rates quoted.

1.8 Measurement will be made for various items under schedule of rates on the following basis as indicated in the unit column.

i) Weight : MT or Kg
ii) Length : M
(Metre)
iii) Number : No.
iv) Volume : Cu.M
v) Area : Sq.M

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1.9 All measurements shall be in metric system. All the works in progress will be jointly measured by the representative of the Engineer-in-charge and the contractor's authorized agent progressively. Such measurements will be either recorded/typed by the contractorin the numbered measurement sheets to be supplied by Engineer-in-Charge / Owner or computerized by Contractor themselves. The measurements shall be signed in token of acceptance by the contractor or his authorized representative. The contractor shall submit the bill in the approved Performa in quadruplicate to the Engineer-in-Charge of the work. issued materials from owner's / BGL/PMC storage points to contractor's store/workshop within 50 km in GA of Hyderabad and the same are deemed to be included in the unit rates for the respective item of work.

1.11 In-case the Valve chamber sizes for the items 11.0 & 13.0 in the SOR varies due to siteconstraints, the payment for exceeded quantity shall be paid under respective civil works.

2.0 PIPING

2.1 For pipe sizes 2'' and above, Length of pipes shall be measured along the curvilinear centre of the pipelines laid/ installed and shall exclude all types of specials, fittings, flanges , valves and instruments like pressure gauges, RPD meters with EVC. Length of all types of specials, fittings, flanges, valves, and instruments like pressure gauges, RPD meters with EVC, shall be excluded from piping measurement and shall be considered on number basis at the rates given separately in the Schedule of Rates. Any dismantling and re-erection of the valves required for the purpose of testing, calibration etc. will be carried out by the contractor within his quoted rates.

2.2 For pipe sizes below 2", Length of pipes shall be measured along the curvilinear centre ofthe pipelines laid/ installed and shall include all types of specials, fittings, flanges, and valves etc i.e All Socket weld fittings & hot/cold bends, reducers etc. for size 1½" and below shall be fabricated and erected as per requirements by the contractor at no additional cost and his rates for piping of size 1½" and below shall be inclusive of this work.

2.3 Vents and drains shall be measured from O.D. of pipe lines and shall be paid for at the corresponding unit rates for similar sizes of pipe. Other piping attachment such as couplings, earthing lugs etc. shall be supplied & erected by the contractor within his quoted rates for piping.

2.4 Fabrication of spool pieces for temporary use to aid Contractor's work such as fabrication, erection, flushing and testing of piping etc. shall be done by Contractor as part of piping work and no separate payment shall be made for this.

2.5 In case of branch piping, the measurement shall be made from outer surface of the main line except in case of equal size branches, in which case measurement shall be made from centre line of the branching header.

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2.6 DRS and MRS along with associated accessories shall be paid in nos.

2.7 Fabrication of Supports

- Fabrication of all types of pipe supports, provided as per drawings & instructions of the Engineer-in-Charge, will be paid on weight basis. Bolts, nuts and washers including U-bolt will be supplied by contractor. Weight of bolts, nuts and clamps etc. shall not be added to the weight of pipe support for payment purpose.
- Erection of all types of supports, spring supports and turn buckles, including grouting of supports, if required, shall be carried out by the Contractor as part of piping work and no separate payment will be made for it.
- While fabricating the supporting elements, the contractor will ensure that the dimensions shown in the drawings match with site conditions. No payment shall be made for rectification arising out of discrepancies in dimensions of the fabricated items of supporting elements due to site conditions.
- Additional supports as necessary with the site condition shall be fabricated and erected in accordance with the standard engineering practices and instructions of Engineer-in-charge.

3.0 RADIOGRAPHY/DYE-PENETRANT EXAMINATIONS/MAGNETIC PARTICLE TEST(MPT)

Radiography charges towards Pipeline works is included in laying cost and **no separate payment shall be paid for mainline and other Mechanical & piping works.** Repeat radiography due to defective films or on repaired joint due to Contractor's fault or for additionalradiography necessitated due to poor performance of Contractor's welder will be done at Contractor's cost

4.0 STRUCTURAL STEEL WORK

4.1 Payment for steel work shall be made on basis of admissible weight of the structure accepted, the weight being determined as described below.

4.2 The weight for payment will be assessed from the approved fabrication drawings and the respective bill of materials prepared by the contractor and approved by the Engineer-in-Charge. The weight of structural material/ Plate shall be calculated wherever necessary on the basis of IS Hand Book. If sections are different from IS sections, then Manufacturer Hand Book shall be referred to.

4.3 Sections built out of plates/structural shall be paid on the actual weight

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incorporated except for gussets which will be paid on the weight of the smallest rectangle enclosing the shape.

4.4 Gratings shall be paid on the basis of calculated weights as determined from the dimensions given on the design drawings/ bill of materials. Full deduction shall be made for all opening above 300 mm size and skews.

4.5 Welds, bolts, nuts, washers etc. shall not be measured. Rate of structural steel work shall be deemed to include the same.

4.6 No other payment either for temporary works or for any other item such as welds, shims, packing plates etc., shall be made. Such items shall be deemed to have been included in the rate quoted for steel work.

5.0 ELECTRICAL WORKS

Earthing

Payment is on lump sum basis for each set as per SOR.

6.0 INSTRUMENTATION WORKS

6.1 Pressure Gauges ,RPD meters shall be accounted in terms of the quantity in numbers.

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TERMS OF PAYMENT
(ANNEXURE-5 TO SPECIAL CONDITIONS OF CONTRACT)

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ANNEXURE- 5 TO SCC

1.0 TERMS OF PAYMENT

Pending completion of the whole works, provisional progressive payments for the part of work executed by the contractor shall be made by Owner on the basis of said work completed and certified by the Engineer-in-Charge as per the agreed milestone payment schedule and the percentage break-ups given below.

Contractor shall submit his invoices to the Engineer-in-Charge fortnightly in the manner as instructed by Owner. Each invoice will be supported by documentation acceptable to Owner and certified by the Engineer-in-Charge. Payments made by owner to the contractor for any part of the work shall not deem that the Owner has accepted the work.

I.	**MAINLINE WORKS**		
A	**Pipeline Laying with Associated Works by open cut (SOR item no.1.1 & 1.2)**		
	After grading, stringing, trenching, welding, NDT, joint coating,lowering, and Backfilling (as per respective item rate of SOR)	:	65%
	Tie-in, NDT & field coating of tie-in joints (as per respectiveitem rate of SOR) and backfilling of respective area.	:	10%
	Hydro-testing, dewatering & Swabbing incl. testing of PE pipe	:	10%
	Final cleanup and restoration (as per respective rate)	:	5%
	Submission of As built drgs. and documents line pipe book etc. and reconciliation of materials Final completion, handingover of complete pipeline system and acceptance of the system by Owner along with the final bill	:	10%
B	**Cutting/ Breaking of Hard Rock & Borrowed soil for filling(SOR item No 1.5 & 3.0)**		
	On completion of work & certification by EIC	:	90%
	After completion of works and along with final bill	:	10%
C	**Restoration (SOR Item no.2.0)**		
	On completion of work & certification by EIC	:	75%
	After obtaining NOC from concerned authorities	:	15%

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	After completion of works and along with final bill	:	10%
D	**Pipeline Laying by HDD/ boring / Moling (SOR item nos.1.6, 1.8, 4.0, 5.0)**		
	On completion of HDD/Boring/moling	:	80%

	Final tie-in and testing	:	10%
	Submission of all as-built drawings material reconciliation and5% closure of contract	:	10%
E	**Supply of Long radius bends (SOR Item no.13.0)**	:	
	On supply with TC	:	60%
	On lowering / erection at site	:	20%
	Testing & Commissioning	:	10%
	After completion of works and along with final bill	:	10%
F	**Repair of pipes / leak /burst , idle time preservation ofpipe line, (SOR Item no. 7.0, 8.0, 10.0, 12.0)**		
	On completion and acceptance by EIC	:	90%
	Along with final bill		10%
G	**Permanent markers (SOR Item no.9.0)**		
	On supply & installation	:	90 %
	After completion of works and along with final bill	:	10%
H	**Pre-commissioning & assistance in commissioning (SORitem nos. 11.0)**		
	On completion pre-commissioning	:	80' %
	On commissioning	:	10%
	On final closure of contract	:	10%
		:	
I	**Valves erection (SOR Item no.14.0)**		
	On installation	:	80%
	On testing & documentation	:	10%
	After completion of works and along with final bill	:	10%

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J	**Supply & Installation of Fittings, Flanges, PE isolationvalves (SOR item No. 15, 17)**		
	On supply with TC	:	60%
	On lowering / erection at site	:	20%
	Testing & Commissioning	:	10%
	After completion of works and along with final bill	:	10%
K	**Liaisioning activities (SOR no. 6)**		
	On obtaining demand note from authorities	:	70 %
	Progressively, laying min 3 KM pipeline in single stretch.		20%
	After completion of works and along with final bill	:	10%
L	**Construction of Valve pits (SOR item No 16, 18)**		
	On completion of work & certification by EIC	:	90 %
	After completion of works and along with final bill	:	10%
M	Supply of Hard Barricading **(SOR item No 19)**		
	On supply & installation	:	90 %
	After completion of works and along with final bill	:	10%
N	**Hot Tapping Works (SOR Item no. 20)**	:	
	On supply with TC of Tees and Valves	:	20%
	On hot tapping / erection at site	:	60%
	Testing & Commissioning	:	10%
	After completion of works and along with final bill	:	10%
2.0	**CATHODIC PROTECTION WORKS (TCP)**		
2.1	**Design of TCP works (SOR Item no.1)** On Design approval	:	90 %
	After handing over & final documentation	:	10%
2.2	**Supply & installation of TCP works (SOR Item no.2)**		
	On supply	:	55 %
	On installation & testing	:	35 %
	After handing over & final documentation		10%
3.0	**Piping & Mechanical works (PP)**		
3.1	Erection of pipes and valves supplied as free issue items (SOR no.1.0 & 3.0)	:	

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	Fabrication & erection	:	60 %
	Testing & supports	:	30%
	On commissioning & final billing	:	10%
3.2	Supply & installation of pipes & fittings (SOR no.2.0)		
	Supply of pipes & valves	:	70 %
	Installation	:	20%
	On commissioning & final billing		10%
3.3	Erection of free issue valves & installation of free issue MRS/DRS (SOR no. 4 & 5)		
	On completion of erection of valves & MRS/DRS	:	90%
	On commissioning & final billing	:	10%
4	**Civil works (SOR Sl. no. CIV-1 to 13)**		
	On completion and acceptance by EIC	:	90%
	On submission of all the documents (All test certificates, cement consumption statement etc.) with final bill	:	10%
5	**Structural works (SOR No. ST-1 to 3)**		
	Supply of steel structures	:	70%
	Completion of Fabrication, welding & erection work	:	20%
	On commissioning & final billing		10%
6	**Electrical works (EL)**		
	Supply of electrical items	:	70%
	Completion of installation work including testing	:	20%
	On commissioning & final billing	:	10%
7	**Instrumentation works (IN)**		
	Supply, if instrumentation items		70%
	Completion of installation work including testing		20%
	Along with final bill with complete testing & commissioning ifrequired.		10%

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PAYMENT METHODOLOGY

1. The contractor may raise invoices on monthly basis. Bidder shall enclose all documents as per check list issued by BGL/PMC/BGL.

2. The payments to the Contractor will be released within a period of 15 days from the date of receipt of the complete invoice as per the terms and conditions of the Contract.

3. Further break-up of Lumpsum Prices, if deemed necessary for any progressive payment of individual item may be permitted after request by Contractor showing relevance of further breakup & recommendation by EIC

4. All payments against running bills are advance against the work and shall not be taken as final acceptance of work / measurement carried out till the final bill

5. Bills shall be raised by contractor in line with check list attached in Tender document.

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STANDARD SPECIFICATIONFOR HEALTH, SAFETY AND ENVIRONMENTAL (HSE)MANAGEMENT AT CONSTRUCTION SITES

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SPECIFICATION
FOR
HEALTH, SAFETY
AND
ENVIRONMENT (HSE)
MANAGEMENT

SPECIFICATION NO.

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C O N T E N T S

SL. NO.	DESCRIPTION
1.0	SCOPE
2.0	REFERENCES
3.0	REQUIREMENT OF HEALTH, SAFETY & ENVIRONMENT (HSE) MANAGEMENT SYSTEM TO BE COMPLETED BY BIDDERS.
4.0	DETAILS OF HSE MANAGEMENT SYSTEM BY CONTRACTOR
5.0	RECORDS
	ANNEXURE-A
	ANNEXURE-B
	ANNEXURE-C
	ANNEXURE-D
	ANNEXURE-E

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1.0 **SCOPE**

This specification establishes the Healthy, Safety and Environment (HSE) management requirement to be compiled with by the Contractors during construction.

This specification is not intended to replace the necessary professional judgement needed to design & implement an effective HSE system for construction activities and the contractor is expected to exceed requirements given in this specification.

Requirement stipulated in this specification shall supplement the requirement of HSE management given in relevant Act (S)/ legislations. General Condition of Contract (GCC) Special Condition of Contract (SCC) and Job Specifications. Where different documents stipulate different requirements, the most stringent shall be adopted.

2.0 **REFERENCES**

This document should be read in conjunction with following:

- General Conditions of Contract (GCC)
- Special Conditions of Contract (SCC)
- Building and other construction workers (regulation of employment and condition of service) Act, 1996
- Job Specifications
- Relevant IS Codes (refer Annexure-A)
- Reporting Formats (refer Annexure-B)
- Statutory requirements

3.0 **REQUIREMENT OF HEALTH, SAFETY & ENVIRONMENT (HSE) MANAGEMENT SYSTEM TO BE COMPLETED BY BIDDERS.**

3.1 **Management Responsibility**

3.1.1 The Contract should have a document HSE policy to cover commitment of the organization to ensure health, safety and environment aspects in their line of operations

3.1.2 The HSE management system of the Contractor shall cover HSE requirement including but not limited to what specified under clause 1.0 & 2.0 mentioned above

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3.1.3 Contractor shall be fully responsible for planning and implementing HSE requirement to the satisfaction of the company. Contractor as a minimum requirement shall designate/deploy the following to co-ordinate the above:

No. Of workers deployed		
Up to 250	-	Designate one safety supervisor who will guide the workers from time to time, as well as impart training basic guidelines at least weekly once.

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Above 250 & upto 500	-	Deploy one qualified and experienced safety Engineer/ Officer who will guide the workers from time to time as well as impart basic guideline & training at least weekly once. He / She shall possess a recognized Degree in any branch of engineering or technology or architecture and had a post qualification construction experience of minimum two years or possess a recognized Diploma in any branch of engineering or technology or Graduate in Science stream and had a post qualification construction experience of minimum five years.
Above 500 (for every 500 or less)	-	One additional safety engineer/Officer whose function will be as mentioned above

Contractor shall indemnify and hold harmless OWNER/ PMC & their representative's from any and all liabilities arising out of non fulfillment of HSE requirements.

Above is the minimum requirement and the Contractor shall ensure physical presence of a safety personnel at each place where Hot work permit is required. No work shall be started at site until above safety personnel are physically present at site. The contractor shall submit a safety organogram clearly indicating the lines of responsibility and reporting system. He shall furnish Bio-Data/Resume/Curriculum Vitae of the safety personnel he intends to mobilize, at least 1 month before the intended mobilization, for PMC/Owner's approval.

3.1.4 The Contractor shall ensure that the Health, Safety and Environment (HSE) requirements are clearly understood & faithfully implemented at all levels, at each and every site/ work place.

3.1.5 The Contractor shall promote and develop consciousness for Health, Safety and Environment among all personnel working for the Contractor. Regular awareness programs and fabrication shop/work site meeting shall be arranged on HSE activities to cover hazards involved in various operations during construction.

3.1.6 Arrange suitable first aid measures such as First Aid Box, trained personnel to give First Aid, Stand by Ambulance or Vehicle and install fire protection measures such as: adequate number of steel buckets with sand and water and adequate fire extinguishers to the satisfaction of OWNER/ PMC. In case the number of workers exceeds 500, the Contractor shall position an ambulance /vehicle on full time basis very close to the worksite.

3.1.7 The Contractor shall evolve a comprehensive planned and documented system for implementation and monitoring of the HSE requirements. This shall submitted to

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OWNER & PMC for approval well in advance, prior to start of work. The monitoring for implementation shall be done by regular inspection and compliance to the observations thereof. The Contractor shall get similar HSE requirements implemented at his sub-contractor (s) work site/ Office. However, compliance of HSE requirement shall be the sole responsibility of the Contractor. Any review/ approval by OWNER/ PMC shall not absolve the Contractor of his responsibility/ liability in relation to all HSE requirements.

3.1.8 Non-Conformance on HSE by the Contractor (including his Sub-contractors) as brought out during review/ audit by PMC/ OWNER representative shall be resolved forthwith by Contractor. Compliance report shall be possibility submitted to PMC/ OWNER at the earliest.

3.1.9 The Contractor shall ensure participation of his Resident Engineer/Site-in-Charge in the Safety Committee/HSE Committee meetings arranged by OWNER/ PMC. The compliance of any observation shall be arranged urgently. Contractor shall assist OWNER/PMC to achieve the targets set by them on HSE during the project implementation.

The contractor shall ensure that his staff members & workers (permanent as well casual) shall not be in a state of intoxication during working hours and shall abide by any law relating to consumption & possession of intoxicating drinks or drugs in force. Awareness about local laws on this issue shall form part of the Induction Training.

The contractor shall ensure that all personnel working for him comply with No-smoking requirements of the owner as notified from time to time. Cigarettes, lighters, auto ignition tools or appliances shall not be allowed inside the plant complex. Smoking shall be permitted only inside smoking booths expressly designated & authorized by the Owner/PMC.

3.1.10 The Contractor shall adhere consistently to all provisions of HSE requirements. In case of non-compliance or continuous failure in implementation of any of HSE provisions; OWNER/ PMC may impose stoppage of work without any Cost & Time implication to Owner and/or impose a suitable penalty for non-compliance with a notice of suitable period, upto a cumulative limit of 1.0% (one percent) of Contract value with a ceiling of Rs. 10 lakhs.

0.2% (Zero decimal two percent) of the contract value for LSTK, EPC, EPCC or Package contracts with an overall ceiling of Rs. 1,00,00,000/- (Rupees one crore).

S. No.	Violation or HSE norms	Penalty Amount
1.	For not using personal protective equipment (Helmet, Shoes, Goggles, Gloves, Full body harness, Face shield, Boiler suit, etc.)	Rs. 250/- per day / item / person
2.	Working without Work Permit / Clearance	Rs.5,000/- per occasion

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S. No.	Violation or HSE norms	Penalty Amount
3.	Unsafe electrical practices (not installing ELCB, using poor joints of cables, using naked wire without top plug into socket, laying wire / cables on the roads, electrical jobs by incompetent person, etc.)	Rs.3,000/- per item per day.
4.	Working at height without full body harness, using non-standard / rejected scaffolding and not arranging fall protection arrangement as required like Safety Nets.	Rs.1,000/ per case per day.
5.	Unsafe handling of compressed gas cylinders (No trolley, jubilee clips double gauge regulator, improper storage / handling).	Rs. 100/- per item per day
6.	Use of domestic LPG for cutting purpose.	Rs.1,000/- per occasion
7.	No fencing / barricading of excavated areas.	Rs.1,000/- per occasion
8.	Not providing shoring / strutting / proper slope and not keeping the excavated earth at least 1.5 M away from excavated area.	Rs.5,000/- per occasion
9.	Non display of caution boards, list of hospitals, emergency services available at work locations.	Rs.500/- per occasion
10.	Traffic rules violations like over speeding of vehicles, rash driving, wrong parking, not using seat belts, vehicles not fitted with reverse warning alarms.	Rs.1,000/- per occasion
11.	Absence of Contractor's top most executive at site in the safety meetings whenever called by PMC / Owner	Rs.1,000/- per occasion
12.	Failure to maintain safety records by Contractor Safety personnel.	Rs.1,000/- per month.
13.	Failure to conduct daily safety site inspection, HSE meeting and HSE audit at predefined frequencies.	Rs.1,000/- per occasion
14.	Failure to submit the monthly HSE report by 5th of subsequent month to Engineer-in-Charge.	Rs. 1,000/- per occasion and Rs. 100/- per day for further delay.
15.	Poor House Keeping	Rs.1,000/- per occasion
16.	Failure to report & follow up accident (including Near Miss) reporting system.	Rs. 10,000/- per occasion

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S. No.	Violation or HSE norms	Penalty Amount
17.	Degradation of environment (not confining toxic spills oil / lubricants onto ground)	Rs.1,000/- per occasion
18.	Not medically examining the workers before allowing them to work at height, not providing ear muffs while allowing them to work in noise polluted areas, made them to work in air polluted areas without respiratory protective devices, etc.	Rs.1,000/- per occasion
19.	Violation of any other safety condition as per job HSE plan, work permit and HSE conditions of contract (using crowbar on cable trenches, improper welding booth, not keeping fire extinguisher ready at hot work site, unsafe rigging practices, non-availability of First-Aid box, etc.)	Rs.1,000/- per occasion
20.	Any violation not covered above.	To be decided by PMC / Owner

This penalty shall be in addition to all other penalties specified else where in the contract. The decision of imposing stoppage of work, its extent & monitory penalty shall rest with PMC/OWNER & binding on the Contractor.

3.1.11 All fatal accidents and other personnel accidents shall be investigated by a team of Contractor's senior personnel for root cause and recommend corrective and preventive actions. Findings shall documented and suitable actions taken to avoid recurrences shall be communicated to OWNER / PMC. OWNER / PMC shall have the liberty to independently investigate such occurrences and Contractor shall extend all necessary help and co-operation in this regard. PMC / Owner shall have to right to share the content of this report with the outside world.

3.2 **House Keeping**

3.2.1 Contractor shall ensure that a high degree of house keeping is maintained and shall ensure the followings:

a. All surplus earth and debris are removed/disposed off from the working site to identified location (s).

b. Unused/Surplus Cables Steel items and steel scrap lying scattered at different places within the working areas are removed to identified location (s).

c. All wooden scrap, empty wooden cable drums and other combustible packing materials shall be removed from work place to identified location(s).

