

1. SCOPE OF WORK

The Scope of Work under this contract shall in general include design, supply, construction, finishing and execution of all civil-structural works for all type of structures in “Supply, laying, installation, testing & commissioning including all fittings, crossings for 1500mm dia. PCCP Pipeline for Water Supply Project At GIDC Jhagadia Estate Project” as per Engineering Design Basis, the detailed Scope of work, Scope of Supply, Schedule of Rates (SOR)/ Bill of Quantities (BOQ), Specifications, Standards, Drawings, Codes, good engineering practices and directions of Engineer-in-Charge etc. all complete.

The scope of work has been elaborated in detail under subsequent clauses of this document as well as respective SOR/ BOQ.

Contractor shall visit the sites to ascertain actual site conditions to quantify/ assess the job himself before quoting rates. No extra claim at a later date shall be entertained due to non-familiarization of site.

Major structures shall include the following but not limited to the same:

- i. Valve Pits.
- ii. Pipeline Thrust Blocks etc.

Major civil-structural activities involved under this tender shall include the following but not be limited to the same:

- 1.1. Design of valve pits, thrust blocks and any other structures as deemed required by engineer-in-charge for satisfactory completion of the project shall be in contractor's scope. Engineering cost to be included while quoting for material items provided in SOR/ BOQ.
- 1.2. Earthwork in excavation including dewatering, if required, below ground level for all types of soils including soft and hard rock and providing shoring & strutting, where required, by open & close timbering method. Royalty payment for excavation items, if any, shall be in contractor's scope.
- 1.3. Storing/stacking excavated earth at safe location near foundation or at designated place for reuse as instructed by Owner/ Engineer-in-charge. Segregating unserviceable earth separately and disposing the same at designated place as instructed by Owner/ Engineer in charge.
- 1.4. Backfilling at all depths with selected and approved earth available from excavated soil and transportation & disposal of surplus earth and debris (including rock material) to the designated areas with due approval of Engineer-in-Charge.
- 1.5. PCC work including lean concrete at all depths below foundations of all types, plinth beams, walls, non-suspended slabs, trenches, pits etc., and in screed at all depths below plinth level.
- 1.6. PCC works including lean concrete in screed at all heights above plinth level.
- 1.7. RCC works in sub-structures for foundation of all types, plinth beams, walls, non-suspended floor slabs, etc. at all heights, trenches etc. at all depths, including preparation of detailed bar

bending schedule and supplying and placing of reinforcement in position as shown in the drawing.

- 1.8. RCC works in super-structure at all elevations, columns, beams, walls, floor & roof slabs, etc. at all heights, including preparation of detailed bar bending schedule and supplying and placing of reinforcements in position as shown in the drawings.
- 1.9. Supply, cutting, bending, binding, fixing of reinforcement bar of grade Fe 500D (TMT) for RCC works in sub-structure at all depths and in super-structure at all heights.
- 1.10. Supplying and mixing of approved brand of bipolar concrete penetrating corrosion inhibiting admixture in concrete in superstructure and substructure as per manufacturer's specification and EIL Specification for protection of reinforcement against corrosion.
- 1.11. Epoxy resin (prepared as per manufacturer's recommendation) for bonding of fresh concrete to old concrete in all types of structure at all depths and heights.
- 1.12. Centering & Shuttering (including curved shuttering) in sub-structure at all depths and in super-structure at all stages/heights/ elevations at different stages of concreting.
- 1.13. Curing of RCC works at all depths below plinth level and all heights above plinth level as per specification.
- 1.14. Dismantling/Demolishing of PCC/RCC, masonry work (brick/ stone/ block) etc. for all depths below & above plinth level.
- 1.15. Compacting the sub-grade/ foundation beds at all depths as per the direction of Engineer-In-Charge before placing of foundations.
- 1.16. Structural steel works with rolled steel, parallel flange and built-up sections including supply, fabrication, erection and preparation of detailed fabrication drawings for all types of structures at all locations and heights in super-structure.
- 1.17. Surface preparation and applying shop primer & final paint (wherever applicable) to the structural steel members as per specifications and taking up of the repair works at field to cover the damages (if any), during the course of erection.
- 1.18. Fabrication & placing/ erection of miscellaneous steel items like Anchor Bolts, Metal Insert Plates, Anchor Fasteners, Rungs, Pipe Sleeves etc. as per standards/ specifications or as directed by Engineer-in-charge at any location wherever required.
- 1.19. Dismantling of steel structures wherever required.
- 1.20. Providing & fixing MS chequered plates at all heights on structures.
- 1.21. Providing anchor fasteners to fix structures/ pipe supports etc. on pavement/ foundations/ structures.
- 1.22. Preparation of AS-BUILT mark-up prints on AFC drawings and subsequent updating of the same in soft copy (Auto Cad) of AFC drawing and submission of hard copy and soft copy to Engineer-in-charge as specified elsewhere in this Bid package.

- 1.23. Removal of scrap generated during construction/ demolition/ dismantling, including segregation of scrap into serviceable and unserviceable material and transportation of serviceable material to Owner's storage.
- 1.24. Clearing and removal of debris including clearing the site of all unserviceable material from the site after completion of work and disposal of the same at a designated area as directed by Engineer- in- charge.
- 1.25. Fabrication of structural steel at contractor's workshop with rolled steel, parallel flange, built-up sections using rolled/ parallel flange and/or with plates including supply of material as per scope of supply, transportation, unloading, assembly, preparation of detailed fabrication drawings using TEKLA, Autodesk Advance Steel or similar 3D modeling software, including submission of design calculation for connections, submitting structure wise master index of drawings, erection drawing having marking of all member/assembly and sequence of erection. Connections in fabrication drawing shall be prepared only after review of connection details by owner. Final TEKLA model shall be submitted to OWNER which shall include all fabrication drawing, related attribute files, profile catalogue, MTO report etc.
- 1.26. Obtaining all approvals from owner, statutory authorities such as Factory Inspector, Local Municipal or Development Authorities and other designated authorities etc. for all necessary works included in the tender.
- 1.27. Any other structural work, not specifically mentioned herein, but required for the satisfactory and successful completion of the project as per directions of the Engineer-in-Charge shall also be in the scope of the contractor.

2. SCOPE OF SUPPLY

2.1. Owner's scope

NIL

2.2. Contractor's scope

Procurement and supply of all materials (consumables / non-consumables) including materials, tools, tackles, plant machinery, workers/labors etc. required for completion of all civil-structural works as per Schedule of Rates shall be in contractor's scope of supply and shall be the responsibility of Contractor within the quoted rates.

All material shall be of approved brand/ make as per the list of approved brand/ vendors for Civil Structural items attached elsewhere in the contract. However, in case of any deviation from the list of approved brand/ vendors, prior approval from Owner/ Engineer In-charge shall be obtained prior to use of the material at site.

3. SPECIFIC REQUIREMENTS

Note: In case of any contradiction between Specific Requirements mentioned below and Requirements/Specification specified elsewhere in the tender document, the Specific Requirements given below shall have precedence.

- 3.1. Mandatory use of mechanical excavators for excavation, however manual excavation for minor foundation can be taken up after due approval of Engineer-in-Charge.
- 3.2. Mandatory installation of weigh batching plant of adequate capacity for concrete along with transit mixers and concrete pumps/ usage of Ready-Mix Concrete (RMC) as per the direction of Engineer-in-Charge.
- 3.3. Location for borrow areas/ disposal of surplus earth, debris & rock etc. to be identified by the contractor. Contractor shall obtain relevant statutory approval from all statutory authorities (like municipal etc.) and including payment of charges/ royalty/ octroi for the same. Contractor shall keep client indemnified of any liability and/ or complaint from local authorities/ municipal bodies.
- 3.4. For cutting & bending of rebars mechanized equipment/ cutting-bending machine shall be used.
- 3.5. Generally, the use of one of the following cements shall be considered
 - 43 Grade Ordinary Portland cement as per IS: 8112.
 - 53 Grade Ordinary Portland cement as per IS: 12269.
 - Portland Slag cement conforming to IS: 455. (Not applicable when chloride-based admixture are in use).
 - Portland Pozzolona Cement (PPC, Fly ash based) cement conforming to IS: 1489 Part-1.
 - Portland Pozzolona (Clacined clay based) conforming to IS: 1489 Part-2.
 - Sulphate resistant Portland cement conforming to IS: 12330 (If required as per soil recommendations for respective site).
- 3.6. The exposure condition for the tender shall be considered as severe.
- 3.7. The minimum concrete grade for RCC works in sub-structure & super-structure shall be approved design mix M25 with minimum cement content and maximum free water-cement ratio as per Table-5 of IS: 456. However minimum cement content, type of cement and any remedial actions required for foundations due to aggressiveness of sub-soil conditions shall be as per Geo-technical report.
- 3.8. Cup-lock type scaffold systems shall be used for construction. All temporary approaches shall be with scaffolding staircases of min. 750 mm walkway, min. 230 mm tread and max. 200 mm rise of each step.
- 3.9. Concrete grade for PCC works for lean concrete below foundation shall be 1:5:10 as per SOR/BOQ and maximum free water-cement ratio as per Table-5 of IS:456.
- 3.10. High strength deformed bars of Grade Fe-500D conforming to IS: 1786 shall be used for all RCC structure.
- 3.11. Grade of Structural Steel shall be Grade E250 Quality A/B0/BR conforming to IS: 2062.
- 3.12. Anchor bolts shall be of mild steel confirming to IS: 2062.

- 3.13. Fabrication of anchor bolts shall be taken up on priority to ensure placement of the same at the time of concreting.
- 3.14. All inserts/ sleeves shall be properly secured in position before pouring concrete. Metal insert plates shall be of mild steel confirming to IS: 2062. All primer/ epoxy except finish paint shall be applied to all insert/ sleeve prior to fixing in position before pouring of concrete.
- 3.15. All lugs shall be of high strength deformed bars of minimum grade Fe500D conforming to IS: 1786.
- 3.16. The contractor shall ensure the required founding strata confirming to soil recommendation for all foundations. If the founding depth encountered is different from that specified in the drawings, the same shall be brought to the notice of Engineer-in-Charge before execution.
- 3.17. Dewatering including supply of adequate nos. of pump wherever required shall be carried out by the contractor at his cost to keep the ground water table below the founding level.
- 3.18. Proper management of loose earth, mud, water is to be ensured to avoid making area messy and slippery.
- 3.19. All field connections shall be galvanized bolted connection unless otherwise mentioned in AFC/ approved fabrication drawing. For all bolted connections high strength hot dip galvanized bolts of property class 8.8 as per IS:3757 & IS:4000 shall be used. Hot dip galvanized nuts and washers shall conform to IS:6623 & IS:6649 respectively. Quoted rate for structural steel shall include the cost of nut, washer & bolts.
- 3.20. Fabrication of structure steel shall be done in contractor's fabrication shop (area to be arranged by Contractor) and shall be transported to project site. All shop connections shall be welded & field/ site connections shall be bolted unless otherwise mentioned. To the extent possible erection of Structural steel shall be done in modules. The modules shall be prepared in areas defined by Engineer in-charge.
- 3.21. During the execution of the work, the contractor, at his own cost, shall keep structures, materials and equipment adequately braced by guys, struts or other approved means which shall be supplied, installed and stored by the Contractor as required till such time the erection work is completed to the satisfaction of the owner. The provided 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.
- 3.22. The contractor shall ensure proper co-ordination / co-operation with other agencies, while working in the area, without affecting others work front areas.
- 3.23. Various tolerances required as marked on the drawings conforming to code requirements/ specifications or as directed by the Engineer-in-Charge shall be maintained by the Contractor. Verticality shall be maintained at every stage and the same shall be verified with Theodolite / Total Station.
- 3.24. All works shall be done to the entire satisfaction of the Engineer-in-Charge. Any work not carried out in accordance with the instructions shall be dismantled and made good without any extra cost and time implication to the owner.

4. LIST OF SPECIFICATIONS, STANDARDS AND OTHER DOCUMENTS

4.1. STANDARD SPECIFICATIONS

SL. NO.	SPECIFICATION NO.	TITLE
1.	6-68-0001	Standard specification for civil and structural works - General Scope
2.	6-68-0002	Standard specification for civil & structural works - Materials.
3.	6-68-0003	Standard specification for civil & structural works – Earthwork
4.	6-68-0004	Standard specification for civil & structural works - Plain and Reinforced Cement Concrete
5.	6-68-0006	Standard specification for civil & structural works - Structural Steel Works.
6.	6-68-0008	Standard specification for civil & structural works - Miscellaneous Steel Works
7.	6-68-0012	Standard specification for civil & structural works - Demolition and Dismantling
8.	6-68-0013	Standard specification for civil & structural works - Miscellaneous items
9.	6-68-0017	Standard specification for civil & structural works - Bipolar concrete penetrating corrosion inhibiting admixture
10.	6-68-0021	Standard specification for civil & structural lump-sum turn-key works (L.S.T.K works) - General Requirements
11.	6-68-0022	Standard specification for civil & structural LSTK works - Material and Construction
12.	6-68-0056	Standard specification for civil & structural works - Bonding fresh concrete to old concrete by epoxy resin bonding system
13.	6-79-0020	Standard specification for surface preparation and protective coating (new construction)

4.2. ENGINEERING STANDARDS

SL. NO.	STANDARD NO.	TITLE
1.	7-68-0051	Standard lifting hooks in precast slabs & chequered plates.
2.	7-68-0052	Details of M.S. rungs for concrete structures.
3.	7-68-0056	Metal Insert Plate
4.	7-68-0062	Typical cranking detail of rebar at beam & col. junctions.