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d. Roads shall be kept clear and materials like pipes, steel, sand, boulders, concrete chips and bricks, etc. shall not be allowed in the roads to obstructs free movement of men & machineries.

e. Fabricated steel structurals, pipes & piping materials shall be stacked properly for erection.

f. Water logging on rods shall not be allowed.

g. No parking of trucks/ trolleys, cranes and trailors etc. shall be allowed on of roads, which may obstruct the traffic movements.

h. Utmost care shall be taken to ensure over all cleanliness and proper up keep of the working areas.

i. Trucks carrying sand, earth and pulverized materials etc. shall be covered while moving within the plant areas.

j. The contractor shall ensure that the atmosphere in plant area and on roads is free from particulate matter like dust, sand, etc. by keeping the top surface wet for ease in breathing.

k. At least two exits for any unit area shall be assured at all times.

3.3 **Healthy, Safety and Environment**

a) The Contractor shall provide safe means of access to any working place including provision of suitable and sufficient scaffolding at various stages during all operations of the work for the safety of his workmen, and OWNER/ PMC. Contractor shall ensure deployment of appropriate equipment and appliances for adequate safety and healthy of the workmen and protection of surrounding areas.

Contractor shall ensure identification of all Occupational Health, Safety & Environmental hazards in the type of work he is going to undertake and enlist mitigation measures. Contractor shall carry out Job Safety Analysis (JSA) specifically for high risk jobs like working at height & in confined space, deep excavations, radiography jobs, electrical installations, blasting operations, demolishing / dismantling activities, welding / gas cutting jobs and submit the findings to PMC / Owner. The necessary HSE measures devised shall be in place prior to start of an activity by the contractor.

b) The Contractor shall ensure that all their staff workers including their sub-Contractor (s) shall wear Safety Helmet and Safety shoes. Contractor shall also ensure use of safety belt, protective goggles, gloves etc. by the personnel as per jobs requirements. All these gadgets shall conform to relevant IS specification equivalent.

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The Contractor shall ensure that all their staff, workers and visitors including their sub-contractor(s) have been issued (records to be kept) & wear appropriate PPEs like nape strap type safety helmets preferably with head & sweat band with ¾" cotton chin strap (made of industrial HDPE), safety shoes with steel toe cap and antiskid sole, full body harness (C∈ marked and conforming to EN361), protective goggles, gloves, ear muffs, respiratory protective devices, etc. All these gadgets shall conform to applicable IS Specifications / C∈ or other applicable international standards.

Owner may issue a comprehensive color scheme for helmets to be used by various agencies. The Contractor shall follow the scheme issued by the owner. All Safety / Fire personnel shall preferably wear red colour helmet so that workmen can approach them for guidance during emergencies.

For shot blasting, the usage of protective face shield and helmets, gauntlet and protective clothing is mandatory.

For offshore jobs/contracts, contractor shall provide PPEs (new) to PMC & Owner's personnel, at his (contractor's) cost. All personnel shall wear life jacket at all time.

An indicative list of HSE standards/codes is given under Appendix-A.

The contractor shall issue height permit for working at height after verifying and certifying the checkpoints as specified in the attached permit (Format No. HSE-6). He shall also undertake to ensure compliance to the conditions of the permit during the currency of the permit including adherence to personal protective equipments.

The permit shall be issued initially for one week or expected duration of an activity and extended further for the balance duration. This permit shall be applicable in areas where specific clearance from Owner's operation Deptt. / Safety Deptt. is not required. PMC field Engineers / Safety Officers / Area Coordinators may verify and counter sign this permit (as an evidence of verification) during the execution of the job.

In case work is undertaken without taking sufficient precautions as given in the permit, PMC Engineers may cancel the permit and stop the work till satisfactory compliance is arranged. Contractors are expected to maintain a register for issuance of permit and extensions thereof including preserving the used permits for verification during audits etc.

Contractor shall arrange (at his cost) and ensure use of Fall Arrester Systems by his workers. Fall arresters are to be used while climbing / descending tall structures. These arresters should lock automatically against the anchorage line, restricting free fall of the user. The device is to be provided with a double security opening system to ensure safe attachment or release of the user at

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any point of rope. In order to avoid shock, the system should be capable of keeping the person in vertical position in case of a fall.

Contractor shall ensure that Full body harnesses conforming EN361 and having authorized CC marking is used by all personnel while working at height. The lanyards and life lines should have enough tensile strength to take the load of the worker in case of a fall. One end of the lanyard shall be firmly tied with the harnesses and the other end with life line. The harness should be capable of keeping the workman vertical in case of a fall, enabling him to rescue himself.

Contractor shall provide Roof Top Walk Ladders for carrying out activities on sloping roofs in order to reduce the chances of slippages and falls.

c) Contractor shall ensure that a proper Safety Net System shall be used at appropriate locations. The safety net shall be located not more than 30 feet (9.0 metres) below the working surface at site to arrest or to reduce the consequences of possible fall of persons working at different heights.

d) Contractor shall ensure that flash back arrestors conforming to BS:6158 or equivalent are installed on all gas cylinders as well as at the torch end of the gas hose, while in use. All cylinders shall be mounted on trolleys and provided with a closing key. The burner and the hose placed downstream of pressure reducer shall be equipped with Flash Back Arrester / Non Return Valve device. The hoses for acetylene and oxygen cylinders must be of different colours. Their connections to cylinders and burners shall be made with a safety collar. At end of work, the cylinders in use shall be closed and hoses depressurized. All welding machines shall have effective earthing. In order to help maintain good housekeeping, and to reduce fire hazard, live electrode bits shall be contained safely and shall not be thrown directly on the ground.

e) The Contractor shall assign to his workmen, tasks commensurate with their qualification, experience and state of health for driving of vehicles, handling and erections of materials and equipment's. All lifting equipments shall be tested certified for its capacity before use. Adequate and suitable lighting at every work place and approach there to shall be provided by the contractor before starting the actual work/ operation at night.

Contractor shall ensure installation of Safe Load Indicator (SLI) on all cranes (while in use) to minimize overloading risk. SLI shall have capability to continuously monitor and display the load on the hook, and automatically compare it with the rated crane capacity at the operating condition of the crane. The system shall also provide visual and audible warnings at set capacity levels to alert the operator in case of violations.

The contractor shall be responsible for safe operations of different equipments mobilized and used by him at the workplace like transport

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vehicles, engines, cranes, mobile ladders, scaffoldings, work tools, etc.

f) Hazardous and/or toxic material such as solvent coating or thinners shall be stored in appropriate containers.

g) All hazardous materials shall be labeled with the name of the materials, the hazards associated with its use and necessary precautions to be taken.

The work place shall be checked prior to start of activities to identify the location, type and condition of any asbestos materials which could be disturbed during the work. In case asbestos material is detected, usage of appropriate PPEs by all personnel shall be ensured and the matter shall be reported immediately to PMC / Owner.

h) Contractor shall ensure that during the performance of the work all hazards to the health of personnel have been identified assessed and eliminated.

i) Chemical spills shall be contained & cleaned up immediately to prevent further contamination.

j) All personnel exposed to physical agents such as ionizing or non-ionizing radiation ultraviolet rays or similar other physical agents shall be provided with adequate shielding or protection commensurate with type of exposure involved. For ionizing radiation, requirements of Bhabha Atomic Research Centre (BARC)/ Atomic Energy Regulatory Board (AERB) shall be followed.

k) Where contract or exposure of hazardous materials could exceed limits or could otherwise have harmful affects, appropriate personal protective equipment's such as gloves, goggles, aprons, chemical resistant clothing and respirator shall be used.

l) Contractor shall ensure the following facilities at work sites:

I) A Crèche where 10 or more female workers are having children below the age of 6 years.

II) Reasonable Canteen facilities are made available at appropriate location depending upon site conditions.

m) Suitable facilities for toilet, drinking water, proper lighting shall be provided at site and labor camps, commensurate with applicable Laws/Legislation.

n) Contractor shall ensure storage and utilization methodology of material that are not detrimental to the environment. Wherever required Contractor shall ensure that only the environment friendly material are selected.

Emphasize on recycling of waste materials such as metals, plastics, glass, paper, oil & solvents. The waste that can not be minimized, reused or

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recovered shall be stored and disposed of safely. In no way, toxic spills shall be allowed to percolate into the ground. The contractor shall not use the empty areas for dumping the wastes.

o) All person deployed at site shall be knowledgeable of and comply with the environmental laws, rules & regulation relating to the hazardous materials substance and wastes. Contractor shall not dump, release or otherwise discharge or dispose off any such materials without the authorization of OWNER/ PMC.

Suitable scaffoldings shall be provided to workmen for all works that cannot be safely done from the ground or from solid construction except such short period work that can be safely done using ladders. When a ladder is used, an extra workman shall be engaged for holding the ladder.

The contractor shall ensure that the scaffolds used during construction activities shall be strong enough to take the designed load. Owner / PMC reserves the right to ask the contractor to submit certification and or design calculations from his Engineering regarding load carrying capacity of the scaffoldings.

All scaffolds shall be inspected by a Scaffolding Inspector of the contractor. He shall paste a GREEN tag on each scaffold found safe and a RED tag on each scaffold found unsafe. Scaffolds with GREEN tag only shall be permitted to be used and RED ones shall immediately be removed from the site.

All electrical installations / connections shall be carried out as per the provisions of latest revision of following codes/standards, in addition to the requirements of Statutory Authorities and IE / applicable international rules & regulations:

- OISO SID 173 : Fire prevention & protection system for electrical installations
- SP 30 (BIS) : National Electric Code

All electrical installations shall be approved by the concerned statutory authorities.

- The contractor shall meet the following requirements:

  i) Ensure that electrical systems and equipment including tools & tackles used during construction phase are properly selected, installed, used and maintained as per provisions of the latest revision of the Indian Electrical / applicable international regulations.

  ii) Shall deploy qualified & licensed electricians for proper & safe installation and for regular inspection of construction power

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distribution system / points including their earthing. A copy of the license shall be submitted to PMC / Owner for records. Availability of at least one competent licensed electrician shall be ensured at site round the clock to attend to the normal / emergency jobs.

iii) All switchboards / welding machines shall be kept in well-ventilated & covered shed. The shed shall be elevated to avoid water logging. No flammable materials shall be used for constructing the shed. Also flammable materials shall not be stored in and around electrical equipment / switchboard. Adequate clearances and operational space shall be provided around the equipment.

iv) Fire extinguishers and insulating mats shall be provided in all power distribution centers.

v) Temporary electrical equipment shall not be employed in hazardous area without obtaining safety permit.

vi) Proper house keeping shall be done around the electrical installations.

vii) All temporary installations shall be tested before energising, to ensure proper earthing, bonding, suitability of protection system, adequacy of feeders/cables etc.

viii) All welders shall use hand gloves irrespective of holder voltage.

ix) Multilingual (Hindi, English and local language) caution boards, shock treatment charts and instruction plate containing location of isolation point for incoming supply, name & telephone No. of contact person in emergency shall be provided in substations and near all distribution boards / local panels.

x) Operation of earth leakage device shall be checked regularly by temporarily connecting series test lamp (2 bulbs of equal rating connected in series) between phase and earth.

xi) Regular inspection of all installations (at least once in a month)

- The following features shall also be ensured for all electrical installations during construction phase by the contractor:

i) Each installation shall have a main switch with a protective device, installed in an enclosure adjacent to the metering point. The operating height of the main switch shall not exceed 1.5 M. The main switch shall be connected to the point of supply by means of armoured cable.

ii) The outgoing feeders shall be double or triple pole switches with fuses / MCBs. Loads in a three phase circuit shall be balanced as far as

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possible and load on neutral should not exceed 20% of load in the phase.

iii) The installation shall be adequately protected against overload, short circuit and earth leakage by the use of suitable protective devices. Fuses wherever used shall be HRC type. Use of rewirable fuses shall be strictly prohibited. The earth leakage device shall have an operating current not exceeding 30 mA.

iv) All connections to the hand tools / welding receptacles shall be taken through proper switches, sockets and plugs.

v) All single phase sockets shall be minimum 3 pin type only. All unused sockets shall be provided with socket caps.

vi) Only 3 core (P+N+E) overall sheathed flexible cables with minimum conductor size of 1.5 mm^2 copper shall be used for all single phase hand tools.

vii) Only metallic distribution boxes with double earthing shall be used at site. No wooden boxes shall be used.

viii) All power cables shall be terminated with compression type cable glands. Tinned copper lugs shall be used for multistrand wires / cables.

ix) Cables shall be free from any insulation damage.

x) Minimum depth of cable trench shall be 750 mm for MV & control cables and 900 mm for HV cables. These cables shall be laid over a sand layer and covered with sand, brick & soil for ensuring mechanical protection. Cables shall not be laid in waterlogged area as far as practicable. Cable route markers shall be provided at every 25 M of buried trench route. When laid above ground, cables shall be properly cleated or supported on rigid poles of atleast 2 M high. Minimum head clearance of 6 meters shall be provided at road crossings.

xi) Under ground road crossings for cables shall be avoided to the extent feasible. In any case no under ground power cable shall be allowed to cross the roads without pipe sleeve.

xii) All cable joints shall be done with proper jointing kit. No taped / temporary joints shall be used.

xiii) An independent earthing facility should preferably be established within the temporary installation premises. All appliances and

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equipment shall be adequately earthed. In case of armoured cables, the armour shall be bonded to the earthing system.

xiv) All cables and wire rope used for earth connections shall be terminated through tinned copper lugs.

xv) In case of local earthing, earth electrodes shall be buried near the supply point and earth continuity wire shall be connected to local earth plate for further distribution to various appliances. All insulated wires for earth connection shall have insulation of green colour.

xvi) Separate core shall be provided for neutral. Earth / Structures shall not be used as a neutral in any case.

xvii) ON/OFF position of all switches shall be clearly designated / painted for easy isolation in emergency.

The contractor shall identify all operations that can adversely affect the health of its workers and issue & implement mitigation measures.

For surface cleaning operations, sand blasting shall not be permitted even if not explicitly stated elsewhere in the contract.

To eliminate radiation hazard, Tungsten electrodes used for Gas Tungsten Arc Welding shall not contain Thorium.

Appropriate respiratory protective devices shall be used to protect workmen from inhalation of air borne contaminants like silica, asbestos, gases, fumes, etc.

Workmen shall be made aware of correct methods for lifting, carrying, pushing & pulling of heavy loads. Wherever possible, manual handling shall be replaced by mechanical lifting equipments.

For jobs like drilling / demolishing / dismantling where noise pollution exceeds the specified limit of 85 decibels, ear muffs shall be provided to the workers.

To avoid upper limb disorders and backaches, Display Screen Equipments' workplace stations shall be carefully designed & used with proper sitting postures. Power driven hand-held tools shall be maintained in good working condition to minimize their vibrating effects and personnel using these tools shall be taught how to operate them safely & how to maintain good circulation in hands.

The contractor shall arrange health check up for all the workers at the time of induction. Health check may have to be repeated if the nature of duty assigned to him is changed necessitating health check or doubt arises about his wellness. PMC / Owner reserve the right to ask the contractor to submit test reports.

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Weather Protection

Contractor shall take appropriate measures to protect workers from severe storms, solar radiations, poisonous gases, dust, etc. by ensuring proper usage of PPEs like Sun glasses, Sun screen lotions, respirators, dust masks, etc. and rearranging / planning the construction activities to suit the weather conditions.

Communication

All persons deployed at the work site shall have access to effective means of communication so that any untoward incident can be reported immediately and assistance sought by them.

All health & safety information shall be communicated in a simple & clear language easily understood by the local workforce.

Unsuitable Land Conditions

Contractor shall take appropriate measures and necessary work permits / clearances if work is to be done in or around marshy areas, river crossings, mountains, monuments, etc.

Under Water Inspection

Contractor shall ensure that boats and other means used for transportation, surveying & investigation works shall be certified seaworthy by a recognized classification society. It shall be equipped with all life saving devices like life jackets, adequate fire protection arrangements and shall posses communication facilities like cellular phones, wireless, walkie-talkie. All divers used for seabed surveys, underwater inspections shall have required authorized license, suitable life saving kit. Number of hours of work by divers shall be limited as per regulations. PMC / Owner shall have the right to inspect the boat and scrutinize documents in this regard.

TOOL BOX MEETING (TBM)

Contractor shall conduct daily TBM with workers prior to start of work and shall maintain proper record of the meeting. A suggested format is given below. The TBM is to be conducted by the immediate supervisor of the workers.

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TOOLBOX MEETING RECORDING SHEET

Date & Time		
Subject		
Presenter		
Hazards involved		
Precautions to be taken		
Worker's Name	Signature	Section
Remarks, if any		

The topics during TBM shall include

- Hazards related to work assigned on that day and precautions to be taken.
- Any forthcoming HSE hazards / events / instruction / orders, etc.

The above record can be kept in local language, which workers can read. These records shall be made available to PMC / Owner whenever demanded.

TRAINING

Contractor shall ensure that all his personnel possess appropriate training to carry out the assigned job safely. The training should be imparted in a language understood by them and should specifically be trained about

- Potential hazards to which they may be exposed at their workplace
- Measures available for prevention and elimination of these hazards

The topics during training shall cover, at the minimum;

- Education about hazards and precautions required
- Emergency and evacuation plan
- HSE requirements
- Fire fighting and First-Aid
- Use of PPEs
- Local laws on intoxicating drinks, drugs, smoking in force

Records of the training shall be kept and submitted to PMC / Owner whenever demanded.

For offshore and jetty jobs, contractor shall ensure that all personnel deployed have undergone a structured sea survival training including use of lifeboats, basket landing, use of radio communication etc. from an agency acceptable to Owner / PMC.

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INSPECTION

The contractor shall carryout daily HSE inspection and record observations at a central location. These inspection records shall be freely accessible to Owner / PMC representatives. The contractor shall also assist Owner / PMC representatives during the HSE inspections conducted by them.

ADDITIONAL SAFETY REQUIREMENTS FOR WORKING INSIDE A RUNNING PLANT

As a minimum, the contractor shall ensure adherence to following safety requirements while working in or in the close vicinity of an operating plant :

a) Contractor shall obtain permits for Hot work, Cold work, Excavation and Confined Space from Owner in the prescribed format.

b) The contractor shall monitor, record and compile list of his workers entering the operational plant/unit each day and ensure & record their return after completing the job.

c) Contractor's workers and staff members shall use designated entrances and proceed by designated routes to work areas only assigned to them. The workers shall not be allowed to enter units' area, tanks area, pump rooms, etc. without work authorization permit.

d) Work activities shall be planned in such a way so as to minimize the disruption of other activities being carried out in an operational plant / unit and activities of other contractors.

e) The contractor shall submit a list of all chemicals / toxic substances that are intended to be used at site and shall take prior approval of the Owner.

f) Specific training on working in a hydrocarbon plant shall be imparted to the work force and mock drills shall be carried out for Rescue operations / First-Aid measures.

g) Proper barricading / cordoning of the operational units / plants shall be done before starting the construction activities. No unauthorized person shall be allowed to trespass. The height and overall design of the barricading structure shall be finalized in consultation with the Owner and shall be got approved from the Owner.

h) Care shall be taken to prevent hitting underground facilities such as electrical cables, hydrocarbon piping during execution of work.

i) Barricading with water curtain shall be arranged in specific/critical areas where hydrocarbon vapors are likely to be present such as near horton spheres or tanks. Positioning of fire tenders (from owner) shall also be ensured during execution of critical activities.

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j) Emergency evacuation plan shall be worked out and all workmen shall be apprised about evacuation routes. Mock drill operations may also be conducted.

k) Flammable gas test shall be conducted prior to any hot work using appropriate measuring instruments. Sewers, drains, vents or any other gas escaping points shall be covered with flame retardant tarpaulin.

l) Respiratory devices shall be kept handy while working in confined zones where there is a danger of inhalation of poisonous gases. Constant monitoring of presence of Gas / Hydrocarbon shall be done.

m) Clearance shall be obtained from all parties before starting hot tapping, patchwork on live lines and work on corroded tank roof.

n) Positive isolation of line/equipment by blinding for welding/cutting/grinding shall be done. Closing of valve will not be considered sufficient for isolation.

o) Welding spatters shall be contained properly and in no case shall be allowed to fall on the ground containing oil. Similar care shall be taken during cutting operations.

p) The vehicles, cranes, engines, etc. shall be fitted with spark arresters on the exhaust pipe and got it approved from Safety Department of the Owner.

q) Plant air should not be used to clean any part of the body or clothing or use to blow off dirt on the floor.

r) Gas detectors should be installed in gas leakage prone areas as per requirement of Owner's plant operation personnel.

s) An experienced full time safety personnel shall be exclusively deployed to monitor safety aspects in running plants.

HSE PROMOTION

The contractor shall encourage his workforce to promote HSE efforts at workplace by way of organizing workshops / seminars / training programmes, celebrating HSE awareness weeks & National Safety Day, conducting quizzes & essay competitions, distributing pamphlets, posters & material on HSE, providing incentives for maintaining good HSE practices and granting bonus for completing the job without any lost time accident.

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4.0 **DETAILS OF HSE MANAGEMENT SYSTEM BY CONTRACTOR**

4.1 **On Award of Contract**

The Contractor shall prior to start of work submit his Health. Safety and Environment Manual of procedure and HSE Plans for approval by OWNER/PMC. The Contractor shall participate in the pre-start meeting with OWNER/PMC to finalize HSE plans including the following.

- Job procedure to be followed by Contractor for activities covering Handling of equipment's, Scaffolding, Electric Installation, describing the risks involved, actions to be taken and methodology for monitoring each.

- Organizations structure alongwith responsibility and authority records/ reports etc. on HSE activities.

4.2 **During job execution**

4.2.1 Implement approved Health, Safety and Environment management procedure including but not limited to as brought our under para 3.0. Contractor shall also ensure to:

- Arrange workmen compensation insurance, registration under ESI Act, third party liability insurance etc. as applicable.

- Arrange all HSE permits before start of activities (as applicable) like her work, confined space, work at heights, storage of Chemicals/explosives materials and its use and implement all precautions mentioned therein

- Submit timely the completed check list on HSE activities, Monthly HSE report, accident report, investigation report, etc. as per OWNER/PMC requirements. Compliance of instructions on HSE shall be done by Contractor and informed urgently to OWNER/PMC.

- Ensure that resident Engineers/Site-In-Charge of the Contractor shall amend all the Safety Committee/HSE meeting arranged by OWNER/ PMC only in case of his absence from site, a seconds senior most person shall be nominated by him in advance and communicated to OWNER/PMC.

- Display at site office and work locations caution boards, list of hospitals for emergency services available.

- Provided posters, banners, for safe working to promote safety consciousness

- Carryout audits/inspection at sub Contractor work as per approved HSE documents & submit the reports for OWNER/PMC review.

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- Assist in HSE audits by OWNER/ PMC and submit compliance report.

- Generate & submit HSE records/ reports as per HSE Plan.

- Appraise OWNER/PMC on HSE activities at site.

5.0 RECORDS

At the minimum, the contractor shall maintain/ submit HSE records in the following reporting formats:

1.	Monthly HSE Checklist cum compliance report	HSE-1
2.	Accident / Incident Report	HSE-2
3.	Supplementary Accident / Incident Investigation report	HSE-3
4.	Near Miss Incident Report	HSE-4
5.	Monthly HSE Report	HSE-5
6.	Permit for working at height	HSE-6
7.	Permit for working in confined space	HSE-7
8.	Permit for radiation work	HSE-8
9.	Permit for demolishing / dismantling	HSE-9

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ANNEXURE-A

A. I.S. CODES ON HSE

SP:53	Safety code for the use, Care and protection of hand operated tools.
IS: 818	Code of practice for safety and health requirements in electric and gas welding and cutting operations
IS: 1179	Eye and Face precautions during welding, equipment etc.
IS: 1860	Safety requirements for use, care and protection of abrasive grinding wheels.
IS: 1989(Part-I & II)	Leather safety boots and shoes
IS: 2925	Industrial Safety Helmets
IS: 3016	Code of practice for fire safety precautions in welding and cutting operations.
IS: 3043	Code of practice for earthing.
IS: 3764	Code of safety for excavation work
IS: 3786	Methods for computation of frequency and severity rates for industrial injuries and classification of industrial accidents.
IS: 3996	Safety Code of scaffolds and ladders.
IS: 4082	Recommendation on stacking and storage of construction materials and components at site.
IS: 4770	Rubber gloves for electrical purposes
IS: 5121	Safety code for piling and other deep foundations
IS: 5216 (Part-I)	Recommendations on Safety procedures and practices in electrical works
IS: 5557	Industrial and Safety rubber lined boots.
IS: 5983	Eye protectors
IS:6519	Selection, care and repair of Safety footwear
IS: 6994 (Part-I)	Industrial Safety Gloves (Leather & Cotton Gloves)
IS: 7293	Safety Code for working with construction Machinery

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IS: 8519	Guide for selection of industrial safety equipment for body protection
IS: 9167	Ear protectors
IS: 11006	Flash back arrestor (Flame arrestor)
IS:11016	General and safety requirements for machine tools and their operation
IS: 11057	Specification for Industrial safety nets
IS: 11226	Leather safety footwear having direct moulded rubber sole
IS: 11972	Code of practice for safety precaution to be taken when entering a sewerage system
IS: 13367	Code of practice-safe use of cranes
IS: 13416	Recommendations for preventive measures against hazards at working place

B. INTERNATIONAL STANDARDS ON HSE

Safety Glasses	:	ANSI Z 87.1, ANSI ZZ 87.1, AS 1337, BS 2092, BS 1542, BS 679, DIN 4646 / 58211
Safety Shoes	:	ANSI Z 41.1, AS 2210, EN 345
Hand Gloves	:	BS 1651
Ear Muffs	:	BS 6344, ANSI S 31.9
Hard Hat	:	ANSI Z 89.1 / 89.2, AS 1808, BS 5240, DIN 4840
Goggles	:	ANSI Z 87.1
Face Shield	:	ANSI Z 89.1
Breathing Apparatus	:	BS 4667, NIOSH
Welding & Cutting	:	ANSI Z 49.1
Safe handling of compressed Gases in cylinders	:	P-1 (Compressed Gas Association 1235 Jefferson Davis Highway, Arlington VA 22202 – USA)

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ANNEXURE-B

DETAILS OF FIRST AID BOX

SL. NO	DESCRIPTION	*QUANTITY*
1.	Small size Roller Bandages, 1 inch wide (Finger Dressing small)	6 Pcs.
2.	Medium size Roller Bandages, 2 inch wide (Hand and Foot Dressing)	6 Pcs.
3.	Large size Roller Bandages, 4 inch wide (Body Dressing Large)	6 Pcs.
4.	Large size Burn Dressing (Burn Dressing Large)	4 Pkts.
5.	Cotton wool (20 gms packing)	4 Pkts.
6.	Antiseptic Solution Dettol (100 ml.) or Savlon	1 Bottle
7.	Mercurochrome Solution (100 ml.) 2% in water	1 Bottle
8.	Ammonia Solution (20 ml.)	1 Bottle
9.	A Pair of Scrissors	1 Piece
10.	Adhesive Plaster (1.25 cm x 5 m)	1Spool
11.	Eye pads in Separate Sealed Packet	4 Pcs.
12.	Tourniqut	1 No.
13.	Safety Pins	1 Dozen
14.	Tinc. Iodine / Betadin (100 ml.)	1 Bottles
15.	Ointment for burns (Burnol 20 gms.)	1 Bottole
16.	Polythene Wash cup for washing eyes	1 No.
17.	Potassium Permanganate (20 gms.)	1 Pkt.
18.	Tinc. Benzoine (100 ml.)	1 Bottole
19.	Triangular Bandages	2 Nos.
20.	Band Aid Dressing	5 Pcs.
21.	Iodex / Moov (25 gms.)	1 Bottole
22.	Tongue Depressor	1 No.
23.	Boric Acid Powder (20 gms.)	2 Pkt.
24.	Sodium Bicarbonate (20 gms.)	1 Pkt.
25.	Dressing Powder (Nebasulf) (10 gms.)	1 Bottole
26.	Medicinal Glass	1 No.
27.	Duster	1 No.
28.	Booklet (English & Local Language)	1 No. each
29.	Soap	1 No.
30.	Toothache Solution	1 No.
31.	Eye Ointment	1 Bottle
32.	Vicks (22 gms.)	1 Bottle
33.	Forceps	1 No.
34.	Cotton Buds (5 nos.)	1 Pkt.
35.	Note Book	1 No.
36.	Splints	4 Nos.
37.	Lock	1 Piece
38.	Life Saving/Emergency/Over-the Counter Drugs	As decided at site
	Box size : 14” x 12” x 4”	

Note : The medicines prescribed above are only indicative. Equivalent medicines can also be used. A prescription, in this regard, shall be required from a qualified Physician.

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ANNEXURE – C

TYPE OF FIRES VIS-À-VIS FIRE EXTINGUISHERS

Fire	Fire Extinguishers				
	Water	**Foam**	**CO_2**	**Dry Powder**	**Multi Purpose (ABC)**
Originated from paper, clothes, wood	√	√	Can control minor surface fires	Can control minor surface fires	√
Inflammable liquids like alcohol, diesel, petrol, edible oils, bitumen	x	√	√	√	√
Originated from gases like LPG, CNG, H_2	x	x	√	√	√
Electrical Fires	x	x	√	√	√

Legend : √ Can be used
x Not to be used

Note : Fire extinguishing equipment must be checked atleast once a year and after every use by an authorized person. The equipment must have an inspection label on which the next inspection date is giver:. Type of extinguisher shall clearly be marked on it.

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ANNEXURE – D

Indicative List of Statutory Acts & Rules Relating to HSE

- The Indian Explosives Act and Rules
- The Motor Vehicle Act and Central Motor Vehicle Rules
- The Factories Act and concerned Factory Rules
- The Petroleum Act and Petroleum Rules
- The Workmen Compensation Act
- The Gas Cylinder Rules and the Static & Mobile Pressure Vessels Rules.
- The Indian Electricity Act and Rules
- The Indian Boiler Act and Regulations
- The Water (Prevention & Control & Pollution) Act
- The Water (Prevention & Control of Pollution) Cess Act
- The Mines & Minerals (Regulation & Development) Act
- The Air (Prevention & Control of Pollution) Act
- The Atomic Energy Act
- The Radiation Protection Rules
- The Indian Fisheries Act
- The Indian Forest Act
- The Wild Life (Protection) Act
- The Environment (Protection) Act and Rules
- The Hazardous Wastes (Management & Handling) Rules
- The Manufacturing, Storage & import of Hazardous Chemicals Rules
- The Public Liability Act
- The Building and Other Construction Workers (Regulation of Employment and Condition of service) Act
- Other statutory acts Like EPF, ESIS, Minimum Wage Act.

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ANNEXURE – E

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES

ACTIVITY	*TYPE OF HAZARD*	EFFECT OF HAZARD	PREVENTIVE MEASURES
(A) EXCAVATION Pit Excavation up to 3.0m	▶ Falling into pit	▶ Personal injury	▶ Provide guard rails/barricade with warning signal. ▶ Provide at least two entries/exits. ▶ Provide escape ladders.
	▶ Earth Collapse	▶ Suffocation / Breathlessness ▶ Buried	▶ Provide suitable size of shoring and strutting, if required. ▶ Keep soil heaps away from the edge equivalent to 1.5m or depth of pit whichever is more. ▶ Don't allow vehicles to operate too close to excavated areas. Maintain at least 2m distance from edge of cut. ▶ Maintain sufficient angle of repose. Provide slope not less than 1:1 and suitable bench of 0.5m width at every 1.5m depth of excavation in all soils except hard rock. ▶ Battering/benching the sides.
	▶ Contact with buried electric cables ▶ Gas/ Oil Pipelines	▶ Electrocution ▶ Explosion	▶ Obtain permission from competent authorities, prior to excavation, if required. ▶ Locate the position of buried utilities by referring to plant drawings. ▶ Start digging manually to locate the exact position of buried utilities and thereafter use

ACTIVITY	*TYPE OF HAZARD*	EFFECT OF HAZARD	PREVENTIVE MEASURES
			mechanical means.
Pit Excavation beyond 3.0m	▶ Same as above plus ▶ Flooding due to excessive rain/ underground water	▶ Can cause drowning situation	▶ Prevent ingress of water ▶ Provide ring buoys ▶ Identify and provide suitable size dewatering pump or well point system

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	▶ Digging in the vicinity of existing Building/ Structure	▶ Building/ Structure may collapse ▶ Loss of health & wealth	▶ Obtain prior approval of excavation method from local authorities ▶ Use under-pining method ▶ Construct retaining wall side by side
	▶ Movement of vehicles / equipments close to the edge of cut.	▶ May cause cave-in or slides ▶ Persons may get buried	▶ Barricade the excavated area with proper lighting arrangements ▶ Maintain at least 2m distance from edge of cut and use stop block to prevent over-run. ▶ Strengthen shoring and strutting
Narrow deep excavations for pipelines, etc.	▶ Same as above plus ▶ Frequent cave-in or slides	▶ May cause severe injuries or prove fatal	▶ Battering/benching of sides ▶ Provide escape ladders
	▶ Flooding due to Hydrostatic testing	▶ May arise drowning situation	▶ Same as above plus ▶ Bail out accumulated water ▶ Maintain adequate ventilation
Rock excavation by blasting	▶ Improper handling of explosives	▶ May prove fatal	▶ Ensure proper storage, handling & carrying of explosives by trained personnel. ▶ Comply with the applicable explosive acts & rules.
	▶ Uncontrolled explosion	▶ May cause severe injuries or prove fatal	▶ Allow only authorized persons to perform blasting operations. ▶ Smoking and open

ACTIVITY	***TYPE OF HAZARD***	**EFFECT OF HAZARD**	**PREVENTIVE MEASURES**
			flames are to be strictly prohibited.
	▶ Scattering of stone pieces in atmosphere	▶ Can hurt people	▶ Use PPE like goggles, face mask, helmets etc.
Rock excavating by blasting (Contd)	▶ Entrapping of persons/ animals.	▶ May cause severe injuries or prove fatal	▶ Barricade the area with red flags and blow siren before blasting.
	▶ Misfire	▶ May explode suddenly	▶ Do not return to site for at least 20 minutes or unless announced safe by designated person.
Piling Work	▶ Failure of pile-driving equipment	▶ Can hurt people	▶ Inspect Piling rigs and pulley blocks before the beginning of each shift.

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	▶ Noise pollution	▶ Can cause deafness ▶ and psychological imbalance	▶ Use personal protective equipments like ear plugs, muffs, etc.
	▶ Extruding rods / casing	▶ Can hurt people	▶ Barricade the area an install sign boards ▶ Provide first-aid
	▶ Working in the vicinity of 'Live-Electricity'	▶ Can cause electrocution / asphyxiation	▶ Keep sufficient distance from Live-Electricity as per IS code. ▶ Shut off the supply, if possible ▶ Provide artificial/rescue breathing to he injured.
(B) CONCRETING	▶ Air pollution by cement	▶ May affect Respiratory System	▶ Wear respirators or cover mouth and nose with wet cloth.
	▶ Handling of ingredients	▶ Hand s may get injured	▶ Use gloves and other PPE.
	▶ Protruding reinforcement rods.	▶ Feet may get injured	▶ Use Safety shoes. ▶ Provide platform above reinforcement for movement of workers.
	▶ Earthing of electrical mixers,	▶ Can cause electrocution / asphyxiation	▶ Ensure earthing of equipments and proper functioning of

ACTIVITY	***TYPE OF HAZARD***	**EFFECT OF HAZARD**	**PREVENTIVE MEASURES**
	vibrators, etc. not done		electrical circuit before commencement of work.
	▶ Falling of materials from height	▶ Persons may get injured	▶ Use hard hats ▶ Remove surplus material immediately from work place ▶ Ensure lighting arrangements during night hours.
	▶ Continuous pouring by same gang	▶ Cause tiredness of workers and may lead to accident.	▶ Insist on shift pattern ▶ Provide adequate rest to workers between subsequent pours.
	▶ Revolving or concrete mixer/ vibrators	▶ Parts of body or clothes may get entrapped.	▶ Allow only mixers with hopper ▶ Provide safety cages around moving motors ▶ Ensure proper mechanical locking of vibrator

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Super-structure	▶ Same as above plus ▶ Deflection in props or shuttering material	▶ Shuttering / props may collapse and prove fatal	▶ Avoid excessive stacking on shuttering material ▶ Check the design and strength of shuttering material before commencement of work ▶ Rectify immediately the deflection noted during concreting
	▶ Passage to work place	▶ Improperly tied and designed props / planks may collapse	▶ Ensure the stability and strength of passage before commencement of work ▶ Do not overload and under the passage.
(C) REINFORCEMENT	▶ Curtailment and binding of rods	▶ Persons may get injured	▶ Use PPE like gloves, shoes, helmets, etc. ▶ Avoid usage of shift tools
	▶ Carrying of rods for short distance/ at	▶ Workers may injure their hands and shoulders	▶ Provide suitable pads on shoulders and use safety

ACTIVITY	***TYPE OF HAZARD***	**EFFECT OF HAZARD**	**PREVENTIVE MEASURES**
	heights		gloves. ▶ Tie up rods in easily liftable bundles ▶ Ensure proper staging.
	▶ Checking of clear distance/ cover with hands	▶ Rods may cut or injure the finger	▶ Use measuring devices tape, measuring rods, etc.
	▶ Hitting projected rods and standing on cantilever rods	▶ Persons may get injured and fall down	▶ Use safety shoes and avoid standing unnecessarily on cantilever rods ▶ Avoid wearing loose clothes
	▶ Falling of material from height	▶ May prove fatal	▶ Use helmets ▶ Provide safety nets
	▶ Transportation of rods by trucks / trailers	▶ Protruded rods may hit the persons	▶ Use red flags/lights at the ends ▶ Do not protrude the rods in front of or by the side of driver's cabin. ▶ Do not extend the rods 1/3rd of deck length or 1.5 m which is less

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(D) WELDING AND GAS CUTTING	▶ Welding radiates invisible ultraviolet and infrared says	▶ Radiation can damage eyes and skin.	▶ Use specified shielding devices and other PPE of correct specifications ▶ Avoid throated tungsten electrodes for GTAW.
	▶ Improper placement of oxygen and acetylene cylinders	▶ Explosion may occur	▶ Move out any leaking cylinder ▶ Keep cylinder in vertical position ▶ Use trolley for transportation of cylinders and chain them ▶ Use flash back arrestors
	▶ Leakage / cuts in hoses	▶ May cause fire	▶ Purge regulators immediately and then turn off ▶ Never use grease or

ACTIVITY	***TYPE OF HAZARD***	**EFFECT OF HAZARD**	**PREVENTIVE MEASURES**
			oil on oxygen line connections and copper fittings on acetylene lines ▶ Inspect regularly gas carrying hoses ▶ Always use red hose for acetylene & other fuel gases and black for oxygen.
	▶ Opening-up of cylinder	▶ Cylinder may burst	▶ Always stand back from the regulator while opening the cylinder ▶ Turn valve slowly to avoid bursting ▶ Cover the lug terminals to prevent short circuiting.
	▶ Welding of tanks, container or pipes storing flammable liquids	▶ Explosion may occur	▶ Empty & purge them before welding ▶ Never attach the ground cable to tanks, container or pipe storing flammable liquids ▶ Never use LPG for gas cutting

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(E) RADIOGRAPHY	▶ Ionizing Radiation	▶ Radiations may react with the skin and can cause cancer, skin irritation, dermatitis, etc.	▶ Ensure safety regulations as per BARC/AERB before commencement of job. ▶ Cordon off the area and install Radiation warning symbols ▶ Restrict the entry of unauthorized persons ▶ Wear appropriate PPE and film badges issued by BARC/AERB
	▶ Transportation and Storage of Radiography source	▶ Same as above	▶ Never touch or handle radiography source with hands ▶ Store radiography source inside a pit in an exclusive isolated

ACTIVITY	*TYPE OF HAZARD*	EFFECT OF HAZARD	PREVENTIVE MEASURES
			storage room with lock and key arrangement. The pit should be approved by BARC/AERB ▶ Radiography source should never be carried either in passenger bus or in a passenger compartment of trains. ▶ BARC/AERB have to be informed before source movement. ▶ Permission from Director General of Civil Aviation is required for booking radio isotopes with airlines.
	▶ Loss of Radio isotope	▶ Same as above	▶ Try to locate with the help of Survey Meter. ▶ Inform BARC/AERB(*) (*) Atomic Energy Regulatory Board (AERB), Bhabha Atomic Research Centre (BARC) Anushaktinagar, Mumbai – 400 094

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(F) ELECTRICAL INSTALLATION AND USAGE	▶ Short circuiting	▶ Can cause Electrocution or Fire	▶ Use rubberized hand gloves and other PPE ▶ Don't lay wires under carpets, mats or door ways. ▶ Allow only licensed electricians to perform on electrical facilities ▶ Use one socket for one appliance ▶ Ensure usage of only fully insulated wires or cables ▶ Don't place bare wire ends in a socket

ACTIVITY	***TYPE OF HAZARD***	**EFFECT OF HAZARD**	**PREVENTIVE MEASURES**
			▶ Ensure earthing of machineries and equipments ▶ Do not use damaged cords and avoid temporary connections ▶ Use spark-proof/flame proof type field distribution boxes. ▶ Do not allow open/bare connections ▶ Provide all connections through ELCB ▶ Protect electrical cables / equipment's from water and naked flames ▶ Check all connections before energizing.
	▶ Overloading of Electrical System	▶ Bursting of system can occur which leads to fire	▶ Display voltage and current ratings prominently with 'Danger' signs. ▶ Ensure approved cable size, voltage grade and type. ▶ Switch off the electrical utilities when not in use. ▶ Do not allow unauthorized connections. ▶ Ensure proper grid wise distribution of Power.