SL. NO.	STANDARD NO.	TITLE
5.	7-68-0106	Standard lap length of bar
6.	7-68-0201	Standard lugs.
7.	7-68-0203	Typical chequered plate support
8.	7-68-0417	M.S. Anchor Bolt Assemblies

4.3. OTHER REFERENCE SPECIFICATIONS

SL. NO.	TITLE OF THE SPECIFICATION
1.	CPWD Specifications (Vol-1)
2.	CPWD Specifications (Vol-2)
3.	Approved Vendor List - B828-000-81-41-LL-01 Rev.A

Wherever applicable civil-structural work is not covered by EIL standards/ specifications, reference to CPWD specifications shall be made.

4.4. ADDENDUM TO STANDARD SPECIFICATIONS & SOR/ BOQ

SL. NO.	DOCUMENT NO.	CLAUSE NO.	MODIFICATION
1	7-68-0056	All Relevant	Wherever “Fe 500” is mentioned, the same shall be read as “Fe 500D”
2	SOR/ BOQ		
3	Other relevant Spec., if any.		

5. PREAMBLE TO SCHEDULE OF QUANTITIES

- 5.1 SOR indicates only estimated quantities and liable to change. Unit rate quoted against each SOR item shall be applicable for addition or deletion during execution of the project.
- 5.2 The expected water table depth may fluctuate. The quoted rate of excavation shall include requirement of dewatering etc. for completion of total works including concreting, backfilling etc. and no extra amount is payable on this account.
- 5.3 Depth of foundation in general shall be 4.0M below NGL. (This data is for general guidance of the Contractors; however deviation from the noted depth shall not form a basis for any extra claim).
- 5.4 Wherever Blended cement as specified is in use, special precautions shall be taken for the curing of the executed concrete works.
- 5.5 Item description provided in Schedule of Rates (Short Description) is in brief, while quoting and filling the rate in these Schedule of Rates (Short Description), Bidder shall take into consideration complete scope of work/item description as mentioned in Schedule of Rates (Detailed Description) for the relevant item. The rate quoted in Schedule of Rates (Short Description) shall be deemed to include all activities of work mentioned in item description of

Schedule of Rates (Detailed), scope of work, specifications, standards etc. & stringent of all shall govern.

- 5.6 All items in the Schedule of Rates shall be inclusive of all materials, workmanships, constructional infrastructures like scaffolding/ staging, finishing, cleaning, cutting chases/ holes etc. in brick work/ RCC work for making it proper and rectification of any damaged work shall be applicable for all heights and locations.

6. SCHEDULE OF RATES

As provided.

ENGINEERING DESIGN BASIS STRUCTURAL

JOB NO: B828

PROJECT: Review/Due Diligence of Existing Detailed Project Report
& PMC Services to Augment & Up-Grade Water

CLIENT: NAA-GIDC JHAGADIA

EIL SIGNATURE:

CLIENT SIGNATURE:



B	18/Oct/2024	Revised & Reissued For Tender	RAHUL KUMAR	MANJEET SINGH SANGWAN	ATANU HAZRA
A	19/Apr/2024	Issued For Tender	RAHUL KUMAR	MANJEET SINGH	ATANU HAZRA
Rev. No.	Date	Purpose	Prepared by	Reviewed by	Approved by

Legend: ***Bold italic*** text denotes change with respect to previous revision.

Table of Contents

1.0 SCOPE	4
2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS	4
2.1 ABBREVIATIONS	4
2.2 CODES & STANDARDS / PUBLICATIONS	4
3.0 GENERAL / DESIGN CONSIDERATIONS	7
3.1 MATERIAL OF CONSTRUCTION	7
3.2 LOADS	8
3.2.1 DEAD LOADS	8
3.2.2 IMPOSED LOADS	8
3.2.2.1 LIVE LOADS	8
3.2.2.2 HYDRO-TEST LOAD	8
3.2.2.3 OPERATING LOAD OF EQUIPMENT	8
3.2.2.4 BUNDLE PULL	8
3.2.2.5 PIPING LOAD	8
3.2.2.6 IMPACT & VIBRATORY LOADS	8
3.2.3 WIND LOAD	8
3.2.4 SEISMIC LOAD	9
3.2.5 BLAST FORCES	9
3.2.6 OTHER LOADS	9
3.3 FLOORING DETAILS FOR BUILDINGS & SHEDS	9
4.0 SPECIFIC DESIGN CONSIDERATIONS	10
4.1 FOUNDATION DESIGN	10
4.1.1 MINIMUM REQUIREMENTS	10
4.1.2 FACTORS OF SAFETY IN FOUNDATION DESIGN	11
4.1.3 ANTI-TERMITE TREATMENT	12
4.1.4 MINIMUM COVER TO FOUNDATION BOLT/ POCKET	12
4.1.5 HEIGHT OF PEDESTAL	12
4.1.6 GROUTING & MINIMUM GROUT THICKNESS	12
4.2 RCC STRUCTURES & FOUNDATIONS	12
4.2.1 GENERAL/ DESIGN METHODS	12
4.2.2 CONCRETE	13
4.2.2.1 MINIMUM CEMENT CONTENT & MAXIMUM WATER-CEMENT RATIO	14
4.2.3 REINFORCEMENT BARS	14
4.2.4 MINIMUM COVER TO MAIN REINFORCEMENT	14
4.2.5 MINIMUM THICKNESS OF STRUCTURAL CONCRETE ELEMENT	15
4.3 STEEL STRUCTURES	15

4.3.1 GENERAL/ DESIGN METHODS	15
4.3.2 GRADE OF STEEL	16
4.3.3 LIMITING PERMISSIBLE STRESSES	16
4.3.4 LIMITING DEFLECTION	16
4.3.4.1 LIMITING VERTICAL DEFLECTION	17
4.3.4.2 LIMITING HORIZONTAL DEFLECTION	17
4.3.5 MINIMUM THICKNESS	17
4.3.6 ELECTRICAL SWITCHYARD STRUCTURE & TRANSMISSION TOWER	18
4.3.7 PROTECTIVE COATING	18
4.4 MASONRY WORKS	18
4.4.1 GENERAL	18
4.4.2 CEMENT MORTAR	18
4.4.3 FIRE WALLS	18
4.5 SPECIFIC APPLICATIONS	18
4.5.1 PIPE RACK	18
4.5.2 RCC & STEEL CHIMNEYS	19
4.5.3 MACHINE FOUNDATIONS	19
4.5.4 BARRICADING	19
5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS	19

1.0 SCOPE

This document specifies the design criteria and loads that shall be taken into account for the design of all the buildings, boundary wall, water retaining structures, crib intake well, pipeline thrust blocks and all other civil-structural works pertaining to the project.

2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

2.1 ABBREVIATIONS

Code	Description
CRS	Corrosion resistant steel
DBE	Design basis earthquake
EDB	Engineering design basis
FBEC	Fusion bonded epoxy coating
FFL	Finished floor level
FGL	Finished grade level
FOS	Factor of safety
HPP	High point of pavement
MCE	Maximum considered earthquake
MOC	Material of construction
NA	Not applicable
PCC	Plain cement concrete
RCC	Reinforced cement concrete
SBC	Safe bearing capacity
TMT	Thermo-mechanically treated

2.2 CODES & STANDARDS / PUBLICATIONS

S.No.	Description	Standards / Codes
1	Specification for Coarse and Fine Aggregates from Natural Sources for Concrete	IS:383
2	Specification for Expanded Metal Steel Sheets for General Purposes	IS:412
3	Mild Steel and Medium Tensile Steel Bars and Hard-Drawn Steel Wire for Concrete Reinforcement	IS:432
4	Specification for Portland Slag Cement	IS:455
5	Code of practice for plain & reinforced concrete	IS:456
6	Specification for Test Sieves: Part-I Wire Cloth Test Sieves	IS:460
7	Methods of Test for Strength of Concrete	IS:516
8	General construction in steel - Code of practice	IS:800
9	Code of practice for use of cold formed light gauge steel structural members in general building construction.	IS:801
10	Code of Practice for use of Structural Steel in Overhead Transmission Line Towers	IS:802

S.No.	Description	Standards / Codes
11	Code of Practice for Design, Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Storage Tanks	IS:803
12	Code of Practice for use of Steel Tubes in General Building Construction	IS:806
13	Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle Sections	IS:808
14	Cold Formed Light Gauge Structural Steel Sections	IS:811
15	Code of practice for use of metal arc welding for general construction in mild steel	IS:816
16	Code of practice for design loads	IS:875
17	Code of Practice for Design of Structural Timber In Building	IS:883
18	Steel Tubes for Structural Purposes - Specification	IS:1161
19	Bitumen-Mastic for Flooring -Specification	IS:1195
20	Steel Tubes, Tubulars and other Wrought Steel Fittings	IS:1239
21	Specification for Bitumen Felts for Water Proofing and Damp-Proofing	IS:1322
22	Hexagon Head Bolts, Screws and Nuts of Product Grade 'C' - Part-1: Hexagon Head Bolts	IS:1363
23	Technical Supply Conditions for Threaded Steel Fasteners	IS:1367
24	Specification for Portland Pozzolana Cement	IS:1489
25	Specification for Hard-Drawn Steel Wire Fabric for Concrete Reinforcement	IS:1566
26	Code of practice for construction of stone masonry	IS:1597
27	High Strength Deformed Steel Bars And Wires for Concrete Reinforcement-Specification	IS:1786
28	Preformed Fillers for Expansion Joint in Concrete Pavement and Structures (non extruding and resilient type)	IS:1838
29	Criteria for earthquake resistant design of structures	IS:1893
30	Code of practice for design & construction of foundations in soil - general requirements	IS:1904
31	Code of practice for structural use of un-reinforced masonry	IS:1905
32	Specification for Plain Washers	IS:2016
33	Hot Rolled Low, Medium and High Tensile Structural Steel	IS:2062
34	Specification for Sand for Masonry Mortars	IS:2116
35	Specification for Concrete Masonry Units	IS:2185
36	Code of Practice for Brickworks	IS:2212
37	Steel Wire Ropes for General Engineering Purposes - Specification	IS:2266
38	Recommended practice for hot dipped galvanising of iron and steel	IS:2629

S.No.	Description	Standards / Codes
39	Methods for testing uniformity of coating of zinc coated articles	IS:2633
40	Integral Waterproofing Compounds for Cement Mortar and Concrete -Specification	IS:2645
41	Code of practice for Design and construction of Pile foundations	IS:2911
42	Code of practice for design & construction of raft foundations	IS:2950
43	Code of practice for design & construction of machine foundations	IS:2974
44	Code of practice for concrete structures for storage of liquids	IS:3370
45	Steel Chequered Plates - Specification	IS:3502
46	Specification for Structural Timber in Building	IS:3629
47	Specification for High Strength Structural Bolts	IS:3757
48	High Strength Bolts in Steel Structures - Code of Practice	IS:4000
49	Code of practice for design and construction of foundation for transmission line towers and poles	IS:4091
50	Code of practice for earthquake resistant design and construction of buildings	IS:4326
51	Hollow Steel Sections for Structural Use	IS:4923
52	Criteria for blast resistant design of structures for explosions above ground	IS:4991
53	Criteria for design of Reinforced concrete bins	IS:4995
54	Criteria for design of RCC chimneys	IS:4998
55	Determination of dynamic properties of soil	IS:5249
56	Code of practice for determination of bearing capacity of shallow foundations	IS:6403
57	Code of practice for anti-termite measures in buildings	IS:6313
58	Specification for High Alumina Cement For Structural Use	IS:6452
59	Code of practice for design & construction of steel chimney	IS:6533
60	Method for determination of mass of zinc coating on zinc coated iron and steel articles	IS:6745
61	Code of practice for calculation of settlements of foundations	IS:8009
62	Specification for 43 grade Ordinary Portland Cement	IS:8112
63	Concrete Admixtures -Specification	IS:9103
64	Criteria for design of steel bins for storage of bulk materials	IS:9178
65	Code of Practice for Design and Construction of Shallow Foundations on Rocks	IS:12070
66	Provision of Water-Stops at Transverse Contraction Joints in Masonry and Concrete Dams - Code of Practice	IS:12200
67	Specification for 53 Grade Ordinary Portland cement	IS:12269

S.No.	Description	Standards / Codes
68	Specification for sulphate resisting Portland cement	IS:12330
69	Hot Rolled Parallel Flange Steel Sections for Beams, Columns and Bearing Piles- Dimensions and Section Properties	IS:12778
70	Pulverised Fuel Ash Lime Bricks - Specifications	IS:12894
71	Fusion Bonded Epoxy Coated Reinforcing Bars	IS:13620
72	Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces	IS:13920
73	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel	IS: 814
74	Chlorpyrifos emulsifiable concentrates	IS: 8944
75	Recommendations for metal arc welding of carbon and carbon manganese steel	IS: 9595
76	Two parts poly supplied based sealants	IS: 12118

Note: The above list is suggestive and not exhaustive. Apart from these basic codes any other related code shall also be followed wherever required. All codes & standards shall be latest revision with all amendments issued there to.