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	▶ Improper laying of overhead and underground transmission lines / cables	▶ Can cause electrocution and prove fatal	▶ Do not lay unarmored cable directly on ground, wall, roof of trees ▶ Maintain at least 3m distance from HT cables ▶ All temporary cables should be laid at least 750 mm below ground on 100 mm

ACTIVITY	*TYPE OF HAZARD*	EFFECT OF HAZARD	PREVENTIVE MEASURES
			fine sand overlying by brick soling ▶ Provide proper sleeves at crossings/ intersections ▶ Provide cable route markers indicating the type and depth of cables at intervals not exceeding 30m and at the diversions / termination.
(G) FIRE PREVENTION AND PROTECTION	▶ Small fires can become big ones and may spread to the surrounding areas	▶ Cause burn injuries and may prove fatal.	▶ In case a fire breaks out, press fire alarm system and shout “Fire, Fire” ▶ Keep buckets full of sand & water/fire extinguishing equipment near hazardous locations ▶ Confine smoking to ‘Smoking Zones’ only ▶ Train people for using specific type of fire equipments under different classes of fire ▶ Keep fire doors/ shutters, passages and exit doors unobstructed ▶ Maintain good house keeping and first-aid boxes (for detail refer Annex-2) ▶ Don’t obstruct assess to Fire extinguishers ▶ Do not use elevators for evacuation during fire ▶ Maintain lightening arrestors for elevated structures ▶ Stop all electrical motors with internal combustion. ▶ Move the vehicles from dangerous

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ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			locations. ▶ Remove the load hanging from the crane booms. ▶ Remain out of the danger areas.
	▶ Improper selection of Fire Extinguisher	▶ It may not extinguish the fire	▶ Ensure usage of correct fire extinguisher meant for the specified fire (for details refer Appendix-C) ▶ Do not attempt to extinguish Oil and electric fires with water. Use foam cylinders/CO_2/sand or earth.
	▶ Improper storage of highly inflammable substances	▶ Same as above	▶ Maintain safe distance of flammable substances from source of ignition ▶ Restrict the distribution of flammable materials to only min. necessary amount ▶ Construct specifically designed fuel storage facilities ▶ Keep chemicals in cool and dry place away from hat. Ensure adequate ventilation ▶ Before welding operation, remove or shield the flammable material properly ▶ Store flammable materials in stable racks, correctly labeled preferably with catchments trays. ▶ Wipe off the spills immediately

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES

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	▶ Short circuiting of electrical system	▶ Same as above ▶ Can cause Electrocution	▶ Don't lay wires under carpets, mats or door ways ▶ Use one socket for one appliance ▶ Use only fully insulated wires or cables ▶ Do not allow open/bare connections ▶ Provide all connections through ELCB ▶ Ensure earthing of machineries and equipments
(H) VEHICULAR MOVEMENT	▶ Crossing the Speed Limits (Rash driving)	▶ Personal injury	▶ Obey speed limits and traffic rules strictly ▶ Always expect the unexpected and be a defensive drive ▶ Use sat belts/helmets ▶ Blow horn at intersections and during overtaking operations. ▶ Maintain the vehicle in good condition ▶ Do not overtake on curves, bridges and slopes
	▶ Adverse weather condition	▶ Same as above	▶ Read the road ahead and ride to the left ▶ Keep the wind screen and lights clean ▶ Do not turn at speed ▶ Recognize the hazard, understand the defense and act correctly in time.
	▶ Consuming alcohol before and during he	▶ Same as above	▶ Alcohol and driving do not mix well. Either choose

ACTIVITY	***TYPE OF HAZARD***	**EFFECT OF HAZARD**	**PREVENTIVE MEASURES**

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	driving operation		alcohol or driving. ▶ If you have a choice between hitting a fixed object or an oncoming vehicle, hit the fixed object ▶ Quit the steering at once and become a passenger. Otherwise take sufficient rest and then drive. ▶ Do not force the driver to drive fast and round the clock ▶ Do not day dram while driving
	▶ Falling objects / Mechanical failure	▶ May prove fatal	▶ Ensure effective braking system, adequate visibility for the drives, reverse warning alarm. ▶ Proper maintenance of the vehicle as per manufacturer instructions
(I) PROOF TESTING (HYDROSTATIC/ PNEUMATIC TESTING	▶ Bursting of piping ▶ Collapse of tanks ▶ Tanks flying off	▶ May cause injury and prove fatal	▶ Prepare test procedure & obtain CONSULTANT/ Owner's approval ▶ Provide separate gauge for pressurizing pump and piping/equipment ▶ Check the calibration status of all pressure gauges, dead weight testers and temperature recorders ▶ Take dial readings at suitable defined intervals and ensure most of them fall between 40-60% of the gauge scale range ▶ Provide safety relief valve (set at

ACTIVITY	***TYPE OF HAZARD***	**EFFECT OF HAZARD**	**PREVENTIVE MEASURES**

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			pressure slightly higher than test pressure) while testing with air/nitrogen ▶ Ensure necessary precautions, stepwise increase in pressure, tightening of bolts/ nuts, grouting, etc. before and during testing ▶ Keep the vents open before opening any valve while draining out of water used for hydro testing of tanks ▶ Pneumatic testing involves the hazard of released energy shored in compressed gas. Specific care must therefore be taken to minimize the chance of brittle failure during a pneumatic leak test. Test temperature is important in this regard and must be considered when the designer chooses the material of construction ▶ A pressure relief device shall be provided, having a set pressure not higher than the test pressure plus the lesser of 345 KPa (50 psi) or 10% of he test pressure. The gas used as test fluid, if not air, shall be nonflammable and nontoxic.
(J) WORKING AT HEIGHTS	▶ Person can fall down	▶ May sustain severe injuries or	▶ Provide guard rails/barricade at the

ACTIVITY	*TYPE OF HAZARD*	EFFECT OF HAZARD	PREVENTIVE MEASURES

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		prove fatal	work place ▶ Use PPE like safety belts, full body harness, life line, helmets, safety shoes, etc. ▶ Obtain a permit before starting the work at height above 3 meters ▶ Fall arrest systems like safety nets, etc. must be installed ▶ Provide adequate working space (min. 0.6 m) ▶ Tie/weld working platform with fixed support ▶ Use roof top walk ladder while working on a slopping roofs ▶ Avoid movement on beams
		▶ May hit the scrap / material stacked at the ground or in between	▶ Keep the work place neat and clean ▶ Remove the scrap immediately
	▶ Material can fall down	▶ May hit the workers working at lower levels and prove fatal.	▶ Same as above plus ▶ Do not throw or drop material or equipment from height ▶ All tools to be carried in a toolkit bags or on working uniform ▶ Remove scrap from the planks ▶ Ensure wearing of helmet by the workers at low level
(K) CONFINED SPACES	▶ Suffocation / drowning	▶ Unconsciousness, death	▶ Use respiratory devices, if required ▶ Avoid over crowding inside a confined space ▶ Provide Exhaust Fans for ventilation ▶ Do not wear loose clothes, neck ties,

ACTIVITY	***TYPE OF HAZARD***	**EFFECT OF HAZARD**	**PREVENTIVE MEASURES**

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			etc. ▶ Fulfill conditions of the permit. ▶ Check for presence of hydrocarbons, O_2 level ▶ Obtain work permit before entering a confined space ▶ Ensure that the connected piping of the equipment which is to be opened is pressure free, fluid has been drained, vents are open and piping is positively isolated by a blind flange
	▶ Presence of foul smell and toxic substances	▶ Inhalation can pose threat to life.	▶ Same as above plus ▶ Check for hydrocarbon and Aromatic compounds before entering a confined space ▶ Depute one person outside the confined space for continuous monitoring and for extending help in case of an emergency
	▶ Ignition / flame can cause fire	▶ Person may sustain burn injuries or explosion may occur	▶ Keep fire extinguishers at a hand distance ▶ Remove surplus material and scrap immediately ▶ Do not smoke inside a confined space ▶ Do not allow gas cylinders inside a confined space ▶ Use low voltage (24V) lamps for lighting ▶ Use tools with air motors or electric tools with max.

ACTIVITY	*TYPE OF HAZARD*	EFFECT OF HAZARD	PREVENTIVE MEASURES
			voltage of 24V ▶ Remove all equipments at the end of the day

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(L) HANDLING AND LIFTING EQUPMENTS	▶ Failure of load lifting and moving equipments	▶ Can cause accident and prove fatal	▶ Avoid standing under the lifted load and within the operating radius of cranes ▶ Check periodically oil, brakes, gears, horns and tyre pressure of all moving machinery ▶ Check quality, size and condition of all chain pulley blocks, slings, U-clamps, D-shackles, wire ropes, etc. ▶ Allow crane to move only on hard, firm and leveled ground ▶ Allow lifting slings as short as possible and check gunny packings at the friction points ▶ Do not allow crane to tilt its boom while moving ▶ Install Safe Load Indicator ▶ Ensure certification by applicable authority.
	▶ Overloading of lifting equipments	▶ Can cause electrocution and fire	▶ Safe lifting capacity of derricks and winches written on them shall be got verified. ▶ The max safe working load shall be marked on all lifting equipments ▶ Check the weight of columns and other heavy items painted on them and accordingly decide about the crane

ACTIVITY	*TYPE OF HAZARD*	EFFECT OF HAZARD	PREVENTIVE MEASURES
			capacity, boom and angle of erection ▶ Allow only trained operators and riggers during crane operation

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	▶ Overhead electrical wires	▶ Can cause electrocution and fire	▶ Do not allow boom or other parts of crane to come within 3 m reach of overhead HT cables ▶ Hook and load being lifted shall preferably remain in full visibility of crane operator.
(M) SCAFFOLDING, FORMWORK AND LADDERS	▶ Person can fall down	▶ Person may sustain severe injuries and prove fatal	▶ Provide guard rails for working at height ▶ Face ladder while climbing and use both hands ▶ Ladders shall extend about 1m above landing for easy access and tying up purpose ▶ Do not place ladders against movable objects and maintain base at ¼ unit of the working length of the ladder ▶ Suspended scaffolds shall not be less than 500 mm wide and tied properly with ropes ▶ No loose planks shall be allowed ▶ Use PPE, like helmets, safety shoes, etc.
	▶ Failure of scaffolding material	▶ Same as above	▶ Inspect visually all scaffolding materials for stability and anchoring with permanent structures. ▶ Design scaffolding

ACTIVITY	*TYPE OF HAZARD*	EFFECT OF HAZARD	PREVENTIVE MEASURES

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			for max. load carrying capacity ▶ Scaffolding planks shall not be less than 50x250 mm full thickness lumber or equivalent. These shall be cleared or secured and must extend over the end supports by at least 150mm and not more that 300 mm ▶ Don't overload the scaffolds ▶ Do not splice short ladders to make a longer one. Vertical ladders shall not exceed 6m.
	▶ Material can fall down	▶ Persons working at lower level gets injured.	▶ Remove excess material and scrap immediately ▶ Carry the tools in a tool-kit bag only ▶ Provide safety nets
(N) STRUCTURAL WORKS	▶ Personal negligence and danger of fall	▶ Can cause injury or casualty	▶ Do not take rest inside rooms built for welding machines or electrical distribution system ▶ Avoid walking on beams at height ▶ Wear helmet with chin strap and safety belts when working at height ▶ Use hand gloves and goggles during grinding operations ▶ Cover or mark the sharp and projected edges ▶ Do not stand within the operating radius of cranes
	▶ Lifting / slipping of	▶ Same as above	▶ Do not stand under the lifted load

ACTIVITY	*TYPE OF HAZARD*	EFFECT OF HAZARD	PREVENTIVE MEASURES

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	material		▶ Stack properly all the materials. Avoid slippage during handling ▶ Control longer pieces lifted up by cranes from both ends ▶ Remove loose materials from height ▶ Ensure tightening of all nuts and bolts
(O) PIPELINE WORKS	▶ Erection / lowering failure	▶ Can cause injury	▶ Do not stand under the lifted Load ▶ Do not allow any person to come within the radii of the side boom handling pipes ▶ Check the load carrying capacity of the lifting tools and tackles ▶ Use safe Load Indicators ▶ Use appropriate PPEs
	▶ Other	▶ Same as above	▶ Wear gum boots in marshy areas ▶ Allow only one person to perform signaling operations while lowering of pipes ▶ Provide night caps on pipes ▶ Provide end covers on pipes for stoppage of pigs while testing/cleaning operations.

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FORMAT NO. : HSE-1, REV. 0

HSE CHECKLIST CUM COMPLIANCE REPORT (1/6)

Project: _____ Contractor :_____
Date: _____ Owner :_____
Inspection By:_____ Report No. :_____
Frequency : Fortnightly Job No :_____

Note: write 'NA' wherever the item is not applicable

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
1	**HOUSEKEEPING**				
a)	Waste containers provided and used				
b)	Sanitary facilities adequate and clean				
c)	Passageways and Walkways clear				
d)	General neatness of working areas				
e)	Others				
2	**PERSONNEL PROTECTIVE EQUIPMENT**				
a)	Goggles; Shields				
b)	Face protection				
c)	Hearing protection				
d)	Safety shoes				
e)	Hand protection				
f)	Respiratory Masks etc.				
g)	Safety Belts				
h)	Safety Helmet/Hard Hat				
I)	Others				
3	**EXCAVATIONS/OPENINGS**				
a)	Openings properly covered or barricaded				
b)	Excavations shored				
c)	Excavations barricaded				
d)	Overnight lighting provided				
e)	Others				
4	**WELDING & GAS CUTTING**				
a)	Gas cylinders chained upright				
b)	Cables and hoses not obstructing				
c)	Screens or shields used				
d)	Flammable materials protected				
e)	Fire extinguisher(s) accessible				
f)	Others				
5	**SCAFFOLDING**				
a)	Fully decked platforms				
b)	Guard and intermediate rails in place				

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
c)	Toe boards in place				
d)	Adequate shoring				
e)	Adequate access				
f)	Others				
6	**LADDERS**				
a)	Extension side rails 1m above				

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b)	Top of landing				
c)	Properly secured				
d)	Angle + 70 from horizontal				
e)	Others				
7	**HOISTS, CRANES AND DERRICKS**				
a)	Condition of cables and sheaves OK				
b)	Condition of slings, chains, hooks and eyes OK				
c)	Inspection and maintenance logs maintained				
d)	Outriggers used				
e)	Signs/barricades provided				
f)	Signals observed and understood				
g)	Qualified operators				
h)	Others				
8	**MACHINERY, TOOLS AND EQUIPMENT**				
a)	Proper instruction				
b)	Safety devices				
c)	Proper cords				
d)	Inspection and maintenance				
e)	Others				
9	**VEHICLE AND TRAFFIC**				
a)	Rules and regulations observed				
b)	Inspection and maintenance				
c)	Licensed drivers				
d)	Others				
10	**TEMPORARY FACILITIES**				
a)	Emergency instructions posted				
b)	Fire extinguishers provided				
c)	Fire-aid equipment available				
d)	Secured against storm damage				
e)	General neatness				
f)	In accordance with electrical requirements				
g)	Others				
11	**FIRE PREVENTION**				
a)	Personnel instructed				
b)	Fire extinguishers checked				
c)	No smoking in Prohibited Areas				
d)	Hydrants Clear				

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
e)	Others				
12	**ELECTRICAL**				
a)	Use of 3-core armoured cables				
b)	Usage of 'All insulated' or 'double insulated' electrical tools				
c)	All electrical connection are routed through ELCB				
d)	Natural Earthing at the source of power (main DB)				
e)	Continuity and tightness of earth conductor				
f)	Covering of junction boxes, panels and other energized wiring places				
g)	Ground fault circuit interrupters provided				
h)	Prevention of tripping hazards				
i)	Others				
13	**HANDLING AND STORAGE OF MATERIALS**				
a)	Properly stored or stacked				

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b)	Passageways clear				
c)	Others				
14	**FLAMMABLE GASES AND LIQUIDS**				
a)	Containers clearly identified				
b)	Proper storage				
c)	Fire extinguishers nearby				
d)	Others				
15	**WORKING AT HEIGHT**				
a)	Erection plan and work permit obtained				
b)	Safety nets				
c)	Full body harness and lanyards; chute lines				
d)	Health Check record available for workers going up?				
e)	Others				
16	**CONFINED SPACE**				
a)	Work permit obtained				
b)	Test for toxic gas and sufficient availability of oxygen conducted				
c)	At least one person outside the confined space for monitoring deputed				
d)	Availability of sufficient means of entry, exit and ventilation				
e)	Fire extinguishers and first-aid facility ensured				
f)	Lighting provision made by using 24V lamps				
g)	Proper usage of PPEs ensured				
17	**RADIOGRAPHY**				
a)	Proper storage and handling of source as per BARC / AREB guidelines				
b)	Working permit obtained				
c)	Cordoning of the area done				

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
d)	Use of appropriate PPE's ensured				
e)	Proper training to workers/supervisors imparted				
f)	Minimum occupancy of workplace ensured				
18	**HEALTH CHECKS**				
a)	Workers medically examined and found to fit for working : i) At heights ii) In confined space.				
b)	Availability of First-aid facilities				
c)	Proper sanitation at site, office and labour camps				
d)	Arrangement of medical facilities				
e)	Measures for dealing with illness				
f)	Availability of Portable drinking water for workmen & staff				
g)	Provision of crèches for children				
h)	Stand by vehicle available for evacuation of injured.				
19	**ENVIRONMENT**				
a)	Chemical and other effluents properly disposed				
b)	Cleaning liquid of pipes disposed off properly				
c)	Seawater used for hydro-testing disposed off as per agreed procedure				
d)	Lubricant Waste/Engine oils properly disposed				
e)	Waste from Canteen, offices, sanitation etc. disposed properly				

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f)	Disposal of surplus earth, stripping materials, oily rags and combustible materials done properly				
g)	Green belt protection				

Signature of Resident
Engineer with Seal

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FORMAT NO. : HSE-2, REV. 0

ACCIDENT / INCIDENT REPORT

(To be submitted by Contractor after every Accident / Incident within 24 hours)

Report No:_____
Date: _____

Name of Site:-_____
CONTRACTOR_____

Type of Accident / Incident : ☐ Fatal ☐ Other Lost Time ☐ Non Loss Time ☐ First-Aid case

---

NAME OF THE INJURED……
AGE …….
FATHER'S NAME……..
SUB-CONTRACTOR M/S……..
DATE & TIME OF ACCIDENT…….
LOCATION ……

BRIEF DESCRIPTION OF ACCIDENT

CAUSE OF ACCIDENT

NATURE OF INJURY/DAMAGE

MEDICAL AID PROVIDED/ACTIONS TAKEN

INTIMATION TO LOCAL AUTHORITIES (IF APPLICABLE)

DATE: SIGNATURE OF CONTRACTOR
WITH SEAL

To : OWNER…….. 1 COPY
: RCM/SITE-IN-CHARGE, PMC 3 COPIES

→ Divisional Head (Constn.) through RCM
→ Project Manager PMC, through RCM

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Date: 2024.09.16 18:15:02 IST

FORMAT NO. : HSE-3, REV. 0

SUPPLEMENTARY ACCIDENT / INCIDENT INVESTIGATION REPORT

Supplementary to Report No: _____(Copy enclosed)

Project:_____ Site:_____
Name of Work :_____ Date:_____
Contractor:_____ Work Order / LOI No. :_____

NAME OF THE INJURED …….
AGE : ……..
SUB-CONTRACTOR M/S……...
DATE & TIME OF ACCIDENT / INCIDENT ……
LOCATION……

BRIEF DESCRIPTION & CAUSE OF A ACCIDENT/ INCIDENT

NATURAL OF INJURY/DAMAGE

COMMENTS FROM MEDICAL PRACTITIONER WHO ATTENDED THE VICTIM/INJURED

SUGGESTED IMPROVEMENT IN THE WORKING CONDITION IF ANY

LOSS OF MANHOURS AND IMPACT ON SITE WORKS

ANY OTHER COMMENT BY SAFETY OFFICER.

DATE: SIGNATURE OF CONTRACTOR
WITH SEAL

To : OWNER…….. 1 COPY
: RCM/SITE-IN-CHARGE, PMC 3 COPIES

→ Divisional Head (Constn.) through RCM
→ Project Manager PMC, through RCM

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Date: 2024.09.16 18:15:02 IST

FORMAT NO. : HSE-4, REV. 0

NEAR MISS INCIDENT – SUGGESTED PROFORMA

Report No: _____

Name of Site :_____ Date :_____

Name of Work :_____ Contractor :_____

INCIDENT REPORTED BY :

DATE & TIME OF INCIDENT :

LOCATION :

BRIEF DESCRIPTION OF INCIDENT

PROBABLE CAUSE OF INCIDENT

SUGGESTED CORRECTIVE ACTION

STEPS TAKEN TO AVOID RECURRENCE YES ☐ NO ☐

DATE: SIGNATURE OF CONTRACTOR
WITH SEAL

To : OWNER…….. 1 COPY
: RCM/SITE-IN-CHARGE, PMC 3 COPIES

→ Divisional Head (Constn.) through RCM
→ Project Manager PMC, through RCM

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FORMAT NO. : HSE-5, REV. 0

MONTHLY HEALTH, SAFETY & ENVIRONMENT (HSE) REPORT
(To be submitted by each Contractor)

Actual work start Date:_____ For the Month of:_____
Project:_____ Report No:_____
Name of the Contractor:_____ Status as on:_____
Name of Work:_____ Name of Safety officer:_____

	ITEM		UPTO PREVIOUS MONTH	THIS MONTH	CUMU-LATIVE
a)	Average number of Staff & Workmen (average daily headcount, not man days)				
b)	Manhours Worked				
c)	Number of HSE meeting organized at site				
d)	Number of HSE awareness programmes conducted at site				
e)	Number of Lost Time Accidents (LTA)	Fatal			
		Other LTA			
f)	Number of Loss time Injuries (LTI)	Fatalities			
		Other LTI			
g)	Number of Loss Time Accidents				
h)	Number of First Aid Cases				
i)	Number of Near Miss Incidents				
j)	Man-days lost due to accidents				
k)	LTA Free Manhours i.e. Number of LTA free manhours from the Lst LTA				
l)	Compensation cases raised with Insurance				
m)	Compensation case resolved and paid to workmen				
n)	Whether workmen compensation policy taken		Y/N		
o)	Whether workmen compensation policy valid		Y/N		
p)	Whether workmen registered under ESI Act		Y/N		
Remark					

DATE:

Safety Officer /Resident Engineer
(Signature and Name)

To : OWNER
: RCM/, PMC (2 COPIES)

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FORMAT NO. : HSE-6, REV. 0

PERMIT FOR WORKING AT HEIGHT (ABOVE 2 METER)

Project Site : …… Sr. No.: ……
Name of the work: …… Date: ……
Name of Contractor : …….. Nature of Work : ……
Total No.of Workers: ..... Exact location of work : ……
Duration of work: from ..…….. to ……

The following items have been checked and compliance shall be ensured during the currency of the permit:

Sl.	ITEM	DONE	NOT REQD.
1.	Equipment/Work Area inspected	☐	☐
2.	Considered hazard from other routine/non-routine operations and concerned person alerted	☐	☐
3.	ELCB provided	☐	☐
4.	Proper lighting provided	☐	☐
5.	Area cordoned off.	☐	☐
6.	Precautions against public traffic taken	☐	☐
7.	Sound Scaffolding provided	☐	☐
8.	Adequate protected Platform provided	☐	☐
9.	Acces and Exit to the area (Ladder properly fixed)	☐	☐
10.	Floor Openings covered	☐	☐
11.	Safety Net provided	☐	☐
12.	Heath check of personnel	☐	☐

A. Following personal protective equipment are provided (mark) and used as relevant Safety helmet/Gloves/Goggles/Shoes/Face Shield/Life Line/Safety Belt/Safety Harness.

B. This permit shall be available at the work site at all times.

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C. Permit shall be issued for maximum one week only (Monday to Sunday).

D. This permit shall be applicable in non-operational areas.

E. After completion of the work, used permits shall be preserved for record purposes.

F. Additional precautions, if any ……

Permission is granted to work (See overleaf) = Yes/No

Name of Contractor's Supervisor
(Initiator)

Name of Contractor's Safety Officer
(Issuing Authority)

GRANT OF PERMIT AND EXTENSIONS

Sl. No.	Validity Period From …… To ……	Work time From …..Hrs. To.....Hrs.	Initiator (Supervisor of Contractor)	Issuing Authority (Safety Officer) of Contractor	Verification by CONSULTANT with date

Additional safety instructions, if any.