3.0 GENERAL / DESIGN CONSIDERATIONS

3.1 MATERIAL OF CONSTRUCTION

S.No.	Name of Structure	Material of Construction	Level up to	Fire Proofing up to	Remarks
1.0	Thrust Blocks	RCC			
2.0	Valve Pits	RCC (Precast/ Cast-in-situ) with chequered plate covers or as per AFC drawings			
3.0	Elevated Service Reservoirs	Leak Proof RCC			
4.0	GSR - Storage Reservoirs	Leak Proof RCC			
5.0	Pump Houses	RCC with underground part in Leak Proof RCC			
6.0	Boundary Wall	RCC (Precast/ Cast-in-situ)			
7.0	Crib Intake Well	RCC			

Notes:

- a) Buildings shall have RCC floors & masonry infill walls. Material of construction of masonry shall be as per Engineering Design Basis - Architectural.
- b) Material of construction for buildings shall be as per Engineering Design Basis - Architectural.

3.2 LOADS

3.2.1 DEAD LOADS

The weight of all permanent construction, including foundation, walls, floors, roofs, partitions, stairways and fixed service and other equipments including all fixtures, ladders etc. Component of soil backfill weight over foundation slab shall be considered as foundation dead load.

The dead load of false ceiling & false flooring shall be considered as 0.75 kN/Sq.m. wherever applicable.

The unit weight of materials in general, should be in accordance with IS: 875 Part-1.

3.2.2 IMPOSED LOADS

Following may be considered under Imposed Loads:

3.2.2.1 LIVE LOADS

Live loads shall, in general, be as per IS:875 Part-2.

3.2.2.2 HYDRO-TEST LOAD

As Applicable

3.2.2.3 OPERATING LOAD OF EQUIPMENT

NOT APPLICABLE

3.2.2.4 BUNDLE PULL

NOT APPLICABLE

3.2.2.5 PIPING LOAD

NOT APPLICABLE

3.2.2.6 IMPACT & VIBRATORY LOADS

Structures subjected to impact or vibratory loads shall be designed as per the provisions of IS:875 & IS:2974.

3.2.3 WIND LOAD

Wind loads shall generally be as per IS:875 Part-3.

S.No.	Title / Description	Value	UOM	Remarks
1.0	Basic wind Speed, V_b	44	m/sec	
2.0	k_1 (Probability factor, risk coefficient)			
2.1	For permanent structures	1.00	-NA-	
2.2	For temporary structures	0.73	-NA-	Based on V_b
2.3	For boundary wall/ barricading	0.73	-NA-	
3.0	k_2 (Terrain, height & structure size factor)		-NA-	
3.1	for category	1	-NA-	Class of structure (A/B/C) shall be as per its relevant horizontal & vertical dimensions.
4.0	k_3 (Topography factor)	1.00	-NA-	
5.0	k_4 (Importance Factor for Cyclonic Region)	1.15	-NA-	Cyclonic region.
6.0	Mean probable design life for computation of wind forces shall be considered as follows:			
6.1	All structures	50	Years	
6.2	temporary sheds, structures such as those used during construction operations (for example, formwork and false work), structures during construction stages and boundary walls	5	Years	

3.2.4 SEISMIC LOAD

Seismic forces shall be based on IS: 1893 (Part-1 & 4).

3.2.5 BLAST FORCES

NOT APPLICABLE

3.2.6 OTHER LOADS

S.No.	Project Philosophy
1.0	Apart from the specified live loads, any other equipment load or possible overloading during construction/ erection shall also be considered in the design.
2.0	Design of all structures shall also consider any other relevant and consequential load/ stress imparted to the structure.
3.0	All buildings/ structures shall be designed to resist the worst combination of the above loads. However wind/ seismic loads shall not be considered in combination together or with loads during maintenance.

3.3 FLOORING DETAILS FOR BUILDINGS & SHEDS

S.No.	Description	Flooring Type I	Flooring Type II	Flooring Type III
-------	-------------	-----------------	------------------	-------------------

S.No.	Description	Flooring Type I	Flooring Type II	Flooring Type III
1.0	Sub Grade			
1.1	Earth-fill base compacted to 95% dry density.	To be provided	To be provided	To be provided
1.2	Compacted layer of sand over thoroughly compacted Earth fill (mm)	200 mm thick	200 mm thick	150 mm thick
2.0	Structural Grade Slab			
2.1	Lean concrete 1:5:10 over sand layer (mm)	50 mm thick	50 mm thick	50 mm thick
2.2	Structural non-suspended slab in M20 Grade concrete (Reinforced with 8 mm dia bars @ 200 c/c both ways) over lean concrete	150 mm thick slab with reinforcement placed centrally.	150 mm thick slab with reinforcement placed in two layers (at top & bottom).	100 mm thick slab without reinforcement.

Note:

- Flooring details as given above shall be adopted for the non-suspended ground floor slabs for buildings & sheds only as categorized for various flooring types.
- Flooring Type I shall be considered for Plant Buildings such as Control Rooms, Sub-Stations, Pump Houses, Utility Compressor Houses, Parking Areas, Stores, Porches.
- Flooring Type II shall be considered for Ware Houses, Workshops, Cement Godowns, Fire Stations, Process Compressor Houses.
- Flooring Type III shall be considered for Non-plant Buildings such as Administration, Laboratory, Canteen, Time Office, Gate House, Training Centre, Guest House, Residential buildings.
- Floor finish for all the above three types of flooring shall be as per Engineering Design Basis - Architectural.
- Reinforcement steel shall be as per clause 4.2.3 of this document.
- 20 mm gap to be provided between floor slab and equipment foundation/ column and shall be sealed using joint sealing compound.
- Outdoor pavements shall be as per Engineering Design Basis - General Civil.

4.0 SPECIFIC DESIGN CONSIDERATIONS

4.1 FOUNDATION DESIGN

4.1.1 MINIMUM REQUIREMENTS

S.No.	Project Philosophy
1.0	Minimum depth of foundation for all structures/ buildings shall be as per Geotechnical Recommendations.
2.0	Factors of safety against overturning and sliding shall be as per clause 4.1.2 of this document.
3.0	For stability checks the weight of soil as overburden (soil backfill weight over foundation slab) shall be as per clause 4.1.2 of this document.
4.0	The design ground water level shall be as per the Geotechnical Recommendations and the hydrostatic pressure shall be adequately accounted for in design.
5.0	Allowable net safe bearing capacity (SBC) of soil for isolated/ raft/ pile/ tank foundations shall be based on the settlement criteria as per the Geotechnical Recommendations.
5.1	For foundations of RCC building settlement shall be considered as 25mm.
5.2	For foundations of other structure, settlement shall be considered as 40mm.
5.3	For Raft foundations, settlement shall be considered as 40mm.
6.0	For transient loadings, e.g. wind/ seismic, SBC (safe bearing capacity) based on shear criteria shall be considered instead of considering settlement as design criteria.
6.1	Permissible increase in SBC/ Pile capacities (for compression, shear and uplift/ tension) shall be as per the Geotechnical Recommendations.
7.0	Foundation for tanks up to 10 m diameter shall be of RCC ring wall type.
8.0	Foundation for vibrating equipment shall be kept independent of building floors/ Foundations and other adjacent foundations.

4.1.2 FACTORS OF SAFETY IN FOUNDATION DESIGN

S.No.	Type of Structure	FOS OT-W/S (EL) (i)	FOS OT-N-W/S (EL) (ii)	FOS OT-W/S (OL) (iii)	FOS OT-N-W/S (OL) (iv)	FOS SL-W/S (v)	FOS SL-N-W/S (vi)
1.0	All Structures except those listed below	1.5	1.5	1.5	2.0	1.5	1.5
2.0	Overhead tank	1.5	-	2.0	-	1.5	-
3.0	Flood Light Mast	1.5	-	1.5	-	1.5	-
4.0	Retaining Wall	-	-	1.5	2.0	1.5	1.5

Legend:

- (i) OT-W/S (EL) - FOS against Overturning with Wind/ Seismic in Erection condition.
- (ii) OT-N-W/S (EL) - FOS against Overturning without Wind/ Seismic in Erection condition.
- (iii) OT-W/S (OL) - FOS against Overturning with Wind/ Seismic in Operating condition.
- (iv) OT-N-W/S (OL) - FOS against Overturning without Wind/ Seismic in Operating condition.
- (v) SL-W/S - FOS against Sliding with Wind/ Seismic.
- (vi) SL-N-W/S - FOS against Sliding without Wind/ Seismic.

Note:

- a) Minimum factor of safety against uplift shall be 1.2 for all structures (in case of sumps, lining weight shall not be included)
- b) Percentage weight of overburden shall be taken as 100% & to be considered on projected plan area of footing.

4.1.3 ANTI-TERMITE TREATMENT

Buildings shall be provided with anti-termite treatment as per IS:6313 and IS:8944 wherever applicable as per Engineer-in-Charge.

4.1.4 MINIMUM COVER TO FOUNDATION BOLT/ POCKET

S.No.	Project Philosophy
1.0	Minimum distance from the centerline of foundation bolt/ anchor bolt to edge of pedestal shall be the maximum of the following:
1.1	Clear distance from the edge of the base plate/ base frame to the outer edge of the pedestal shall be minimum 50 mm.
1.2	Clear distance from the face of pocket to the outer edge of the pedestal shall be 100 mm.
1.3	Clear distance from the edge of the sleeve or anchor plate to the edge of pedestal shall be 100 mm
2.0	The tension capacities of anchor bolts shall be worked out based on the bolt to bolt spacing and the distance between anchor bolts to the edge of concrete. If required, additional reinforcement around anchor bolts shall be provided in the concrete pedestal.

4.1.5 HEIGHT OF PEDESTAL

S.No.	Project Philosophy
1.0	The minimum projection of pedestals supporting any steel structure/ column bases shall be 300 mm/ 150 mm above the high point of pavement/ finished grade/ finished floor level whichever is higher, for outdoor and indoor located pedestals respectively.
2.0	The maximum projection of pedestals for staircase/ ladder shall be 200 mm.

4.1.6 GROUTING & MINIMUM GROUT THICKNESS

S.No.	Project Philosophy
1.0	The thickness of grout shall be as follows:
1.1	Minimum 50 mm for equipment unless otherwise required in equipment datasheet.
1.2	Minimum 30 mm & maximum 50 mm for all other foundations/ structures, unless otherwise required in equipment/ vendor data sheet.
2.0	All anchor bolt sleeves/ pockets and spaces under column bases, shoe plates etc. shall be grouted with free flow, non shrink (premix type) grout with 28 day minimum cube crushing strength of 40 N/sq mm.
3.0	Grouting requirement for machines and equipments are not covered here. The same shall be governed by vendor's requirement.

4.2 RCC STRUCTURES & FOUNDATIONS

4.2.1 GENERAL/ DESIGN METHODS

S.No.	Project Philosophy
1.0	All buildings, structures, foundations, machine/ equipment foundations, liquid retaining/ storage structures, trenches, pits etc. shall be of RCC and designed based on the following IS Codes in general and other relevant IS Codes applicable: IS:456, IS:875, IS:1893, IS:1904, IS:2911, IS:2950, IS:2974, IS:3370, IS:4091, IS:4326, IS:4991, IS:4995, IS:4998, IS:5249, IS:6403, IS:8009, IS:13920.