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FORMAT NO. : HSE-7, REV. 0

CONFINED SPACE ENTRY PERMIT

Project Site : …… Sr. No.: ……
Name of the work: ……. Date: ……
Name of Contractor : …….. Nature of Work : ……
Exact location of work : ……..

Safety Requirements : POSITIVE ISOLATION OF THE VESSEL IS MANDATORY

(A)		**Has the equipment been ?**						
Y	**NR**		**Y**	**NR**		**Y**	**NR**	
o	o	isolated from power / steam / air	o	o	water flushed &/or steamed	o	o	radiation sources removed
o	o	isolated from liquid or gases	o	o	Manways open & ventilated	o	o	Proper lighting provided
o	o	depressurized &/or drained	o	o	cont. inset gas flow arranged	o	o	
o	o	blanked / blinded / disconnected	o	o	adequately cooled	o	o	

(B)		**Expected Residual Hazards**						
Y	**NR**		**Y**	**NR**		**Y**	**NR**	
o	o	lack of O_2	o	o	combustible gas / liquid	o	o	H_2S / toxic gases
o	o	corrosive chemicals	o	o	pyrophoric iron / scales	o	o	electricity / static
o	o	Heat / stream / frost	o	o	high humidity	o	o	ionizing radiation
o	o		o	o		o	o	

(C)		**Protective Measures**						
Y	**NR**		**Y**	**NR**		**Y**	**NR**	
o	o	gloves	o	o	ear plug / muff	o	o	goggles / face shield
o	o	protective clothing	o	o	dust / gas / air line mask	o	o	personal gas alarm
o	o	Grounded air educater / blower / AC	o	o	attendant with SCBA / air mask	o	o	rescue equipment / team
o	o	Fire fighting arrangements	o	o	safety harness & lifeline	o	o	communication equipment
o	o		o	o		o	o	

Authorization / Renewal (It is safe to enter the confirmed space)

Date	**No. of Persons Allowed**	**Name of Persons allowed**	**Signature**		**Time**		**Signature**
			Contractor's Supervisor	**Contractor's Safety Officer**	**From**	**To**	**Workman**

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Permit Closure :

(A) Entry ϒ was closed ϒ stopped ϒ will continue on

(B) ϒ Site left in a safe condition
ϒ Housekeeping done

(C) Multi lock ϒ removed ϒ key transferred
ϒ Ensured all men have come out ϒ Manways barricaded

Remarks, if any :

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FORMAT NO. : HSE-8, REV. 0

RADIATION WORK PERMIT

Project : Sr. No.:

Name of the work : Date:

Name of Contractor : Job No. :

Location of work :

Source Strength :

Cordoned distance (m) :

Name of Radiographing agency : Approved by Owner / PMC ☐

The following items have been checked & compliance shall be ensured during currency of the permit :

S. No.	Item Description	Done
1.	Safety regulations as per BARC/AERB ensured while source in use/ in transit & during storage.	☐
2.	Area cordoned off.	
3.	Lighting arrangements for working during nights ensured.	
4.	Warning signs / flash lights installed.	
5.	Cold work permit taken (if applicable)	
6.	PPEs like film badges, dosimeters used.	

Additional precautions, if any _____

(Radiography Agency's BARC / AREB authorized Supervisor) (Contractor's Safety Officer)

Permission is granted.

Permit is valid from _____ AM/PM _____ Date to _____ AM/PM _____ Date

(Signature of permit issuing authority)

Name : Designation : Date :

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Permit renewal :

Permit extended upto		Additional precautions required, if any.	Sign of issuing authority with date
Date	**Time**		

Work completed / stopped / area cleared at _____ Hrs. of Date _____

(Sign of permit issuing authority)
Name :

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FORMAT NO. : HSE-9, REV. 0

RADIATION WORK PERMIT

Project : Sr. No.:

Name of the work : Date:

Name of Contractor : Job No. :

Name of Contractor :

Line No. / Equipment No. /Structure to be dismantled :

Location details of dismantling / demolition with sketch : (Clearly indicate the area)

The following items have been checked & compliance shall be ensured during currency of the permit :

S. No.	Item Description	Done	Not Applicable
1.	Services like power, gas supply, water, etc. disconnected.	☐	☐
2.	Dismantling / Demolishing method reviewed & approved.	☐	☐
3.	Usage of appropriate PPEs ensured.	☐	☐
4.	Precautions taken for neighboring structures	☐	☐
5.	First-Aid arrangements made	☐	☐
6.	Fire fighting arrangements ensured	☐	☐
7.	Precautions taken for blasting	☐	☐

(Contractor's Supervisor) (Contractor's Safety Officer)

Permission is granted.

(Permit issuing authority)
Name :
Date :

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Completion Report :

Dismantling / Demolishing is completed on _____ Date at _____ Hrs.

Materials / debris transported to identified location ☐

Tagging completed (as applicable) ☐

Services like power, gas supply, water, etc. restored ☐

(Permit issuing authority)

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CONDITIONS FOR ISSUE AND RECONCILIATIONOF MATERIAL
(ANNEXURE – 8 to SCC)

BGL/632/2024-25

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ANNEXURE-8 TO SCC

1.0 CONDITIONS FOR ISSUE OF MATERIALS

Whenever any material is issued by Owner, following conditions for issue of material inaddition to other conditions specified in the contract shall be applicable:

1.1 Necessary indents will have to be raised by the Contractor as per procedure laid down by the Engineer-in-Charge from time to time, when he requires the above material for incorporation in permanent works.

1.2 Materials will be issued only for permanent works and not for temporary works, enabling works etc. unless specifically approved by the Engineer-in-Charge and the same shall not be taken into account for the purpose of materials reconciliation.

1.3 The Contractor shall bear all other cost including lifting, carting from issue points to work site/Contractor's store, custody and handling etc. and return of surplus/serviceable scrap materials to Owner's storage points to be designated by the Engineer-in-Charge etc. No separate payment for such expenditure will be made.

1.4 No material shall be allowed to be taken outside the plant without a gate pass.

1.5 The Contractor shall be responsible for proper storage, preservation and watch & ward of the materials.

1.6 RETURN OF UNUSED MATERIAL

1.6.1 All unused/scrap materials shall be the property of the Owner and shall be returned in good and acceptable condition size wise, category wise by the Contractor at his own cost to Owner's Store(s).

1.6.2 No credit will be given to the Contractor for return of scrap. The Contractor should quote the rates accordingly.

1.6.3 In case the Contractor fails to return unused/scrap materials, then recovery for such quantity of materials, not returned by the Contractor shall be affected at following penal rates from the Contractor's bills or from any other dues of the Contractor to the Owner. Contractor shall make his own arrangements for weighing the off cuts to be returned to Owner's stores.

1.6.4 Penal Rates for non- return / return of materials :

Sl.No.	Material	Penal Rates

BGL/632/2024-25

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(a)	Penal rate for non return ofaccountable scrap	Issue Rate + 25% or Landed Rate + 25% (in case issuerate are not indicated in the contract)
(b)	Penal rates for non return of Unused material/excess scrap	Twice the Issue Rates or Twice the Landed Rates (in case Issue Rates are not indicated in the Contract)
(c)	Penal rate for return of excess scrap	Issue Rate + 75% or Landed Rate + 75% (in case issuerate are not indicated in the contract)
(d)	Penal rate for return of excess serviceable materials	Issue Rate + 50% or Landed Rate + 50% (in case issuerate are not indicated in the contract)

NOTE: 1) Landed Rate shall be arrived from the latest Purchase Order of respective material received at site by Owner/BGL/PMC.

2) In case different penal rates have been indicated in the Contract (based onProject requirement), the same will supersede the above rates.

2.0 ABOVE GROUND BARE PIPES AND PIPING MATERIALS

2.1 All pipes shall be issued in available lengths/shapes and no claims for extra payments on account of issue of non-standard length & shape will be entertained. Pipes shall be issued on linear measurement basis. All valves, flanges, fittings etc. shall be issued on number(s) basis. Contractor shall store the materials in such a way so as to avoid mixingof different types of material and shall maintain complete identification and traceability at all times.

2.2 The scrap allowance for pipes issued by the Owner shall be 3% (2½% accountable + ½% non-accountable) of the actual consumption as incorporated in the works.

2.3 All pipes in length of 2 meters and above shall be considered as serviceable material provided the material is in good and acceptable condition and has clear identification and traceability (Manufacturer's name, heat number/batch number and test certificates). Pipes in lengths less than 2M shall be treated as scrap.

2.4 For the non-account of pipes drawn by the Contractor over and above the actual consumption as determined by the Engineer-in-Charge, plus 3% (2½% accountable +

BGL/632/2024-25

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½% non-accountable) thereof to cover the scrap allowance, recovery at penal rate shall be effectedfrom the Contractor's bill(s) or from any other dues of the Contractor to the Owner.

2.5 All unused/scrap pipes, valves, flanges, forged fitting like elbows, reducers tees shall be returned by the Contractor category wise duly cleaned, greased and spec. marked at his own cost to Owner's stores. In case the Contractor fails to do so then recovery for such quantityof pipes not returned by the Contractor at the penal rates shall be effected from the Contractor's bill(s) or from any other dues of the Contractor to the Owner.

3.0 EQUIPMENTS & VALVES

Various equipment & Valves intended for the installation will be received by Owner inunpacked, skid mounted, crated, packed or loose condition and will be stored in the received' condition. It will be the Contractor's responsibility to draw, load and transport all materials from Owner's designated places of issue to the point of installation and return all packing materials like steel frames, wooden boxes/scrap etc. to Owner's stores.

All materials supplied by the Owner shall be duly protected by the Contractor at his own cost with appropriate preservative like primer, lacquer coating, grease etc. as required.

4.0 CABLES

4.1 Appropriation of cables shall be done as follows:

4.1.1 All the surplus and serviceable cables out of the cables quantity(ies) issued by the Owner to the Contractor shall be returned by the Contractor to the Owner's store in good condition and as directed by the Engineer-in-Charge.

4.1.2 The Contractor shall be allowed a cutting/wastage allowance of 1.5% for power cables and 3% for the control cables. This cutting/wastage allowance shall be computed on the length of cables actually laid, measured and accepted.

4.1.3 All cables being returned to store should carry Aluminium sheet tags indicating the size & type of cable. Cables of less than 15 meters length will be termed as scrap. Cables of lengths 15M and above shall be termed as serviceable material & shall be returned size wise and category wise to the Owner's store in wooden drums. Cables of serviceable length being returned to stores in drum(s) shall be accepted only after Megger value continuitytest and physical measurement is carried out by the Contractor to the satisfaction of Engineer-in-Charge. Empty cable drums and major packing material (as decided by Engineer-in-charge) shall be Owner's property and shall be returned to Owner's Store/designated place without any additional cost.

4.1.4 While carrying out material appropriation with the Contractor, the above points will

BGL/632/2024-25

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be taken into account. All serviceable materials returned by the Contractor (size wise & category wise) shall be deducted from the quantity(ies) issued to the Contractor for the respective sizes. Scrap generated for power cable and control cable shall also be returned to Owner's store on Lot basis.

4.1.5 Material appropriation shall be done & allowable scrap quantity calculated. The wastage generated by the Contractor in excess of the allowable percentage shall be charged at the penal rates.

5.0 LINE PIPES

5.1 All coated line pipes as per Line Pipe specifications shall be issued on linear measurement basis. The line pipes shall be issued in available lengths and shapes and no claim for extra payment on account of issue of non-standard length and shape will be entertained. Contractor shall store and maintain the line pipes in proper manner to avoid mixing of different classes of pipes. Contractor shall maintain complete identification and traceability at all times. All cut pieces when returned to Owner's storage points after bevelling, shall be considered as serviceable material provided:

5.1.1 Corrosion Protection Coating is intact.

5.1.2 Pipe pieces have pipe specifications, manufacturer's logo/name and heat number duly authenticated with hard stamp of the authorised inspector as per approved procedure. All cut pieces of pipes measuring less than 2 M will be treated as wastage/scrap.

5.2 For the purpose of accounting of coated line pipes, following allowances shall be permitted:

a) Unaccountable wastage 0.1%
b) Scrap (All cut pieces of pipes measuring 0.25%less than 2 Meter)
c) Serviceable materials (All cut pieces of pipe 0.5%measuring 2 Meter and above)

Scrap shall be accounted at actuals as per site assessment subject to maximum limits asstated above.

The percentage allowance shall be accounted on the basis of pipe book chainage formain pipeline

5.2.1 Material appropriation shall be done & allowable scrap quantity calculated. The wastage generated by the Contractor in excess of the allowable percentage shall be charged at the penal rates as given in the contract.

6.0 DELETED

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MINIMUM NO. OF MAJOR EQUIPMENTS/ MOBILISATION EQUIPMENT SCHEDULE TO BEDEPLOYED

(Annexure- 9 of Special Condition of Contract)

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ANNEXURE-9A TO SCC

LIST OF MINIMUM EQUIPMENTS REQUIRED TO BE OWNED BY THE BIDDER

Sr. No.	Equipment Description	Qty. (Nos.)
1	Holiday Detector with accessories	1
2	Diesel Welding Machine/ DG set with Rectifier	2

Note:

1. The bidder shall submit the certificate from statutory auditor / chartered accountant (for ownership / possession of equipments / vehicles) as per format F-23 enclosed in the Bid Document.

2. The submission of Format F-23 is mandatory.

3. "For equipment to be purchased" - Purchase order duly accepted by equipment supplier and with equipment delivery to project site, meeting the equipment deployment schedule. However, contractor to own minimum 50% of the equipment against each type of equipment; balance 50% may be covered under to be purchased "Category". If 50% is a fraction, the same needs to be rounded off to next higher number for the minimum owned category. The purchase order shall be duly signed & stamped by statutory auditors.

4. The bidder shall submit Certificate from Chartered Engineer certifying that the bidder own equipments are under good health and working condition as per Format F-24 enclosed in the Bid Document.

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ANNEXURE-9 TO SCC

LIST OF MINIMUM NOS. OF CONSTRUCTION EQUIPMENT TO BE DEPLOYED

Sl. No.	Equipment Description	Qty. (Nos.)
1.	JCB Or, Excavator/ Back-Hoe (Hitachi 60 or equivalent)	As required
2.	Hydra-(8-15 MT)	2
3.	Diesel Welding Machine	4
4.	DG Set 120 kVA + Stabilizer	As required
5.	Bevelling Machine	1
6.	a) External Clamp ND 6" / 4" (as per the scope & project requirement)	2 Nos. foreach size
7.	External X-ray Unit (Complete)	Nil
8.	Gamma Ray Unit (Complete)	1
9.	Radiography Film Viewer	1
10.	Blasting cleaning Unit (Complete)	1
11.	Air Compressor (Minimum 300 CFM)	1
12.	Air Compressor (Minimum 600 CFM)	1
13.	Holiday Detector	2
14.	Dewatering Pump	As Required
15.	Water Filling Pump of Adequate Capacity	1
16.	Dosing Pump of Adequate Capacity	1
17.	Pressurization Pump – Motorised (Adequate capacity)	1
18.	Complete hydrotesting kit (dead weight tester, pressure instrument, temperature inst. Etc.)	1
19.	Pipe Bending Machine	1
20.	Horizontal Augur Boring Machine	1
21.	HDD Machine with adequate pipe pulling capacity ≥ 10T minimum alongwith complete accessories/ equipment	As Required
22.	Pipe Trailers of adequate size	As required

Note:

1. Detail of minimum equipments in good working condition suitable to lay the Pipeline, required to be mobilized by the execution contractor to complete the work within schedule is given above for each Section. Contractor is required to augment the above list with additional numbers / categories of equipments as per actual requirement and instruction of Engineer-In-Charge without any additional financial implication to client.
2. Contractor to ensure **WELDING & NDT** procedure and welders are qualified within **15 DAYS** time after award of contract.
3. Contractor shall replace any defective / damaged equipments promptly to complete

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the workwithout any time & cost implication to the client / owner.

4. After completion of certain activities, in case equipments are not required the same can bedemobilised with prior approval of Engineer-In-Charge.

5. For all the above listed equipments, bidder is required to give an undertaking for deploying theequipments during execution of the contract.

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MINIMUM NO. OF SKILLED MANPOWER TOBE DEPLOYED

(Annexure-10 of Special Condition of Contract)

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ANNEXURE-10 TO SCC

MINIMUM NUMBER OF SKILLED MANPOWER TO BE DEPLOYED

Sl. No	DESCRIPTION	REQUIREMENT
1.	Resident Construction Manager / Section Incharge	1 (Note-4)
2.	Planning engineer	1 (Note-4)
3.	QA/ QC engineer	1 (Note-4)
4.	Safety officer	1 (Note-4)
5.	Qualified Surveyor	1
6.	Welding/ NDT engineer	2
7.	Discipline Engineer's (Civil/ Mech)	1/ 2
8.	Foreman / Supervisor	5
9.	Civil surveyor / liaison team	1
10.	Document controller	1
11.	Store keeper / store in-charge	1 (Note-4)
12.	Welder (Manual)	8
13.	Fitter	4
14.	Grinder	4
15.	Machine operator	8
16.	Blast cleaning crew	3
17.	Electrician / Machine mechanic	1
18.	Rigger	12
19.	Drivers	As Required
20.	X-ray / Gamma Ray crew	1
21.	Hydrotesting crew	1
22.	Field joint coating crew	1
23.	Holiday testing crew	1
24.	HDD crew	1 (Refer Note1)
25.	HDPE Jointing Crew	1
26.	Civil survey crew (with equipment)	1
27.	Station civil works (carpenter/bar-bender/mason/fitter etc.)	As Required
28.	Unskilled workers	20
29.	Station mechanical, pre-fabrication / erection crew	1
30.	Civil engineer	1

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The above proposed list of skilled manpower is the minimum to be deployed by Contractor for each part,however as per the requirement to meet the target schedule contractor shall augment workforce.

NOTE :-

(1) HDD equipment and Crew as required shall be deployed based on the SOW finalized and as per instruction of EIC.

(2) The details of minimum manpower required to be mobilized by the execution contractor to complete the work within schedule is given above for each section

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and is not exhaustive. Contractor is required to augment the above list with additional numbers/categories of workmen as required anddirected by Engineer-In charge to complete the work within the completion time schedule and quoted price.

(3) The Manpower as identified above, should have required qualification and adequate relevantexperience.

(4) These man power are to be mobilized per section within 15 days of award of work

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HIRING / RECOVERY RATE FORDEPLOYMENT OF MANPOWER
(Annexure-11 of Special Condition of Contract)

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ANNEXURE –11 TO SCC

HIRING / RECOVERY RATE FOR DEPLOYMENT OF MANPOWER

1. The Labour rates are "all inclusive". These rates include but are not limited to all payroll costs and allowances, payroll taxes, fringe benefits, protective and/or special clothing, construction supplies required for work of a nature included in this contract, overhead & profit , service tax, insurance, transportation and travel time.

2. The rates are inclusive of providing hand tools and consumables such as electrodes, filler wire, gases, grinding wheels where the concerned category of labour is expected to use in execution of the job but exclusive of all major equipment and machineries.

3. The normal time labour rates shall apply for all hours worked up-to eight (8) hours in a day. The payment for part of the day shall be made on prorata basis.

Sl. No.	Classification Personnel	Rates per day ofNormal Hours (in Rs.)	Rate per hour for OT, Sunday & Holiday (in Rs.)
1.	Foreman	2000	430
2.	Supervisor	2000	430
3.	Engineer	2500	650
4.	Gas Cutter	700	170
5.	Grinder	700	170
6.	Brick Mason	520	120
7.	Stone Mason	520	120
8.	Structural welder	1000	260
9.	Qualified Arc welder – manual / semi automatic	1500	260
10.	Qualified Arc welder – automatic	2000	430
11.	Welder helper	470	120
12.	Pipe Fitter /Bender / PE Technician	750	150
13.	Structural Fitter	650	120
14.	Pipeline Fitter	850	190
15.	Coater	520	120
16.	Mechanic	520	120
17.	Site Equipment / Machine Operator	520	120

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18.	Electrician	600	150
19.	Fabricator	650	150
20.	Carpenter	500	130
21.	Plumber	500	120
22.	Painter	500	120
23.	Cable Jointer	780	190

Sl. No.	Classification Personnel	Rates per day ofNormal Hours (in Rs.)	Rate per hour for OT, Sunday & Holiday (in Rs.)
24.	Instrumentation Technician	1000	190
25.	Insulator	600	120
26.	Rigger	400	110
27.	Bhisti (water man)	390	60
28.	Heavy duty driver	700	170
29.	Civil Surveyor	750	130
30.	Document Controller	1000	300
31.	Account Officer	1500	360
32.	Store Keeper / Incharge	1000	300
33.	AUT Interpreter	5000	750
34.	Liasioning Team (2 persons)	2000	430
35.	Light duty driver	500	120
36.	Sand Blaster	500	130
37.	Qualified Surveyor	750	130
38.	Un skilled Worker	390	80
39.	Construction Manager	10000	1000
40.	QA/QC / Safety / Planning / NDT Engineer	5000	750

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(SIGNATURE OF BIDDER)

NOTES:-

1. Rates are final and Tenderer is to sign only without deviation.
2. In case of foreign bidder, conversion rate applicable on one day prior to price

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bidopening date published by the State Bank of India will be considered.