S.No.	Project Philosophy
2.0	Only limit state method as per IS:456 shall be followed in the design unless otherwise specified elsewhere in this document for special structures.
3.0	All structures shall be of frame type construction, with ductile detailing as per IS:13920.
4.0	Where the specified design depth of ground water table so warrants all underground pits, tunnels, basements etc. (excluding appurtenances of storm water/effluent collection system, cable trench, pipe trench) shall be of leak-proof RCC construction using approved make of water-proofing compounds.
5.0	All liquid retaining/ storage RCC structures shall be leak-proof and designed as un-cracked section as per IS: 3370. However, the parts of such structures not coming in contact with the liquid shall be designed according to IS:456 except ribs of beams of suspended floor slabs, counter forts of walls (located on the side remote from the liquid) and roof which shall be designed as un-cracked section. No increase in permissible stresses in concrete and reinforcement shall be made under wind or seismic conditions for such structures.
6.0	The walls and base slabs of liquid retaining/ storage structures shall be provided with reinforcement on both faces for thickness greater than or equal to 150 mm. In all liquid retaining structures, PVC water bars (minimum size 230 mm wide x 5 mm thick) shall be provided at each construction joint(horizontal and vertical).
7.0	Ground improvement below and around foundations and backfilling shall be as per Geotech recommendation.

4.2.2 CONCRETE

S.No.	Project Philosophy
1.0	<i>Exposure condition shall be taken as severe. The minimum grade of reinforced cement concrete to be used for different structures and foundations (unless otherwise specified in Geotechnical Recommendations) shall be as follows:-</i>
1.1	<i>For thrust blocks - M25 (design mix) as per IS: 456</i>
1.2	<i>For all other structures - M30 (design mix) as per IS: 456</i>
2.0	Generally the use of one of the following type of cements shall be considered:
2.1	43 Grade Ordinary Portland cement as per IS: 8112.
2.2	53 Grade Ordinary Portland cement as per IS: 12269.
2.3	Portland Slag cement conforming to IS: 455. (Not applicable when chloride-based admixture are in use).
2.4	Portland Pozzolona Cement (PPC, Fly ash based) cement conforming to IS: 1489 Part-1.
2.5	Portland Pozzolona (Clacined clay based) conforming to IS: 1489 Part-2.
2.6	Sulphate resistant Portland cement conforming to IS: 12330 (If required as per soil recommendations for respective site).
3.0	Minimum cement content for concrete in foundation shall be as per Geotechnical Recommendations document.
4.0	75 mm thick lean concrete of grade 1:5:10 (nominal mix) shall be provided under all RCC foundations (except under base slab of liquid retaining structures). The lean concrete shall extend 50 mm beyond the foundation edges on all sides.
5.0	100 mm thick lean concrete of grade M20 shall be provided under base slab of liquid retaining structures. The lean concrete shall extend 75 mm beyond the foundation edges on all sides.
6.0	Plain Cement Concrete (PCC) mud mat of grade M20 of minimum 150 mm thickness shall be provided under all masonry wall foundations.

S.No.	Project Philosophy
7.0	Plain cement concrete of grade M20 (nominal mix) of minimum 40mm thickness shall be provided as damp proof course at plinth level of all masonry walls. Integral water-proofing compound conforming to IS: 2645 shall be mixed with concrete (as per manufacturer's specifications) and coated with bitumen emulsion.
8.0	Crystalline water-proofing compound of approved make shall be mixed with concrete for all liquid retaining/ leak-proof structures.
9.0	From durability considerations the minimum cement content and maximum free water-cement ratio shall be as per table given under clause 4.2.2.1 of this document.
10.0	However, the maximum cement content shall not exceed 450 kg/cum.

4.2.2.1 MINIMUM CEMENT CONTENT & MAXIMUM WATER-CEMENT RATIO

Minimum cement content & maximum water-cement ratio shall be corresponding to the grade of concrete shall be as per Table 5 of IS:456.

4.2.3 REINFORCEMENT BARS

S.No.	Project Philosophy
1.0	High Strength deformed steel bars (TMT) of Grade Fe500D shall be used as reinforcement for all structures.
2.0	18 gauge black soft annealed SWG wire shall be used for binding of reinforcement bars.
3.0	Minimum and maximum bar spacing for foundations, slabs, stirrups for beams, Ties for columns, pedestals, walls etc. should be 100 mm and 300 mm respectively. Bar spacing should be provided in multiples of 5 mm.
4.0	Minimum bar diameter shall be as follows:
4.1	Major & Minor Foundations : 12 mm
4.2	Block Foundations: Main Bars : 12 mm
4.3	Block Foundations: Tie Bars : 12 mm
4.4	Pedestals, Columns: Main Bars : 12 mm
4.5	Pedestals, Columns: Tie Bars : 8 mm
4.6	Beams: Main Bars : 12 mm
4.7	Beams: Anchor Bars : 10 mm
4.8	Beams: Stirrups : 8mm
4.9	Slabs & Walls: Main Bars : 10 mm
4.10	Slabs & Walls: Distribution Bars : 8mm
4.11	Minor Elements (e.g. chajja, parapet, lintel, etc.) : 8 mm

4.2.4 MINIMUM COVER TO MAIN REINFORCEMENT

Clear cover shall be considered over links/ stirrups/ ties. Unless otherwise specified in Geotechnical Recommendations, minimum clear cover to RCC elements shall be provided as follows:

S.No.	Title / Description	Value	UOM
1.0	Foundation slab, base slab, pedestal, plinth beam	50	mm
2.0	Retaining Wall, Basement and Pit Wall:		
2.1	Face in contact with earth	50	mm
2.2	Free face	30	mm
3.0	Column	45	mm

S.No.	Title / Description	Value	UOM
4.0	Tie beam, Floor beam, Roof beam	45	mm
5.0	Floor slab, Roof slab, Canopy, Lintel	30	mm
6.0	Liquid retaining structure		
6.1	Face in contact with liquid	45	mm
6.2	Face away from liquid but in contact with earth	50	mm
6.3	Free face	45	mm

4.2.5 MINIMUM THICKNESS OF STRUCTURAL CONCRETE ELEMENT

The following minimum thickness shall be followed:

S.No.	Title / Description	Value	UOM
1.0	Footings (all types, with or without beams)	300	mm
2.0	Tapered footings	150 (at edge) 300 (average)	mm
3.0	Liquid retaining/ Leak-proof structure/ Basement/ Pit:		
3.1	Base slab	300	mm
3.2	Walls	150	mm
4.0	Floor/ Roof Slab, Walkway, Canopy slab	150	mm
5.0	Cable/ Pipe Trench/ Launder Walls & Base Slab	125	mm
6.0	Parapet	100	mm
7.0	Louver/ Fin	100	mm
8.0	Louver (in contact with liquid)	125	mm
9.0	Precast Trench Cover/ Precast Floor Slab	125	mm

4.3 STEEL STRUCTURES

4.3.1 GENERAL/ DESIGN METHODS

S.No.	Project Philosophy
1.0	Design, fabrication and erection of the above work shall be carried out in accordance with the following IS Codes as applicable to the specific structures, viz. IS:800, IS:801, IS:802, IS:806, IS:814, IS:816, IS:875, IS:1893, IS:6533, IS:9178, IS:9595, etc. Basic consideration of structural frame work shall primarily be stability, ease of fabrication/ erection and overall economy satisfying relevant Indian Standard Codes of Practice. Simple and fully rigid design as per IS:800 shall be used. Where fully rigid joints are adopted they shall generally be confined to the major axis of the column member.
2.0	Crane gantry girders shall generally be of welded construction and of single span lengths. Chequered plate shall be used for gantry girder walkway flooring.

S.No.	Project Philosophy
3.0	Steel staircases for main approaches to operating platforms shall have channels provided as stringers with minimum clear width of 750 mm and slope of approximately 41 degree. The vertical height between successive landings shall not be less than 2.6 m nor exceed 4.0 m. Treads shall be minimum 230 mm wide made of electro-forged galvanized grating (with suitable nosing) spaced equally so as to restrict the rise to maximum 200 mm. However for non-important structures like cross-overs etc. the minimum width of stair shall be 750 mm.
4.0	Electro-forged hot-dipped galvanized MS Gratings shall be as per EIL Standard No. 7-68-0697.
5.0	Welded connections shall be adopted during shop fabrication, except where only bolted connections are required (viz. removable members, galvanized electrical switchyard structures and transmission towers). Field/ site connections shall be bolted/ welded.
6.0	Structural connections shall have minimum two bolts of 16 mm diameter, unless otherwise limited by the size of members.
7.0	Minimum two nuts shall be used for all anchor bolts.

4.3.2 GRADE OF STEEL

S.No.	Project Philosophy
1.0	Structural steel shall be Grade E250 Quality A/BR/B0 conforming to IS: 2062. Anchor Bolts and metal insert plates shall be of mild steel conforming to IS: 2062. Minimum grade of steel for grating & steel structure in platforms taken from equipment shall be of Grade E250 Quality A/BR/B0 conforming to IS: 2062.
2.0	Tubular/hollow steel shall be of Grade Yst22.
3.0	Properties of steel sections shall be as follows:
3.1	Rolled Section as per IS:808
3.2	Parallel flanged sections as per IS:12778
3.3	Circular Hollow Sections (CHS) as per IS:1161
3.4	Square Hollow Sections (SHS)/ Rectangular Hollow Sections (RHS) as per IS:4923
4.0	Connection Bolts shall be High Strength Structural Steel Bolts of Property Class 8.8 (minimum) conforming to IS: 3757&IS: 4000. Hexagonal Nuts shall conform to IS: 6649. Washers shall conform to IS: 6649.

4.3.3 LIMITING PERMISSIBLE STRESSES

S.No.	Project Philosophy
1.0	Permissible stresses in structural members shall be as follows:
1.1	Hot rolled sections (excluding transmission towers and switchyard structures) as specified in IS:800
1.2	Cold formed light gauge sections as specified in IS:801
1.3	Tubular structures as specified in IS:806
2.0	Permissible stresses in bolts shall be as follows:
2.1	Hot rolled sections (excluding transmission towers and switchyard structures) as specified in IS:800
2.2	Cold formed light gauge sections as specified in IS:801
3.0	Permissible stresses in welds shall be as follows:
3.1	Cold formed light gauge sections as specified in IS:801
3.2	Metal Arc Welding as specified in IS:816

4.3.4 LIMITING DEFLECTION

4.3.4.1 LIMITING VERTICAL DEFLECTION

The limiting permissible vertical deflection for structural steel members shall be as specified in IS: 800.

Note:

- a) Limiting permissible vertical deflection for grating/chequered plate shall be $L/200$ or 6mm whichever is minimum.
- b) Limiting permissible vertical deflection for other structures/ structural components, not covered in the above table, shall be as specified in relevant BIS Codes.

4.3.4.2 LIMITING HORIZONTAL DEFLECTION

The limiting permissible horizontal deflection for structural steel members shall be as specified below, where 'H' represents the height:

S.No.	Title / Description	Value	UOM
1.0	Multi storeyed steel structure/ building	as per IS: 800	
2.0	Flare stack supporting structure	H/200	Same as 'H'

4.3.5 MINIMUM THICKNESS

The minimum thickness of various structural components (hot rolled sections) shall be as given:

S.No.	Title / Description	Value	UOM	Remarks
1.0	Trusses, purlins, side girts & bracings	6	mm	
2.0	Columns, beams	7	mm	
3.0	Gussets in trusses & girders			
3.1	upto and including 12m span	8	mm	
3.2	above 12m span	10	mm	
4.0	Stiffeners	8	mm	
5.0	Base plates	10	mm	
6.0	Chequered plate	6	mm	(on plain)
7.0	Grating	3	mm	

Notes:

- a) The minimum thickness for rolled beams and channels shall be mean flange thickness regardless of the web thickness.
- b) The minimum thickness of structural components (except gratings & chequered plates) which are directly exposed to weather and inaccessible for repainting shall be 8 mm.
- c) The minimum thickness of tubes shall be as specified in IS:806.
- d) Structural members exposed to marked corrosive action shall be increased in thickness

or otherwise suitably protected against corrosion.

e) Chequered plates shall be avoided on structures exposed to atmosphere.

4.3.6 ELECTRICAL SWITCHYARD STRUCTURE & TRANSMISSION TOWER

NOT APPLICABLE

4.3.7 PROTECTIVE COATING

Protective Coating (including surface preparation, shop primer, field primer & finish coat) to Concrete, Structural Steel and Gratings, Ladders, Spiral Stairways & Hand Rails shall be as per the "Standard Specifications for Surface Preparation and Protective Coating" No. 6-79-0020. Protective Coating (including surface preparation, shop primer, field primer & finish coat) to Gratings shall be as per Standard No 7-68-0697.

Cement painting of the external concrete surfaces shall be as per Architecture specification.

Wherever no other surface application is specified, "three coats of cement based waterproof paint as per IS: 5410 shall be applied over RCC surfaces. Prior to application of the paint, the surface shall be prepared to remove all foreign particle, loose materials, extra deposited concrete lumps, etc. using appropriate mechanical/ manual means".