3. The recovery rates shall be the rates provided above plus 20% (twenty percent).

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EQUIPMENT HIRING/RECOVERY RATES
(Annexure-12 of Special Condition of Contract)

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ANNEXURE-12 TO SCC

EQUIPMENT HIRING/RECOVERY RATES

SL. NO.	DESCRIPTION OF EQUIPMENT	HIRING/RECOVERY RATES(ININR) PER DAY(MINIMUM 8 HOURS) INCLUDING CONSUMABLES & FUEL
1.	Back Hoe-Ex 280 / 300 & Above or Equivalent	Rs. 16000
2.	JCB Excavator	Rs. 6000
3.	DG along with Welding Machines	Rs. 4000
4.	Hydra (8 – 10 MT)	Rs. 6000
5.	Bevel Cutting Machine –Manual	Rs. 600
6.	Tyre Mounted Cranes (10 MT & above)	Rs. 15000
7.	HDD Rig with All Equipments & Accessories (Cap. 25 T and above)	Rs. 40000
8.	X-Ray M/C – External	Rs. 5000
9.	Gamma Source	Rs. 4000
10.	Water Lifting Pump	Rs. 1200
11.	Filling Pumps	Rs. 1500
12.	Pressurization Pump – Motorized	Rs. 3000
13.	Induction/Resistance Heating Equipment or LPGMulti Torch.	Rs. 3000
14.	Air Compressor – (300CFM)	Rs. 2000
15.	Air Compressor –(above 300 CFM)	Rs. 15000
16.	D.G. Sets : 62.5 KVA to 200 KVA (inclusive ofgenerators)	Rs. 7000
17.	Blast Cleaning Machine	Rs. 1000
18.	Pipe Trailers (FB / Semi Low Bed)	Rs. 10000
19.	Mono drill crawler mounted	Rs. 3000
20.	Hand drill (pneumatic) for rock breaking/JCBbreaker	Rs. 4000
21.	Rock breaker attachment	Rs. 3000
22.	Dosing Pump	Rs. 1000
23.	UT Machine with operator	Rs. 1000
24.	Dewatering Pump	Rs. 1000
25.	Holiday Detector Unit	Rs. 1000
26.	Dead WT Tester	Rs. 1000
27.	Dumper / Tippers	Rs. 11000
28.	Pipe locator	Rs. 2000
29.	Pipe Clamp – External	Rs. 500
30.	Pipe Trailer for Coated Line Pipe	Rs. 12000
31.	Rock Breaking Machine with Excavator	Rs. 25000/-
32.	Grinding machine	Rs. 1000/-
33.	Gas cutting set with cylinders	Rs. 1500/-
34.	Trucks	Rs. 4000/-

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SL. NO.	DESCRIPTION OF EQUIPMENT	HIRING/RECOVERY RATES(ININR) PER DAY(MINIMUM 8 HOURS) INCLUDING CONSUMABLES & FUEL
35.	Car/Jeep	Rs. 2000/-
36.	Tractor with trolley	Rs. 4000/-
37.	Tripod with 5 Tons Chain Pulley Block	Rs. 700/-

(SIGNATURE OF BIDDER)

NOTES:-

1. Rates are final and Tenderer is to sign only without deviation.
2. Rates are inclusive of operators / drivers as applicable.
3. Rates are all inclusive of all taxes and duties, including service taxes /GST etc., contractor's overheads & profit.
4. The recovery rates shall be the rates provided above

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SECTION 9: SCHEDULE OF RATES (SOR)

SCHEDULE OF RATES (SOR)

Bhagyanagar Gas Limited

Bid Document NO: BGL/632/2024-25 Dated 11.06.2024

Subject: LAYING & CONSTRUCTION OF 6" NB U/G STEEL P/L NETWORK & ASSOCIATED WORKS FOR CITY GAS DISTRIBUTION PROJECTS FOR CONNECTVITY OF CNG STATION IN LUNGERHOUSE, HYDERABAD

				Name of the Bidder	**M/s**		
1	**MAINLINE WORKS**						
Sl. No.	**Description of Item**	**Unit**	**Qty.**	**Unit Rate (all inclusive except GST) in Rs.**	**Total Amount (all inclusive except GST) in Rs.**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**		
					(4) x (5)		
ML-1	**CARBON STEEL PIPES & MDPE PIPES**						
1.1	**PIPELINE LAYING / INSTALLATION**						
	a) Coated Steel pipe lines laying						

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	Receiving , loading , unloading and transportation and stacking of 3-Layer PE coated and bare line pipes issued by BGL as free issue materials from BGL designated store yard within GHMC limits of Hyderabad to Contractor's stock yard/workshop/work-site. The scope of contractor includes preparation of drawings, wherever required for crossing etc. including handling, stacking, stringing on the pipeline route alignment, carrying out inspection of BGL supplied materials including linepipes at the time of taking over, laying/ installation of coated linepipes as per specification wherever required depending on site condition including execution of all works, "taking over", handling , including loading and unloading, transportation of Owner supplied materials from Owner's designated place (s) of issue to work site. Arrangement of all additional lands required for Contractor's storage, fabrication, access for construction, procurement and supply of all materials (except Owner supplied materials), consumables, equipment, labour and other inputs, carrying out						

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	all temporary, ancillary, auxiliary works, ready for commissioning of pipeline as per drawings, specifications, other provisions of Contract document and instructions of Engineer-in-charge, including but not limited to carrying out the following works:						
	Surveying of route and detours required at the time of execution including marking the same in topographical sheet, preparation of construction drawings showing survey details, and submit same to Owner for review / approval.						
	Clearing, full filling all the requirements of various statutory/ environment authorities to the entire satisfaction of concerned authorities, grading of work area. Relocating of any obstruction within the Pipeline route alignment / Approved route viz. electrical lines/ poles, telephone line / poles, foreign pipeline, etc. in co-ordination with concerned authorities						

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	and obtain permissions from these authorities for pipeline execution.						
	Trenching to required depths by excavation in all types of soils **except built up sections** on top as different type of pavement / footpath / roads etc. as required by using mechanical excavator or manually depending on the site condition and storing excavated soil, reusable materials at designated area as directed by Engineer in charge and to a width to accommodate the pipeline as per the relevant standard/ specification etc. [The minimum depth of the top of pipeline shall be 1.0 m measured from top of pipeline coating to the top of undisturbed surface of the soil or as per SCC/ relevant code, whichever is higher]. All necessary arrangement will be made and adequate precautions for working at the required depth will be taken by the contractor. Dewater of trenches if required as per site condition is included in the scope of contractor. As SVs shall be buried on the pipeline						

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	alignment itself with RCC pits and covers, the steel pipeline has to be taken to the required lower depth (as required) by use of slope or vertical bends to accommodate the above without additional cost to BGL						
	During the execution of the work, the construction area shall be barricaded to ensure the smooth execution of work and safety of the public/ working area. The item also includes fabrication, trsansportation and placing the barricading at the site. Barricading to be made as per approved drawing and to the entire satisfaction of Owner / Engineer-in-charge. cost towards barricading shall be paid as per separate SOR item.						
	Carrying out repairs of pipe defects/ replacement in case of irreparable defects and repairs of defects of pipe coating not attributable to Owner including defects/ damages occurring during transportation / handling.						
	Stringing of line pipes along pipeline trench /sand / soft soil bags including						

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	supply of bags and its filling materials.						
	Checking, cleaning, aligning, bending, cutting and bevelling (as required) of pipes for welding and field adjustments including pipe fittings, welding, carrying out non-destructive testing of welds as required including 100% radiography by X - ray (Gamma Ray where X-ray is not possible at the discretion of EIC) and providing all requisite equipment, labour, supervision, materials, films, consumables, all facilities and personnel to process, develop, examine and interpret radiographs and other tests as required, carrying out repairs of weld joints found defective by Engineer-in-Charge, carrying out re-radiography and other tests as required on repaired joints.						
	Carrying out installation of carrier line pipe at all minor crossing viz. road, carttrack, pathway, water bodies etc. at designated depth by open cut (except at crossing by HDD method/ moling / Augur boring).						
	Obtaining in principle ROU permission for laying of the pipeline from the concerned land owning authority (i.e. GHMC /						

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	HMWSSB / NHAI / HMDA , R&B etc.) is in the scope of the contractor. Amount for Application fees, Demand note or any other statutrory fees will be paid by BGL. Also all the liasioning with any authority such as GHMC / HMWSSB / NHAI / HMDA, R&B, local officials, traffic police, police, ESCOM, BSNL, Railways, RTO etc. and any other utility companies / agencies such as OFC operators etc. during the execution of pipeline laying, are in the scope of the contractor. The scope also inlcudes liasioning with Society / individual land owners, road owning authorities for smooth execution of pipeline laying. Repairing/replacement of all damaged utilities if any, and payment of any compensation (if claimed by owner/other utility agencies/ authorities) is in scope of the Contractor. The laisoning during the execution for all the pipelines for the installed buried length shall be paid as per SOR item ML-6.0 separately.						

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	Coating of field weld joints, long radius bends (R=3D), elbows, buried fittings and valves etc. including supply of coating materials etc. (i.e. heat shrinkable sleeves and high build epoxy etc.) as per PJS & Technical Specification compatible with 3 layer PE coating material of the line pipe.						
	Installation of LR Bend (R = 3D) , as per specification wherever required depending on site condition. However, Supply of 3D bends shall be paid by separate item mentioned elsewhere in SOR.						
	Installation / lowering the pipeline in trench to required depth as per PJS, Technical Specification & drawings including padding around pipeline with suitable soil duly approved by EIC including supply of padding material, backfilling and its compaction to the satisfaction of concerned authorities with excavated earth / borrowed select soil including supply of borrowed select soil duly approved by EIC.						
	Supply & Installation of warning mat (600 mm width and 0.5 mm thick) covering both steel & MDPE pipe on the entire length of both the pipelines						

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	as per specification. Warning tape should have anti rodent properties.						
	Supply and installation of slope breakers, wherever required or, as directed by Owner / Engineer–in–charge.						
	Crossing the all-foreign pipeline / HT line / cable / any other utilities etc. with necessary concrete / PVC protection/ grating including coordination with all agencies and obtaining NOC.						
	Carrying out air cleaning, flushing, cleaning and hydrostatic testing of complete pipeline with required quantity of corrosion inhibitor including pre-testing of designated sections complete as per specification and approved by Engineer–in–charge to specified pressures indicated elsewhere and duration after stabilization as per specification, providing all equipment, pumps, fittings, instruments, dead weight tester, pressure recorder, thermocouples etc., and services, supervision, labour, consumables, water including supply of corrosion inhibitor, air, etc. as required,						

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	locating of leaks and rectification of defect attributable to Contractor (rectification of defects in linepipe material not attributable to contractor shall be paid separately as per other item of schedule of rate), re- testing after rectification, dewatering after successful completion of hydrotesting of entire section and as approved by Engineer-in-Charge.						
	(Note : Leak detection, its rectification and successfully re-hydrotesting shall be carried out by Contractor with a view that completion of all activity for successful hydrotesting is not inordinately extended, which will hamper the overall project schedule. Further, no extra payment claim shall be entertained for re-hydrotesting and leak detection if defects found attributable to Contractor.						
	All tieing-in, including the tie-in(s) of the pipeline with the adjacent sections of pipeline including cutting of test header, rebevelling as required, radiography and other NDT examination, joint coating as per specification.						

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	Final clean-up & restoration of right-of-use or area disturbed by contractor including obtaining NOC from respective land owner and statutory authorities during their construction activities for laying of pipeline works and disposal of debris, excess soil to designated disposal areas as per local authorities/BGL and returning all surplus material to designated storage yard and backfilling of trench and compaction of the same as per satisfaction of Owner and / Or as directed by Engineer–in–charge.						
	Restoration of land, facilities and boundary wall etc. And associated facilities dismantled/damaged by the Contractor during construction;						
	Installation of all burried valves inside the valve pit and making provision to operate the valve.						
	Carrying out Sectionalising valve station including tap-off for distribution pipelines on underground steel grid main pipeline & branch pipeline, valves, barred tees, insulating joints, bends (R=3D/1.5D/1D), flanges & fittings, accessories etc. , tie-in of valve assembly including radiography of tie-in joints as per Schematic Layout						

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	Drawings of respective sections, Technical Specification and aboveground approach pipeline upto Insulating Joint (including installation of aboveground / underground insulating joint) for various stations. However, construction of valve pits and erection of flow tees, valves, pipe fittings etc. on the burried pipeline in the valve pits for sectionalising valve stations and tap off shall be paid by separate item mentioned elsewhere in SOR.						
	Protective coating of 500 micron thick two component (applied with the help of minimum three coats) liquid epoxy including supply of materials duly approved by Owner for all piping valves, fittings, structural steels etc. for buried installation and inside the valve pit as approved by the Engineer-in-charge.						
	Carrying out all temporary, ancillary, auxiliary works and all incidental works required to make the pipeline ready for pre-commissioning;						

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	Preparation of as-built drawings, pipe-books including collection of GPS co-ordinates.(Drawings /documents to be submitted as per SCC) All the works shall be executed in accordance with the provision of contract including carrying out all temporary/ ancillary/ auxiliary works required for the performance of the works and all other acts, deeds, matters and things necessary to make the pipeline ready for precommissioning activities.						
	b) MDPE Pipes laying in the same trench of Steel pipe lines						
	Trenching to required depths by excavation in all types of soils except built up sections on top as different type of pavement / footpath / roads etc. Storing excavated soil, reusable materials at designated area as directed by Engineer in charge and to a width (steel pipe line to MDPE clearance shall be 150 mm) to accommodate the pipeline , MDPE Pipe (125 / 90mm, SDR 11, PE 100 Pipe), adjacent to each other with 150 mm clearance except for the location of crossover points of MDPE over steel pipeline for change of sides						

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	due to site condition and MDPE pipe flexibility as per the relevant standard/ specification etc. [The minimum depth of the top of pipeline shall be 1.0 m measured from top of pipeline to the top of undisturbed surface of the soil or as top of MDPE pipeline whereevcer crossing the steel pipeline, as per SCC/ relevant code, whichever is higher]. Dewater of trenches if required as per site condition.						
	Loading, storing, unloading and laying of PE100, SDR11 line pipes of size 125 / 90 mm in steel pipe line trench including ,proper stacking, identification,and supply of accessories of all sizes & thickness like PE Bends, Couplers, Endcaps, Tee, Reducer, CS to PE Fittings, Saddle Tapping, GI sleeves etc.. Handling, Stringing/ uncoiling,aligning of the PE line pipe on the pipeline Right-of-Use/route , laying/ installation of PE line pipe alongwith required accessories as mentioned above as per specification wherever required depending on site condition including execution of all works; additional lands required for contractor's storage , fabrication, access for construction;procurement						

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	and supply of all materials , consumables,equipments, labour and other inputs. In case of free issue items,the scope also includes, receiving and loading from BGL designated store, transportation, unloading and stacking of free issue items at Contractor's store						
	Carrying out all temporary, ancillary, auxiliary works requiredto make the PE pipeline ready for commissioning including cleaning, flushing and removing the ingress of water / moisture etc., as per drawings.						
	Specifications, scope of work indicated in PJS and other provisions of Contract document and instructions of Engineer- in-charge, including but not limited to carrying out the following works:						
	Carrying out preliminary activities such as preperation of drawings wherever required for crossing etc.						
	Preparation and getting approval of schedules, executionprocedures, drawings/ sketches/ wherever required, making trial pits to determine the underground utilities/						

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	services etc., restoration of the abandoned trial pits to original condition.						
	Uncoiling/ stringing & aligning of PE pipes, clamping, jointing of the pipe ends/ fittings/ valves by qualified personnel using approved electro-fusion techniques as per specification.						
	Installation / lowering the pipeline in trench to required depth as per PJS, Technical Specification & drawings.						
	Electro-fusion jointing of valves wherever required and as directed by Engineer-in-charge.						
	Pneumatic testing, purging with nitrogen and commissioning as per specification and approved procedures providing all tools and tackles, nitrogen, instruments, manpower and other related accessories and as per the instructions of the Engineer-in-charge.						
	Supply of bricks (class 35) and placing the brick along its length across the length of MDPE pipeline.						

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	Any other activities not mentioned/ covered explicitly above, but otherwise required for satisfactory completion/ operation/ safety/ statutory/ maintenance of the works shall also be covered under the scope of work and has to be completed by the Contractor within specified schedule at no extra cost to BGL. All the work shall be executed in accordance with the provision of contract.						
	Installation of Coated Line Pipes & MDPE pipes as per following details:						
	Specified dia. Thk (mm) Material Coating Type Length of each pipe (mm) NB						
1.1.1	150# 6.4 API 5L Gr. X-52 3 Layer PE Double random Coating (Externally) (approx.11.5 m to 12.5 m) & MDPE Pipe - 125 / 90 mm dia of PE 100	Meter	1100.00		-		
	Note:						

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i)	This item shall be applicable for the underground steel grid main pipeline & branch pipeline including tap-off for distribution pipelines, valves, barred tees, insulating joints, bends (R=3D), flanges & fittings, accessories etc. , tie-in of valve assembly including radiography of tie-in joints as per Schematic Layout Drawings of respective sections, Technical Specification and aboveground approach pipeline upto Insulating Joint (including installation of aboveground / underground insulating joint) for various stations.						
ii)	Supply of all valves, flanges, fittings, assorted pipes, barred tees & insulating Joints, etc. shall be paid by separate item mentioned elsewhere in SOR.						
iii)	In above item, backfilling of pipeline trench by borrowed select soil duly approved by Owner / EIC shall be paid by separate item mentioned elsewhere in the SOR.						
iv)	Contractor shall not perform any pipeline activities along Pipe alignment without specified barricading as per Std. Drg. and other safety measures.						

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v)	The lengths of pipelines are tentative. All items required to complete the laying and commissioning except the Items covered separately in this SOR are included under the scope of this item						
vi)	Cutting of Hard Rock shall be paid on CUM basis as per separate SOR item.						
vii)	The Quoted rate shall be of laying of steel pipe line & MDPE pipeline laying in the same trench as per the drawing. line trench . CS main pipes & MDPE pipes are free issue materials to the contractor. Any stand-alone trenching required to detour PE pipeline laying due to space constraint shall be in the scope of contractor without any extra cost to BGL.						
viii)	The Quoted rate shall include PE pipe branch connections laying in the same item as steel pipe laying. BGL will not provide any Tees, pipe, caps and fittings as free issue for PE branch connections whereever required. PE pipe laying is to be included in the rate quoted for steel pipe laying. i.e. parallel laying of both steel and MDPE in same						

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1.20	**Same as item 1.1 above but with built up sections (different type of pavement / footpath / roads etc. which includes Asphalt roads, Tiled pavement and PCC/RCC roads) on the top surface**						
	Installation of Coated Line Pipes & MDPE Pipes as perfollowing details:						
	Specified dia. Thk (mm) Material Coating Type Length of each pipe (mm) NB						
1.2.1	150 6.4 API 5L Gr. X-52 3 Layer PE Double random Coating (Externally) (approx. 11.5 m to 12.5 m) & MDPE Pipe - 125 / 90 mm dia of PE 100	Meter	363.00		0		
1.30	Cutting/ breaking of hard rock found in trenches using mechanical means such as rock breakers / excavators (blasting prohibited) etc. Scope also includes disposal of rocky earth after breaking to designated disposal areas as per local authorities/BGL. (wherever hard rock of single piece exceeding 1.0 m in length along the trench direction as per the decision &	CUM	1390.00		0		

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	direction of EIC) The above item also include liasioning with state authorities / owners : Obtaining ROU and all permissions from the concerned land-owning / statutory authorities along the proposed route / area. However, the required statutory / mandatory fees will be paid by M/s BGL against demand note.The liasioning during the pipeline laying execution with local authorities & local officials, traffic ploice, police and any other utility companies / agencies such OFC operators etc are in the scope of the contractor. Repairing/replacement of all damaged utilities if any, and payment of any compensation (if claimed by owner/other utility agencies) is in scope of the contarctor.						
1.40	**PE Pipe Laying using Horizontal Directional Drilling (HDD) Technique:**						

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	Laying of PE pipe , including supply of Couplers, as required to complete the job. Survey of U/G utilities, survey with requisite equipment / manpower, submission of profile drawings and design for approval, execution of the work as per standard procedure attached with proper capacity machine including excavation of pits and subsequent backfilling, compaction, jointing and insertion of PE pipe, testing & commissioning, restoration of the pits to to original condition, submission of As-Built Graph as per specifications and the instruction of Engineer-in-charge. If any additional temporaray space is required for poistioning of equipment for HDD adjacent to pipeline route, same needs to be arranged by the contractor. Item also inlcudes liasioning with all local authorities, permission if any required, shall be obtained by the contractor.						
i)	**HDD Without casing Pipe**						
1.4.1	125 / 90 mm PE 100 pipe	Meters	120.00		0		

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ML-2	**Restoration of asphalted roads / concrete roads / pavements / foot paths, wherever instructed by EIC .Job includes getting NOC from the concerned authorities.**						
a)	**Asphalt road** :Restoration of bitumen Asphalt road after laying of Pipe lines as per the relevant drawing, specifications and instruction of Engineer-In-Charge. Restoration of roads shall be done as per requirement of **EIC/Hyderabad GHMC/NH/etc.** and to get NOC from the concerned authorities. Restoration of the asphalt road cut portion for pipeline trench width shall be carried out by filling the bottom layer with with stone dust / Quarry dust watering & compaction followed by 200mm thk GSB & 250 mm thk WMM with top bituminous layers comprising of primer coat, tack coat, 50mm thk DBM & 40 mm thk BC matching with the existing road top level.This item alos includes disposal of surplus soil / debris with all lift & leads. Reinforced Cement Concrete road/ pavement: Restroration of Reinforced concrete road and pavements shall be done by providing PCC 1:4:8 of 75 mm thick and RCC 1:2:4 of 100 mm thickness	Meter	1400.00		0		

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	and providing minimum 8mm dia reinforcement steel at 200mm c/c . The cost of reinforcement . Shuttering, compacting the base surface etc. are in the scope of this item.						
ML-3	**BORROWED SELECT SOIL FOR BACKFILLING**						
	Additional work over and above item 1.5 for supply of specified and approved quality of borrowed foreign soft graded soil / sand in place of available excavated material and / or other suitable soil as per applicable standards / specifications, including backfilling of excavated trench for specified length after laying and padding of pipeline, including transportation of such special backfill material over all distances, complete. (Also to be used in open cut road crossing if required as per decision of EIC)	CUM	725.00		0		