4.4 MASONRY WORKS

4.4.1 GENERAL

S.No.	Project Philosophy
1.0	All masonry works shall be designed in accordance with IS:1077, IS:1905, IS:1597, IS:2185, IS:4326, IS:12894 and other relevant IS Codes as applicable.
2.0	Brick masonry shall be of Class 7.5 as per IS:1077
3.0	All external brick masonry walls shall be of minimum 230 mm thickness respectively except for fire walls.
4.0	AAC block masonry shall be as per IS: 6041 and other applicable codes and DSR specifications.

4.4.2 CEMENT MORTAR

All masonry work shall be constructed in cement sand mortar 1:4 for load bearing walls and 1:6 cement sand mortar for non-load bearing walls except half brick partition walls which shall be constructed in 1:4 cement sand mortar with two numbers of 6 mm diameter MS bars provided at every fourth course properly anchored with cross walls or pillars.

4.4.3 FIRE WALLS

Thickness of all masonry firewalls shall 345 mm or as per OISD-STD-173, whichever is more.

4.5 SPECIFIC APPLICATIONS

4.5.1 PIPE RACK

NOT APPLICABLE

4.5.2 RCC & STEEL CHIMNEYS

NOT APPLICABLE

4.5.3 MACHINE FOUNDATIONS

Machine foundations shall satisfy the requirements of IS:2974 and any other parameter as specified by the machine manufacturer.

4.5.4 BARRICADING

Foundation and super structure shall be designed as per POSD/ General Civil requirements of location & height, keeping in view the mean probable design life of structure.

5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

NOT APPLICABLE

WATER PIPELINE FROM RUNDH (PH) TO JHAGADIA PUMP HOUSE

SPECIFIC REQUIREMENTS AND SCOPE OF WORK FOR GEOTECHNICAL INVESTIGATION AND HYDROLOGICAL DATA COLLECTION

FOR CROSSINGS

**PROJECT : SUPPLY, LAYING, INSTALLATION, TESTING &
COMMISSIONING INCLUDING ALL FITTINGS, CROSSINGS
FOR 1500MM DIA. PCCP PIPELINE FOR WATER SUPPLY
PROJECT AT GIDC JHAGADIA**

OWNER : GIDC

CONSULTANT : ENGINEERS INDIA LIMITED

1	29-04-2026	REVISED AND RE-ISSUED FOR TENDER	MC	RB	VKP
0	22-04-2026	ISSUED FOR TENDER	MC	RB	VKP
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

1.0 GENERAL

This specification covers the requirement of Geotechnical Investigation & Hydrological Data collection for all crossings along the proposed water pipeline from Rundh (PH) to Jhagadia Pump house. The Geotechnical Investigation & Hydrological Data collection report shall be submitted to OWNER/CONSULTANT for review and approval.

Bidder shall acquaint himself with the site conditions before quoting and, no claim whatsoever on cost and time shall be entertained by the owner on this account. Bidder shall include the cost of Geotechnical investigation in the quoted rates itself, no extra payment for the same will be provided to the Bidder.

2.0 SCOPE OF WORK FOR GEOTECHNICAL INVESTIGATION

2.1 This scope of work covers the requirement of Geotechnical Investigation for river crossings along the proposed water pipeline from Rundh (PH) to Jhagadia Pump house.

2.2 Boring/Coring

2.2.1 Boring/coring into all type of soil/rock shall be done as below.

2.2.1.1 Rivers to be crossed:

S. No.	Name of River	Bank to Bank width (m) Approx.	Borehole at River Bed	Borehole on River Bank
1	Madhumati River	90	3 Nos. 20m deep (Boreholes to be conducted at equal intervals along the width of the river)	2* Nos. 20m deep
2	Kaveri River	50	1 Nos. 20m deep (Borehole to be conducted at the center of the river)	2* Nos. 20m deep

Notes:

- * Borehole to be conducted on each side of the river at about 25m away from river bank.
- Chainages shall be as per pipeline schematic drawing/KMZ file to be provided to successful bidder.

2.2.1.2 For all other crossings (Railway/Roads) minimum 1 nos. 10m deep borehole shall be carried out on either side of the crossings.

2.3. The minimum scope of work shall comprise of as mentioned above in clause 2.2 but not be limited to the following:

2.3.1 Contractor shall mobilize necessary no of rigs, equipment, tools & tackles etc. for carrying out the field investigation works specified above within the stipulated time period.

2.3.2 Boring in the river bed (having water depth > 0.50m) may be carried out with the help of a Boat/Pontoon/raft including staging etc. specially designed for this purpose. The boring

plant (included Tripod Stand, Rig & Mud circulation Pump etc.) should be erected on the Boat/Pontoon/raft with sufficient numbers of anchoring, so that the lateral movement of the Boat/Pontoon/raft will be completely arrested. The Vertical Movements or oscillation of the Boat/Pontoon/raft should be arrested by suitable provisions with due tolerance for current of flow/waves etc. The Vertical alignment of the borehole should be ensured by fixing Casing guard at the center of the Boat/Pontoon/raft (from Boat/Pontoon/raft floor level to a sufficiently hard stratum in the sub soil to withstand the movement of the Boat/Pontoon/raft as well as protect the sides of bore holes. No separate payment shall be paid for mobilization & demobilization. Cost for this activity shall be built in quoted rates of different items.

- 2.3.3** Establishing reduced levels and co-ordinates of the test locations with respect to permanent bench mark/reference point.
- 2.3.4** Conducting Standard penetration tests and collecting disturbed and undisturbed Soil samples from boreholes.
- 2.3.5** Collection of soil and ground water samples for chemical testing.
- 2.3.6** Recording water table in the boreholes.
- 2.3.7** Carrying out laboratory tests on soil/rock/water samples collected from boreholes.
- 2.3.8** Contractor shall submit interim Geotechnical investigation report, which shall include field bore logs with ground water table, co-ordinates & RL of boreholes to the Engineer-in-charge immediately after completion of boreholes.
- 2.3.9** Preparation and submission of final reports (Draft copies in soft form; 3 nos. hardbound final reports with 2 nos. soft copies in USB drives. All data should also be provided in Cloud downloadable link).
- 2.3.10** Any other work not specifically mentioned in this document but required for completion of work to the satisfaction of OWNER/EIL.
- 2.4** Bathymetric survey to develop river cross section along center line of proposed pipeline route.

3.0 SCOPE OF WORK FOR HYDROLOGICAL DATA COLLECTION

- 3.1** Bidder has to collect hydrological data for the river crossings along the pipeline route from authentic source such as CWC, State PWD, Irrigation, Maritime board etc. The data shall include but not limited to the following:
 - i) High Flood Level (HFL)
 - ii) Maximum Discharge at HFL
 - iii) Maximum Velocity of flow at HFL
 - iv) River bed Slope
 - v) Lowest water level (LWL)
 - vi) Other river details such as meandering etc.
 - vii) Calculation of Scour Depth & Furnishing Scour Profile
 - viii) Existence of any bridge or barrage or any other hydraulic structures within ten kilometers (10KM) upstream and downstream of the crossings for each river crossings site from the local/regional agencies such as CWC, Department of Irrigation, Flood Control Authority, PWD etc. The data shall be maximum of the recorded data in the last 25 years.

4.0 MANDATORY REQUIREMENT

- 4.1 Field Work: The contractor shall mobilize an experienced Geotechnical Engineer having minimum 5 (five) years' experience for supervision of field works during the entire period of field investigation. Field work shall not be permitted without the Geotechnical Engineer at site.
- 4.2 Other Work: The contractor shall engage a Geotechnical Engineer having postgraduate qualification with minimum 5 (five) years' experience for preparation of the investigation report and the Engineer should visit site to familiarize with the site conditions and to assess various field and laboratory tests to arrive at design parameters.
- 4.3 All test equipment and tools shall conform to the relevant IS code of practice.
- 4.4 The contractor shall confirm their schedule of field/lab investigations well in advance for the purpose of witness of tests by OWNER/CONSULTANT.
- 4.5 The contractor shall obtain all working permission from statutory authorities/local bodies prior to commencement of work.

5.0 FIELD WORK

5.1 Boring/Coring

Boring shall be carried out in accordance with the provision of IS: 1892. **Minimum diameter of boring shall be 150mm.** Auger boring shall be resorted to above the water table, whereas below the water table the boreholes shall be advanced by rotary drilling with mud circulation through all kinds of soil other than rock. While boring above water table, no water shall be introduced in the boreholes. Casing shall be used to support the sides of boreholes in soft to firm soils.

Use of chisel, percussion, and drilling with NX size may be permitted exclusively in strata having SPT-N greater than 100 blows per 30cm penetration and as per direction of Engineer-in-charge.

Coring shall be done with NX size diamond drill bit of double tube core barrel. The depth of ground water table shall be measured. The water table in the borehole shall be allowed to stabilize after depressing the water level adequately by bailing.

5.1.1 Termination Criteria of borehole

Termination criteria of boreholes in river Bank/Bed:

- i) Maximum depth as specified
- ii) After coring 3m in soft / weathered rock (core recovery up to 50%) or after coring 1m in hard rock (core recovery greater than 50%).

5.2 Standard Penetration Test (SPT)

These shall be conducted in boreholes at interval of 1.5m or at change of strata starting first test at 0.5m depth. Last SPT shall be conducted at the termination depth of borehole. The disturbed representative samples shall be visually classified, labeled for identification, and properly preserved for laboratory testing. SPT shall be terminated at any depth when the number of blows exceeds 100 for a penetration of 30cm or less. All test equipment and tools shall conform to relevant IS code of practice

5.3 Undisturbed Sample

Undisturbed samples of 100mm diameter shall be taken from all boreholes and from representative strata at intervals of 3.0m or change of strata whichever occurs earlier starting first UDS at 2.5m depth. For stiff clays, area ratio of the sampling tubes shall not exceed 20%. In soft deposits piston sampler shall be used to collect UDS. Quoted rates shall include transport of samples to the laboratory.

Care shall be taken to minimize sample disturbance during collection of samples. Samples shall be collected by pushing the sampler. Driving by hammer above ground level (like SPT) is not acceptable. However, for stiff / hard soil a sliding hammer can be used for driving the sampler at sampler head

5.4 Disturbed Sample

Disturbed soil/wash samples shall be collected at every 0.5m intervals and at every change of strata from boreholes. Identification labels indicating depth, borehole no. and visual soil classification shall be affixed on the containers

6.0 LABORATORY TEST

After collecting disturbed and undisturbed samples from different boreholes at different depths a laboratory test schedule shall be prepared and submitted to OWNER/CONSULTANT for review. Adequate number of the following tests shall be conducted to clearly determine the mechanical strength and compressibility characteristics of each strata of soil encountered. All tests on rock and soil samples shall confirm to IS codes of practice. The laboratory tests shall essentially comprise of but not limited to the followings:

6.1 Grain Size Distribution

Wherever applicable both the sieve & hydrometer analysis shall be conducted to indicate complete range of grain sizes of soil samples tested.

6.2 Atterberg's Limits

Wherever applicable, these tests shall be carried out by the skilled personnel. The test result should include liquid limit, plastic limit and shrinkage limit of the soil samples tested. These tests should be conducted as per IS-2720, Part V & VI.

6.3 Unconfined Compressive Strength Test

These tests shall be done as per IS-2720 (Part- X) on selected soil sample.

6.4 Triaxial Test

These tests shall be done on specimens saturated by the application of back pressure. Only if the water table is at sufficient depth so that chances of it's rising to the base of the footing are meager or nil, the tri axial tests shall be performed on specimens at natural moisture content. The magnitude of the back pressure applied shall be indicated in the report.

All the stress strain diagrams as well as Mohr circle envelopes shall be included in the report. Density and water content of the sample tested and modulus of elasticity along with shear strength parameters shall be reported.

6.5 Direct Shear Test

These tests shall be carried out as per IS-2720 (Part-XIII) on selected soil samples.

6.6 Chemical Tests

Chemical tests shall be conducted on soil and water samples as per relevant IS (latest revision) to report the following:

- i) pH
- ii) Chlorides in ppm & percentage
- iii) Sulphates in ppm, percentage & expressed as SO_3 & SO_4

6.7 Free Swell Index & Swelling Pressure Test

Wherever applicable, these tests shall be conducted on the selected soil samples collected from boreholes/trial pits from different depths, as per relevant IS codes (latest edition).

7.0 REPORT

7.1 Interim reports shall be furnished at various stages of investigation for our comments.

7.2 Detailed report(s) shall be prepared and submitted to OWNER/CONSULTANT as soon as the field and laboratory works are completed in a draft form for review and comments. All the information as mentioned below shall be furnished in the draft copy of final report. After reviewing, contractor shall be informed about OWNER/CONSULTANT comments/remarks, if any, the same shall be incorporated in the final report. The report shall include but not limited to following:

- i) A plot plan showing all the test locations with respect to reference chainage.
- ii) General geological information of the site.
- iii) Character and genesis of soil.
- iv) Procedure of investigation and method of various testing adopted.
- v) Detailed bore logs indicating co-ordinates, reduced level, ground water table etc., subsoil section along various profiles indicating boreholes nos. depth wise in situ tests like SPT.
- vi) All field and laboratory test results shall be plotted against depth and also in tabular form.
- vii) Recommendations for detailed hydrological data available from regulatory agencies for each of the river crossings as per clause no. 3.1 and their interpretation to evaluate various hydrological parameters.
- viii) Silt factor at various depths shall be given against each borehole.
- ix) Recommendation of scour depth with backup calculations as per IRC-78 (latest edition).

- x) The historical local data available for any bank erosion, scour observed at near bridge etc. for each river crossings, change in the river course shall be furnished in the report along with the source of data.
- xi) Recommendations for bank protections/bank erosion controls/slope stabilizations including details of the proposed method, specifications, execution methodology and bank profile details etc. wherever required, shall be furnished in the report along with back-up calculations.
- xii) All calculations, recommended design parameters, and measurements shall be reported in SI units.
- xiii) Cross sections of the rivers along the centerline of the proposed water pipeline crossing.

7.3 All recommendations shall be supported by back up calculations.

ANNEXURE-I

NUMBER OF LABORATORY TESTS ON SOIL/ROCK SAMPLES:

The minimum nos. of laboratory tests on soil/rock samples **collected from each of 20m deep borehole** shall be as below:

Table-1

S.No.	DESCRIPTION OF ITEMS	UNIT	QTY (For each Borehole)	
			In River Bed	In River Bank
	Conducting the following laboratory tests:			
1	Conducting Atterberg's limit (Liquid Limit & Plastic Limit & Shrinkage Limit) as specified	No.	5	5
2	Conducting Natural water content on soil samples as specified	No.	5	5
3	Conducting Bulk and dry density tests on soil samples as specified	No.	5	5
4	Conducting Specific gravity and void ratio tests on soil samples as specified	No.	2	3
5	Conducting Sieve analysis for grain size distribution on samples as specified	No.	14	18
6	Conducting Hydrometer Analysis for grain size distribution on samples as specified	No.	5	7
7	Conducting Tri-axial Unconsolidated Un-drained (UU) test on soil samples as specified	No.	2	3
8	Conducting Unconfined Compression Tests on soil samples as specified	No.	1	2
9	Conducting Direct Shear Test on soil samples as specified, if soil is COHESIONLESS nature	No.	1	2
10	Conducting Consolidation tests on soil samples as specified	No.	2	3
11	Conducting Unconfined Compression Test on Rock samples as specified	No.	1	1
12	Conducting Point Load test on Rock samples as specified	No.	1	1
13	Conducting Swelling Potential and Swelling Pressure tests on soil samples as specified	No.	1	1
14	Conducting Chemical tests on SOIL SAMPLES as specified	No.	2	2
15	Conducting Chemical tests on WATER SAMPLES as specified	No.	2	2

The minimum nos. of laboratory tests on soil/rock samples **collected from each of 10m deep borehole shall** be as below:

Table-2

S.No.	DESCRIPTION OF ITEMS	UNIT	QTY (For each Borehole)
	Conducting the following laboratory tests:		
1	Conducting Atterberg's limit (Liquid Limit & Plastic Limit & Shrinkage Limit) as specified	No.	3
2	Conducting Natural water content on soil samples as specified	No.	2
3	Conducting Bulk and dry density tests on soil samples as specified	No.	3

**SPECIFIC REQUIREMENTS &
SOW FOR WATER PIPELINE
FROM RUNDH (PH) TO
JHAGADIA PUMP HOUSE**

**Document No.
B828-000-81-47-SP-9510
Rev. No. 1
Page 9 of 9**

S.No.	DESCRIPTION OF ITEMS	UNIT	QTY (For each Borehole)
4	Conducting Specific gravity and void ratio tests on soil samples as specified	No.	2
5	Conducting Sieve analysis for grain size distribution on samples as specified	No.	9
6	Conducting Hydrometer Analysis for grain size distribution on samples as specified	No.	3
7	Conducting Tri-axial Unconsolidated Un-drained (UU) test on soil samples as specified	No.	2
8	Conducting Unconfined Compression Tests on soil samples as specified	No.	1
9	Conducting Direct Shear Test on soil samples as specified, if soil is COHESIONLESS nature	No.	1
10	Conducting Consolidation tests on soil samples as specified	No.	2
11	Conducting Unconfined Compression Test on Rock samples as specified	No.	1
12	Conducting Point Load test on Rock samples as specified	No.	1
13	Conducting Swelling Potential and Swelling Pressure tests on soil samples as specified	No.	1
14	Conducting Chemical tests on SOIL SAMPLES as specified	No.	1
15	Conducting Chemical tests on WATER SAMPLES as specified	No.	1

PROCESS DESIGN BASIS

FOR

Supply, Laying, Installation, Testing & Commissioning including all fittings, crossings for 1500mm Dia. PCCP Pipeline for Water Supply Project at GIDC Jhagadia Estate

0	19.04.2024	CLIENT COMMENTS INCORPORATED ISSUED FOR APPROVAL/TENDER	DKM	VKP	HKP
A	04.12.2023	ISSUED FOR COMMENTS	DKM	VKP	HKP
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

TABLE OF CONTENTS

SECTION	CONTENTS	PAGE
1.0	INTRODUCTION	4
2.0	PURPOSE OF THIS DOCUMENT	4
3.0	BASIC PARAMETERS OF PROPOSED PIPELINE	4
4.0	PROJECT BATTERY LIMITS	5
5.0	DESPATCH/RECEIPT STATION PARAMETERS	5
6.0	INSTRUMENTATION	6
7.0	METERING SYSTEM	6
8.0	GENERAL PROJECT SPECIFICATIONS	6
9.0	EXCLUSIONS	6
ANNEXURE -I	RAW WATER QUALITY	7
ANNEXURE-II	GROUND ELEVATION PROFILE	8

ABBREVIATION :

GIDC	: Gujarat Industrial Development Corporation
NAA	: Notified Area Authority
EIL	: Engineers India Limited
PMC	: Project Management Consultant
MLD	: Million Liters per Day
GRP	: Glass fiber Reinforced Plastic
CS	: Carbon Steel
MOC	: Material Of Construction
CA	: Corrosion Allowance
PCCP	: Prestressed Concrete Cylinder Pipe

1.0 INTRODUCTION

M/s GIDC, Gujarat intends to install a PCCP water pipeline from Rundh, Gujarat to Jhagadia, Gujarat.

The PCCP pipeline length is approx. 24.5 km long and internal diameter is 1500 mm. The pipeline runs from well intake terminal in Rundh, Gujarat to receipt terminal in Jhagadia, Gujarat. The pipeline also has associated facilities like mainline isolation valves, combination type tamper proof air valves, drain/ scour valves, etc.

Engineers India Limited (EIL) has been appointed as EPCM consultant for implementation/execution of pipeline from Rundh, Gujarat to Jhagadia, Gujarat.

2.0 PURPOSE OF THIS DOCUMENT

This document covers the Process Design Basis for pipeline from Rundh, Gujarat to Jhagadia, Gujarat. The purpose of this document is to provide the basic process design parameters necessary for carrying out the basic and detailed engineering design of the above facilities.

3.0 BASIC PARAMETERS OF PROPOSED PIPELINE

3.1	Pipeline Design life	35 Years
3.2	Pipeline Length	24.373 KM
3.4	Main Trunk line size	As per hydraulics
3.5	Pigging Facilities	Not envisaged
3.6	Pipeline roughness	To be provided by Engg.
3.7	Material of construction (MOC) for pipeline	PCCP
3.8	Pipeline Corrosion Allowance	Not applicable
3.9	Subsoil temperature	25 - 30 °C throughout the entire length of the pipeline.
3.10	Design Pressure	As per hydraulics.

3.11	Design temperature	0 °C to 45 °C for all buried sections 0 °C to 65 °C for above ground portion
3.12	Pipeline laying	Buried
3.13	Burial Depth, m	As per pipeline Engg. documents
3.14	Ground profile	Refer Annexure-2
3.15	Pipeline corrosion protection system	To be provided by Engg.
3.16	Design margin (for pipeline)	On flow : NIL On length : NIL
3.17	Mainline Block Valves	Number of mainline valves and their location shall be finalized by engineering during detailing.
3.18	Air Valves	Air valves will be provided along the pipeline as per AWWA code. Number of air valves and their location shall be finalized by engineering during detailing.

4.0 PROJECT BATTERY LIMITS

Battery Limit of Pipeline shall be between Hookup point at pipeline start (i.e. Pump Discharge at Rundh) and Hookup point at pipeline end point (at Jhagadia) locations.

Battery limit conditions :

Inlet flow rate, m ³ /hr	:	7500 m ³ /hr (120MLD)
Supply pressure, Kg/cm ² g	:	As per Hydraulic
Supply temperature, ° C	:	Ambient

5.0 DESPATCH/RECEIPT STATION PARAMETERS

5.1 Design Parameters (For Raw water)

	Despatch terminal of Pumping station	
5.1.1	Source of Raw water	Naramda river
5.1.2	Location	Rundh, Jhagadia
5.1.3	Supply temperature, Deg C at B/L	Ambient
5.1.4	Supply pressure, kg/cm ² g at B/L	To be provided by client
5.1.5	Flow rate, m ³ /hr	1000m ³ /hr (As per DPR Provided by client)
	Receipt station of Pipeline	
5.1.6	Source of Raw water	Pipeline
5.1.7	Location	Jhagadia industrial estate, Jhagadia

5.1.8	Receipt temperature, Deg C at B/L	As per hydraulics
5.1.9	Receipt pressure, kg/cm ² g at B/L	As per hydraulics
5.1.10	Flow rate, m ³ /hr	6000m ³ /hr (20 operating hours) & 7500m ³ /hr (16 operating hours).

6.0 INSTRUMENTATION

6.1	General	Adequate instruments and control system shall be provided for safe and efficient operations.
6.2	Control Philosophy:	Conventional control panel with receiver instrument and flow computers for local control & monitoring shall be considered at manned terminals.
6.3	Block & by-pass valve for control valves	As per design.

7.0 METERING SYSTEM

9.1	Flow meters	Not envisaged
-----	-------------	---------------

8.0 GENERAL PROJECT SPECIFICATIONS

10.1 Numbering System

Unit no.	:	010
Equipment no.	:	As per EIL Standard
Instruments no.	:	As per EIL Standard
Documents no.	:	As per EIL Standard