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ML-4	**Steel Pipeline Laying by Horizontal Directional Drilling (HDD) Technique (without casing pipe):**						
	Complete HDD work of the road /Nala crossing (between the limits are defined as in approved drawings including HDD along the road / nala) by HDD method including "Receiving and taking over" owner supplied three layer PE coated line pipes from Owner's designated place to issue/ dump site(s) and transportation to Contractor's stock yard/ work shop/ work site including all handling loading, unloading, aligning etc., manpower, equipment, other resources and aquiring the required land for storage, fabrication inclduing string preparation of pipes(carrier), welding, welding repair, radiography, coating of field joints with special type Heat Shrink Sleeve and repair of pipeline coating with special repair patch materials as per specification, pre-testing etc. of complete string made for crossing access for Contractor etc. and execution of, but not limited to, following works in accordance with specifications and instruction of						

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	Engineer-in- charge and as per all provision of Contract Document.						
	Pre-construction survey based on site visit, collection of data (if required) from concerned Authority including design and detail engineering and making of crossing drawings for getting their approval from concerned Authority/ & Engineer-in- charge, getting work permit/ NOC for road/ Nala crossing as well as utility crossings (if any) encountered during road/ Nala crossing prior to start the execution of work.						
	Directional drilling to required depth from top of road/ Nala Bed including maintenance of drill hole in all types of strata including rocky terrain at all depth to accommodate the pipeline at all conditions encountered during road/ Nala crossing by approved HDD methods for providing minimum						

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	cover specified in code/ specification or the actual depth as decided by concerned authority, whichever is more.						
	Backfilling of the ditch/ trench including restoration and cleanup of area and all other works including pigging, cleaning, final hydrotesting etc. alongwith mainline works (as mentioned in item no. 1.0 above) required as per specification, approved drawings, calculations, methods and to the satisfaction of Engineer-in-charge and/or as directed by concerned Authority.						
	Obtaining in principle permission for HDD of the pipeline from the concerned authority (i.e. GHMC / HMWSSB / NHAI / HMDA , R&B, railway etc.) is in the scope of the contractor. Amount for Application fees, Demand note or any other statutrory fees will be paid by BGL. Also all the liasioning with any authority such as GHMC / HMWSSB / NHAI / HMDA, R&B, local officials, traffic police, police, ESCOM, BSNL, Railways, RTO, Local vendors, shops, etc. and any						

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	other utility companies / agencies such as OFC operators etc. during the execution of pipeline laying, are in the scope of the contractor. The scope also inlcudes liasioning with Society / individual land owners, road owning authorities for smooth execution of work. Repairing/replacement of all damaged utilities if any, and payment of any compensation (if claimed by owner/other utility agencies/ authorities) is in scope of the Contractor. The laisoning during the execution for all the pipelines for the HDD length shall be paid as per SOR item ML-6.0 separately.						
	Incase of hard rock contractor has to establish through bore log soil investigation data for carrying out the HDD with suitable diamond bit						
4.1	**Steel pipeline HDD (without casing pipe): In all type of soil excluding HARD ROCK AREA**						
	For carrier pipeline of 3LPE Coated Carbon Steel Pipeline with Line pipe detail 6" NB, 6.4 mm thk API 5LX52	Meter	151.00		0		

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4.2	**Steel pipeline HDD (without casing pipe): IN HARD ROCK AREA USING DIAMOND CUTTER with drilling in hard rock length at the rate of not more than 4.5 m per hour and carrying out soil investigation and lab analysis at a maximum span of 25 metres for establishing the hard rock HDD length to be paid under this item**						
	For carrier pipeline of 3LPE Coated Carbon Steel Pipeline with Line pipe detail 6" NB, 6.4 mm thk API 5LX52	Meter	546.00		0		
ML-5	**JACKING / BORING OF STEEL PIPELINES:**						
5.1	Complete work of the road (National Highway, State Highway, MDR) or Rail crossing (between the limits as defined in approved drawings) & Jacking / Boring at other places as specified includes handling, loading, transportation, unloading to Contractor's own stock yard/ work site.						
	Pre-construction survey and making of crossing drawing based on site visit and getting their approval from concerned Authority/						

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	& Engineer-in-charge prior to start the execution of work.						
	Supply and Installation of casing pipe by jacking/ boring/or as described below for rail crossings in all type of soil strata including soft / hard rock and open cut for adjacent service road, canal, minor nature of water channel, utility line crossing etc. (if any) wherever required for all depth in all type of soils and terrrain for carrier pipe insertion. All other Contractor supplied materials like casing insulators, Zinc Ribbon Anodes and casing end seals as per enclosed specification/ drawings materials for casing vents and drain assembly etc. including supply of all other materials, equipments, consumables, manpower, welding including visual inspection of all weld joints.The casing pipes shall conform to material API 5L Gr. B / IS :3589 or equivalent ERW Pipe duly Corrosion coated of High build epoxy of minimum 450 microns thickness						

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	Preparation of required length of carrier pipeline welded string including all other works as mentioned in item no. 1.0 above and as per specification/ drawings. Insertion of carrier pipe in casing pipe after above ground pretesting at specified test pressure including installation of casing insulators, end seal insulators and Zn ribbon anode as per approved design calculation, specification/ drawings. Insatllation of vent and drain assembly, fixing of end seals, backfilling and restoration as original of the facilities crossed and performing all other works including pigging, cleaning, final hydrotesting etc. alongwith mainline works (as mentioned in item no. 1.0 above) and as per specification, approved procedure, drawing etc. and instruction of Engineer-in-charge and provision of contract document, getting NOC from all concerned Authority of the facilities crossed.						
	2.5 m min depth to maintain throughout the railway crossing as per instruction of railway DRM.						

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	Obtaining in principle permission for HDD of the pipeline from the concerned authority (i.e. GHMC / HMWSSB / NHAI / HMDA , R&B, railway etc.) is in the scope of the contractor. Amount for Application fees, Demand note or any other statutrory fees will be paid by BGL. Also all the liasioning with any authority such as GHMC / HMWSSB / NHAI / HMDA, R&B, local officials, traffic police, police, ESCOM, BSNL, Railways, RTO etc. and any other utility companies / agencies such as OFC operators etc. during the execution of pipeline laying, are in the scope of the contractor. The scope also inlcudes liasioning with Society / individual land owners, road owning authorities for smooth execution of work. Repairing/replacement of all damaged utilities if any, and payment of any compensation (if claimed by owner/other utility agencies/ authorities) is in scope of the Contractor. The laisoning during the execution for all the pipelines for the						

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	HDD length shall be paid as per SOR item ML-6.0 separately.						
5.1.1a	**Major Jacking & boring (includes crossings like railways & Highways)**						
	Major Jacking & boring in all types of Soil excluding HARD ROCK AREA						
	By Jacking/ Boring of Casing Pipe - 18 " NB (457 mm OD X 7.92 mm wall thickness) - for laying of 6" NB steel pipeline & 4" steel pipeline/125 / 90 mm MDPE pipe line in common casing pipe . Transition fittings shall be supplied by the bidder.	M	80.00		0		
	Major Jacking & boring in HARD ROCK AREA						

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5.1.1b	By Jacking/ Boring of Casing Pipe - 18 " NB (457 mm OD X 7.92 mm wall thickness) - for laying of 6" NB steel pipeline & 4" steel pipeline /125 / 90 mm MDPE pipe line in common casing pipe . Transition fittings shall be supplied by the bidder.	M	40.00		0		
5.1.2	**Minor Jacking & boring (includes drains, nallahs, cross roads, culverts & at other places as required)**						
	Minor Jacking & boring in all types of Soil excluding HARD ROCK AREA						
	By Jacking/ Boring of Casing Pipe - 18 " NB (457 mm OD X 7.92 mm wall thickness) - for laying of 6" NB steel pipeline & 125 / 90 mm MDPE pipe line in common casing pipe .	M	50.00		0		
5.1.3	**Other unspecified crossing by open cut method**						
	Cased crossings in all type of Soil excluding HARD ROCK AREA						
	By Jacking/ Boring of Casing Pipe - 18 " NB (457 mm OD X 7.92 mm wall thickness) - for laying of 6" NB steel pipeline & 4"steel/ 125 / 90 mm	M	50.00		0		

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	MDPE pipe line in common casing pipe .						
	Cased crossings in HARD ROCK AREA						
5.1.4	By Jacking/ Boring of Casing Pipe - 18 " NB (457 mm OD X 7.92 mm wall thickness) - for laying of 6" NB steel pipeline & 4" steel /125 / 90 mm MDPE pipe line in common casing pipe .	M	120.00		0		
	Note: (i) Actual length & cover from top of casing pipe string may vary depending upon site conditions, approved drawings, specification etc. and / or as decided by concerned Authority / Engineer-in-charge.						
	(ii) Payment for supply & installation of Zinc ribbon anode and its design excluded from above item and covered elsewhere in the SOR.						
	(iii) Width of above crossings shall be as per requirement at site for crossings at different locations.						

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ML-6	Liasioning & Obtaining Permission for laying of steel pipelines of all sizes by all methods including laying of 125 / 90 NB PE pipeline in the steel pipe trench, wherever required: Obtaining ROU permission for laying of the pipeline from the concerned land owning authority (i.e. GHMC / HMWSSB / NHAI / HMDA , R&B etc.) is in the scope of the contractor. All liasioning and pursuation till issuance of Demand note / other applicable similar document is issued by the permitting authority, is to be carried out by the contractor only. BGL will hand over the application form to the contractor. Amount for Application fees, Demand note or any other statutrory fees will be paid by BGL. Further, all the liasioning with any authority such as GHMC / HMWSSB / NHAI / HMDA, R&B, local officials, traffic police, police, ESCOM, BSNL, Railways, RTO etc. and any other utility companies / agencies such as OFC operators etc. during the execution of pipeline laying, are in the scope of the contractor. The scope also inlcudes liasioning	Meters	2500		-		

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	with Society / individual land owners, road owning authorities for smooth execution of pipeline laying. Repairing/replacement of all damaged utilities if any, and payment of any compensation (if claimed by owner/other utility agencies/ authorities) is in scope of the Contractor.						
ML-7	**REPAIR OF DEFECT IN PIPES (NOT ATTRIBUTED TO CONTRACTOR)**						
	Repair of defects on Owner supplied linepipes of all grades and wall thickness as specified in following items, noted and recorded at the time of "receiving and taking over" by Contractor in the presence of Engineer-in-charge.						
7.1	Cutting and rebevelling for dents in bevels exceeding 3 mm in depth for pipe sizes:						
	6" NB	Nos.	35		0		

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7.2	Jack out of dents in bevels ranging between 1 mm and 3 mm in depth for pipe sizes:						
	6" NB	Nos.	35		0		
ML-8	**REPAIR OF COATING DEFECTS (NOT ATTRIBUTED TO CONTRACTOR)**						
8.1	**Repair of Holiday in Coating (Noted and recorded at the time of "receiving and taking over")**						
	Supply of all coating repair materials as per requirements of specification to be compatible with line pipe coating material, supply of all consumables, utilities, equipments and all manpower required, pipe cleaning and surface preparation, repairing of coating defects (resulting in holiday) and testing including all handling, transportation, etc. for line pipes, performing all works necessary for the completion of the works stirctly in accordance with relevant specification and instructions of Engineer-In-Charge. This rate shall be applicable per sq. cm of the exposed steel area.	Sq. cm	70		0		
ML-9	**PERMANENT MARKERS**						

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	Supply, fabrication and installation of all types of permanent markers along the route including all associated civil works such as excavation in all types of soil, construction in all types of soil, construction of pedestals and grouting with concrete, clearing, supply and application of approved colour and quality of primer and paint, stencil letter cutting for numbers, direction, change etc., restoration of area to original condition and performing all works as per drawing, specification and instruction of engineer-in-charge.						
9.1	Pipeline RCC boundary / route marker as per drawing	Nos.	50		0		
9.2	Pipeline warning markers with post & foundations	Nos.	25		0		
9.4	Pipeline direction marker with post & foundations	Nos.	5		0		
9.5	Pipeline KM with post & foundations	Nos.	3		0		
ML-10	**LEAK / BURST (ATTRIBUTABLE TO OWNER)**						

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	All works for locating leak / burst in Company's supplied material only (occurred during hydro-static testing) including necessary repairing/replacing defective pipe lengths including cutting out and removing the defective pipe, pre-testing and welding of replacement pipe, NDT of welds, repair and retesting of defective welds, coating/painting of replacement pipe, pretesting the replacement pipe into mainline/branch line, coating/painting of welding joints, cleanup, retesting including cost of all labour materials, consumables and performing all works in accordance with the provisions of the Contract document and as directed by Owner /Engineer-in- charge/ Engineer in-charge						
	For 6" NB Line	LUMPSUM	2		0		
	Note:						
i)	This rate is applicable for manufacturing defects in Owner supplied material only.						
ii)	Leak detection, its rectification and successfully re-hydrotesting shall be carried out as per approved procedure by Contractor with a view that completion of all activity for						

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	successful hydrotesting is not inordinalely extended which will hamper the overall project schedule.						
ML-11	**PRE-COMMISSIONING AND ASSISTANCE IN COMMISSIONING OF PIPELINE SYSTEM**						
	Swabbing, vaccum drying, purging with nitrogen of the complete pipeline network and the associated facilities being installed to the specified acceptance criteria, carrying out pre- commissioning works, providing assistance during the complete duration of commissioning operations for entire pipeline network system including supply of all equipment, man-power, consumables (including pigs & nitrogen required for purging with maintaining nitrogen column of mininum 10% of pipeline geometric volume) materials for all temporary works and performing all associated works, complete as per the relevant specifications, other provisions of Contract document and instructions of Engineer-in-charge.						
	For 6" NB Line	Meter	2500		0		

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ML-12	**IDLE TIME PRESERVATION OF PIPELINE**						
	Preservation of complete pipeline and associated facilities forming part of the pipeline as per Bid document and its maintenance including supply of all consumables, all equipment, man-power, etc. complete as per the requirements of specifications, other provisions of Contract document and instructions of Engineer-in-charge.						
	Note : Owner reserves the right to exercise either or none of the rates below.						
12.1	By filling and pressurizing with nitrogen to a pressure of 2 bar(g) for a period of one month.						
iii)	For 6" NB Line	Meter	2500		0		
12.2	For every additional period of one month or proportionately						
iii)	For 6" NB Line	Meter	2500		0		
ML-13	**LONG RADIUS BENDS**						
	Supply of Long Radius Bends (R = 3D) for 6" dia.pipe, (thk.6.4 mm) as per specification enclosed in Tender Document. (Installation of bends is included in the pipeline laying and measured along with the pipeline)						

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13.1	22.5 ° and lower MSS-SP-75, Gr. WPHY-42, 6.4 mm thk.	Nos.	3		0		
13.2	23 °- 45°, MSS-SP-75, Gr. WPHY-42, 6.4 mm thk.	Nos.	2		0		
13.3	46° - 60°, MSS-SP-75, Gr. WPHY-42, 6.4 mm thk.	Nos.	2		0		
13.4	61° - 90°, MSS-SP-75, Gr. WPHY-42, 6.4 mm thk.	Nos.	2		0		
ML-14	**VALVE ERECTION**						
	Handling including lifting and transportation from COMPANY'swarehouse to CONTRACTOR'S Stores and/or work site and installation of all types of valves, including assembly of valve accessories, (if any) by bolting, threading or welding, supply and insertion of gaskets, nuts & bolts, nipples, etc. at all elevations of pipe sleepers, supports or overhead on racks, equipments nozzle, skid & painting etc. supply of all consumables, manpower, equipment, etc. for completion of all works as per scope of work and as per drawings, specifications and instructions of Engineer-in-charge including						

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	servicing/ cleaning of valve wherever requried.						
	Erection of all types of valves in valve pits on underground pipe lines						
	6"NB	Nos.	3		0		
	Note: 2" & Below Valves shall be in contractors scope of supply.						
15.2	**FLANGES**						
15.2.1	Weld Neck (B-16.5, A105(Charpy), 125 AARH, RF, 300#) raised face flanges along with fasteners (A193, Gr. B7, B 18.2 for black studs & A194 Gr. 2H B 18.for black nuts) & Sp.WND SS grafill gaskets (B16.20 & B16.5)						
	(End Thickness to match pipe thickness)						
	6"NB	Nos.	4		0		
15.3	**Weldolet**						
	6x2"	Nos.	4		0		

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15.4	**Figure 8 / Spacer & blind set or spectacle blind (B16.48, A105N charpy, 125 AARH)**						
	6"NB	Nos.	4		0		
15.5	**90" Elbow, R=1.5 D (A234 WPB(charpy), B 16.9)**						
	6" NB	Nos.	4		0		
ML-16	**Construction of Valve pits for Steel Line**						
	Construction of Valve Pits for Steel line as per the enclosed drawing and specification. The item includes supply of all the material including Pre-cast RCC cover, shuttering, reinforcement, labour,curing etc. as per the drgs, specification and instruction of EIC.						
	As per drawing with vent lines & horizontal tap off from mainline. Having internal size of 2000mm x1200mm	Nos	1		0		
ML-17	**Supply and installation of PE Isolation Valves**						
	Supply of isolation valves (as per data sheet) and installtion of valves in the valve pits as per typical drawing and specification enclosed and instructions						

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	of Engineer-in-charge. Payment of valve pits shall be paid separately as per SOR item No: 18						
	PE Valve 125 / 90mm dia	Nos.	3		0		
ML-18	**Construction of Valve pits for MDPE line**						
	Construction of Valve Pits as per the enclosed drawing and specification. The item includes supply of all the material including Pre-cast RCC cover, shuttering,reinforcement,labour,curing etc as per the drgs ,specification and instruction of EIC.						
	Type- having Internal size of Minimum 500x500mm (for 125 mm PE Valve) - RCC type	Nos.	3		0		
ML-19	**Supply of hard barricading**						
19.1	Supply, placement & handling hard barricading, as per the drawing in the tender document. The item includes supply of all materail for fabrication, welding, painting, lettrering etc. complete in all respect. On completion of work the barricading are to be returned back to BGL designated yard**. Before start of**	Nos.	10		0		

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	fabrication works, written approval from EIC to be taken						
A	**Total Amount (all inclusive except GST) in Rs.**				**-**		
2-(I)	**CATHODIC PROTECTION WORKS**						
Sl. No.	**Description of Item**	**Unit**	**Quantity**	**Unit Rate (all inclusive except GST) in Rs.**	**Total Amount (all inclusive except GST) in Rs.**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**		
					(4) x (5)		
TCP-1	**TEMPORARY CATHODIC PROTECTION SYSTEM**						
1.1	Survey, Design, detail engineering of the temporary Cathodic protection system using Mg (Min 3.0 Kg Each)/ Zn galvanic anodes to protect the external surface of **6" dia** , 3LPE Coated pipeline in the Geographical Area (GA) of Hyderabad against corrosion for a design life of minimum 2 year as						

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	per standard specification enclosed with the tender for temporary cathodic protection system, approved design document, data sheets & drawings. Scope shall also include but not limited to the following for completion of jobs:						
a)	Measurement of soil resistivity along the right of way of the main pipeline & take atleast one soil sample for one pipeline section for its chemical & microbial analysis along the pipeline route as per specification for corrosion survey MEC/TS/05/21/016C.						
b)	Collection of additional data related to cathodic protection along the right of way of pipeline as per standard specifications.						
c)	Design, Detailed Engineering, Preparation of Design Document, Preparation of Test station schedule & Bill of Material as per the corrosion survey & Chemical analysis of Soil / Water samples for Temporary Cathodic Protection system.						
	6" Pipeline section from IJ to IJ with varying length and for requisite No. of sections	m	2500		0		

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	Note: Design shall be carried out from Insulation Joint to Insulation Joint. Each stretch of length will be vary from location to location						
1.2	Manufacturing, Inspection/FAT (Factory acceptance test), supply, Packing, transportation to site, storage, installation, testing & commissioning of the temporary Cathodic protection system using Mg (Min 3.0 Kg Each)/ Zn galvanic anodes to protect the external surface of **6" dia** , 3LPE Coated pipeline in the Geographical Area (GA) of Hyderabad against corrosion for a design life of minimum 2 year as per standard specification enclosed with the tender for temporary cathodic protection system, approved design document, data sheets & drawings. Scope shall also include but not limited to the following for completion of jobs:						
2-(I)	**CATHODIC PROTECTION WORKS**						

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a)	Supply, installation, testing & commissioning of Mg/ Zn Galvanic anodes including carrying out Thermit welding on main pipeline, suppy of clits, cables to conenct to anodes as per the standard specification- MEC/TS/05/E9/016A. The weight of the Mg Anode & the total nos. of anodes shall be calculated as per the result of corrosion survey, soil chemical analysis, total weight and current requirement of the pipeline section. However, Min one anode is to be installed at every one KM with test station. The scope of work includes the the following:and also to be carried out as poer approved design including supply of all item						
b)	Supply, Installation, Testing & commissioning of Test stations (Big Size & Normal Size) weather proof (IP-55) as per specification & enclosed drawings.						
c)	Supply, installation, testing & commissioning of one set of spark gap arrestor 100 kA (Solid State) across each insulating joint provided at tap-off, SV & various consumer terminals as per scope of work / specification. The un-protected/above ground pipeline shall						

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	be earthed through GI earth electrodes with separate earth pit. The resistance of grounding shall be limited to 5 ohms max.						
d)	Supply, installation, testing & commissioning one set of polarization cell (Solid State) with zinc anode at all high tension electrical power transmission line/equipments /railway tractions (all 66 KV & above) crossing or running parallel to the pipeline for grounding purpose as per specification. The rating shall depend upon anticipated fault current & ground bed resistance at the location of installation. However, the rating of polarisation cell (solid state) shall not be less than 3.7 KA @ 30 cycle & number of 20 kg net weight zinc anode shall not be less than two.The resistance to earth of grounding shall be limited to 5 ohms max.						
e)	Supply & installation of Zinc Ribbon Anodes at 4-8 O'clock position in the interval of 2 meter (max.) on carrier pipes where casing pipe is coated and no addtional protection for carrier pipe where casing is bare which also includes Zn						

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	bentonite filling b/w carrier & casing cased crossings i.e. roads etc as per specification & Scope of work.						
f)	Bonding in between pipelines running parallel or crossing as required.						
g)	Supply, Laying of HDPE/PVC sheets between the GAS pipeline and the other CP protected foreign pipelines at the crossing locations for providing electrical isolation.						
h)	Earthing of above ground catholically unprotected pipeline at , SV, R/T & D/T etc, as applicable the earth electrode shall be 65 mm dia, 4.5 mm thickness & 3000mm long.						
i)	Supply, installation, testing & commissioning of Electrical resistance Probes (1 No. with 1 no. of ER probe reading Instrument)(if applicable) utilizing the electrical resistance technique shall be provided along the pipeline at marshy areas and at vulnerable locations to monitor the external corrosion activity on the pipeline.						

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	Location of external ER probe shall be decided during detail engineering.						
j)	Supply, installation, testing & commissioning of Polarisation coupons (2 Nos.) (if applicable) have one side exposed area of 100 mm x 100 mm with 2 nos. of spare coupons shall be provided along the pipeline at marshy areas and at vulnerable locations to monitor the external corrosion activity on the pipeline as per enclosed standard specification. Location of external Polarisation coupons shall be decided during detail engineering. Magnetic devices for operation of magnetic switch shall be provided.						
k)	Supplying,laying ,testing of 35 ,25,10 ,6 sq.mm, 600/1100 V grade copper cables XLP insulated /PVC sheath of including excavation in soil or rock of minimum 1.2m depth below GL,						
l)	Making cable to pipe jointing by thermit welding/Pin brazing (for charged pipeline) for 35 ,25,10 ,6 sq.mm copper cable including						

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	excavation and exposing piping , recoating with epoxy, testing etc.						
m)	Monitoring of the TCP system till commissioning of PCP system & handing over of the pipeline system to BGL.						
n)	All civil/ structural works related to TCP system including supply of bricks, cement & steel etc. required for completion of the system.						
iii)	6" Pipeline section from IJ to IJ with varying length and for requisite No. of sections	m	2500		0		
B	**Total Amount (all inclusive except GST) in Rs.**				**-**		
3-(I)	**PIPING & MECHANICAL WORKS**						
Sl. No.	**Description of Item**	**Unit**	**Size**	**Rating/ Thk.**	**Quantity**	**Unit Rate (all inclusive except GST) in Rs.**	**Total Amount (all inclusive except GST) in Rs.**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
				Sch.			**(6) x (7)**
PP-1	**PIPING (ABOVEGROUND)**						

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-	Transportation including loading, unloading & handling of all piping items (6", 4" NB pipes & valves are free issue items) from Owner's and/ or Contractor's storage point to work site/ workshop as applicable, complete work of fabrication, erection, painting, testing of pipes, flanges and fittings, insulation joints and making ready for further Commissioning / Start-up of carbon steel piping of all sizes and ratings including supply of all consumables, equipment, manpower and other resources and execution of, but not limited to, the following works in accordance with relevant specifications & scope of work, drawings, specification and instructions of Engineer-in-charge and as per all provisions of the CONTRACT DOCUMENT. **Note : Valve erection shall be paid through separate SOR**						
-	Fabrication including cutting, edge preparation, inclusive of grinding the edges of pipes, fittings, flanges etc. to match with the matching edges of uneven/different thickness wherever required, welding, attachment of all pipe fittings like elbows, tees, reducers. Supply of nipples,						

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	couplings,caps, plugs, gasket, stud bolts, nuts, U Clamps etc. as required for completion of job.						
-	Checking, cleaning, aligning, bending, cutting and bevelling (as required) of pipes for welding and field adjustments including pipe fittings, welding, carrying out non-destructive testing of welds as required including 100% radiography by Gamma-ray and providing all requisite equipment, labour, supervision, materials, films, consumables, all facilities and personnel to process, develop, examine and interpret radiographs and other tests as required, carrying out repairs of weld joints found defective by Engineer-in-Charge, carrying out re-radiography / x ray and other tests as required on repaired joints.						
-	Fixing/ Installation of weldolets, sockolets, flanges, vent and drain point connection etc., including providing stub-in connections, fabricated fittings and reinforcement pads etc., as required.						

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-	Erection including prior cleaning, lifting, placing on pipe sleepers and supports, overhead on racks, skids and at all elevations including installation and carrying out connected activities for all types of valves including supply and fixing of gaskets, studs/ bolts, nuts wherever required for all sizes, levelling, aligning, joining of flanges, blind flanges, connecting with equipment, nozzles, strainers, tie-in with existing piping/facilities, etc. tapping for inline instruments like pressure gauges, thermowells, sample connection, etc.						
-	Preparation of final bill of material based on piping GADs.						
-	Preparation of isometric and fabrication drawings.						
-	Carrying out Non-destructive testing as required except items mentioned in sl. no. 5 of SOR.						
-	Surface preparation before application of primer by means of sand blasting including supply of approved quality of dry abrasive, manpower, machineries, tools & tackles to achieve required roughness as per specification and as per instruction of Engineer-in-charge.						

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-	Painting of entire system (including aboveground all pipes fittings, flanges and accessories) as per specification MEC/S/05/21/07 including supply of approved paints and primers, application of primer and paints, indentification lettering/ numbering, colour coding, etc. as specified including rub down & touch up of shop primer or scrapping of shop primer wherever required by COMPANY and providing scafolding for all heights etc.						
-	Cleaning and flushing by water/ compressed air, testing of the systems including hydrostatic, pneumatic and any other type of testing as specified, draining, drying by compressed air/other methods approved by COMPANY.						
-	Precommissioning & making operational all piping system and equipments and provide all necessary assistance in term of supply of man-power, equipment, tools and tackles required amount of nitrogen for purging of entire terminal piping system including equipments etc. to the company during commissioning activities.						

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-	Clean-up and restoration of site, preparation of as built drawings, documents and project records; transportation of surplus free issue material to Owner's designated plac(s); completing all works in all respects as per the AFC drawing, specifications, standards and other provisions of Contract and instruction of Engineer-in-charge.						
-	Completion of all such work in all respects as per scope of work and as per drawings, specifications and instructions of the Engineer-In-Charge and keeping the system ready in all respects for further commissioning and start up.						
-	Hook-up works including making provision for hooking up and carrying out shutdown activities at terminals if necessary.						
1.1	Complete Carbon Steel Piping Work with painting including all fittings, flanges and supply of all required gaskets, studs bolts & nuts etc. as described under item 1.0 above						
1.1.1	Pipes of different grades and thickness	m	4" NB		120		0

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PP-2	**SUPPLY & ERECTION OF ASSORTED PIPE, FITTINGS AND FLANGES AND INSULATION JOINTS**						
	Complete work of supply of pipes, fittings and flanges , insulation joints including all taxes, duties, transportation and inspection charges but not limited to, the following items in accordance with relevant specifications indicated in clause of SCC & scope of work indicated in SCC, drawings, specification and instructions of Engineer-in-charge and as per						
-	Handling including lifting, transportation from Contractor Stores to CONTRACTOR's workshop for fabrication and/ or to work site for field fabrication and erection for all piping items						
2.1	**CARBON AND STEEL PIPES**						
2.1.1	CS Pipe Sch.80 API 5L, Gr. B, PSL-2, Seamless, BE / ASTM A106, Gr. B (Charpy), Seamless, BE	m	2" NB	S80	30		0
2.1.2		m	1½" NB	S80	5		0
2.1.3		m	1½" NB	XS	5		0
2.1.4		m	1" NB	S80	5		0
2.1.5		m	1" NB	XS	5		0
2.1.6		m	¾" NB	S160	5		0

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2.1.7		m	½" NB	S160	5		0
2.2	**FLANGES**						
	Weld Neck (B-16.5, A105(Charpy), 125 AARH, RF)						
2.2.1	(End Thickness to match pipe thickness)	Nos.	6"	300#	5		0
2.2.2		Nos.	4"	300#	5		0
2.2.3		Nos.	2"	300#	4		0
2.2.4		Nos.	1½" NB	S80	2		0
2.2.5	Socket Welded (B-16.5, A105, 125 AARH, SW end to B16.11)	Nos.	¾"	300#	2		0
2.2.6	**Blind Flanges (B-16.5, A105 (Charpy), 125 AARH, RF**	Nos.	6"	300#	2		0
2.2.7		Nos.	4"	300#	2		0
2.2.8		Nos.	2"	300#	2		0
2.2.9		Nos.	¾"	300#	2		0
2.3	**ELBOW**						
2.3.1	90° Elbow (A234, Gr. WPB (Charpy), B-16.9, 1.5D), BW	Nos.	6"	S40	5		0
2.3.2		Nos.	4"	S40	5		0
2.3.3		Nos.	2"	XS	5		0
2.4	**TEE**						
2.4.1	Equal Tee (A234, Gr. WPB (Charpy), B-16.9, 1.5D), BW	Nos.	2"	XS	5		0
2.4.2		Nos.	4"	S40	2		0
2.4.3		Nos.	6"	S40	3		0

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	Unequal Tee (A234, Gr. WPB (Charpy), B-16.9, 1.5D), BW						
2.4.4		Nos.	4" x 2"	S40 x XS	2		0
2.5	**REDUCER**						
	Concentric Reducer (A234, Gr. WPB (Charpy), B-16.9)						
2.5.1		Nos.	4" x 3"	S40	1		0
2.5.2		Nos.	6" x 4"	S40	2		0
2.5.3		Nos.	4" x 2"	S40	2		0
2.6	**SOCKOLET** (A105, SW)						
2.6.1		Nos.	4" x ¾"	3000#	3		0
2.6.2		Nos.	4" x 1"	3000#	3		0
2.7	**WELDOLET (**A105 (Charpy), BW**)**						
2.7.1		Nos.	6" x 2"	7.9 x XS	5		0
2.8	**INSULATING JOINTS** (As per Standard Specification and Data Sheets enclosed)						
2.8.1		Nos.	6"	300#	2		0
			4"	300#	2		0
	Note: A) All butt welded fittings end shall generally match with connecting pipe wall thickness however in case of misalignment Contractor shall						

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	have to do end preparation without any extra cost.						
	B) All coupling, nipples etc. as required shall be supplied by contractor but no separate payments shall be made as it is covered under erection rate.						
PP-3	**SUPPLY OF VALVES & INSTALLATION**						
	supply and installation of valves including all taxes,duties,transportation and inspection charges in accordance with relevant Specifications & relevant Data Sheets indicated in scope of work indicated in SCC, drawings, specification and instructions of EIC and as perall provisions of the CONTRACT DOCUMENT and Installation						
3.1	Plug Valves						
3.1.1	RF	Nos.	2"	300#	3		0
3.1.2	BW	Nos.	2"	300#	3		0
3.1.3	SW	Nos.	1½ "	800#	2		0
3.1.4	SW	Nos.	1"	800#	2		0
3.2	Ball Valves						
3.2.2	RF, FB	Nos.	2"	300#	3		0

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3.2.4	BW, FB	Nos.	2"	300#	3		0
3.2.5	SW, FB	Nos.	1"	800#	3		0
3.2.6	SW, FB	Nos.	¾"	800#	3		0
PP-4	**ERECTION and installation OF VALVES**						
	Handling including lifting and transportation from COMPANY's warehouse to CONTRACTOR'S Stores and/or work site and installation of all types of valves including assembly of valve accessories, (if any) by bolting, threading or welding, supply and insertion of gaskets, nuts & bolts, nipples, etc. at all elevations of pipe sleepers, supports or overhead on racks, equipments nozzle, skid & painting etc. supply of all consumables, manpower, equipment, etc. for completion of all works as per scope of work and as per drawings, specifications and instructions of Engineer-in-charge including servicing/ cleaning of valve wherever requried. For 6" NB valves are under free issue items.						
4.1	**Butt welded Valves (Full Bore/ Reduced Bore)**						
4.1.1	Ball valves BW, FB/ RB	Nos.	6"	300#	3		0

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4.1.2	Ball valves BW, FB/RB	Nos.	4"	300#	4		0
PP-5	**Installation of MRS/DRS**						
5.1	Handling, including lifting, transportation from Company's stores at Hyderabad to Contractor's work-shop for fabrication or/ and to worksite for field fabrication, assembly of parts/ sub- assemblies erection for all vessels, equipments, skid supplied by company above ground/ underground at all elevation/ depth, fixing of foundation bolts welding wherever required, alinging, grouting, hooking-up, cleaning and flushing by water draining, drying by compressed air providing all mountings, ancilliary, enabling works as required and completing in all respect as per drawings, specification and instruction of Engineer-in-charge. Contractor's scope shall include supply of all material and accessories including but not limited to any fixtures, clamps, gasket, nut bolts, finish coat of painting including rub down & touch up of shop primer/ paint scrapping of shop primer/ paint and further their painting after	Nos.			1		0

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	application of primer as per specification, wherever required by Company.						
C	**Total Amount (all inclusive except GST) in Rs.**						-
3-(II)	**CIVIL WORKS**						
Sl. No.	**Description of Item**	**Unit**	**Quantity**	**Unit Rate (all inclusive except GST) in Rs.**	**Total Amount (all inclusive except GST) in Rs.**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**		
					(4) x (5)		
CIV-1	**SITE CLEARANCE**						
a)	**DEMOLITION OF R.C.C./BRICKS/STONE MASONARY**						

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	Site clearance by demolition of R.C.C./Brickwork/Stone masonry/ Stone soling, Flexible pavements (including steel bars)etc.,alongwith removing the debris and disposal of unserviceable material to any lead and staking of serviceable materials, handing over serviceable material to concerned department if required as per technical specifications and direction of Engineer-in-charge.	M3	2		0		
b)	**TREE CUTTING**						
	Tree cutting (only of girth more than 30 cm shall be counted for payments) including royalties, disposal, taking approval from competent authorities etc. all complete, as per technical specifications and direction of Engineer-in-charge.	Nos.	2		0		
CIV-2	**EARTH WORK IN EXCAVATION/ SITE GRADING AND BACKFILLING**						

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a)	Earth work in excavation,site grading and backfilling in all kinds of soil including soft rock in any plan dimension up to 3.0M depth including disposal of excavated surplus and unserviceable earth up to any lead in all conditions. Soil to be leveled and neatly dressed complete in all respect as per scope of work, detailed construction drawings, as per technical specifications and directions of the Engineer-in- charge.	M3	50		0		
CIV-3	**EARTH WORK IN EXCAVATION/ SITE GRADING IN HARD ROCK**						
a)	Earth work in excavation in hard rock requiring blasting for all type and size of foundations in any plan dimension up to required depth including disposal of excavated material up to any lead in all conditions, and disposal of surplus and unserviceable material. Surface to be leveled and neatly dressed complete in all respect as per scope of work, detailed construction drawings and directions of the Engineer-in-charge.	M3	30		0		

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CIV-4	**EARTH WORK IN FILLING**						
a)	Earth work in filling with good quality imported earth from approved source in the layers of 150 mm and compacted up to 95% to its MDD up to 3 m depth and any plan dimension including all testing, watering, rolling each layer with 1/2 tonne roller or wooden or steel rammers, and dressing / filling up ground depressions etc. complete in all respect as per scope of work, detailed construction drawings , as per technical specifications and directions of the Engineer-in-charge.	M3	30		0		
CIV-5	**PLAIN CEMENT CONCRETE**						
a)	Supplying and laying plain cement concrete with stone aggregate 20mm down grade (including shuttering if required) in all types of concrete works including levelling courses below foundations, columns, pedestals, pedestal bases, pipe supports,floors, chambers, cable trench, under floors and any other locations (which are not covered as						

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	part of composite items) , at all levels and locations as per drawings, specifications and directions of the Engineer-in-charge.						
	i) 1:2:4	M3	8		0		
	ii) 1:4:8	M3	8		0		
CIV-6	**REINFORCED CEMENT CONCRETE**						
	Providing and laying RCC (reinforced cement concrete) of grade M-25 with 20mm and down grade crushed stone aggregate in all types of structures like Beams, foundations, walls, columns, pedestals, pedestal bases, pipe supports, sleepers, cable trench, RCC retaining wall foundation for boundary wall including construction joints, shuttering at all depths and levels complete as per drawings, specifications and directions of the Engineer-in-charge.						
	i) Sub structures	M3	10		0		
	ii) Super structures	M3	5		0		

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CIV-7	**REINFORCEMENT STEEL**						
	Supplying and Fabricating and Fixing in position HYSD Steel Reinforcements/ TMT Grade Fe-415 conforming to IS1786-1985 at all levels (all deapth & hights) and positions including the Cost of transport, Straightening, Cutting, Bending, Cranking, Binding, Welding, Provision of necessary Chairs and Spacers, Preparation of bar bending schedule, getting the same approved by EIC etc., complete as per Drawings and Specifications and including Cost of binding wire, Labour etc., all complete in all respects as per scope of work, detailed construction drawings, technical specifications and direction of Engineer-in-charge. The chairs and spacer bars provided will not be Measured for payment.	MT	2		0		
CIV-8	**BRICK WORK**						

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	Providing and laying brick work with brick class designation M-7.5 of IS:1077 in Cement Mortar 1:4 (1cement : 4 sand) in steps, compound wall, drains, or at any other location at all depths & height for all leads including providing required finishes, curing, scaffolding, etc., complete as per specifications and drawings with all bye-works as per direction of the Engineer-in-charge.	M3	20		0		
CIV-9	**DELETED**						
CIV-10	**Concertina coil**						
	Supply and fixing of 610 mm dia hot dip galvanized barbedrazor tape concertina coil fencing each coil having 80 circles,200 clips with optimum openable stretch of 8 mtrs length supported/tied with two rows of same razor runner wires to the existing 'Y' angle at the top and one run wire at the bottom with 'U' nails, clips etc., complete as per manufacture's specification, drawings and site engineer's instructions. Measurement shall be based on the	rm	20		0		

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	length of the compound wall.GENERAL SPECIFICATION OF CONCERTINA : Razor Strips: 0.5mm thick hot dip galvanized width 19 mm (Before wrapping on central core wire) and wrapped on central core GI wire of 2.6 mm dia. Zinc coating of 120 g/m2. Central core GI wire : UTS 145-160 Kg/mm2; Zinc coating 250-300 gm/m2; diameter 2.6 mm Clips: GI 1.6 mm thick.						
CIV-11	**PAVER BLOCK FLOORING**						
	Supply , construction and handing over of CC inter locking paver block 80 mm thick, I shape, rough finish, M-30 strength of approved brand laid over the sand bed of minimum 50 mm thick. The CC interlocking blocks to be of uniform Grey colour or as approved by EIC complete in all respects as per scope of work, detailed construction drawings, technical specifications and directions of the Engineer-in-charge.	M2	100		0		
CIV-12	**KERB STONE FIXING**						

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	Providing and fixing precast concrete Kerb stones (125 wide X 300 deep) of M-25 grade or equivalent of approved make and shape at or near ground level as per approved pattern and setting in position with cement mortar 1:3 (one cement : 3 coarse sand) including the cost of required centering, shuttering and finishing smooth with 6 mm thick cement plaster 1:3 (1 cement : 3 fine sand) wherever required over 75 mm thick PCC M-10 levelling course, complete in all respects as per scope of work, detailed construction drawings, technical specifications and directions of the Engineer-In- Charge.	Rm	30		0		
CIV-13	**SAND FILLING**						
	Supplying and filling Sand in maximum 300 mm thick layers and compacting by rolling, ramming, consolidating and dressing the surface including cost of sand (zone-II/Zone-III sand only) complete in all respect as per scope of work, detailed construction drawings as per technical specifications and directions of the Engineer-in-charge.	M3	25		0		

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D	**Total Amount (all inclusive except GST) in Rs.**				-		
3-(III)	**STRUCTURAL WORKS**						
Sl. No.	**Description of Item**	**Unit**	**Quantity**	**Unit Rate (all inclusive except GST) in Rs.**	**Total Amount (all inclusive except GST) in Rs.**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**		
					(4) x (5)		
ST-1	**Steel structure Fabrication & Erection**						
	Supply ,fabrication and erection of all types of pipes supports like clamps saddle,guide stops,cradles,turn buckles,anchors,T-post,stockade/trestle and pipe bridge for over head piping ,approach ladders and platform,crossover,cable tray supports,etc. including painting as per painting specification(Bolts,nuts,washer,U-clamps etc. shall be supplied by the contractor within the rates quoted.These items will not be measured and paid seperately).The work is to be completed in all	KG	100		0		

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	respect as per drawings and techanical specification and direction of the Engineer-in-Charge						
E	**Total Amount (all inclusive except GST) in Rs.**				**-**		
3-(IV)	**ELECTRICAL WORKS**						
Sl. No.	**Description of Item**	**Unit**	**Quantity**	**Unit Rate (all inclusive except GST) in Rs.**	**Total Amount (all inclusive except GST) in Rs.**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**		
					(4) x (5)		
EL-1	**EARTHING**						
	Supply, installation, testing & commissioning of the complete earthing system, earth electrodes/pit, earth main ring, earthing of metering skid, electrical equipments, instrument panels, field instruments, process equipments & pipes / flanges and accessories such as GI wire, wire rope and all balance earthing						

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	material as per the specification including all associated civil work with all material & labour as per specification & drawings approved by the company.						
1.1	Earth Electrodes including earthpit with 6 mm thick chequered plate cover	Nos.	5		-		
1.2	GI Strip (25 x 5) mm WITH pvc Pipe & cable	Meters	30		-		
F	**Total Amount (all inclusive except GST) in Rs.**				**-**		
3-(V)	**INSTRUMENTATION WORKS**						
Sl. No.	**Description of Item**	**Unit**	**Quantity**	**Unit Rate (all inclusive except GST) in Rs.**	**Total Amount (all inclusive except GST) in Rs.**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**		
					(4) x (5)		
IN-1	**Supply, Calibration and Installation of instrumentation items listed below**						

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1.1	Pressure Gauges, Pressure Rating 300# Pressure Range 0 - 50 Kg/cm2 (Includes supply of two isolation valves per each gauge to provide double isolation)	Nos.	4		0		
1.2	Temperature Gauges [Range 0 - 100°C]	Nos.	4		0		
G	**Total Amount (all inclusive except GST) in Rs.**				-		
	TOTAL AMOUNT OF A+B+C+D+E+F+G				-		
	GST…..% ON OVERALL SOR				-		
	TOTAL AMOUNT INCLUSIVE GST				-		

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