10.2 Drawings/Documents : All drawings & other documents shall be prepared as per EIL Standard.

10.3 Units of Measurement : Metric, unless otherwise specified

9.0 EXCLUSIONS

Nil

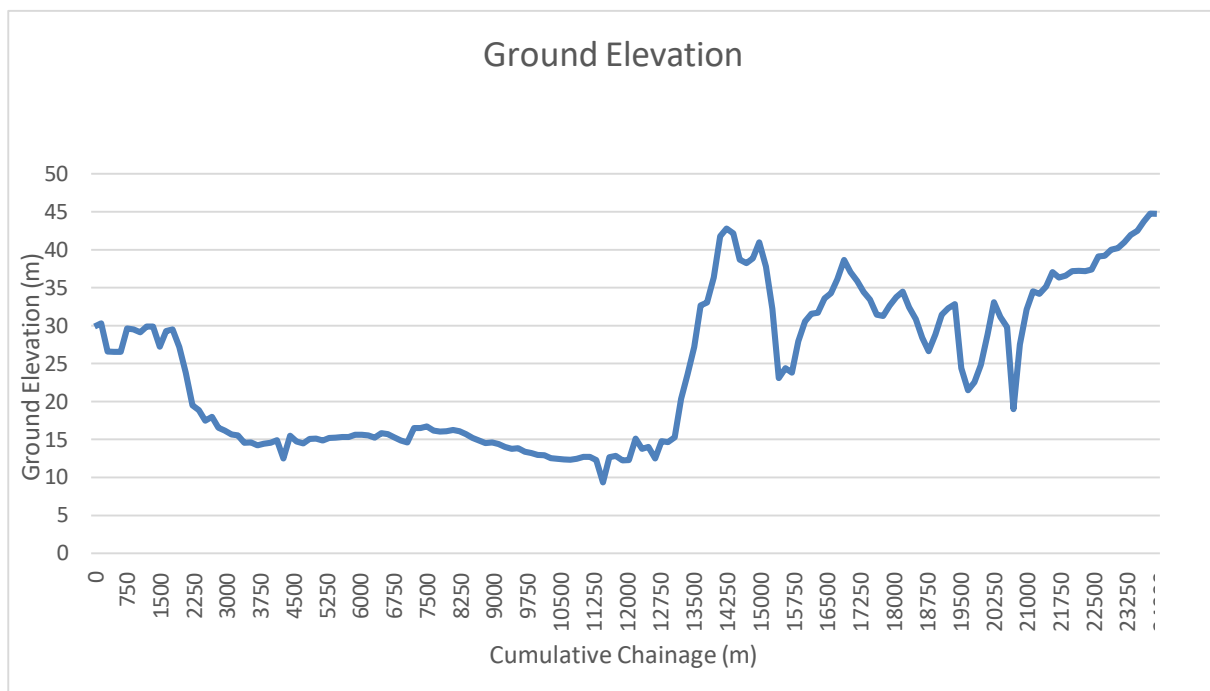
ANNEXURE- I

RAW WATER QUALITY

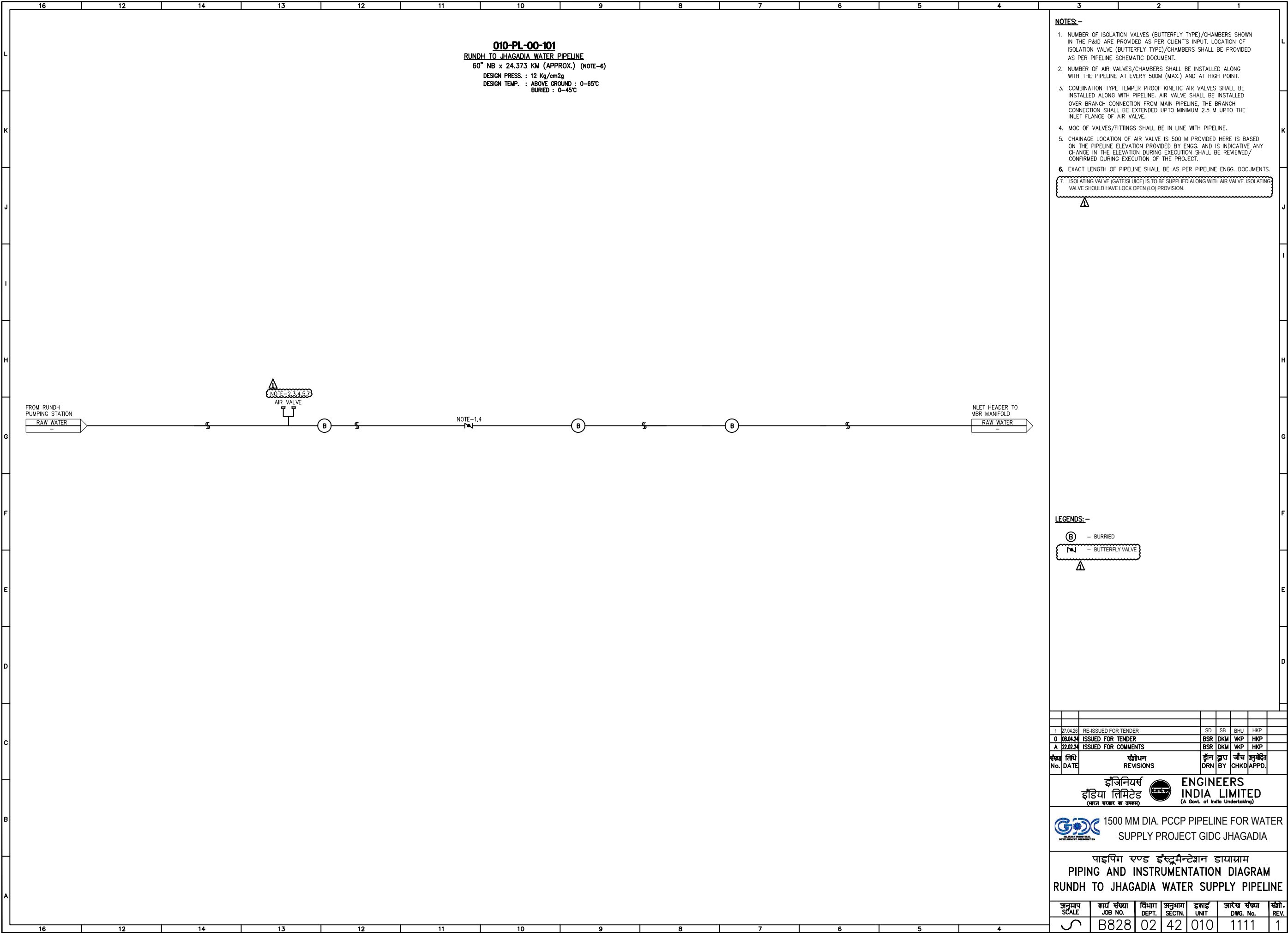
S. No.	Parameters	Unit	Location			
			At the TAP of Narmada River Intakewell Rundh	At the TAP of Pumping Station Rundh	At the TAP of Pumping Station Jhagadia	At the TAP of M/S. Varun Beverages Co's Connection Point
			Date of Sample: 29/12/23	Date of Sample: 29/12/23	Date of Sample: 29/12/23	Date of Sample: 29/12/23
			Date of analysis: 30/12/23	Date of analysis: 30/12/23	Date of analysis: 30/12/23	Date of analysis: 30/12/23
1	Colour	Hazen	<1	<1	<1	<1
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity	NTU	4.87	3.28	3.12	3.18
5	pH at 25 °C	-	7.72	7.94	7.88	7.84
6	Total Dissolved Solids	mg/l	312	288	272	274
7	Total Hardness (as CaCO ₃)	mg/l	244	236	224	232
8	Calcium (as Ca ²⁺)	mg/l	38	34	34	34
9	Magnesium (as Mg ²⁺)	mg/l	36	37	36	37
10	Chlorides (as Cl ⁻)	mg/l	88	76	76	84
11	Sulphates (as SO ₄ ²⁻)	mg/l	31.4	34.01	34.01	34.01
12	Nitrates (as NO ₃ ⁻)	mg/l	0	0	0	0
13	Fluoride (as F ⁻)	mg/l	0.06	0.06	0.05	0.06
14	Total Alkalinity (as CaCO ₃)	mg/l	108	96	92	96

ANNEXURE- II

GROUND ELEVATION PROFILE



This drawing and the design it covers are the property of ENGINEERS INDIA LIMITED. They are merely loaned and on the borrower's express agreement that they will not be reproduced, copied, loaned, exhibited, nor used except in the limited way and private use permitted by any written consent given by lender to the borrower.



[illegible]

**TECHNICAL SPECIFICATION
FOR
PRE-COMMISSIONING AND COMMISSIONING
FOR
SUPPLY, LAYING, INSTALLATION, TESTING & COMMISSIONING
INCLUDING ALL FITTINGS, CROSSINGS FOR 1500MM DIA. PCCP
PIPELINE FOR WATER SUPPLY PROJECT
AT GIDC JHAGADIA ESTATE**

B	27.04.2026	RE-ISSUED FOR TENDER	SB	BHU	HKP
A	19.04.2024	ISSUED FOR TENDER	DKM	VKP	HKP
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

TABLE OF CONTENT

1.0	INTRODUCTION	3
2.0	FACILITIES BRIEFING	3
3.0	GENERAL	3
4.0	RESPONSIBILITY OF CONTRACTOR	4
5.0	SCOPE OF WORK	6
5.1	PRE-COMMISSIONING CHECKS	6
5.2	DEWATERING (HYDRO TEST WATER)	6
5.3	LEAK CHECK (TIGHTNESS TEST) FOR PIPING AND EQUIPMENT	7
5.4	PREPARATIVE STEPS FOR COMMISSIONING ACTIVITIES	8
6.0	DOCUMENTATION	8
7.0	SPARES AND CONSUMABLES	9
8.0	SAFETY	9

ANNEXURE- I

FORMAT FOR BIODATA OF KEY PERSONNEL FOR COMMISSIONING

ANNEXURE-II

QUESTIONNAIRE

ANNEXURE-III

FORMATS TO BE USED DURING PRE-COMMISSIONING AND COMMISSIONING

1.0 INTRODUCTION

- 1.1 GIDC, Gujarat intends to install a PCCP water pipeline from Rundh, Gujarat to Jhagadia, Gujarat.
- 1.2 The PCCP pipeline length is approx. 24.5 km long and internal diameter is 1500 mm. The pipeline runs from well intake terminal in Rundh, Gujarat to receipt terminal in Jhagadia, Gujarat.
- 1.3 This document covers details of work tendered, scope of work, and scope of supply pertaining to pipeline and associated facilities for Detailed Engineering, Procurement, Construction, Inspection, Testing, Pre-Commissioning and Commissioning assistance of the water pipeline, and associated facilities.
- 1.4 The overall scheme of the water pipeline is indicated in the schematic drawing no. B828-000-83-44-30001 attached with the Tender. The Schematic indicates the overall details of the water pipeline system in brief and is for reference purpose. Contractor's quotation shall be based on complete scope of work and all documents/ drawings form part to the tender document.
- 1.5 Details of associated scope of work pertaining to civil, structural, cathodic protection works, etc. are covered elsewhere in the Tender document.
- 1.6 This document shall be read in conjunction with bill of quantities/ schedule of prices, master index, specifications, standards, drawings, and other documents forming part of Tender document.

This specification covers the minimum technical requirements for pre-commissioning activities and commissioning of facilities in the project "Supply, Laying, Installation, Testing & Commissioning including all fittings, crossings for 1500mm Dia. PCCP Pipeline for Water Supply Project at GIDC Jhagadia Estate". For details of the facilities under the scope of this contract, Contractor to refer the same as provided elsewhere in the bid package. However, the major facilities covered under Contract are provided in the 2.0 section of this document.

2.0 FACILITIES BRIEFING

Broadly following new facilities have been envisaged under this project:

Refer P&ID No. B828-02-42-010-1111

- 60" x 24.5km(approx..) pipeline from Rundh, Gujarat to Jhagadia, Gujarat.
- Hook-up with the upstream and downstream facilities at Rundh and Jhagadia respectively.

3.0 GENERAL

This specification covers the minimum technical requirements for Pre commissioning activities and Commissioning of facilities, under the scope of work. The contractor has to co-ordinate between various parties like the Company (Owner) / Company's representatives and other concerned Authority, so that a proper interfacing and understanding is built up during overall commissioning of the complete pipeline and its facilities.

Contractor has to mobilize adequate manpower to co-ordinate commissioning activities at all upgradable location in case of simultaneous test of operation activities.

The contractor will complete all pre-commissioning works and provide all the necessary during commissioning of the facilities under supervision and instruction from the Company/Company's representatives.

The contractor shall be responsible for demonstrating the successful completion of all the activities i.e. pre-commissioning checks, dewatering, flushing of the interconnecting piping in the terminal, leak testing (tightness test), idle time preservation (if required), removal of idle time preserver etc. for the facilities under the scope of work. All necessary work to perform the job successfully, including all necessary modifications required, shall be the responsibility of the contractor.

The contractor shall design and supply all temporary line connections, valves, spools, blind flanges, instruments, tools/tackles/aids etc. as required during the various operations/activities.

In the event of any detail, which is not fully addressed, it should be warranted by the contractor that work shall be performed in accordance with company's specifications and the best recognised practices/standards in the on-shore pipeline-terminal industry.

The contractor, along with his bid documents, is required to submit the execution plan and method statement for pre-commissioning activities and commissioning.

The contractor shall prepare detailed procedures for pre-commissioning checks, dewatering, flushing/cleaning, leak checks, preservation method during idle time before commissioning (if applicable) of the piping and equipment within terminals/stations, removal of idle time preservers, covering all aspects of work, for approval by the Company/ Company's representative. This shall include, but not be limited to, the sequence and description of all operations; data on materials, equipment, Instruments, consumables and communication systems proposed, necessary calculations, detailed time schedule and organisation chart and any contingency plan.

4.0 RESPONSIBILITY OF CONTRACTOR

The contractor shall be responsible for successful completion of all the pre-commissioning activities and provide commissioning that needs to be carried out for the facilities. This broadly includes (but not limited to) the following: -

Pre commissioning activities

- Carrying out pre commissioning checks of the terminal/ station facilities including hook-up piping.
- Dewatering of the piping.
- Flushing of piping
- Leak check or tightness tests
- Supply and supervision of manpower for pre commissioning.

- Supply and operation of machinery and equipment required for pre-commissioning.
- Supply and use of materials and consumables as required for the pre-commissioning activities.
- Design and supply all temporary line connections, valves, spools, strainers, instruments, machineries like compressors etc. as required during various operations.
- Preparation of detailed pre-commissioning procedures, activity schedules, bar charts, schemes etc.
- This shall include process system Identification on P&ID, preparation of detailed procedures for dewatering, flushing and leak check, idle time preservation (if required), removal of idle time preserver, and shall address the sequence and methodology describing all operations, data on materials, equipment, instruments, consumables, communication systems, necessary calculations, waste disposal method, detailed time schedule and organization chart.
- All necessary work to perform the job successfully including all modifications that would be required.
- Co-ordination with other contractors to complete pre-commissioning activities under their scope of work.

Commissioning

Commissioning of the facilities has to be taken up with the commissioning of all the stations/terminals under project "Supply, Laying, Installation, Testing & Commissioning including all fittings, crossings for 1500mm Dia. PCCP Pipeline for Water Supply Project at GIDC Jhagadia Estate". It is emphasized here that, the contractor has to ensure all sorts of interfacing and co-ordination with the pipeline facility /commissioning agency and provide all necessary help as may be required, so that the commissioning of the station/terminal facilities and stabilization of cross-country pipeline can progress uninterrupted in a smooth harmonious manner.

Contractor would be required to provide every necessary interfacing/ co-ordination during commissioning as outlined below:

- Manpower supply and supervision, operation of machineries/ valves for commissioning, supply equipment and consumables for installation of temporary facilities within stations.
- Attending and rectifying leaks as and when required within Dispatch stations/ Tap-off station/ Receipt stations.
- Any other work as required by Company
- Participation in Commissioning checks including Safety Review prior to start of commissioning activities to achieve 'Ready for Commissioning' status for equipment/piping system at Despatch stations/ Tap-off station/ Receipt stations and liquidation of the punch list points of such safety review.
- Stabilization and 72 hours run of the pipeline terminals systems. The countdown for 72 hours operation shall start only after stable operation with all controls and safety system in normal operation for a period of not less than 48 hours.
- All activities needs to logged by the commissioning contractor and duly certified by EPCM Contractor and Owner.
- Erection of all temporary line connections, valves, spools, strainers, instruments, manpower, consumables etc. as required during various operations.
- The responsibility for pre commissioning activities shall be of the facilities shall be in the Contractor's scope. However, they needs to associate OWNER's

operation personnel in all the day to day pre-commissioning activities for hands on experience and training.

- The contractor shall be responsible for the successful completion of all of the above-mentioned activities.

5.0 SCOPE OF WORK

The work to be performed by the contractor as part of Pre-commissioning activities and Commissioning of the facilities under scope, (Scope is outlined in Section-1.0 & 2.0 above and detailed elsewhere in the tender document), shall consist of the following:

5.1 Pre-commissioning checks

Pre-commissioning checks shall be carried out for the Despatch stations/ Tap-off station/ Receipt stations to ascertain that the systems have been mechanically completed in all respects. These checks shall cover the equipment and interconnecting piping work in the stations under the scope of work. The pre-commissioning checks shall include the following, as a minimum:

1. System Checks

The entire facilities shall be checked against the final P&IDs and the latest Engineering and Vendor drawings / documents and other design specifications. Any shortcomings observed shall be listed down in the form of punch lists and these should be duly attended for liquidation. The contractor should check the pipeline stations/terminals from the angle of pre-commissioning and spell out any additional requirement of vents/drains, temporary arrangement/modification etc. that may be required during the pre-commissioning and arrange for the same in consultation with the Company/Company's representative.

2. Checking of Instruments

The entire field instruments shall be checked physically and also for their intended application by simulating the operating condition, in the test benches, test packs or other equivalent suitable arrangements.

3. Any other checks as may be considered necessary.

5.2 Dewatering (Hydro test water)

General

Dewatering of a piping system in the Despatch stations/ Tap-off station / Receipt stations shall be done subsequent to the hydro-test of the respective piping section. Hydro test of the station piping's shall be carried out as per existing standards. During the dewatering operation, the major quantity (to the maximum extent possible) of hydro-test water shall be removed from the main interconnecting piping work in the stations.

Operational requirements

The dewatering operation for the piping work in the stations shall consist of physically draining the water content in the piping work by opening low point drains and/or end

flanges. If required air shall be used to push-off water from the pipes. The contractor shall arrange suitable compressor of for such purposes.

Flushing/ blowing of aboveground piping in the terminal

Flushing/ blowing of above ground piping at Despatch stations/ Tap-off station/ and Receipt stations with water/air to remove debris/dirt/mud from within the piping has to be performed by the contractor. Subsequent to water flushing, to ensure complete cleanliness of the piping work, air blowing/cardboard blasting method has to be adopted. All instruments, to be dismantled from the piping work and any gap produced should be bridged with suitable temporary spool before testing and flushing. Proper supporting of the piping, during such flushing/blowing activities is to be ensured by the contractor.

The contractor has to make arrangement of clean water/ air for these flushing / blowing activities.

The contractor should submit a plan/methodology for carrying out such activities detailing out each aspect/step.

Acceptance criteria

The contractor shall specify when flushing / air blowing is completed to the satisfaction of the Company/Company's representative, and shall obtain approval of the Company/Company's representative before proceeding to the next step.

5.3 Leak check (Tightness test) for piping and equipment

General

The piping and the equipments of the Despatch stations/ Tap-off station/ Receipt stations system shall be checked for leaks at all flange joint points of piping and equipment, instrument impulse tubing points, valve glands etc. This shall be done by pressurizing the system piping / equipment with air and testing the system by means of soap solution for leaks.

All equipments and piping of the stations should be covered under leak/tightness test. For this the total station system piping work may be subdivided into a number of loops or a single loop may be formed as per convenience / suite to site condition. During leak test contractor to ensure that pressure should not exceed piping operating pressure.

Proper record has to be kept for tightness test of each flange joint in the terminal/ station system, with witness signature from authorized persons.

The contractor shall submit the detailed procedure and the duration of the leak check operations and obtain approval of the company/Company's representative before starting the operation.

Acceptance criteria

The leak check operation shall be considered to be completed when the piping system / equipments is free of leaks, when tested at a low pressure of around 7-8 Kg/cm² g & pressure is hold up for a duration of 4 hours. The leak test is satisfactory when the pressure decrease is lower than 0.05 kg/cm²/hr over a period of 4 consecutive hours.

5.4 Preparative steps for commissioning activities

Safety review prior to start of commissioning activities

A pre-startup safety review of the Despatch stations/ Tap-off station/ and Receipt stations shall be carried out. The contractor shall arrange for such safety review, involving all concerned in the commissioning. The Company / Company's representative shall also participate in the pre-startup safety review. The contractor shall generate all requisite formats to record the findings of such Safety Review.

Ready for commissioning

After completion of pre-commissioning activities and Company approved safety startup review followed by liquidation of review punch list points, the contractor shall notify the Company/ Company's representatives that the systems associated with the Despatch stations/ Tap-off station/ Receipt stations are ready in all respects. 'Ready for commissioning status' shall be jointly reviewed by Company and final clearance for start-up of the pumping facilities shall be given by the Company. After such joint assessment, if all the criteria are met, it will then be declared by the Company that the entire pipeline pump stations/terminals system has reached a stage of 'Ready for Commissioning'.

It should be noted that if the actual commissioning of the stations is taken up after idle time of sufficient length. The contractor has to take up all steps during such revisioning activities.

Commissioning

During commissioning of the Despatch stations/ Tap-off station/ Receipt stations and the pipeline together, contractor has to take all steps involved in such commissioning activities of the despatch stations/ Tap-off station/ Receipt stations under the scope of this project.

6.0 DOCUMENTATION

The contractor shall submit for approval of the Company, Company's representative the complete description, detailed procedures and time schedule for all of the following activities:

- Pre-commissioning
- Dewatering
- Flushing/ blowing
- Low pressure leak check with air
- Idle time preservation (if required), including removal of preservers
- Commissioning

All these documents should be prepared covering all aspects of HSE, quality assurance and quality control plans.

The contractor shall ensure that his documents are related to “as-built” conditions of the facilities and structures involved.

Documents shall also contain all safety plans, procedures, to be followed while carrying out the activities.

Upon successful completion of the work, the contractor shall prepare a final report of the work which shall include necessary charts, diagrams, graphs, calculations, recordings, daily logs, measurements, details of the operation, etc. Report shall also include all certificates of calibration of instruments required, together with records of calibration performed at site prior to the start of any operation and the approved pre-commissioning formats and check list sheets.

7.0 SPARES AND CONSUMABLES

The contractor shall identify and arrange for supply of manpower, spares, tools, tackles and consumables as required for pre-commissioning activities and commissioning.

8.0 SAFETY

The contractor shall follow the safety practices during execution of pre-commissioning activities and Commissioning works as detailed in the scope of work. He shall also maintain and follow all safety practices equivalent or better than those being practiced by the industry during pre-commissioning and commissioning activities.

ANNEXURE - I

FORMAT FOR BIODATA OF KEY PERSONNEL FOR COMMISSIONING

1. PROPOSED POSITION IN ORGANISATION CHART:
2. NAME:
3. QUALIFICATION:
4. TOTAL YEARS OF EXPERIENCE IN PLANT OPERATION / COMMISSIONING:
5. DETAILS OF COMMISSIONING EXPERIENCE:

SL NO.	PROJECT DESCRIPTION	PLANT CAPACITY	LICENSOR	OWNER	YEAR OF COMMISS.	DURATION OF STAY AT SITE

ANNEXURE-II

QUESTIONNAIRE

CLAUSE NO.	DESCRIPTION OF CLAUSE	AGREED	NOT AGREED	REMARKS
1.0	SCOPE	☐	☐	
2.0	DEFINITIONS	☐	☐	
3.0	MANUFACTURER REPRESENTATIVE	☐	☐	
4.0	DOCUMENT FOR PRE-COMMISSIONING AND COMMISSIONING	☐	☐	
5.0	OTHER REQUIREMENTS	☐	☐	
6.0	REVIEW/CHECKLISTING/INSPECTION/ CO-ORDINATION	☐	☐	
7.0	COMMISSIONING	☐	☐	
8.0	CONSUMABLES	☐	☐	
9.0	SPECIAL REQUIREMENTS	☐	☐	
10.0	SAFETY	☐	☐	

NOTE:

PLEASE TICK THE RELEVANT BOX.

MENTION THE REASON & THE CLAUSE NOT AGREED IN THE REMARKS COLUMN.

ANNEXURE-III

FORMATS TO BE USED DURING PRE-COMMISSIONING AND COMMISSIONING

TOTAL 5 FORMATS

FORMAT - I

INTIMATION REGARDING SYSTEM COMPLETION

PROJECT: _____CUSTOMER: _____UNIT: _____

Following system/sub-system has been mechanically completed in all respects with exceptions noted below. The system/sub-system can be taken up for checking and preparation of checklist.

SYSTEM NO:

SYSTEM DESCRIPTION:

EXCEPTIONS:

SIGNATURE

DATE

CONTRACTOR'S CONSTRUCTION:
CO-ORDINATOR:

The system is ready/ not ready for Check listing.

OWNER/ PMC:

FORMAT - II

CHECKLIST

PROJECT: _____ CUSTOMER: _____ UNIT: _____

SYSTEM/SUB-SYSTEM: _____

CHECKLIST TYPE

PRELIMINARY/FINAL

SL.NO.

CHECKLIST ITEMS

REMARKS

SIGNATURE

DATE

PMC:

OWNER:

FORMAT - III

READY FOR PRE-COMMISSIONING CERTIFICATE

PROJECT: _____ CUSTOMER: _____ UNIT: _____

SYSTEM/SUB-SYSTEM: _____

This is to certify that the following Plant/system/sub- system as detailed below is completely installed and all the Checklist points are carried out except for minor details as given in the attached list.

DESCRIPTION ON PLANT/SECTION/SUB-SECTION: _____

SIGNATURE

DATE

CONTRACTOR'S CONSTRUCTION
CO-ORDINATOR:

CONTRACTOR'S COMMISSIONING
CO-ORDINATOR:

The system is ready/ not ready for pre-commissioning.

SIGNATURE

DATE

PMC:

OWNER:

FORMAT - IV

READY FOR COMMISSIONING CERTIFICATE

PROJECT: _____ CUSTOMER: _____ UNIT: _____

SYSTEM/SUB-SYSTEM: _____

This is to certify that all the necessary pre-commissioning activities for the system/sub-system as detailed below have been completed and the system/sub-system is ready for commissioning except for the minor details as given below which will not affect the commissioning trial runs.

DESCRIPTION OF SYSTEM/SUB-SYSTEM: _____

SIGNATURE

DATE

CONTRACTOR'S COMMISSIONING

CO-ORDINATOR:

SIGNATURE

DATE

PMC:

OWNER:

FORMAT - V

COMPLETION OF COMMISSIONING CERTIFICATE

PROJECT: _____ CUSTOMER: _____ UNIT: _____

SYSTEM/SUB-SYSTEM: _____

This is to certify that the system/sub-system as detailed below has been successfully commissioned and is under operational control of Client's Production department. The minor items, which will not affect the normal operation of the system/sub-system, are given in the attached list.

DESCRIPTION OF SYSTEM/SUB-SYSTEM: _____

SIGNATURE

DATE

CONTRACTOR'S COMMISSIONING
CO-ORDINATOR:

SIGNATURE

DATE

PMC:

OWNER: