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STANDARD SPECIFICATION FOR TANK PADS

0.0 SCOPE

TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA
The specification describes the technical requirements for the materials and construction of tank pads of murrum fill construction, materials and processes for providing anti corrosive layer and materials and processes for providing RCC Apron and RCC Toe Beam.

1.0 REFERENCE STANDARDS

IS:383
IS: 2720, PART-4,PART-7,PART-8 AND PART-14
IS:1498

2.0 SUB-GRADE PREPARATION

The surface of natural soil exposed at the bottom of excavated pit shall be thoroughly compacted by rolling or other means as directed by HPCL to obtain 95% of Standard Proctor Max. Lab dry density of the virgin soil.

3.0 TANK PAD CONSTRUCTION

The tank pad shall be constructed with murrum or sand or combination of murrum and sand pad.

4.1 MURRUM FILL

It shall consist of coarse and granular murrum containing not more than 20% cohesive fines i.e., clay. The murrum shall be 20mm and down size grading and shall be brought from approved quarries from outside plant premises. The Maximum dry density of material shall be not less than 1.80 grams/cc. The Plasticity Index shall be in the range of 7-17(Medium Plastic).

The murrum shall be spread in layers not exceeding 200mm loose depth over the area. Each layer shall be uniform in density, quality of materials and moisture content before compaction. Each layer shall be copiously watered so that the required standard proctor MDD is attained and also the required mass of the compacted standard proctor sample is attained. However, puddles should be avoided.
Compaction of each layer shall be done by a vibratory roller. Only inaccessible reaches shall be done manually. Each layer shall be uniformly compacted to obtain 95% of standard proctor maximum laboratory dry density of the material as per IS: 2720. If the material fails to achieve the required density, the layer shall be reworked so that the necessary compaction is achieved.

Further layers shall be placed only after the layer already laid has been compacted to the required density. The finished surface should be dressed to required slope and grade. Excess material must be removed from compaction site.

4.2 PAYMENT

Payment for murrum filling shall be made on the basis of volume of fill, after placement and compaction and achieving the grade and slope as per drawings. Any additional filling carried out or required as per site conditions/ specification requirements for attaining the MDD/OMC requirements on slopes, etc will be carried out by Contractor and same are deemed to be included in quoted rates. No payment will be made by HPCL for such additional filling which is to be subsequently stripped.

5.0 SAND PAD

Sand for filling shall be clean and well graded conforming to IS 383 with grading zone II or III. It shall not contain any vegetable and organic materials. And shall be obtained from a source approved by Engineer in charge.

Sand used for filling shall be laid in 150 mm layers and compacted in successive layer, to a relative density of 85% as per IS 2720 Part XIV.

6.0 ANTI-CORROSIVE LAYER(75 MM COMPACTED THICKNESS)

6.1 Anti-corrosive layer shall consist of screened coarse sand mixed with 80/100 bitumen or equivalent 8 to 10% by volume.

5.2 Materials

SAND
Sand shall be clean, dry, coarse, hard, angular, free from coatings of clay, dust and mix of vegetable and organic matters and shall conform to IS:383 Grade III.

BITUMEN

Bitumen required shall be 80/100 grade or equivalent

5.2 Bitumen shall be heated to a temperature of 175 to 190 deg.C with 3% kerosene if required and sand shall be mixed thoroughly with it in a mixing drum to give uniform mixture and shall be laid over the compacted surface of pad in line, grade and levels as shown in the drawings and as directed by HPCL. The area of pad to be provided with Anti-Corrosive layer shall be thoroughly cleaned of all dust and loose materials. On the clean surface, a tack coat at the rate of 1 kg/sq.m of hot bitumen shall be uniformly applied by sprayers. The applied binder shall be evenly brushed. Bitumen shall not be heated beyond the limits shown above. The layer shall be tamped to form a hard mass of uniform compacted thickness of 75mm as per drawings and specifications.

5.3 PAYMENT

The payment shall be made on sq.m basis of the area of the layer laid on top of tank pads. The quoted rate shall include cost of materials, transportation, mixing, laying, tamping, finishing, curing, etc.

6.0 RCC APRON

6.1 Materials

6.1.1 Water

Water used for all civil and structural works shall be clean and free from injurious amount of oil, acids, alkalies, organic matters or other harmful substances which may be deleterious to Concrete or Steel. The pH value of water sample shall not be less than 6.

Tests on water samples shall be carried out in accordance with IS: 3025 and they shall fulfill all the guidelines and requirements given in IS: 456-latest edition.
Contractor shall collect water samples prior to start of Work. HPCL Engineer-in-Charge will issue Covering letter for getting the same tested at a lab approved by HPCL. Based on the test results and after reviewing same with respect to IS Standards and acceptance thereof, HPCL Engineer-in-Charge may permit use in the works. In case there is any change in source of water, water samples shall be tested again.

Water shall be stored in tin Barrels, steel tanks or water tight reservoirs made with bricks/stone or RCC. These storages shall be of sufficient capacity to meet the water requirement at any stage of construction.

Water for curing shall be of the same quality as used for concreting works.

Borewell water may be permitted to be used if the same is found meeting the IS Standards' requirements.

6.1.2 Aggregates

Coarse and Fine aggregates for Civil and Structural works shall conform in all respects to IS: 383(Specification for coarse and fine aggregates from natural sources for concrete). Aggregates shall be obtained from an approved source known to produce the same satisfactorily. Aggregates shall consist of naturally occurring (crushed or uncrushed) stones and sand. These shall be chemically inert, hard, strong, durable, dense, clean and free from veins, adherent coatings, injurious amount of alkalies, vegetable matter and other deleterious substances such as iron pyrites, coal, lignite, mica, shale, sea shells, etc.

Source and type of aggregates shall be got approved by the Engineer-in-Charge prior to procurement. Change in source and type of aggregates at a later stage may be permitted by the Engineer-in-Charge based on satisfactory lab test results of samples of changed sources (proposed). Design mix wherever warranted may be revised by the Contractor as per instructions of HPCL Engineer-in-Charge.

Aggregates which may chemically react with alkalies of cement or might cause corrosion of reinforcement steel shall not be used.
Tests for deleterious materials as per IS: 2386-Part II shall be carried out in an approved laboratory and based on satisfactory test results, the aggregates may be accepted by HPCL Engineer-in-Charge.

The Concrete shall be placed by volume batching only and the mix design, wherever applicable shall be carried out for volume batching only. Coarse and Fine aggregates shall be batched separately.

Whenever required by HPCL Engineer-in-Charge, the aggregates shall be sieved and/or washed by the Contractor prior to use in the works without any extra cost to HPCL.

Whenever a particular lot/ load of aggregates is rejected by HPCL Engineer, same shall be forthwith removed by the Contractor from the Site.

Coarse aggregates shall have a sp.gr. not less than 2.6( Saturated surface dry basis) and retained on 4.75 mm IS Sieve. They may be supplied as single sized or graded. The grading shall be as per IS:383 or as required by the Mix design to obtain densest possible concrete. For this purpose, the Contractor shall submit at least three sets of mix design and test results each with different gradings of coarse aggregates, proposed to be used. HPCL engineer-in-Charge may permit All-in Aggregates conforming to IS: 383 requirements to be used in the works.

Fine aggregates (Sand) are the aggregate which pass through 4.75 mm IS Sieve but no more than 10% pass through 150 micron IS Sieve. Fine aggregates conforming to grading requirements of Zones I, II and III of IS: 383 only shall be used for RCC Works.

The Contractor shall carry out all the tests including Mix design at his own expense at the start of work as well as during any stage of construction as required by HPCL Engineer-in-Charge. Testing shall be carried out in HPCL approved laboratories. However, HPCL engineer-in-Charge may permit Silt Content test and Sieve Analysis to be conducted by the Contractor at Site and review and accept the same.

Storage of all types of aggregates shall be at Contractor’s own expense and risk. Proper drainage shall be ensured by the Contractor around the storage heaps to avoid water logging.

6.1.3 Cement

Cement to be used for Civil and structural works shall be one of the following:
Ordinary Portland Cement (OPC) 43 Grade as per IS: 8112
OPC 53 Grade as per IS: 12269
Portland slag Cement (PSC) as per IS: 455
Portland Pozzolana Cement - Fly ash based as per IS: 1489 (Part-1)

Specific requirement of cement from among those listed above shall be decided by HPCL Engineer-in-Charge.

The storage of cement at the site of work shall be at Contractor’s expense and risk. The cement shall be stored above ground in a suitable weather tight godown/ shed to prevent deterioration due to moisture. Any damage to cement quality due to improper storage or force majeure shall be borne by the Contractor only.

Cement bags shall be stacked in such a manner that inspection by HPCL engineers is unobstructed.

Approved Brands of Cement are Ultratech (Formerly L&T) cement, ACC, Lafarge, Birla Cements, Gujarat Ambuja, Ramco Cement and India Cements. However, prior to commencement of CC/RCC work, Contractor shall submit technical details of the Brand and type of cement proposed to be used in the works and samples shall be tested in HPCL approved laboratory for conformance to relevant IS Standards/ specifications. Only the approved type and brand shall be used by the Contractor in Design of Mix.

Stack of cement bags shall not exceed 8 bags arranged one over another. The Contractor shall ensure that Cement is consumed on FIFO (First In First Out) Basis. The Contractor shall maintain a Cement Consumption Register in HPCL approved proforma containing details of Receipt of Cement and daily theoretical and actual consumption and daily balance. The Register shall be signed on a regular basis by the Contractor and HPCL Engineer.

Each consignment of cement shall be tested by the Contractor at his own expense for conformance to relevant IS Standards’ requirements at HPCL approved laboratory. Additionally, each batch of cement shall be accompanied by the Manufacturer’s Test Certificate for conformance to relevant IS Standards’ requirements.
Any lot / batch of cement rejected by HPCL Engineer due to any reason whatsoever shall be removed forthwith by the Contractor and details of the same shall be incorporated in the Cement register.

6.1.4 Reinforcement Steel

Reinforcement steel shall be sourced from SAIL, TISCO or VIZAG STEEL/ RINL only. Reinforcement steel shall be High Yield Strength Deformed (HYSD) bars conforming to IS: 1786. Each batch/Lot of reinforcement steel shall be accompanied by the relevant Batch test certificate issued by the relevant Manufacturer. After receipt at site, samples shall be drawn by HPCL engineer and same shall be tested by Contractor at his own expense for Yield strength, Ultimate tensile Strength, elongation, Bend & Rebend and chemical Composition. Laboratory testing shall be carried out by the Contractor @ One Full set of tests as mentioned above for every 40 MT quantity or part thereof.

Reinforcement Steel Consumption Register shall be maintained by the Contractor. This shall contain details of Receipt of steel rods, details of daily consumption with bar bending schedules duly approved by HPCL Engineer. The Register shall be signed on a regular basis by HPCL engineer and Contractor.

The reinforcement shall normally be held in position by tying the bars at every intersection with 20 G Black annealed steel binding wires. The quoted rates for Reinforcement steel shall include the cost of supplying and tying these binding wires.

6.2 Curing shall be carried out for a minimum period of 7/10 days as per IS: 456 by the Contractor. Curing shall normally commence after completion of Final set of Concrete has completed. The Concrete shall be kept continuously wet during the entire duration of the day by using pitchers, gunny bags/ hay / hessain and dedicated manpower.
TECHNICAL SPECIFICATIONS
FOR CIVIL WORKS
TECHNICAL SPECIFICATIONS - CIVIL – MATERIALS

1.0 WATER

1.1 Water used shall be clean and free from organic impurities etc. Potable water is generally considered satisfactory for construction and during purpose. Water for construction purpose shall be tested for suitability as per IS codes at the start of the project and also at every three months interval.

2.0 CEMENT

2.1.0 Cement used shall be any of following types with prior approval of Engineer in Charge: -

a) Ordinary or Low Heat Portland Cement conforming to IS: 269-1976.

b) Rapid Hardening Portland cement conforming to IS: 8041-1978.

c) Portland Blast Furnace Slag Cement conforming to IS: 455-1976.


e) White Portland cement conforming to IS: 8042-19789.

f) Ordinary Portland cement conforming to IS: 8112 (43-Grade)

NOTE: -

i) Low Heat Portland cement conforming to IS: 269-1976 shall be used with adequate precautions with regard to removal of formwork etc.,

ii) White Portland cement is generally used for architectural and decorative purpose and is generally meant for non structural use.

iii) Generally ordinary Portland cement is used for construction purposes.

2.2.0 ORDINARY PORTLAND CEMENT

Shall conform to the requirements of IS 8112 (43 Grade).

2.2.1 Physical Requirements

i) Fineness; - Specific surface shall not be less than 2250cm2/grm.

ii) Soundness: - Expansion (unaerated) shall be not more than 10 mm by Le Chatelier method. If it fails, expansion of aerated sample shall not be more than 5mm. Expansion by Autoclave test shall not be more than 0.8%.
iii) Setting Time :-

a) Initial: not less than 30 minutes.

b) Final: Not more than 10 hours.

iv) Compressive Strength of mortar cubes (1 cement : 3 standard sand) shall not be less than following:

--- 330 kgf/cm² at 168+/−2 hours

--- 430 kgf/cm² at 672+/−4 hours

2.3.0 PORTLAND POZZOLANA CEMENT

shall conform to the requirements of IS 1489-1976

2.3.1 Physical Requirements :-

i) Fineness :- Specific surface shall not be less than 3000 Sq. cm/gm.

ii) Soundness :- Expansion (unaerated) shall be not more than 10mm by Le Chatelier method. If it fails, expansion of aerated sample shall not be more than 5mm. Expansion by Autoclave test shall not be more than 0.8%

iii) Setting Time :-

a) Initial: not less than 30 minutes

b) Final: not more than 10 hours

iv) Compressive Strength of mortar cubes (1 cement: 3 standard sand) shall not be less than following:

--- 220 kgf/cm² at 168+/−2 hours

--- 310 kgf/cm² at 672+/−4 hours.

v) Drying shrinkage :- not more than 0.15%

2.4.0 TESTING

The details of test for cement shall be as given in IS: 4031-1968 (Methods of physical tests for hydraulic cement) and IS: 4032-1968 (Method of chemical analysis of hydraulic cement).
3.0 AGGREGATES:

3.1.0 Aggregates shall consist of naturally occurring stones, gravel and sand and shall be hard, strong dense durable clear and free from veins, adherent coating and injurious amounts of disintegrated pieces and deleterious substances.

3.1.1 Aggregates shall not contain harmful organic impurities such as pyrites, laminated material, alkali, seashells and organic impurities and those, which may attack the reinforcement when used in RCC work. Aggregates shall not be chemically reactive with alkalis of cement.

3.2.0 FINE AGGREGATES:

3.2.1 Aggregates most of which passes 4.75mm size IS sieve is known as fine aggregates. The sum of the percentage of all deleterious materials shall not exceed 5%.

3.2.2 Fine-aggregates shall be either sand or crushed stone dust. However, generally sand is used as fine aggregate for concrete or mortar. Two varieties of sand are available normally:

i) FINE SAND: This shall be natural river sand conforming to the requirements ofIS:383-1970. Its grading shall be within the limits of grading zone IV of the table shown below:

<table>
<thead>
<tr>
<th>IS SIEVE</th>
<th>PERCENTAGE PASSING FOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESIGNATION</td>
<td>GRADING</td>
</tr>
<tr>
<td></td>
<td>ZONE I</td>
</tr>
<tr>
<td>10 mm</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>90-100</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>60-95</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>30-70</td>
</tr>
<tr>
<td>600 microns</td>
<td>15-34</td>
</tr>
<tr>
<td>300 microns</td>
<td>5-20</td>
</tr>
<tr>
<td>150 microns</td>
<td>0-10</td>
</tr>
</tbody>
</table>
Note: Fine aggregate conforming to grading Zone IV shall not be used in reinforced concrete unless ascertained for suitability by mix designing.

ii) COARSE SAND:- This shall be either river sand or pit sand conforming to the requirements of IS:383-1970. It shall be clean, sharp, angular, strong and composed of hard silicious material. Its grading shall be within the limits of zone I, II or III of the table shown above.

3.2.3 The maximum quantity of silt content shall not exceed 8%.

3.2.4 TESTING:-

The details of test shall be as per IS:2386 (part I) -1963 to IS:2386 (part VIII)-1963 (Methods of testing aggregates for concrete).

3.3.0 COARSE AGGREGATES:-

3.3.1 Coarse aggregates used for concrete can be either stone, gravel (river bed shingle or pit gravel) or brick. However, crushed stone shall be used as coarse aggregates for concretes.

3.3.2 STONE:-

This shall be crushed or broken from hard stone obtained from approved quarry. It shall be hard, strong, dense, durable, clean and free from soft, thin, flat, elongated or laminated, flaky pieces and shall be roughly cubical in shape. It shall be clean and free from dirt and any foreign matter. However the total amount of deleterious materials shall not exceed 5% of its weight.
3.3.2.1 SIZE: Graded aggregate of nominal sizes 40, 20, 16 or 12.5 mm shall conform to the requirement of the table given below:

<table>
<thead>
<tr>
<th>IS SIEVE</th>
<th>PERCENTAGE PASSING FOR NMINL SIZE OF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40 MM</td>
</tr>
<tr>
<td>80.0</td>
<td>100</td>
</tr>
<tr>
<td>40.0</td>
<td>95-100</td>
</tr>
<tr>
<td>20.0</td>
<td>30-70</td>
</tr>
<tr>
<td>16.0</td>
<td>------</td>
</tr>
<tr>
<td>12.5</td>
<td>------</td>
</tr>
<tr>
<td>10.0</td>
<td>10-35</td>
</tr>
<tr>
<td>4.75</td>
<td>0-35</td>
</tr>
<tr>
<td>2.36</td>
<td>------</td>
</tr>
</tbody>
</table>
3.2.2 Single size aggregate (ungraded) of nominal sizes 63, 40, 20, 16, 12.5 or 10 mm shall conform to the requirements of the table given below:

<table>
<thead>
<tr>
<th>IS SIEVE DESIGNATION</th>
<th>63</th>
<th>40</th>
<th>20</th>
<th>16</th>
<th>12.5</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM 63</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MM 40</td>
<td>85-100</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MM 20</td>
<td>0-30</td>
<td>85-100</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MM 16</td>
<td>0-5</td>
<td>0-20</td>
<td>85-100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MM 12.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>85-100</td>
<td>100</td>
</tr>
<tr>
<td>MM 10.2</td>
<td></td>
<td>0-5</td>
<td>0-20</td>
<td>0-30</td>
<td>0-45</td>
<td>85-100</td>
</tr>
<tr>
<td>MM 4.75</td>
<td></td>
<td></td>
<td>0-5</td>
<td>0-5</td>
<td>0-10</td>
<td>0-20</td>
</tr>
<tr>
<td>MM 2.36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-5</td>
</tr>
</tbody>
</table>

3.3.3 TESTING:

The details of test shall be as per IS : 2386 (part-I)-1963 to IS 2386 (part VIII)-1963 (Methods of testing aggregates for concrete).

4.0 BRICKS:-

4.1.0 Common burnt clay building bricks having compressive strength upto 400 kg/cm² shall conform to IS:1077-1976.

4.1.1 Burnt clay bricks having compressive strength more than 400 kg/cm² shall conform to IS:2180-1978.

4.1.2 Bricks shall be hand or machine molded and free from cracks and flaws and nodules of free lime. Bricks of 9 cm height shall be provided with frog of 1 to 2 cm deep on one of its flat sides. No frog is required for 4 cm height bricks and extruded bricks.

4.2.0 CLASSIFICATION :-

4.2.1 Bricks shall be classified based on their compressive strength as given in table below:

TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA
4.2.1.1 Each class of brick shall be further divided into sub classes A and B based on tolerances and shape.

4.2.1.2 Sub class A bricks shall be smooth rectangular faces with sharp corners and uniform colour.

4.2.1.3 Sub class B bricks may have slightly distorted and rounded edges.

4.2.1.4 The bricks of class designation 100 shall have smooth rectangular faces with sharp corners and emit clear ringing sound when struck. Tolerances on dimensions upto +/-3% shall be permitted. Dimension test to be carried out as per IS.

**TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA**
4.2.1.5 Bricks of class designation 75, 50 and 35 may be permitted to have slight distorted and rounded edges provided no difficulty shall arise on this account in laying of uniform courses. Tolerances on dimensions upto +/- 8% shall be permitted. Dimension test to be carried out as per IS.

4.3.0 PHYSICAL REQUIREMENTS:

4.3.1 Compressive Strength: This shall conform to table given above. Compressive strength of any individual brick shall not fall below this minimum requirement by more than 20%.

4.3.2 Water Absorption :- Shall not be more than 20% upto class 125 and not more than 15% for higher classes.

4.3.3 Efflorescence :- The rating of efflorescence shall not be more than moderate upto class 125 and not more than slight for higher classes.

4.4.0 TESTING:-

The details of test shall be as per IS-3495-1976 Part I, II and III (Method of test of burnt clay building brick).

Part I: Determination of Compressive Strength

Part II : Determination of water absorption

Part III : Determination of efflorescence

Percentage of Deleterious materials (testing).

5.0 STEEL REINFORCEMENT:-

5.1.0 The steel reinforcement as specified shall be as follows:-


MILD STEEL AND MEDIUM TENSILE STEEL:

5.1.1.1 The physical requirements for mild steel, Grade I and II and medium tensile bars shall be as per table below:

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>NOMINAL SIZE OF BARS</th>
<th>MILD STEEL</th>
<th>MEDIUM TENSILE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>GR.I</td>
<td>GR.II</td>
</tr>
</tbody>
</table>

i) ULTIMATE TENSILE STRESS, KG/SQ. MM MINIMUM

- UPTO & INCL. 20 MM
  - 42
  - 38
  - 55

ii) YIELD STRESS, KG/SQ. MM MINIMUM

- UPTO AND INCL. 40 MM
  - 24
  - 21.5
  - 34.5

- OVER 40 MM
  - 24
  - 21.5
  - 33

iii) ELONGATION, PERCENT MINIMUM

- UNDER 10 MM
  - 20

- 10 MM & OVER
  - 23

NOTE: - Mild steel Grade II is available in two varieties designated as ST 42-0 and ST 32-0. ST 42-0 only shall be used conforming to above requirements. ST 32-0 shall not be used as reinforcement.

5.1.1.2 Note: Grade II mild steel bars shall not be used in the following conditions:

i) Where structures are located in earthquake zones subjected to severe damage.

ii) Where the structures are subjected to dynamic loading (other than wind loadings such as railway and highway bridges).

iii) Where welding has to be employed for fabrication

iv) Where the design of structures are based on plastic theory.
5.1.1.3 WEIGHT:

The tolerance on weight for round and square bars shall be the following percentage of the weight calculated based on unit weight of 0.785 kg/cm²/m run.

- Upto and including 8mm - + 4%
- Over 8mm - + 2.5%

5.1.1.4 TESTING

The details of test shall be as follows:


ii) Bend test: As per IS 1599-1960.

5.1.2 COLD TWISTED BARS:

5.1.2.1 The physical requirements of all sizes of cold twisted bars whether plain or deformed shall be as follows:

--- Tensile strength :: Minimum 49.5 kgf/sq. mm

--- 0.2% proof stress :: Minimum 42.5kgf/sq.mm

--- Elongation:: Minimum on gauge length 5.65/60 where so is the cross sectional area of the test piece - 14.5%

5.1.2.2. WEIGHT:

The tolerance on the weight of the bars shall be the following percentages of the weight calculated on the above:

- Upto and including 8 mm - + 4%
- Above 8mm - + 2.5%

5.1.2.3 TESTING:

The details of test shall be as per IS 226-1962, IS 1608-1972 and IS 1599-1974 for selection and preparation of test samples, tensile test and bend test.
STRUCTURAL STEEL:

SCOPE OF WORK:

The work covered by this specification consists of supplying, fabricating and erecting of structural steel members for columns, beams, trusses, ladders, grills, doors etc., made out of RS joists, plates, angles, bars, flats, box sections etc., complete in strict accordance with the specifications and the applicable drawings.

MATERIALS:

All structural steel shall be of standard sections as marked on the drawings and shall be free from scale, blisters, laminations, cracked edges and defects of any sort.

All structural steel and electrodes shall comply in all respects with 1. S. for structural steel.

WORKMANSHIP:

All workmanship shall be of first class quality in every respect to the greatest accuracy being observed to ensure that all parts will fit together properly on erection.

All ends shall be cut true to planes. They must fit the abutting surfaces closely.

All stiffeners shall be fit tightly at both ends.

All butt ends of compression members shall be in close contact through the area of the joints.

The base connection shall be provided as shown on drawings and the greatest accuracy of workmanship shall be ensured to provide the best connections.

Figured dimensions on the drawings shall be taken.

ERECCTION AND MARKING:

Erection and fabrication shall be according to 1. S. 800-1984 section-II. During erection, the work shall be securely braced and fastened temporarily to provide safety for all erection stresses etc. No permanent welding shall be done until proper alignment has been obtained.

Any parts which do not fit accurately or which are not in accordance with the drawings and specifications shall be liable to rejection and if rejected, shall at once be made good.
Engineer-in-Charge shall have full liberty at all reasonable times to enter the contractor's premises for the purpose of inspecting the work and no work shall be taken down, painted or dispatched until it has been inspected and approved. The contractor shall supply free of charge all labour and tools required for testing of work.

DELIVERY AT SITE:

Contractor shall deliver the component parts of the steel work in an undamaged state at the site of the works and the Engineer-in-Charge shall be entitled to refuse acceptance of any portion which has been bent or otherwise damaged before actual delivery on work.

PAINTING:

Painting shall be strictly according to I. S. 1477-1971 (Part-I-Pre-treatment) and I. S.1477-1971(Part II-painting). Painting shall be carried out on dry surfaces free from dust, scale etc. The paint shall be approved by the Engineer-in-Charge.

Two coats of Synthetic Enamel paint of approved colour and make over two coats of red oxide primer shall be applied on steel, except where it is to be encased in concrete or where surfaces are to be field welded.

WELDING:

Welding shall be in accordance with I. S. 816-1969, I. S. 819-1957, I. S. 1261-1959, I. S. 1323-2982 and I. S. 9595-1989 as appropriate

WELDING CONSUMABLE:


Fill rods and wires for gas welding shall conform to 1. S. 1278-1972.

The bare wire electrodes for submerged arc welding shall conform to 1. S. 7280-1974. The combination of arc and flush shall satisfy the requirements of 1. S. 3613-1974 .

The filler rods and bare electrodes for gas shielded metal are welding shall conform to 1. S. 6419-1971 and 1. S. 6560-1972 as appropriate.

TYPES OF WELDING:
Are welding (Direct or alternating current) or Oxyacetylene welding may be used. Field welding may be used. Field welding shall be by D. C.

WELDING PROCEDURE:

Welding should be done with the structural steel in flat position in a down hand manner wherever possible. Adequate steps shall be taken to maintain the correct arc length, rate of travel, current and polarity for the type of electrode and nature of work. Welding plant capacity shall be adequate to carry out the welding procedure laid down. Adequate means of measurement of the current shall be available either as a part of the welding plant or by the provision of a portable ammeter. In checking welding current, a tolerance of 10% or 30 amperes from the specified value, whichever is less, shall be permitted.

The welding procedure shall be such as to ensure that the weld metal can be fully and satisfactorily deposited through the length and thickness of all joints so that distortion and shrinkage stresses are reduced to the minimum and thickness of welds meet the requirements of quantity specified.

WORKMANSHIP:

PREPARATION OF FUSION FACES:

Fusion faces shall be cut by steering machine or gas cutting and later dressed by filling or grinding so that they shall be free from irregularities such as would interfere with the deposition of the specified size of weld to cause the defects. Fusion faces and the surrounding surfaces shall be free from heavy slag, oil paint or any substance which might affect the quantity of the weld or impede the progress of welding. The welding face shall be free of rust and shall have metal shine surfaces.

The parts to be welded shall be brought into as close contact as possible and the gap due to faulty workmanship or incorrect fit up shall not exceed 1/16". If separation of 1/16" or more occurs locally, the size of the fillet weld shall be increased at such position by an amount of equal to the width of the gap.

The parts to be welded shall be maintained to their correct position during welding. They shall be securely held in position by means of tack welds, service bolts, clamps or rings before commencing welding so as to prevent relative movement due to distortion, wind or any other cause.

All welds shall be deposited in a pre-arranged order and sequence taking due account of the effects of distortion and shrinkage stresses.

After making each run of welding, all slag shall be removed and shall be protected by clean boiled lined oil till approved.

The weld metal, as deposited shall be free from crack, slag, excessive porosity, cavities and other faults.
The weld metal shall be properly fused with the parent metal without overlapping or serious undercuts at the toes of the weld.

The surface of the weld shall have a uniform and consistent contour and regular appearance.

In welds containing crack, porosity or cavities in which the weld metal tends to overlap on the parent metal without proper fusion, the defective portions of the welds shall be out cut and re-welded. Where serious under cutting occurs, additional weld metal shall be deposited to make good reduction.

**MODE OF MEASUREMENT:**

All structural steel shall be measured on weight basis in metric tones or quintals or kgs as mentioned in the schedule of quantities. The length or areas of various members including gusset plates shall be measured correct to two places of decimals and the net weight worked out from the standard steel tables published by Bureau of Indian Standards.

No separate measurements shall be taken for welding, riveting, bolting, field connections etc. The rate shall include cost of all labour, materials, scaffolding, transport and also cost of welding, riveting and bolting, field connections if any all to complete the job as per specifications.

**PLUMBING WORK**

**GI PIPES & SOCKETS**

**MATERIALS:**

The pipes shall be galvanized mild steel welded and seamless, screwed and socketed tubes conforming to the requirement of IS-1239 /1982 for specified grade. They shall be of diameter (nominal bore) as specified in the description of item.

The pipes and sockets shall be clean finished, well galvanized in and out, free from cracks, surface flaws, laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut clean and square with the axis of the tube. Unless otherwise specified, the pipes below GI or concealed in walls or floors shall be C class and those supported on walls shall be of B class.

All screwed tubes and sockets shall have pipe thread conforming to the requirements of IS: 544-1975. Tubes shall be screwed with taper threads while the sockets with parallel threads.

**PIPE FITTING:**
The fittings shall be of seamless wrought steel or mild steel tubulars complying with the requirements given above or as specified. The fittings shall be designated by the respective nominal bores of the pipes, for which they are intended.

The fittings shall have screw threads at the ends shall be parallel for female threads and taper threads for male.

**CUTTING, LAYING AND JOINTING**

The pipes and fittings shall be inspected at site before use to ascertain that they conform to the specifications given above. The defective pipes shall be rejected. Where the pipes have to be cut or re-threaded, the ends shall be carefully filed out so that no obstruction to the bore is offered. The ends of the pipes shall then be threaded with pipe dies and taps carefully in such a manner as will not result in slackness in the joints when two pieces are screwed together.

The taps and dies shall be used only for straightening the screw thread which have become bent or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in a water tight joint. The screw threads of the pipes and fittings shall be protected from damage until they are fitted.

The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of Teflon tape or spun yam wrapped round the screwed end of the pipe. The end shall then be screwed in the socket, Tee etc., with the pipe wrench. Care shall be taken that all pipes and fittings are properly joined so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burr from the joints shall be removed after screwing. After laying, the open ends of the pipe shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

At Y threads exposed after jointing shall be painted or in the case of underground piping thickly coated with approved anti corrosive paint to prevent corrosion. The pipes shall be laid in chases or exposed to suit the conditions or as specified. All pipes laid in chases shall be coated with hessian cloth impregnated with bitumen and pipe exposed shall be painted with two coats of synthetic enamel.

**TESTING OF JOINTS:**

After laying and jointing, the pipes and fittings inspected under working conditions of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without any extra cost. The following procedure shall be followed for testing of pipes. NO work shall be covered until it has been tested and found OK by EIC.

The pipes and fittings after they are laid shall be tested at hydraulic pressure of 2 kg/sqcm. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw off points shall be plugged and stopcocks shall be closed and specific hydraulic pressure shall be applied gradually. The test pump shall be stopped, the test pressure shall be maintained without loss in pressure for at least half an hour. The pipes and fittings shall be tested in sections as the work of laying proceeds, keeping the joints exposed for inspection during testing.
MEASUREMENTS:

The length shall be measured in running meter correct to a centimeter. For the finished work, which shall include GI pipe and GI fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples, unions and nuts but excludes brass or gun metal taps, valves etc.
TECHNICAL SPECIFICATIONS - CIVIL WORKMANSHIP

EARTHWORK

GENERAL, DEFINITIONS

DEADMEN OR TELL TALES:
Mounds of earth left undisturbed in pits dug out for borrowing earth.

FORMATION:
Final shape or profile of the ground after excavation or filling up.

PROFILE:
The pattern to which the earth is to be out or made up and dressed.

FILL:
Shall mean earth, sand, stabilized aggregate or other material specified to replace earth or rock removed during construction.

CLASSIFICATION
The earth shall be classified, measured and paid separately for categories as mentioned below:

ORDINARY SOIL
Any soil which can be removed with the ordinary or close application of bicks or jumpers or scarifers and rippers.

ORDINARY ROCK
Which may be quarried by crowbars or picks such as limestone, sandstone, hard laterite, hard conglomerate, and unreinforced concrete below ground level shall be treated as ordinary rock.

PROTECTION
a) Trenches and foundation pits shall be securely fenced and proper caution sign and night lighting shall be arranged.

b) Any excavation shall not be carried out below the foundation level of adjoining structure unless proper precautions like underpinnig shoring etc are taken.

EXCAVATION FOR FOUNDATION

SCOPE
Excavation for normal spread footings, trenches, u/g storage tanks, excavation over large areas, etc.
SITE CLEARENCE
Before the earth work is started the area shall be cleared of shrubs, vegetation, grass brush, wood, trees and rubbish.

The roots of trees shall be removed to a minimum 600mm below ground level or 30 cm below formation level whichever is lower and the hollows shall be filled up with earth, leveled and rammed.

SETTING OUT AND MAKING PROFILES
Masonry pillars will be erected at suitable points to serve as benchmark, for execution of work. These bench marks shall be connected to standard bench mark if required by Engg.-in-charge / Architects. In addition to these pillars, centre line pillars shall also be erected by the contractor and footing positions shall be marked with the help of these pillars.

The necessary profile shall be set out. The level shall be taken at an interval as directed by Engg.-in-charge / Architects but the intervals shall not be more than 5 meters in any case. The levels shall be recorded in field books and plotted on plan before starting the excavation and the same shall be countersigned by the Engg.-in-charge / Architects.

CUTTING FOR FOUNDATION:
The cutting shall be done to minimum depths as indicated in the drawings and if required the depth shall be increased to obtain proper strata for foundations. Any excess excavation carried out by the contractor without the proper authorization from etc shall not be paid and the excess depth shall be made good by the contractor by PCC 1:4:8.

CUTTING TRENCHES: Unless otherwise indicated on the drawings, trench excavation shall be by open out and the bottom of the trenches for piping shall be accurately graded so that the pipe is uniformly supported along its entire length. After trench bottom has been graded all holes or depressions for other type of piping joints shall be cut below the trench to the depth necessary for the particular joint.

BACKFILLING:
Backfilling of the excavated spaces shall be done with the selected material from the excavation. Backfilling shall be done to the original ground level or the elevation shown on the plan in layers of 150mms to 220mms and well compacted. When the excavated earth is not suitable or adequate for backfill then approved backfill material shall be brought from outside and the same shall be paid separately. Backfilling is to be done in such a manner as not to cause undue thrust on the any part of the structure.

TRENCH BACKFILL:
Backfilling of trenches for pipelines shall be done first over the middle portion of each length of pipe bringing the cover to a depth of at least 300mm over the top of the pipe while leaving all field joints exposed. After all required tests on the piping have been carried out and approved by the Engg.-in-charge / Architects the remaining trench backfill shall be accomplished. Extreme care shall be exercised during backfilling operations to prevent damages to coated or wrapped pipes.

**SIDE PROTECTION FOR DEEP EXCAVATION:**

In case of excavation for foundations exceeding 2.0 meters depth from existing ground level, proper precautions shall be taken to prevent sides from collapse. This can be ensured by adopting anyone of the following methods given below and as directed by EIC.

1. Stepping
2. Side slopes
3. Planking and Strutting

The first two methods can be adopted where the soil is not loose and sloping/stepping is possible. The sides slopes shall be done to such a degree that the sides are stable. In case of very loose and trecherous soil, planking and strutting shall be done to avoid collapse. Planking and strutting shall be done in accordance with IS 3764 (Safety code for excavation works). Sheetings, shorings and bracings shall be maintained in place until immediately before filling or backfilling and then shall be removed by stages as the filling or the backfilling progresses. The responsibility of designing, supplying and erecting a sound and stable shoring system rests with the contractor and shall be approved by EIC before execution.

**DEWATERING:**

In case of water being encountered during the excavation for foundation, the contractor shall arrange for adequate capacity of dewatering system. Pumping shall be controlled to dispose of water to drainage ditches and shall not be routed to cause inconvenience to the construction operation in general.

**MEASUREMENT:**

The length, breadth and depth shall be measured to nearest centimeter and the quantity shall be worked out in cubic meters to two decimal places. The depth shall be taken as per drawing or as excavated under special conditions under instructions from Engineer-in-Charge/Architects. The width and length shall be taken as per length and width of PCC as per drawing.
MORTARS:

CEMENT MORTAR:

SCOPE

This shall cover cement mortars used in general building works for masonry work and plastering.

Materials:

Cement, Water and Waterproofing compound: As specified in Materials specifications.

Sand:

sand as specified in clause 3.2.0 of materials section shall be used.

Proportioning:

Proportion of sand and cement shall be as specified. The unit of measurement for cement shall be a bag of cement weighing 50kgs and this shall be taken as 0.035 cum. Sand in specified proportion shall be measured in boxes of suitable sizes. It shall be measured on the basis of its dry volume. If the sand is wet, the quantities shall be increased suitably to allow for bulkage.

If the sand as specified for plastering is not available, proper sieving shall be carried out at site to obtain the required fineness modulus and only such sieved sand shall be used for plastering work.

Mixing:

The mixing of mortars shall be done in mechanical mixers operated manually or by power. The Engg.-in-Charge / Architects may however relax this condition taking into account the nature and the location of the work.
TECHNICAL SPECIFICATIONS FOR CONCRETE AND REINFORCEMENT WORKS
1. CONCRETE AND STEEL REINFORCEMENT

1.1 GENERAL:
This section describes and specifies work required for plain and reinforced cement concrete including reinforcement and form work. Unless otherwise specified or agreed in writing by the EIC, all materials and methods used in the production, testing and handling of concrete shall comply with the latest editions or amendments of the relevant Indian Standards.

1.2 MATERIALS:
All materials shall be obtained from sources approved by the EIC. The agreed source or quality of any material shall not be changed during the course of the contract except with the approval of the EIC.

Whenever requested by the EIC, the Contractor shall provide a certificate from the manufacturer, for each and every delivery of material, showing the source, quantity delivered and confirming that the material has been tested and conforms to the required Indian Standard.

1.3 TESTING OF CONCRETE MATERIALS:
Prior to the commencement of concrete work, the contractor shall get all cement aggregates and water tested in the laboratories approved by the EIC and shall keep the approved samples in the site office for inspection at any time of the concreting operation. The test certificates shall be submitted to EIC for review & approval before concreting. During construction also, the materials shall be sampled and tested as often as deemed necessary and also as per the “Periodicity of Testing” by the EIC. Samples shall be taken and tested in accordance with the latest revision of relevant Indian Standard Specifications and the cost thereto shall be borne by the Contractor.

1.4 CEMENT:
The cement used throughout the work shall be to the approval of the EIC. A certificate shall be obtained from the manufacturers and produced to EIC for each delivery of cement and it shall comply with the requirements of as mentioned in the “Technical Specification – Materials”. The Contractor shall store the cement in storage sheds to be provided by him for this purpose at site. The cement shall be delivered to the site in bags sealed with the manufacturer's seal and different types of cement shall be stored separately. The storage sheds with watertight walls and roof, shall be maintained in a perfectly dry and wall ventilated condition, 12" above ground level and the cement shall
be stored a per instructions issued by EIC. It shall be turned over from the bottom as and when required by the EIC. Any cement which has been deteriorated caked or which has been damaged due to any reason whatsoever shall not be used. No cement shall be used for the works that has been stored at site for more than three months. Test samples of cement may be drawn from each consignment as delivered and tested by the EIC. Should the results of such test show that any samples does not comply with the specified requirement, the whole consignment from which the sample was taken, shall be rejected and forthwith removed entirely from the site and replaced with cement of satisfactory quality.

1.5 **SAND:**

Sand to be used for concrete shall be well graded mixture from coarse to fine grains, complying with the requirements of IS 383 Latest edition. It shall be clean, hard and free from salt, earth, clay and other impurities. Fine sand confirming to Zone – iv shall not be used. It will comply with sieve analysis in accordance with IS 2386 Part I & II.

Unless initially clean, all sand shall be thoroughly and carefully cleaned by screening and washing in fresh and clean water. The screened and washed sand shall not contain more than 8% by volume of clay, dust and silt immediately after allowing it to settle for 3 hours in water.

Field tests shall be carried out regularly to ensure the suitability of sand.

Sample loads shall be available at site for inspection of the EIC and if approved by him all sand in the work shall be of quality at least equal thereto.

In case of sand containing moisture the proportions of concrete materials shall be adjusted to give the correct mixture.

1.6 **COARSE AGGREGATE :**

The coarse aggregate for the reinforced concrete work shall consist of crushed gravel, black trap, granite or other stone to the approval of the EIC and shall be free from dust confirming to IS – 383 latest edition. If considered necessary by the EIC, the aggregate shall be washed specially until an approved cleanliness is obtained. The use of laminated stone, flat or flaky material will not be permitted. The combined coarse aggregate shall in all respects be so graded as to allow 95% to 100% by weight to pass a 20mm I.S. sieve 25% to 55% by weight to pass a 5mm I.S. sieve and 0% by weight to pass a 5mm I.S. sieve. The aggregates of different sizes shall be stored in separate stacks in clean state and free from all dirt.

The coarse aggregate where absorption of water after 24 hours immersion is more than 5% by weight shall not be used.
When required by the EIC the tests indicated in I.S. 383 or IS-2386 (all parts) shall be got carried out by the Contractor at his cost to show the acceptability of the materials.

Stowage piles of aggregate shall have good drainage, preclude inclusion of foreign matter and preserve the gradation.

1.7 WATER:

Water used for all purpose in this contract shall be free from oil, acid, vegetable matter, salts or dirt of any kind which will have adverse effect on cement or steel in the case of reinforced concrete. Whenever called for, the Contractor shall produce test results for water being used on work. The water quality shall confirm to IS-456-2000.

1.8 ADMIXTURES:

Admixtures or Cement containing additives (such as accelerators, retarders, water proofing agents etc.) shall not be used unless specified or otherwise directed or approved by the EICs). The Admixtures shall confirm to IS-9103 latest edition.

1.9 FORM WORK:

The form work shall be designed and constructed in such a manner that all concrete work shall be true to line, level and size, and free from honeycombing, pinholes, surface irregularities and every other defect whatsoever.

All form work shall be adequately propped, braced and framed to prevent deformation under weight and pressure of wet concrete, constructional loads, wind, vibrations and other forces. All joints in shuttering shall be close fitting to prevent the loss of cement paste or mortar from the concrete.

All form work shall be carefully cleaned and coated with approved proprietary mould oil before use, care being taken to keep all reinforcement away from contact with such oil. All moulds shall be free from sawdust, shavings, dirt, mud or other debris by hosing with water or oil free compressed air.

The shuttering for beams and slabs shall be erected so that the shuttering on the sides of the beams and of the soffits of the slabs can be removed without disturbing the beam bottoms. For beams having spans greater than 6 meters and for cantilevers, the form work shall be given adequate upward camber as directed by the EIC.
Details of all temporary work (timbering, staging etc.) are to be submitted for the approval of the EIC and the form work shall be inspected and approved by the EIC before concrete is placed within it. Notwithstanding such approval, any damage or consequences arising there from shall be the Contractor's entire responsibility.

1.10 PROPORTIONS FOR CONCRETE:

The contractor shall design concrete mixes (by Ready Mix Concrete Plants) to produce concrete of the required strengths. The contractor must submit full designs done from RMC plants of the mixes for approval of EIC and trial mixes will be prepared by the contractor in the presence of the EIC, having workability, strength, minimum cement content and surface finish as criteria. Notwithstanding the acceptance by the EIC of any mix design and series of trial mixes, variations may be made to the proportions when considered necessary by the EIC. Such variations may be made also to normal mixes if used, but variations of this nature will not be allowed to affect the unit price of concrete.

For both Nominal as well as Design mix concrete, the quantity of cement shall be determined by weight. Where standard bags of cement are used, their weight shall be checked at frequent intervals and any loss in weight due to leakage etc. shall be made good.

In the case of Nominal Mix concrete, aggregates shall be measured by volume, cement by weight and mixing water in graduated cans. In the case of controlled concrete all aggregates and cement shall be measured by weight in approved weigh batching equipment. Mixing water shall be measured in graduated cans.

While calculating the amount of mixing water, the moisture content of the aggregates shall be taken into account.

The grades of concrete shall be in accordance with Table below the cement content of the mixes specified shall not exceed the minimum content specified in Table by more than 20%.
The following specifications, standards and codes are made a part of this specification. All standards, tentative specifications, codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

**APPLICABLE IS SPECIFICATIONS AND CODES OF PRACTICE:**

IS 269:- Specification for ordinary, rapid hardening and low heat portland cement.

IS-10262: Recommended guidelines for concrete mix design.

IS 8112:- Specification for high strength ordinary, portland cement.

IS 1489 - Specification for portland - pozzolona cement.

IS 383:- Specification for coarse and fine aggregates from natural source for concrete.

IS 455: - Specification for Portland Slag Cement

IS 2386:- Methods of test for aggregates for concrete. (Part I to VIII)

IS 516:- Method of test for strength of concrete.

IS 1199:- Method of sampling and analysis of concrete.

IS 3025:- Methods of sampling and test (Physical and chemical) water used in industry.

IS 432:- Specification for mild steel and medium tensile steel (parts I & II) bars and hard drawn steel wire for concrete reinforcement.

IS 1139:- Specification for hot rolled mild steel and medium tensile steel deformed bars for concrete reinforcement.

IS 4926: Ready Mix Concrete – Code Of Practice

IS 1566:- Specification for plain hard drawn steel wire fabric (Part I) for concrete reinforcement.

IS 1786:- Specification for cold twisted steel bars for concrete reinforcement.

IS 2645:- Specification for integral cement waterproofing compound.


IS 3370:- Code of practice for concrete structures for storage of liquids (Part I to IV)

**TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA**
IS 2502:- Code of practice for bending and fixing of bars for concrete reinforcement.


IS 3596:- Safety code for scaffolds and ladders. (Part I & II)

IS 1200:- Method of measurement of building works.

In the event that state, city or other Government bodies have requirements, more stringent than those set forth in this specification, such requirements shall be considered part of this specification and shall supersede this specification where applicable.

The quality of materials, method and control of manufacture and transportation of all concrete works irrespective of the mix, whether reinforced or otherwise, shall conform to the applicable portion of this specification.

Engineer shall have the right to inspect the source/s of material/s, the layout of operations of procurement and storage of materials, the concrete batching and mixing equipment and quality control system. Such an inspection shall be arranged and approval of Engineer-In-Charge shall be obtained prior to starting of concrete work.

Concrete shall be mixed by mechanical mixer only and no hand mixing shall be allowed for RCC works.

GENERAL:

The quality of materials and method and control of manufacture and transportation of all concrete work irrespective of mix, whether reinforced or otherwise, shall conform to the applicable portions of this specification. Engineer shall have the right to inspect the source/s of material/s, the layout and operation of procurement and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and Engineer’s approval obtained, prior to starting of concrete work.

MATERIALS FOR STANDARD CONCRETE:

The ingredients to be used in the manufacture of standard concrete shall consist solely of a standard type portland cement, clean sand, natural coarse aggregate, clean water and admixtures, if specially called for on drawings or specifications.

CONSISTENCY:

The consistency of the concrete shall be such that it flows sluggish during pumping of concrete into the forms and around the reinforcement without any segregation coarse aggregate from mortar. The slump tests are mandatory and shall be carried out at regular intervals so that the consistency concrete can be monitored.

PLACING OF CONCRETE:

Concreting shall commence only after inspection and written approval by EIC.
Shuttering shall be clean and free from deposits of foreign materials and proper deshuttering agent shall be applied to the surface.
Proper arrangements shall be provided for conveying the concrete the place of deposition without disturbing the reinforcement.

COMPACTION:
Concrete shall be compacted immediately after placing by means of mechanical vibrators.
All RCC works shall be cured for a minimum period of 14 days or more as advised by EIC.

INSPECTION AND RECTIFICATION OF DEFECTS:
Immediately on removal of forms, the RCC works shall be examined by the Engg. -in-Charge / Architects before any defects are made good.

The work that has sagged or contains honey combing to an extent detrimental to the structural safety or architectural concept shall be rejected.

Surface defects on a minor nature may be accepted and the same shall be rectified as follows:

a) Bulges due to movement of forms, ridges at forms, ridges at form joints shall be carefully chipped and then rubbed with a grinding stone.

b) Honeycombed and other defective areas must be chipped out, the edges being out as straight as possible and perpendicular to the surface. Shallow patches are first treated with a coat of thin grout (1 cement : 1 sand) and then filled with mortar similar to that used in concrete. Large and deep patches shall be filled up with concrete held in place by forms and shall be reinforced.

c) Holes left by bolts shall be filled carefully with mortar. Holes extending right through the concrete shall be filled with mortar with a pressure gun.

d) The same amount of care to cure the material in patches should be taken as with the whole structure.

POST TREATMENT OF SURFACE:

The surface which has to receive plaster or where it has to be joined with brick masonry walls shall be properly roughened immediately after the shuttering is removed.
REINFORCED CEMENT CONCRETE DRIVEWAY:

The RCC drive way will be cast in panels. The concreting sequence will be discussed and got approved by EIC.
Ready Mix Concrete (RMC) will only be used for concreting. The Mix design from the RMC plant will be submitted to HPCL for approval and concreting job is to be taken up only after the design mix is approved.

Casting of slab in alternate panels of size 6M X 3M (or as instructed by engineer in charge) including vibrating with screed vibrators. The shuttering material should be sufficient for concreting a minimum of 6 Cum (minimum qty of a RMC Transit mixer)

Providing broom finish to the top surface when concrete is green.

Pond curing for 15 days.
Concrete shall conform to IS 456-2000 and also to the specifications discussed above under the Ready Mix Concrete section. Rate shall be exclusive of steel reinforcement, which shall be paid under a separate item.

ACCEPTANCE CRITERIA OF CONCRETE WORK: will be as per IS-456-2000.

MEASUREMENT

All measurements shall be as per IS 1200

1.11  MIXING OF CONCRETE:

Mixing of concrete shall continue until there is a uniform distribution of material and the concrete is uniform in colour and consistency and for at least two minutes.

Mixes and weigh batches shall be maintained in first class condition throughout the contract and any mixer or plant which is faulty shall not be used. The drums on all mixers shall revolve at the speed recommended by the maker. A mixer of any type which has been out of use for more than 20 minutes shall be thoroughly cleaned out before any fresh concrete is mixed. All equipment shall be maintained in a clean serviceable condition and their accuracy periodically checked.

1.12  SLUMP TEST:
The Contractor shall keep at the site of the works for the EIC’s use or his representative a standard slump test mould and shall provide facilities throughout the construction for tests to be made as and when the EIC may require.

1.13 **COMPRESSIVE STRENGTH** : Concrete shall confirm to IS-456-2000.

The Contractor shall keep on site minimum 12 no.s standard 15 cm test cube moulds and ancillary equipment for preparing test cubes. Before the Contractor commences any concrete construction he shall make six cubes of mix concrete with the cement sand, aggregate and water which he proposes using on the contract and shall have them tested at a Laboratory approved by the EIC/EIC. Three cubes shall be tested at 7 days and three cubes at 28 days after casting and curing. In all cases the cubes shall give the minimum compressive strength. No concrete construction shall be commenced until Preliminary Tests on the six cubes referred above have been completed and results show the concrete to have the minimum compressive strength. As construction proceeds samples from fresh concrete shall be taken as per IS 1199 - 1959 and cubes shall be made, cured and tested in accordance with IS 516 1959.

Three test specimens shall be made from each sample for testing at 28 days. Additional cubes may be required for various purposes as to determine the strength of concrete at 7 days or at the time of striking form work, or to determine the duration of curing, or to check the testing error.

The test strength of the sample shall be the average of the strength of three specimens. The individual variation should not be more than 15 percent of the average.

Any part of the work from which the cubes fail to give the required minimum compressive strength shall be dealt with by the Contractor as directed by the EIC and at the expenses of the Contractor.

The concrete is also liable to be rejected or repaired as per the instructions of the EIC/EIC if it is porous or honeycombed, its placing has been interrupted without providing a construction joint or the reinforcement has been disproportionately displaced. The rejected concrete has to be demolished and redone to the satisfaction of the EIC free of cost.
The Contractor shall keep a daily record (Concrete Pour Card) showing the date when each portion of concrete is poured in slab, beam, column etc., curing, removal of form work and test cube results at 7 days and 28 days period. They shall be sent immediately to the EIC/EIC.

1.14 TRANSPORTING, PLACING AND COMPACTING OF CONCRETE:

The concrete shall be transported maintaining required workability in a manner such as to avoid the segregation of the constituent materials, and loss of any of the ingredients. It shall be deposited as nearly as practicable in its final position to avoid re-handling. It shall be placed and compacted before setting commences and should not be subsequently disturbed. Methods of pouring should be such as to preclude segregation, and to avoid displacement of reinforcement and movement of form work. Concrete Pumping needs to be arranged for conveying the concrete from transit mixers to work spot.

The concrete should be thoroughly compacted and fully worked around the reinforcement, around embedded fixtures and into the corner of the form work without formation of honeycombing, pinholes or surface irregularities and any other defects whatsoever.

The use of mechanical vibrators having capacity of producing vibrations at a rate not less than 5000 cycles per minute is recommended. Over vibration or vibration of very wet concrete is harmful. In addition to mechanical vibration, sufficient hand tools must be used to assure full consolidation around reinforcement and at edges and corners.

The deposition of concrete shall be carried out as continuously as possible to reduce to minimum joints between new concrete and concrete which has set. Where construction joints are necessary they shall be formed at right angles to the axis of the member concerned by the insertion of rigid stopping off forms, against which concrete can be properly rammed or as per the advise of Structural EIC.

No unset concrete shall be brought into contact with unset concrete containing cement of different type. Special permission and instructions shall be obtained when concrete has to be deposited under water.
Accumulation of set concrete on the reinforcement shall be avoided. Before fresh concrete is deposited upon or against any concrete which has already hardened, the surface of hardened concrete shall be well roughened if necessary by chipping and laitance remove. The surface shall then be swept clean with wire brushes, thoroughly wetted and covered with a thin layer of cement mortar.

1.15 PROTECTION OF CONCRETE:

Newly placed concrete shall be protected by approved means from rain, sun and drying winds. Concrete placed below the ground shall be protected from falling earth during and after placing. Approved means shall be taken to protect immature concrete from damage by debris, excessive loading, vibration, abrasion, deleterious ground-water, mixing with earth or other materials that may impair the strength and durability of concrete.

1.16 CONSTRUCTION JOINTS:

Before construction commences the Contractor shall submit to the EIC, for his approval, sketches showing proposed positions of construction joints.

Each section of concrete shall be poured continuously between construction joints. Shuttering to all construction joints should be so made that it produces on the face of joints a suitable grooved or indented surface to act as a sheer key or bond for the subsequent concrete. Inclined joints shall not be permitted.

If the concrete has been allowed to harden excessively, the surface shall be chipped over its whole surface to a depth of at least 3/8" and thereafter thoroughly washed. If the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire brushes to avoid dislodgement of particles of aggregate. Before fresh concrete is added to the other site of a construction joint the surface of the old concrete will be thoroughly wetted and then covered with a thin layer of cement mortar of the same quality as that in the concrete.

No distortion or displacement of reinforcement from the positions shown on the drawings shall be permitted at construction joints.

Water stoppers shall be provided to the construction joints of terrace slabs, kitchen and bathroom slabs, and water retaining structures where water leakage poses serious problems.
1.17 **STRUCTURAL JOINTS** :

Expansion joints or other permanent structural joints shall be provided in the positions and of the form described in the drawings or elsewhere. In no case shall the reinforcement, corner protecting angles or other fixed metal items, embedded or bonded into concrete run continuously through as expansion joint. The placing of concrete on either side of the expansion joint shall be done separately after an interval of at least 7 days.

1.18 **CUTTING INTO CONCRETE** :

No concrete shall be cut into, nor shall it be interfered with in any way, without the prior approval in writing of the EIC. Necessary holes shall be provided as required for plumbing work and for electrical pipes etc. at the time of execution.

1.19 **CURING OF CONCRETE** :

Exposed surfaces of concrete shall be kept continuously in a damp or wet condition for at least seven days from the date of placing of concrete.

Approved curing compounds may be used in lieu of moist curing with the permission of the EIC. Such compounds shall be applied to all exposed surfaces of the concrete as soon as possible after the concrete has set.

1.20 **SUPERVISION** :

Constant and strict supervision of all the items of the construction is necessary during the progress of the work, including the proportioning and mixing of the concrete. Supervision is also of extreme importance to check the reinforcement and its placing before being covered.

Before any important operation, such as concreting or striking off the form work is started, adequate notice shall be given to the EIC.

1.21 **CONTRACTOR'S RATES TO INCLUDE** :

The rates of contractor for providing and laying cement concrete in various grades or proportions in the Schedule of Quantities shall, apart from any other factors specified elsewhere in the tender documents, include for the following:
(a) For all factors and method of work described in these specifications.

(b) For all materials, labour, tools and plants, scaffolding, etc. mixing, conveying and placing concrete in position, ramming, vibrating, trawling, curing, providing necessary scaffolding and removing the same after the work is complete.

(c) Unless otherwise specified in the Schedule of Quantities the cost for concrete items shall include for providing and fixing form work as described inclusive of erecting, propping to required heights, bracing, providing stays, struts, bolts, nuts and everything necessary to keep the forms rigid, smoothening the surface to receive concrete as per detailed drawing, striking and stripping form work after the concrete is cured, hacking the concrete surface required to receive plaster etc.

(d) The reinforcement in case of Reinforced Concrete work will be paid for separately unless otherwise stated in the particular items, but rate shall include for pouring concrete and packing around reinforcement.

(e) The measurement of concrete will be as per detailed drawings, shapes and size based on net structural sizes as per drawings i.e. exclusive of plaster.

(f) Rates for concrete items shall cover for any shape of structural members like columns, beams, facias, fins, louvers etc. and for cantilevered beams slabs etc.

(g) Formation and treatment of contraction and expansion joints (where water bars like copper strips or joint fillers like ‘Shalitex’ are specified, such materials shall be paid for separately.

(h) Design of mixes where so required by specification in an approved Laboratory and on tests of materials and work required in the opinion of the EIC and described in these specifications.

(i) Fixing all inserts like pipes, plugs, forming holes etc. as described.

(j) Weigh-batching using a Mechanical weigh-batcher or a batching plant or where so specified for volumetric batching.

TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA
(k) For taking out dowel bars, fan hooks etc. through shuttering.

(l) In case where at the junctions of beams, columns, slabs, the composition of concrete mix or specified strength be different for columns, beams and slabs, then in such cases only the richer concrete among those specified for in all these members shall be used at the junctions and rate quoted for columns, beams and slabs or any member entering such junctions shall allow for the same. Rate shall also cover for spill over of richer concrete in beams to natural angle of repose of wet concrete required from practical considerations, while concreting the junctions.

(m) For forming drip moulds in Chajjas, sills, etc. and where shown in the drawings or as directed.

(n) For work at all levels.
2. **STEEL REINFORCEMENT** :

2.1 **MILD STEEL BARS** :
Mild Steel reinforcement bars shall conform to I.S.226-1962 "Standard Quality" or I.S.432-1960 "Grade I". Other qualities of steel shall not be acceptable.

**HIGH STRENGTH DEFORMED BARS** :
Wherever deformed high strength reinforcement bars are specified, the contractor shall use one of the following, accompanied by a certificate from the Manufacturer like TATA/SAIL/VIZAG only confirming to IS-1786 latest edition.

2.2 **CLEANING OF REINFORCEMENT** :
Before steel reinforcement is placed in position, the surface of the reinforcement shall be cleaned of rust, dust, grease and other objectionable substances.

2.3 **CUTTING OF REINFORCEMENT** :
Before the reinforcement bars are cut, the contractor shall study the lengths of bars required as per drawings and shall carry out cutting only to suit the sizes required as per drawings.

2.4 **PLACING AND SECURING** :
Reinforcement bars shall be accurately placed and secured in position and firmly supported or wedged by precast concrete blocks of suitable thickness, at sufficiently close intervals, so that they will not sag between the supports or get displaced during the placing of concrete or any other operation of the work. It is most important to maintain reinforcement in its correct position without displacement and to maintain the correct specified cover. Contractor shall be responsible for all costs for rectification required in case the bars are displaced out of their correct position.

2.5 **BINDING WIRE** :
The reinforcement shall be securely bound wherever bars cross or wherever required with 18 gauge soft annealed steel wire.

2.6 **WELDING** :
Welding of bars shall not be carried out unless specially authorised in writing by Structural EIC.

2.7 BENDS ETC:

Bends, cranks etc. on steel reinforcement shall be carefully formed, care being taken to keep bends out of winding. Otherwise, all rods shall be truly straight. If any bend shows signs of brittleness or cracking, the rod shall be removed immediately from the site. Minimum radius of 9 times diameter of the bar shall be used unless otherwise specified in the drawings. However, in respect of standard hooks the radius of bend shall be 2 times of diameter of bar. Heating of reinforcement of bar to facilitate bending will not be permitted. The bars shall always be bent cold.

In case of mild steel reinforcement bars of larger sizes, where cold bending is not possible, they may be bent by heating with written permission of the Project Engineer. Bars when bent hot shall not be heated beyond cherry red colour and after bending, shall be allowed to cool slowly without quenching. The bars damaged or weakened in any way in bending shall not be used on the work. High strength deformed bars shall in no case be heated to facilitate bending or cranking.

2.8 INSPECTION OF REINFORCEMENT:

No concreting shall be commenced until the Structural EIC has inspected the reinforcement in position and until his approval has been obtained.

A notice of at least 24 hours shall be given to the Project Engineer by the Contractor for inspection of reinforcement.

If in the opinion of the Project Engineer any material is not in accordance with the specification or the reinforcement is incorrectly spaced, bent or otherwise defective, the contractor shall immediately remove such materials from the site and replace the same and rectify any other defects in accordance with the instruction of the Project Engineer to his entire satisfaction.

2.9 NET MEASUREMENTS:

Reinforcement shall be placed as shown on the structural drawings and payment will be made on the net measurements from drawings. No laps, dowels, chairs and pins in reinforcement shall be paid for. The Contractor shall allow in his quoted rate for all wastage which will not be paid for.
2.10 **RATES QUOTED FOR REINFORCEMENT SHALL IN ADDITION TO ANY FACTORS MENTIONED ELSEWHERE SHALL ALSO INCLUDE FOR:**

(a) All cutting to lengths, labour in bending and cranking, forming hooked ends, handling, hoisting and everything necessary to fix reinforcement in work as per drawings.

(b) Cost of binding wire required as described.

(c) Cost of PVC blocks to maintain cover and holding reinforcement in position.

(d) For fabricating and fixing reinforcement in any structural member irrespective of its location, dimensions and level.

(e) Removal of rust and every other undesirable substances, using wire brush etc. as described.

(f) Stock piling of reinforcement as described.

(g) Work at all levels.

**Testing of materials**

The contractor shall carry out the following tests at his own expense and as directed by the Engg.-in-charge. Also Engineer-in-Charge reserves their right to ask the contractor to carry out any further tests on any material, which is being used in the project.

1. **Water:** Suitability for construction / Concreting purposes as per IS 456 – 2000

   **Periodicity:** One test at the beginning of the project and once in every 3 months as per IS Code.

2. **Sand:**
Tests to be conducted

a. Particle size – Lab
b. Silt content – Field
c. Bulking of Sand – Field
d. Percentage of Deleterious material / Organic impurities – Lab.

IS code for material – IS-383-1970
IS code for testing - IS-2386 (Part I) to IS-2386 (Part VIII)
IS code for Determination of density index (relative density) of cohesionless soils.

IS 2720 Part XIV

Periodicity of testing

Whenever there is a change in source of supply or as directed by the Engineer-in-Charge.

Remarks

Silt content should not exceed 5%.

3. Coarse aggregate

Tests to be conducted

a. Percentage of Soft deleterious materials – Field (Visual)
b. Particle size distribution
c. Aggregate value:

1. Crushing – Lab
2. Impact – Lab

IS code for material - IS-383-1970
IS code for testing - IS-2386 (Part I) to IS 2386 (PartV111)

Periodicity of Testing

Minimum 45 cum. Tests to be repeated for every 45 cum of coarse aggregate or part thereof.
4. **Cement:**

Tests to be conducted

a. Fineness - Lab

b. Soundness - Lab

c. Setting Time – Lab

d. Compressive strength – Lab

**Periodicity of Testing:**

Minimum qty. 20 MT, Tests to be repeated for every 50 MT or part thereof or change of supplier.

**Remarks:**

Cement to be tested if supplied by the contractor. Cement to be tested if stored for more than 3 months.

5. **Cement concrete:**

Tests to be conducted

a. Slump test - Field

b. Cube strength – Lab / field

**Periodicity of Testing:**

a. Once for minimum 5 cum.

b. Minimum 15 cum of part thereof.

**Remarks:**

Cube strength to be taken for both 7 days as well as 28 days. Cubes of critical members (decided by Engg.-in-Charge) shall be tested at lab.

6. **Reinforcement steel**

Tests to be conducted

a. Free from defects - Field (Visual)
b. Weight - Lab

c. Size - Lab

d. Ultimate tensile stress - Lab

e. Yield stress - Lab

f. Elongation percentage - Lab

g. Bend Re-bend test - Lab

IS code for material

IS-432 for mild steel IS-1786 for Tor steel IS Code for testing – IS – 1608

**Periodicity of Testing:**

Minimum qty. 10 MT, tests shall be repeated for every 10 MT of each size (dia) or part thereof.

**Remarks**

a. Steel shall be tested if supplied by contractor.

b. Steel shall be tested if stored in open yard for more than one year.

**NOTE:** All the testing equipment / machines like Sieve, Compression testing machine etc. required for field tests shall be arranged by the contractor at no extra cost.
SCOPE

OF

WORK

FOR

TANKAGE

WORK
**Note:** This scope covers requirements of tankage jobs only and the job scope of pipeline / mechanical jobs will be as per the SOR.

**Tank fabrication Works:**

**1.0 SCOPE OF WORK**

**1.1. Contractor’s Scope of Work:**

The scope of work of Contractor shall include the following but not limited to the same. The scope of work shall also include other items / works required to complete the work in all respects as per specifications, standards, drawings, IS codes/API Standards & instructions of HPCL whether specifically mentioned or not in the tender document:

i) The Contractor shall perform the work.

ii) Getting approvals from statutory authority/ local authority etc, if any required except construction approvals from CCOE /local bodies which will be obtained by HPCL.

iii) The Shell and Wind Girders have been designed by HPCL as per API 650 (latest Edition). The Contractor shall independently verify the above design and confirm his verification and there upon the adequacy of the Free issue plates immediately upon award of the contract.

iv) Preparation of all detailed and working drawings including plate cutting diagrams for various components of storage tanks & getting the same reviewed and approved by HPCL.

v) Preparation, Submission for Review and obtaining approval from HPCL for Detailed Quality Assurance System plans/ procedures developed by contractor basis Std. Inspection & Test Plan furnished in this tender/ Scope of work/SOR/GTCC/SCC & other relevant codes. The same shall be reviewed / approved by HPCL prior to commencement of work. The required competent man power, machinery, tools, tackles, equipments, etc required to execute the work as per the Approved Quality assurance plan (QAP) shall be the responsibility of contractor. Due records will be maintained by contractor throughout the work period as per instructions of Engineer-in-Charge.

vi) Time is the essence of this contract. Monthly/weekly Execution Plans will be developed by Contractor in consultation with Engineer-in-Charge & execution of work as per these plans will be the sole responsibility of contractor.
vii) Procurement & Supply of materials & consumables as indicated in contractor’s scope of supply.

viii) Loading, transportation and handling of all free issue materials from Owner’s stores to work site/ Contractor’s store and fabrication yard as applicable including supply of all necessary tools, tackles, transportation and handling equipments, etc.

ix) Stripping/Removal of vegetation for fabrication yard at Site.

x) (Deleted)

xi) Fabrication, erection and testing including vacuum box testing, liquid penetrant test, diesel chalk test, etc of tank bottom-annular and sketch plates, shell, wind girders with gusset plate stiffeners and all other plate attachments including cutting of plates and structural of required size, edge preparation, rolling, fitting, aligning, welding etc.

SHELL ERECTION SHALL BE STRICTLY BY JACKING UP METHOD ONLY.

xii) Supply, Fabrication and erection of various shell appurtenances and nozzles.

xiii) Supply, Fabrication and erection of Inlet and outlet troughs for Inlet and Outlet nozzles.

xiv) Supply, Fabrication and erection of various Roof appurtenances and nozzles.

Supply & fabrication of stairways, handrails, landing platforms, curb angle, bracing for foam dam, structural supports for wind girders, interconnecting walkways etc.

xv) Supply, fabrication, installation and testing of various roof appurtenances.

xvi) Supply, fabrication & erection of Gauge hatch with still well, still wells for level transmitters, level switch & temperature instruments etc.

xvii) Supply, fabrication & erection of earth connection as per respective IS code.

xvi) DP / Diesel chalk/ Vacuum box test/ any other test on various components of tanks as per Specifications of this Tender document, requirements of IS/API standard & instructions from Engineer-in-Charge.

xxvii) Calibration of tanks and getting approval from Legal Metrology authorities of the State Govt using contractor’s own tape etc.

xxviii) Carrying out hydrostatic / water fill up test in accordance to OISD 129/ Standard Specifications of this Tender & keeping the records for same, pneumatic, vacuum & other test as specified in code/ specifications & as per requirements of Engineer-in-Charge using contractor’s own equipment.
xxix) Accomplishment of any other item of work required to make the storage tanks ready for commissioning and as per instruction of Engineer-in-Charge.

xxx) Assistance to HPCL for commissioning of the tanks including supply of manpower, supervision, labour with all required tools and spares. This commissioning assistance shall extend up to 24 hrs beyond completion of first Pump-in of product into the tanks.

xxxi) Supply of all equipment, machineries, tools, tackles etc, labour and supervision of all works at site.

xxxii) Clean-up job at site for all surplus material, debris, scrap, construction equipment etc as per direction of Engineer-in-Charge.

xxxiii) Reconciliation of free issue steel / material and returning excess plates, off cuts and scrap as per direction of Engineer-in-Charge.

xxxiv) Supply of Power and Water required for the job shall be the responsibility of the Contractor & will be in his scope. HPCL will not give any connection from their existing electrical or Water supply system. Surplus water declared by HPCL in writing after Hydro test shall be disposed off by Contractor in an un objectionable manner to HPCL & its neighbors.

xxxv) Contractor has to perform work in running installation with HOT/ COLD Permit in accordance to OISD 105 and HPCL operational requirements. Complying & meeting all the safety rules & regulations as per standards & instructions of Engineer-in-Charge will be the sole responsibility of contractor.

xxxvi) Supply of all required materials, supplying and providing Single/Double scaffolding wherever required, Carrying out sand blasting and surface preparation, primer and finish painting.

2.0 **SCOPE OF SUPPLY**

2.1 **OWNER’S SCOPE OF SUPPLY**

TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA
2.1.1 Subject to the provisions mentioned elsewhere in the tender document, HPCL will issue the following materials free of charge from Stores at Site for the Steel plates required only for the following components of the tanks:

- Bottom: Annular Ring & Sketch plates

- Shell plates
- Roof plates
- Reinforcing pads for all shell/roof openings and manholes except cleanout nozzle.
- Datum plates for gauge well pipe.
- Primary/Secondary wind girder (For all C/R tanks only) including plate gussets/plate stiffeners.

THE WEIGHT OF ABOVE PLATES WILL BE BASED ON SP. GR. OF STEEL @ 7.85. THAT IS, UNIT WEIGHT SHALL BE 7850 KG/CU.M.

2.1.3) SCRAP/ CUTTING ALLOWANCES FOR OWNER’S FREE ISSUE MATERIALS

The plates will be issued by HPCL to the Contractor on Theoretical weight basis. At the end of the work, Reconciliation shall be also done on theoretical weight basis only.

A Tabulated statement showing the size wise plates issued and Total consumption will be prepared as per HPCL instructions. Based on the Total consumption in MT as a sum of individual size wise consumption for a particular site, generation of maximum 2.7% Returnable accountable scrap is allowed. The Returnable Accountable scrap includes Off cuts and plates smaller than 2400mm perimeter. Off cut plates shall be of minimum perimeter 2400 mm generated as per approved cutting Schedules. Plates smaller than 2400mm in perimeter are also classified under Returnable Accountable Scrap. On an overall basis, the generation of accountable scrap shall be limited to 2.7% of total net consumption taken as a sum of net consumption for various sizes. However, the Contractor shall make an all out effort at the time of preparation of Drawings/BOQ to limit the generation of Returnable Accountable Scrap to a minimum preferably less than 2.7%. It will be the responsibility of the Contractor to load, transport the accountable scrap, weigh at weighbridge including payment of weighbridge charges, return to HPCL Premises, Unloading and handing over to HPCL at their Store yard/scrap yard as per instructions of HPCL Engineer-in-Charge. Apart from
Accountable Scrap, the Contractor shall be allowed a maximum of 0.30% of Burnout Losses.

In case, the actual generation of Returnable Accountable scrap on overall basis is higher than 2.7% or burnout losses being greater than 0.30% of Overall consumption(Theoretical tonnage), then HPCL shall effect recovery @ Rs. 60,000/= per MT for excess scrap generation and/or burnout loss. It shall be therefore the sole responsibility of the Contractor to plan the cutting schedule to control his scrap generation within above limits.

2.2 CONTRACTOR’S SCOPE OF SUPPLY

The procurement and supply in sequence and at the appropriate time of all materials and consumables including structural steel (Plates & sections) required for completion of works as per drawings, specifications and standards shall entirely be the contractor’s responsibility. The items to be supplied by the contractor are in general but not limited to following:

A) All steel plates required for the components other than those where HPCL will be supplying plates as mentioned in the schedule of items.

B) All consumables such as electrodes, filler wires, acetylene, grease, oil, gases, electricity etc.

C) All structural steel sections wherever required for curb angles, Top wind girders Supports/stiffeners/ extensions for stairways, Self supporting truss of C/R, Secondary wind girders, spiral stairways, landings , platforms, handrails, interconnecting walkway structural, Inlet and Outlet Nozzle Troughs, Gratings(which may be fabricated by the Contractor at a workshop/ factory outside HPCL premises), etc.

D) All seamless pipes for nozzle necks 350mm NB and below, internal pipes, Nozzle necks for openings more than 300mm,Materials for Inlet/ Outlet Nozzle troughs, vents, emergency drain, extension piping for roof drain, etc.

E) All pipe fittings, flanges, matching flanges and blind covers wherever specified for all nozzles, brass items etc.
F) Bolts, nuts and gaskets for roof & shell manholes, nozzles with blind cover / matching flange, bolts & nuts for roof structure and other structural works.

G) Aluminium Gauge Hatch with cover.

H) **CLEAN OUT NOZZLE PLATE REQUIRED FOR FABRICATION & ERECTION OF CLEAN OUT NOZZLE AS PER IS 803. PLATES SHALL BE PROCURED AFTER APPROVAL OF DESIGN AND DRAWING TO BE SUBMITTED BY THE VENDOR**

I) Pipes, fittings, flanges, orifice plates, Foam makers/ Pourers and deflectors on point of spray on shell and structural supports for Piping for Foam system

J) MS Deflector plates including supporting arrangement required for cooling system.

K) Internal Bolts & Gaskets.

L) Strapping tapes & accessories for calibration.

M) Earth connections, support cleats for pipes, structural & cables.

N) Any Blind flanges, valves, nipples, plugs, bolts, nuts, gaskets, etc required for conducting hydrostatic testing and any other test required by HPCL.

O) All primer materials and painting materials, scaffolding, coarse sand for sand blasting and related equipment for Painting.

**Note:**

1. Contractor should ascertain the exact quantity required as per drawings as well as in consultation with the engineer in charge before procurement of the same.
2. The materials procured by contractor should be in line with the specifications mentioned in the subsequent chapter i.e. ‘Specifications for Materials in Contractor’s scope of supply.’

3. While every effort has been made to list all the supply items, it shall be the sole responsibility of the Contractor to review the list and seek clarifications, if any at the time of Unpriced Bid itself. HPCL undertakes to provide only Free Issue Steel plates for Fabrication and all the other items shall be supplied by the Contractor only. No claims/ disputes by the Bidder/ Contractor shall be entertained by HPCL at a later date.

3.0 DOCUMENTS / FABRICATION DRAWING DETAILS

The Contractor shall submit the detail fabrication drawings/ documents in the following sequence:

1. Drawing Index

2. General arrangement drawing of tank showing design data, basic dimensions, thickness, nozzle & internal parts.

3. Bottom and annular ring layout.

4. Shell plate layout showing location of nozzles & their distances from weld seams.

5. Nozzle orientation on shell.

6. Details of wind girders.

7. Spiral stairway, ladder and platform.

8. Plate layout of Roof, roof support details, details of appurtenances on cone roof, etc.

9. Any other design calculations as per contract.
10. Orientation and details of nozzles on tank roof.

11. Details of shell & roof nozzles.

12. Details of tank internals like still wells, truss for self supporting roof

13. Deleted

15. Plate cutting diagram for Free Issue Plates along with indicating anticipated the critical scrap i.e. Burn oil losses & Accountable losses.

16. Material test certificate for items supplied by contractor.

17. Welding procedures & welders qualification reports.

19. Final Inspection certificate and Hydrostatic test report.

20. Calibration Charts in hard and soft copies

21. As - Built drawing showing details as listed in Sr. No 1 to 20 above in SOFT COPIES.
STANDARD

SPECIFICATION

FOR

WELDING
## CONTENTS

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12. JOINT COMPLETION
1. GENERAL

This specification covers field and shop welding for carbon steel piping system.

In particular, following types of joints are considered:

Butt welds between pipes, flanges, bends, branch connection valves, etc.
Fillet welds for junction of slip on flanges; butt and socket weld fittings, reinforcing pads, etc

The following accepted standard and procedures shall be applicable:


In case of any variation between the provisions of the codes and the specifications given below the later shall prevail.

2. WELDING REQUIREMENTS

All welds joining two sections of pipe, a section of pipe to a fittings or fittings shall be performed employing qualified welding procedure and welders in accordance with Clauses 3 to 12 of this specification.

3. WELDING PROCEDURE QUALIFICATION

Welding procedure qualifications for all piping except those under the purview of IBR, shall be as per the latest edition of Standard for welding pipelines and related facilities, ASME section IX. The contractor shall submit the welding procedure after receipt of work order. Owner inspector shall review, check and approve welding procedure after conducting such tests as are necessary. It shall be the responsibility of contractor to arrange and carry out such tests at his own costs.

TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA
4. WELDER’S QUALIFICATION

Welder’s qualification for all piping except those coming under the purview of IBR, shall be in accordance with ASME Sec IX. Owner’s Inspector shall witness the test and certify the qualification of each welder. Welders approved by the owners’ Inspector only shall be employed. Contractor shall submit the welder qualification reports before the commencement of work. It shall be the responsibility of the Contractor to carry out the qualification test of the welders at his own cost at the job site all the tools, tackles and auxiliaries required for carrying out Welder’s test shall be supplied by contractor at his own cost.

5. WELDER’S IDENTIFICATION CARD

The welder shall carry on his person identification card as per Exhibit C and shall produce it wherever demanded by Owner’s Inspector. It shall be the responsibility of the Contractor to issue the identification card after it is duly certified by Owners inspector.

No welder shall be permitted to work without the possession of identification card. If a welder is found to perform a type of welding or in a position or on a material for which he is not qualified, he shall be debarred from doing further work. All such welds shall be cut and redone by the contractor at his own cost.

6. WEATHER CONDITIONS

If the welding is to be performed during rain or strong wind, suitable protection shall be provided for the parts to be welded and the welder.

7. BASE MATERIALS

In general this specification shall be used in welding the carbon steel materials having a specified tensile strength of 60,000 psi or less.

Backing rings, if required, shall be similar in chemical composition to the base material.

8. FILLER MATERIALS
Electrodes:

Electrodes used for welding shall conform to IS 814 and IS 815 latest editions.

The electrodes to be used by the Contractor shall be approved by the Engineer in charge after conducting tests as per IS: 814 testing procedure. These tests shall be carried out by the contractor at his own cost.

The contractor shall submit manufacturer’s certificates for each batch of electrodes supplied by him.

Electrodes shall be stored in unopened original containers. They shall be stored adequately to prevent moisture loss or moisture absorption and shall be handled in such a manner so as to avoid the damage of coating.

Electrodes when used shall be free of rust, oil, grease, earth or any other matter which could be harmful for the quality of welding. The electrodes used shall be suitably to the welding process and the base metal and the weld properties shall not be lower than those of base metal.

9. WELDING PROCESS

Welding under this specification shall be done with the manual shielded metal arc process.

Automatic or semi automatic welding shall be done only after the procedure and materials have been specifically approved by the Engineer in charge.

The welding shall conform to the standard codes of welding practice. Welding of carbon steel in general shall be in accordance with IS: 823 - Code of practice for use of metal arc welding in mild steel (for structural work only).

The welding of pipes shall conform to ANSI B 31.3 (latest edition) the compliance with this specification does not relieve fully or partially the contractor, responsible for piping fabrication and erection of his own responsibilities as well as on any contractual obligations.
10. PREPARATION OF PIECES TO BE WELDED

End Preparation

Preparation of ends to be welded will be preferably made by machining. However, preparation of the ends may be made by flame cutting, providing all grooves and irregularities are ground off and all the oxidation is removed.

Cleaning

The ends to be welded shall be properly cleaned. All paint, oil, grease, rust and oxide in general shall be removed, as well as all earth, sand or any other material which could be harmful to the welding. Ends shall be totally dry when welded.

No dirt or debris will be permitted in the pipeline. Prior to alignment, the inside of each joint shall be adequately swabbed, either by use of leather or canvas belt disc of proper diameter or other improved method.

Alignment and Spacing

Pieces to be welded shall be aligned and spaced in a suitable manner, so as to hold the ends during welding at a distance to ensure full penetration. Root opening shall not be more than as specified. Internal misalignment shall not exceed 1.5 mm.

For pipe with thickness 4 mm or larger, the pieces to be butt welded shall be coupled by means of pipe couplers or by yokes or bridge “C” clamps.

Owner’s inspector shall check and approve the joint fit up and alignment prior to the commencement of welding.

11. WELDING TECHNIQUE FOR ROOT PASS
For Butt Joints:

The maximum electrode size shall be 3.25 mm or 1/8 (10 SWG) and the electrode holder shall be connected, having due regard for the polarity requirements of the electrode approved for the use for pipe in horizontal position. Upward technique shall be used with the recommended values of current.

The root pass of butt joints, regardless of the technique used, shall be such as to achieve full penetration. However, projection of weld metal into the pipe bore shall not exceed more than 3 mm. Root grooves and defective restart of the welding shall be carefully avoided.

The weld shall be back chipped from inside by grinding or chiseling and a sealing run shall be given.

At each interruption of welding and on completion of each run, craters, weld irregularities and slag shall be removed by grinding or chiseling.

After the welding is started and until the joint has been completed, displacements, shocks, vibrations or stresses shall be avoided in order to prevent cracks or breaks in the weld.

For fillet welds

The maximum electrode size shall be 4 mm or (5/32) (8 SWG)

On completion of the root pass, any visual defect or irregularities shall be ground off to avoid defects or irregularities in the new pass.

12. JOINT COMPLETION

12.1 Electrode size of more than 8 SWG (4mm or 5/32) shall not be allowed for filling of the weld. Upward technique shall generally be used for pipe in horizontal and vertical position.
12.2 At each interruption of welding, and after each run of welding is completed, chipping and slag removal shall be done.

12.3 When the welding is complete, but joints shall have a cover pass. It shall be slightly convey and fuse into the surface to the base metal in such a manner as to have a gradual notch free finish a good fusion at the joint edges. It shall not be chipped after completion. Welds shall have a regular appearance and shall be free from defects.

12.4 Welder number shall be stamped along side each weld. Whenever required by the Engineer in charge.

12.5 When welding is completed, the butt joints of piping regardless of welding methods used, shall have a weld reinforcement referred to the outside of the pipe, not more than 2 mm for pipes not thicker than 12 mm.
SPECIFICATIONS

FOR

MATERIALS

IN

CONTRACTOR’S SCOPE

OF

SUPPLY

TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA
SPECIFICATIONS FOR MATERIALS IN CONTRACTOR’S SCOPE OF SUPPLY

1.0 SCOPE:

This specification covers the material specification requirements for the materials to be supplied by the Contractor. All the materials covered in this specification shall be sourced from reputed manufacturers / ISI Mark License holders.

2.0 TESTING:

Contractor has to provide Batch wise Manufacturer Test/Guarantee Certificates and the Heat Nos or Batch Nos shall be clearly identified on the materials along with ISI/API markings, as applicable. The entire Manufacturer test Certificates shall be as per relevant Codes/standards. Any material rejected by HPCL shall be forthwith removed from Site. Additionally, HPCL may also select samples of materials in accordance with relevant codes/standards for testing at reputed labs. Contractor shall arrange for testing the same at his own cost.

3.0 LIST OF ITEMS IN CONTRACTOR’S SCOPE OF SUPPLY WITH SPECIFICATIONS:
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<thead>
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<th>SL.NO.</th>
<th>ITEM DESCRIPTION</th>
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<td>200 MM NB</td>
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<td>PLATE FABRICATION</td>
<td>PLATES</td>
<td>IS: 2062 GR. A OR B</td>
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<td>5</td>
<td>NOZZLE NECKS</td>
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<td>6</td>
<td>NOZZLE FLANGES (EXCEPT MANWAY)</td>
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<td>13</td>
<td>CLEAN OUT NOZZLE PLATE</td>
<td>PLATE</td>
<td>Conforming to IS 2062 Gr A or B</td>
</tr>
</tbody>
</table>

4.0 For items not listed above such as bushes, split pins, neoprene bushes, copper cable etc, for which Manufacturer Test certificates may not be available, HPCL may approve for incorporation in works based on visual inspection.

TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA
SPECIFICATIONS

FOR

TANK

FABRICATION
CONTENTS

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12.0 GUARANTEE
1.0 SCOPE

1.1 This specification covers the minimum requirements for design, selection of materials, fabrication, erection, inspection, testing, fitting of other attachments and appurtenances, cleaning, calibration and painting of A/G FLOATING ROOF/CONE ROOF PETROLEUM PRODUCTS AND OPEN TOP WATER storage tanks and is intended to supplement the minimum requirements of the applicable codes.

1.2 Engineering drawings shall take precedence over specifications/standards.

1.3 The Review/ approval of design by HPCL shall not absolve Contractor from the responsibility of successful performance of Floating Roof/Self supporting cone roof. It shall be the sole responsibility of the Contractor to ensure successful performance of Floating Roof design.

1.4 The Shell and Wind Girders have been designed by HPCL as per API 650 (latest Edition). However the Contractor shall independently verify the above design and confirm his verification of adequacy of the steel plates (Free issue materials) to be supplied by HPCL immediately after award of the contract.

2.0 REFERENCE

2.1 Design Codes

The following codes in their latest edition shall form the basis for design, fabrication, inspection, testing and acceptance of storage tanks:

IS 803 (Latest edition) : Vertical Mild Steel Cylindrical welded Oil Storage tanks

API Standard 650 (Latest edition) : Welded steel tanks for oil storage.

TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA
IS : 875 (Part 3) : Code of practice for design loads
Wind Loads other than earthquake) for building and structures.

IS: 1893 : Criteria for earthquake resistant design of Structures.


API : RP 2003 : Protection against ignitions arising out of static, lightning and stray currents.

OISD-129 : Inspection of storage tanks.


OISD-118 : Layouts for Oil & Gas installations.
2.2 **Materials Codes**

Material to be used shall conform to:

Indian Standard Specifications or ASTM standards as applicable.

2.3 **Regulations**

National laws and regulations together with local bye-laws for the country or state wherever the tanks are to be erected must be compiled with.

3.0 **SELECTION OF MATERIALS**

3.1 All materials shall be as per applicable Codes.

3.2 Manhole necks, nozzle necks above 350 mm NB may be fabricated from same plate material as used for shell.

3.3 Plate material used for ring flanges shall have a minimum UTS of 4200 Kg./cm$^2$. For Flange thickness over 38 mm, plate material shall be boiler quality, fine-grained, killed, and normalized and impact tested as per the requirements of API Standard 650.

3.4 All clips and attachments shall be fabricated from carbon steel plates of weldable quality.

3.5 Gaskets for manholes and nozzles fitted with blind flanges shall conform to IS: 2712. Thickness of gasket shall be 1.5 mm for nozzles up to 450 mm NB and 3.0 mm for nozzles above 450 mm NB.

3.6 Bolts and nuts for all nozzles fitted with blind flanges shall conform to ASTM A-307 Gr. B, A-193 Gr. B-7, or A-194 Gr. 2H. Bolts and nuts for all structural shall conform to IS: 1363.

3.8 Following classifications of electrodes are recommended for welding. However, minimum requirements of applicable codes and appendices should be adhered to:

a] Low hydrogen electrodes namely, **E-7018 shall be used for** all manual metal-arc welds of shell courses having a thickness of 12mm or more and for attachment of shell courses to bottom or annular plates.

b] High cellulose/rutile type electrodes namely, E-6013 as per the AWS classification SFA 5.1 is acceptable for all other welding.

**ESAB, ADVANI OERLIKON & D&H SECHERON** make electrodes/approved equivalent will only be permitted to be used in the works. Based on above, fabricator shall furnish samples of welding electrodes to Engineer-in-Charge for approval.

4.0 DRAWINGS AND DOCUMENTS

4.1 All individual tank data sheets shall have dimensional/design as well as material specification. Final drawing with revisions, if any, shall be issued after award of contract/purchase order.

Contractor shall submit the detailed design calculation for floating roof (F.R.) through HPCL to IIT, Mumbai or any other HPCL approved expert, for vetting and review of design and thereafter Review and approval by HPCL.

4.2 Contractor shall prepare all design calculations and fabrication drawings based on the drawings issued on award of contract/purchase order and shall include the following:

1. Drawing index and Schedule of Submission.
2. Design calculation for floating roof wherever called for in the tender document for HPCL review.

3. GA drawing covering all details shown in HPCL data sheets like list of appurtenances, lists of standards and specifications, materials of construction, Tank design data, General Notes including details of test to be conducted on tank, specification and brand-name of welding electrodes to be used etc.

4. Plate layout, details of welding and bill of material for bottom sketch and annular plates.

5. Development details of welding and Bill of Materials for shell including shell extensions showing location of nozzles and stairway on developed shell.

6. Plate layout, details of welding and Bill of Material for Floating Roof/Self supporting cone roof.

8. Details of spiral stairway and extension stairway to still well platform/ LT platform, landings and handrails with bill of materials.


10. Details of rolling ladder and track and Earthing connections with Bill of Material for floating roof tanks.

11. Details of Roof Supporting Structure and Buoys with Bill of Material for Floating roof tanks.

12. Details of shell nozzles and Inlet/ Outlet Troughs and shell earthing cleats with Bill of Material.

14. Details of Floating Roof appurtenances, roof stopper and leg supports for Floating Roof including Bill of Materials for FR Tanks.

15. Orientation of floating roof appurtenances, leg supports, plate joints, rolling ladder track etc. for FR Tanks.

16. Details of primary roof drain and Drain sump for F.R. tanks including Bill of Material.

17. Details of still-wells, Gauge hatch and Bill of Material.

18. Details of mounting of Rim vents.

19. Details of Emergency Roof Drains.

20. Details of Foam Cooling System along with Foam makers and orifice plates.

21. Details of Fixed water spray cooling System along with deflector plates along with structural supports mounted atop secondary and tertiary wind girders and spray nozzles and orifice plates.

22. Details of Roof opening for Float type Servo level gauge.

22. Plate cutting diagrams for all free issue material.

23. Plate reconciliation statement for free issue material.

In case the contractor intends to make some modification for accommodating his fabrication facilities or available materials, the same shall be submitted to HPCL for approval with supplementary design calculations. The approved modifications shall be incorporated in fabrication drawing and submitted to HPCL for approval.
4.4 Requisite number (as per the Time schedule of this Work/Tender document) of prints of detailed fabrication drawings prepared by contractor shall be sent to HPCL for approval and one copy shall be returned to the contractor after comments/approval. No fabrication / erection shall be carried out without approved drawings.

5.0 FABRICATION AND ERECTION

5.1 Plates

a] Plates edges shall preferably be sheared or machine cut as per code. All machined parts shall be suitably protected before assembly.

b] Gas cut plates shall be grounded to the satisfaction of the Engineer-in-Charge.

c] All formed plates shall be match marked with paint on the concave side with numbers as shown on erection drawings.

5.2 Structural steel and Roof

a] Structural steel fabrication shall be carried out to the required shapes for making the structure.

b] A pre-assembly of a sufficient part of roof structure may be called for by the Engineer-in-Charge to assess the correct workmanship.

5.3 Bottom

a] Bottom slope shall be as indicated in the respective tank drawings.

b] Overlaps shall be properly cleaned with steel wire brush before welding.

c] Single pass welds are not permitted.
d] Arrange the laps to shade the water towards the Bottom drain Nozzle/shell.

e] Annular plates shall be assembled by butt welding with backing strips and the sketch plates shall be lap welded to the Annular plates.

f] Three plates lap joints shall be suitably joggled to a length of 150 mm minimum to facilitate welding. Joggling shall be to the satisfaction of Engineer-in-Charge.

g] Contractor shall provide a Welding sequence which shall be adopted so as to give minimum shrinkage and distortion and it shall be indicated on fabrication drawings. This shall be approved by Engineer-in-Charge.

h] Bearing plate under each leg support for floating roof tanks shall be centered and welded to the bottom plate by a continuous fillet weld of size equivalent to bottom plate thickness. Plates shall be 600 mm round or square and 10 mm thick (minimum).

5.4 Shell

a) Shell erection shall be carried out by Jack – up method only. Calculations for deployment of number of jacks and their placement/location shall be submitted by the Contractor for HPCL’s approval.

b) All vertical and horizontal shell joints shall be full penetration and full fusion welds using any one of the edge preparations permitted by the Code. Single side butt welds are not permitted.

c] Top curb angle shall be lap or butt welded to the top course with flange turned outside.
d] Drain holes of 20 mm diameter suitably staggered shall be provided on the horizontal plates of the stiffening ring (wind girder).

e] Hand railing shall be provided all around when stiffening ring is used as walkway for floating roof rank.

f] Curb angle and stiffening ring joints shall not coincide with the vertical shell plate welds.

g] Vertical joints should preferably be offset by at least 1000mm.

h] First shell course plates shall be so arranged that the vertical joints clear the annular ring welds or sketch plates welds by at least 300 mm. Vertical joints of the shell courses shall also clear the nozzle attachment welds or reinforcement pad welds as per code and applicable appendices.

i] Holes shall not be made in shell plates for erection purpose.

j] Shell plate alignment shall be within the limits specified in code and as approved by HPCL.

k] For floating roof tanks, internal diameter shall be maintained in all shell courses.

l] After completion, the inside surface of floating roof tanks walls shall be ground to remove any roughness liable to impair the seal.

5.5 Floating Roof

5.5.1 Overview

a] Floating Roofs shall be of single deck annular pontoon type construction with or without buoys.
b) When floating roof is in the highest position, tank shall be capable of holding its design capacity.

c) Floating roof shall be designed by Contractor considering design data given on each drawing / tender.

d) Central deck of the floating roof shall be provided with at least one manhole of 750 NB. This manhole shall be provided with a ladder for stepping down to bottom when the roof is in the lowest position. For tanks greater than 8 m dia. Additional manhole of 600 NB shall be provided. These manholes shall have suitable clearance from tanks internals.

e) On the bottom side of deck, where flexure can be anticipated adjacent to girders supports or other relatively rigid members, full fillet welds not less than 50mm long on 250mm centers shall be used on any plate laps that occur within 300 mm of any such members. Additionally, the remaining lengths of all lap seams shall be stitch welded for 50 mm lengths @ 600mm c/c.

f) Contractor shall design the parameters of the floating roof such that when floating in product (of specific gravity 0.70) the maximum submergence shall be within 95% of the rim height under conditions as listed below:

(i) For single deck annular pontoon type external floating roofs for the following conditions:

- The submergence of outer rim when 254 mm rain water is accumulated on the roof with primary Roof Drain inoperative.

- The submergence of inner and outer rim near the punctured compartments when deck and two adjacent pontoon compartments are punctured.
f] Contractors shall carry out buoyancy (including tilting) calculations for the floating roof for all the conditions of (g) mentioned above, when it is floating on test water. Calculated value shall be compared with actual submergence measured during floatation test.

5.5.2 Contractor shall submit design calculations for external floating roofs for sufficient buoyancy to keep the roof afloat and with primary roof drains inoperative for the following conditions

(a) For single deck annular pontoon type external floating roofs considering

- The submergence of outer rim when 254 mm rain water is accumulated on the roof with primary Roof Drains inoperative.

- The submergence of inner and outer rim near the punctured compartments when deck and two adjacent pontoon compartments are punctured with No water or live load.

b) Design of leg supports, bleeder vent, emergency drain and primary drains.

c) Design of pontoons and Deflection of deck and structural integrity of floating roof for annular pontoon type floating roofs when centre deck is loaded by its design rain water or when the centre deck and two adjacent pontoons are punctured.

5.5.3 a) Deck shall have level surface with permanent slope towards the drain sump to avoid stagnation of rain water.

b) Each compartment of the floating roof shall be provided with a 500 NB manhole with cover.
c) Each buoy, if provided, shall have 150 NB inspection opening with cover and bolting.

d) Central deck and pontoon shall be suitably stiffened, if required, and calculation for the structural integrity of the floating roof shall be submitted to HPCL for approval.

5.5.4 Seal

Details of Primary mechanical shoe seal and Secondary seal shall be as per Annexure – 1 to this specification.

5.5.5 Floating Roof Supports

a) Support shall be adjustable to two position

1) The lower position (minimum 1200 mm) shall permit the roof to go as low as possible without interference with any internal accessories and roof seal mechanism.

2) The upper position (for cleaning) shall provide a clearance of 1800mm between the pontoon / deck edges and bottom.

b) The number of leg supports shall be determined & designed to ensure that while resting they do not deform the tank bottom and roof; the effective length of the pipe support should be taken as 1.5 times of actual length of the pipe support in clean-out position.

c) Pipe sleeves shall project sufficiently above the roof to take care of flooded condition of roof and extend sufficiently below the roof to prevent escape of vapour (minimum 200 mm).

d) Pipe support length shall be readjusted after hydraulic testing of tank so as to take care of the initial settlement of the tank bottom.

5.5.6 Rolling ladder and track shall be provided as per HPCL Standard Drawings enclosed in this Document.

5.5.7 Roof Drains

a) Roof Drains of Repeatable lay pattern shall be provided by the Contractor as per Manufacturer recommendations with internal supports and shoes/ Guards, Connecting piping duly supported from Roof drain sump to inlet of system and Connecting piping from outlet side of system to Roof Drain Nozzle on shell, if any; Swing check Non return valve with CI body and brass/bronze valve and seat shall be provided for the primary drain for single deck floating roofs. Detailed specifications are provided in a separate section-Specification for flexible pipe for Tank Roof Drain system for floating Roof tanks.
b) The slope of deck leading to primary roof drain sump shall be planned for complete water drainage equivalent to maximum recorded rainfall per hour for given site without allowing any accumulation of water, the deck being at the lowest operating level.

c) Emergency drain shall be provided to take care of primary roof drain failure. This drain shall be equipped with water seal sump inside the roof to prevent back flow of the stored product. It should start functioning after accumulation of around 200mm of rain fall on deck.

d) The minimum thickness of drain pipe shall be Sch. 40.

5.5.8 **Vents**

a) Roof shall be provided with automatic bleeder vents designed to open before the roof reaches its lowest positions and to close when the roof rises above this point. Also same operation should follow in the clean-out position.

b) Rim vents of 150 NB at about 30 meter peripheral spacing (minimum two Nos). shall be provided for venting the dead space between stored liquid and seal. They shall be provided with pressure relief valve of one of the two approved makes, set at 20mm water column.

5.5.9 **Gauge Well/Anti-rotational Device**

Two Nos Gauge hatch with size as indicated in the SOR/drawing shall be provided on diametrically opposite side and shall have a quick opening cover. Gauge hatch shall be spark proof type. One of the Gauge well pipe and Pipe for Level Transmitter/TE shall be located on either side of Rolling Ladder. This shall also act as anti-rotational device. No additional anti-rotational device is suggested.

5.5.10 **Earthing of Floating Roof**

a) Copper cables shall be provided between ladder and track and also between ladder and shell. Two such independent connections should exist in parallel.

b) Adequate number of earthing shunts shall be provided for the seal.

6.0 **APPURtenances**

6.1 **Nozzles & Accessories**

a) All appurtenances and accessories as shown in the respective tank drawings shall be supplied by the Contractor.

b) Manhole and nozzles with blind flanges shall be provided with gaskets and bolting.

c) Nozzle and manholes may be shop assembled.
d) Flange faces shall be varnished and protected by wooden discs using at least three bolts.

e) All nozzles and accessories shall be prefabricated and attached to the shell plate. The prefabricated assembly shall be stress relieved prior to installation, wherever required as per code and applicable appendices.

6.2 Stairways, Roof Access and Hand railing.

Each tank shall be provided with stairway and roof access. Hand railing if not indicated otherwise on tank drawings shall be provided all around.

6.3 Settling Marker:

Marker shall be provided on the shell, 500mm from the bottom to check tank settlement. Size shall be 50x50x5mm angle and 100mm long. The distance between setting market is approximately 5 meter (minimum 4 numbers).

Shell settlement measurement shall be made after tank erection, prior to hydro testing and during water filling.

While taking measurement on settling markers, rim space (distance between shell and outer rim) shall also be measured at location corresponding to settling markers for floating roof tanks.

Bottom internal measurements shall be made after hydro testing; such measurement shall be made at all pipe support location. Additional measurements shall be made in annular plate region at 5 meter intervals around the tank shell.

7.0 INSPECTION AND TESTING

Inspection shall be co-coordinated by Engineer-in-Charge at all stages.

7.1 Inspection

a) All tanks shall be offered for inspection at all stages as desired by Engineer-in-Charge.

b) HPCL’S representatives shall have free access to the entire contractor’s as well as to worksite.

c) The contractor shall provide all facilities, such as access ladder, lighting, tools and tackles, instruments etc. and personnel to inspectors, for proper execution of their inspection.

d) All the inspection shall be carried out in accordance with the relevant codes and requirements of drawings and specifications.
e) Approval of the HPCL’S Engineer-in-Charge shall in no way relieve the contractor of his responsibilities for proper execution of work.

7.1.2 **Welding Procedure**

a) Welding procedure qualification shall be carried out as per ASME Boiler and Pressure vessel Code Section IX.

b) No welding shall be undertaken without approval of the welding procedure and welder qualification test by the Engineer-in-charge.

7.1.3 **Radiography and Inspection of Welds**

a) All welds shall be inspected and tested as per Section 6.1 of API 650, Tenth edition and this specification.

b) All long seams of fabricated nozzles shall be fully radiographed.

c) Weld areas to be radio graphed shall be designated by the Engineer-in-charge.

d) Radiographs shall be taken as soon as welding of the Joint is completed. If repairs are required, these shall be carried out before starting other welds. New radiography examination of such repairs shall also be carried out by the Contractor at his own cost.

e) Radiograph film length shall be 250 mm min. except if the weld is less than 250 mm long. In such cases, film length shall be full length of weld.

f) Radiographic film shall be of approved quality.

g) The radiography films and reports shall be reviewed and approved by a HPCL approved Third Party Agency. The quoted rates are deemed to include same.

7.1.4 **Liquid penetrant examination:**
Wherever specified in drawing/code, liquid penetrant examination shall be carried out as per specifications and codes. Additionally, all Horizontal and vertical Shell joints including extensions above the Maximum Design Liquid Level shall be Dye Penetrant Tested after Root Run and necessary repairs carried out.

7.2 **Testing**

All equipment required for testing shall be supplied by the contractor.

Opening other than those used for hydrostatic test or any other test shall be closed by plugs and blind flanges supplied by the contractors.

7.2.1 **Bottom test**
a) A detailed description of the proposed test method shall be first submitted for approval to the Engineer-in-Charge.

b) Vacuum box testing shall be carried out for detection of leaks in the bottom.

c) The weld joints under the shell periphery shall be tested before erection and welding of first shell course.

d) Contractor shall test the tank bottom for the entire weld length in the presence of the Engineer-in-Charge and test reports shall be issued accordingly.

7.2.2 Shell Test

a) Bottom to shell joints shall be tested as follows:

i) Inner filter weld shall be inspected and tested prior to welding the outside fillet weld. Leak test shall be performed with penetrating oil after removal of slag. Oil shall be removed before, welding the outer fillet.

ii) Examination for inner fillet to detect cracks shall be performed using either the liquid penetrant method.

b) All welded lugs and brackets used for erection purpose shall be carefully removed from inside and outside surface of the tank to the satisfaction of the Engineer-in-Charge.

c) The shell joints above the Design Liquid level and not subjected to Hydrotest shall be radiographed in accordance with API and all such joints shall be Dye penetrant tested for entire length after Root run.

d) Contractor shall perform the hydrostatic test in the presence of Engineer-in-Charge on each tank after complete erection. Any defects observed during the test shall be repaired by the contractor. No Hot work shall be permitted after Hydrotest.

e) Filling of the tank may be restricted by HPCL Engineer-in-Charge for preloading of foundation and hydrostatic test may be extended over a period of 4 weeks or more to ensure proper settlement of the tanks.

f) The filling height, for floating roof tanks shall be restricted to maximum height so that weather shield does not go beyond curb angle while carrying out the hydrostatic testing /filling up water. The steps shall be as follows:

1) On completion of tank ad after cleaning, the tank shall be filled with water as follows, unless otherwise specified in the tender documents.
Filling shall be in 4 stages- 25%, 50%, 75% and 100%. After each stage a load stabilization period shall be observed:
- 24 hrs between each stage for tanks with a capacity under 10,000 cum.

Filling rate shall not exceed 1 metre per day till 50% of the tank capacity and thereafter 0.75 m per day. If the settlement reading after 24 hours of filling exceeds 2 mm, the tank may be observed for another 24 hours to ensure that the settlement comes to a halt. Further filling will be carried out only after ascertaining that there is no settlement of the tank at this stage.

h) When the tank is full all the weld joints shall be hammered by the Contractor in the presence of Engineer-in-Charge. In case of any defect it shall be repaired and retested by the Contractor as per instructions of Engineer-in-charge.

i) Tank shall be emptied at a maximum water level variation rate of 5 metres per day or as per instructions of Engineer-in-Charge.

j) All weld repairs shall be done with water level minimum 300 mm below the joint being repaired.

7.2.3 Floating roof testing

Floating roof test shall be as recommended in API Standard 650 Appendix C or Appendix H and also as given below:

a) During floatation test of roof, contractor shall carry out the proof test as follows on each size of the tank selected by Engineer-in-Charge.

i) For annular pontoon type external floating roofs, with primary drains closed, water equivalent to 10” of rainfall over the tank area shall be poured on the deck and in the stabilized state submergence of outer rim shall not exceed 65% of its height at any point.

ii) For annular pontoon type external as well as internal floating roofs the condition of deck and two adjacent pontoon compartments punctured shall be simulated and the submergence of inner rim and outer rim at the punctured pontoon shall be compared with the calculated value.

iii) Failing to meet the above requirements contractor shall rectify the floating roof and test at his cost till the above requirements are satisfied.

b) All compartment including buoys shall be tested for liquid tightness.

c) Sealing devices shall be installed after floatation test.

7.2.5 Nozzle Reinforcing Plates

Nozzle reinforcing plates shall be pneumatically tested at 1.05 kg/cm² with soap solution. This test shall be carried out before filling the tank for hydrostatic testing.

7.2.6 Primary Drains
Drain pipes in floating roof tank shall be pressure tested with water at 4 kg/cm² g. During the floatation test, the roof drain valve shall be kept open and observed for leakage of the tank contents into pipe drain.

8.0 CALIBRATION

Strapping and Calibration of all tanks shall be done in accordance with IS:2007 & 2008 (Latest editions).

9.0 PAINTING

For details of primer and painting, Painting specification shall be referred to.

10.0 TOLERANCE

10.1 Shell

For tanks to have acceptable appearance and to permit proper functioning of floating roof, they shall have tolerances strictly as specified in applicable codes.

10.2 Floating Roof Tolerance

Tolerance allowed on the annular clearance between shell and floating Roof shall be compatible with the requirement specified by seal manufacturer. This shall be maximum 50 mm radially.

11.0 IDENTIFICATION, PACKING AND TRANSPORTATION

11.1 Identification

Each plate and structural member shall be clearly marked with the specification number, drawing number and assembly number.

11.2 Packing and Transportation

a. All plates shall be transported in tractor or trailer and shall not be dragged.

b. All rolled shell plates shall be packed properly to retain the shape and shall be handled carefully to avoid damage during transit.

c. Contractor shall be responsible for transportation of material fabricated in his workshop or worksite.

12.0 GUARANTEE

Guarantee, if not covered by the General Conditions of contract, shall be as following:

12.1 The entire Work shall be guaranteed in accordance with conditions given in the “General terms and Conditions of Contract”

12.2 Any part of tank found detective within 12 months from the date of Completion of work as per Completion Certificate and not having been subjected to faulty operations or incorrect service conditions shall be promptly replaced/repaired and reassembled by the contractor at his own cost, failing which owner has the right to get the same replaced/repaired by others and charge the cost incurred to the contractor.
STANDARD

SPECIFICATION

FOR

STORAGE TANKS
CONTENTS

1. SCOPE
2. REFERENCE
3. SELECTION OF MATERIALS
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11. IDENTIFICATION, PACKING, AND TRANSPORTATION.
12. GUARANTEE
SCOPE

This specification covers the general requirements for design, selection of materials, fabrication, erection, inspection, testing, fitting of other attachments and appurtenances, cleaning, calibration and painting of storage tanks and is intended to supplement the minimum requirements of the applicable codes.

Engineering drawings take precedence over specifications / standards.

REFERENCE

1. Design Codes

The following codes in their latest edition shall form the basis for design, fabrication, inspection, testing and acceptance of storage tanks.

1. American Petroleum Institute Standard API 650 with applicable indexes

2. ASME Boiler and Pressure Vessel Code Section IX.

3. Indian Boiler Regulation – IBR (wherever applicable)

2. Material codes

Material to be used shall conform to:

1. ASME Boiler and Pressure Vessel Code Section II

2. Indian Standard Specification. Special specification of equivalent grade can be used only after obtaining written approval from
3. Regulations

National laws and regulations together with local by-laws for the country of state wherever the tanks are to be erected must be complied with.

SELECTION OF MATERIALS

4.1 All materials shall be as per applicable codes / drawings / standards

4.2 Plate material conforming to IS: 2062 shall be used upto 20 mm thickness.

4.3 Manhole necks, nozzle necks 350 mm NB and above may be fabricated from same plate material as used for shell.
Plate material used for ring flanges shall have minimum UTS of 4200 kg/cm². For flange thickness over 38 mm, plate material shall be boiler quality, fine-grained, killed, and normalized and impact tested as per the requirements of API Standard 650.

Heating coil pipes shall be of seamless quality.

All clips and attachments shall be fabricated from carbon steel plates of weldable quality.

Hand rails on stairway and tank top shall conform to IS: 2062.

Platforms, spiral stairways and gangways shall have gratings fabricated from flats.

Gaskets for manholes and nozzles fitted with blind flanges shall conform to IS: 2712. Thickness of gasket shall be 1.5 mm for nozzles up to 450 mm NB and 3.0 mm for nozzles above 450 mm NB.

Bolts and nuts for all nozzles fitted with blind flanges shall conform to IS: 1367 or ASTM A-307 Gr. B or A-193. Bolts and nuts for all structural shall conform to IS: 1363.

Floating roof pipe supports and pipe sleeves shall be of carbon steel conforming to A-106/A-53 (seamless) IS: 1978 or equivalent.

Following classifications of electrodes are recommended for welding. However, minimum requirements of applicable codes and appendices should be adhered to:

1. Low hydrogen electrodes shall be used for all manual metal-arc welds of shell courses having a thickness of 12 mm or more and for attachment of shell course to bottom or annular plates.

2. For all other welding

High cellulose / rutile type electrodes as per the AWS classification SFA 5.1 are acceptable. Based on above, fabricator shall furnish brand names of welding consumables to Engineer-in-Charge for approval.
DRAWINGS AND DOCUMENTS

1 All individual tank drawings with design data and material specifications are attached with this document for tendering / quotation. Final drawing with revisions, if any, shall be issued after award of contract / purchase order.

2 Design Calculations

Fabricator shall submit the details design calculation for floating roof and wherever called for in the tender document for HPCL review / approval.

3 Contractor shall prepare all fabrication drawings based on the drawings issued on award of contract / purchase order and shall include the following:

(a) General arrangement drawing
(b) All general information and special instructions provided in drawings.
(c) Tolerances
(d) Specification and brand names of electrodes to be used.
(e) Nozzle orientation
(f) Development and details of shell, roof, floating roof and bottom.
(g) Final plate cutting layout
(h) Complete bill of material indicating scope of supply by owner/ contractor.
(i) Roof support structure.
(j) Stairways, platforms and handrails.
(k) Weld seams, weld joints, and weld sizes.
(l) Reinforcements.

(m) Insulation supports for shell and roof.

(n) Bracket and pipe supports, platforms, ladder / stair case, earthing connection etc.

(o) Appurtenances, foam and cooling water system.

(p) Fixtures for internals

(q) Heating coils

(r) Roof drain.

In case the contractor intends to make some modifications for accommodating his fabrication facilities or available materials, the same shall be submitted to HPCL for approval with supplementary design calculations. The approved modifications shall be incorporated in fabrication drawings and submitted to HPCL for approval.

Requisite number of prints as per the time schedule as called out in Vendor data requirements of all detailed fabrication drawings prepared by contractor shall be sent to HPCL for approval and one copy shall be returned to the contractor after comments / approval. No fabrication / erection shall be carried out without approved drawings.

5. FABRICATION AND ERECTION

During fabrication, contractor shall provide guy ropes and other means to secure semi-finished storage tanks against damage due to sever winds. A scheme shall be submitted to Engineer-in-Charge for review. Wind girders and roof shall be welded to tanks at the earliest. Before commencement of erection, contractor shall submit detailed erection scheme to Engineer-in-charge for approval.

Plates

1 Plate edges shall preferably be sheared or machine cut as per Code. All machined parts shall be suitably protected before assembly.
2 Gas cut plates shall be ground to the satisfaction of the Engineer-in-charge.

3 All formed plates shall be match marked with paint on the concave side with numbers as shown on erection drawings.

Structure

1. Structural steel fabrication shall be carried out to the required shapes for making the structure.

2 A pre-assembly of a sufficient part of roof structure may be called for by the Engineer-In-charge to assess the correct workmanship.

Bottom

(a) Bottom slope shall be indicated in the respective tank drawings.

(b) Overlaps shall be properly cleaned with steel wire brush before welding.

(b) Annular plates shall be provided if specified on tank drawings and shall be assembled by butt welding with backing strips and be lap welded to the sketch plates.

(c) Datum plate shall be welded to tank bottom vertically below the gauge hatch, after calibration of the tank.

(d) Three plate lap joints shall be suitable juggled to a length of 150 mm minimum to facilitate welding. Joggling shall be to the satisfaction of Engineer-in-charge.

(e) Welding sequence shall be adopted so as to give minimum shrinkage and distortion and it shall be indicated on fabricating drawings. This shall be approved by Engineer-in-charge.

(f) Bearing plate under each leg support for floating roof tanks shall be centered and welded to the bottom plate by a continuous fillet weld of size equivalent to bottom plate thickness. Plates shall be 600 mm round or square and 100 mm thick (min.)
Shell

a) All vertical and horizontal shell joints shall be full penetration and full fusion welds using any one of the edge preparations permitted by the Code. Single side butt welds are not permitted.

b) Top curb angle shall be lap/butt welded to the top course with flange turned outside.

c) The stiffening ring (wind girder) when necessary, shall be welded to the tank at the location shown in the respective tank drawings. These shall be of plate/section construction as shown in the drawings duly reinforced with gussets or struts welded to the shell. Welding shall be of same quality as used for Shell.

d) Drain holes of 20 mm diameter suitably staggered shall be provided on the horizontal plates of the stiffening ring. Hand railing shall be provided when stiffening ring is used as walkway.

e) Curb angle and stiffening ring joints shall not coincide with the vertical shell plate welds.

f) Vertical joints should preferably be off set by at least 1000 mm.

g) First shell course plates shall be arranged so that the vertical joints clear the annular ring welds or sketch plate welds by at least 300 mm. Vertical joints of the shell courses shall also clear the nozzle attachment welds or reinforcement pad welds as per code and applicable appendices.

h) Holes shall not be made in shell plates for erection purposes.

i) Shall plate alignment shall be within the limits specified in code and as approved by HPCL.

j) For floating roof tanks, internal diameter shall be maintained in all shell courses.

k) Internal shell weld seams of floating roof tanks shall be ground flush and even to allow proper movement of the roof.
Fixed Roof

(a) The roofs shall be supported by structure as indicated in the drawing/standard.

(b) All supporting structures shall be designed to carry the minimum loads as specified in codes, if the same is included in contractor’s scope of work. While designing, contractor shall also consider lateral loads caused by one bay loaded and the other bay not loaded.

(c) Roof laps shall be minimum 25 mm laps shall be arranged with the lower edge of the upper plate underneath the upper edge of the lower plate.

(d) Roof shall be joined to the shell by means of continuous fillet weld on the curb angle. Roof to shell joint shall be frangible type, otherwise suitable emergency venting shall be provided as per code.

(e) For structure supported roofs, roof plates shall not be welded/attached to the supporting structure. The same shall be well supported on the structure.

Floating Roof

(Applicable to top open floating roof tanks)

Roof

a) Floating roof shall be pontoon type, pontoon and buoy type or double deck type with multiple compartments and shall be leak proof to meet the minimum requirements of code and applicable appendix.

b) Deck shall have a level surface with a permanent slope towards the drain sump to avoid stagnation of rain water.

c) When floating roof is in the highest position, tank shall be capable of holding its designed capacity.
d) Each compartment of the floating roof shall be provided with a 500 mm dia. Manhole with cover.

e) Each buoy, if provided, shall have 150 mm NB inspection opening with cover and bolting

f) Floating roof shall be of low deck (minimum vapour space) type.

g) Floating roof shall be designed by Contractor considering design data given on each drawing / tender.

h) Central deck and pontoon shall be suitably stiffened, if required and calculations for the structural integrity of the floating roof shall be submitted to HPCL for approval.
i) Roof for tank of diameter more than 60 metre shall be designed for elastic stability against “gross out of plane buckling and local buckling”.

j) Central deck of the floating roof shall be provided with at least one manhole. This manhole shall be provided with a welded ladder for stepping down to bottom when the roof is in the lowest position. This shall have suitable clearance from tank internals.

**Seal**

a) Space between outer periphery of the roof and the tank shell shall be sealed by an approved sealing device. Contractor shall furnish details of sealing along with catalogue for HPCL’s approval at the time of quotation. The details shall also include minimum guaranteed life and its average expected life. However, the sealing material shall be guaranteed for its durability / satisfactory performance for a minimum period of five years.

b) Seal components shall be resistant to stored product and also durable against friction due to roof movement and extreme weather / environmental conditions.

c) Foam seal shall exert sufficient sealing pressure in all directions to prevent evaporation loss. Sealing arrangement shall ensure that no vapour space is left between shell and rim in its entire movement.

d) Foam seal shall have excellent flexibility and recovery from compression to accommodate tolerance in tanks and at the same time permit the roof to move up and down freely.

**Floating Roof Supports**

a) Adjustable leg supports shall be provided and the lowest operating position of floating roof shall not interfere with internal accessories / shell openings. The position shall provide clearance of 1800 mm between the lowest portion of the roof and the tank bottom for cleaning.

b) The number of leg supports shall be determined to ensure that while resting they do not deform the tank bottom and roof. The effective length of the pipe support should be taken as 1.5 times of actual length of the pipe support in clear-out position.

c) Pipe sleeves shall project sufficiently above the roof to take care of flooded condition of roof and extend sufficiently below the roof to prevent escape of vapour.
d) Pipe support length shall be readjusted after hydraulic testing of tank so as to take care of the initial settlement of the tank bottom.

e) Pipe supports shall be of Sch. 80 (minimum) and sleeve pipe shall be of Sch. 40 (minimum).

**Stairway and Top platform**

a) A raised platform as per size indicated in the standard shall be provided at the top of the stairway and shall be extended suitably to permit easy access to the accessories (gauge well, level indicator, etc.)

b) A self leveling stairway shall be provided for access from the platform to floating roof.

Roller tracks fixed to the roof shall permit movement of the stairway. Brass rollers for rolling stairway shall be provided to avoid sparking.

**Roof Drains**

a) Metallic articulated pipe drains with swivel joints of approved make and type shall be provided to drain water collecting on the roof. Contractor shall furnish details and catalogues of swivel joints for approval at the time of quotation.

b) All swivel joints shall be tested to a minimum pressure of 3.5 kg / cm2g before putting into roof drain assembly.

c) A swing check non return valve accessible from roof shall be provided in the roof drain sump.

d) Plug type emergency drain shall be provided to take care of roof drain failure. These drains shall be equipped with water seal sump inside thereof to prevent back flow of the stored product.

e) The roof drain size must cater to rainfall intensity as given in the ‘SITE CONDITIONS' of tender document. Maximum water accumulation on roof deck shall not exceed 5” of rain fall for determination of roof drain size in lowest position of roof.
f) The drain shall be designed so as to permit the roof to be lowered upto the lowest position.

g) The minimum thickness of drain pipe shall be Sch. 40.

Vents

a) Roof shall be provided with automatic bleeder vents designed to open before the roof reaches its lowest position and to close when the roof rises above this point and also same operation should follow in the clean-out position.

b) Rim vents at about 50 M peripheral spacing (minimum two nos.) shall be provided for venting the dead space between stored liquid and seal. They shall be provided with a galvanized iron rain hood and 2 mesh screen each.

Gauge well / anti-rotational Device

Gauge hatch size shall be indicated in the drawing and it shall have a quick opening cover. Gauge hatch shall be spark proof type. This shall also act as anti rotational device. No additional anti-rotational device is suggested.

Earthing of Floating Roof.

a) Wire cables shall be provided between ladder and track and also between ladder and shell. Two such independent connections should exist in parallel.

b) Adequate number of earthing shunts shall be provided for the seal.

APPURTENANCES

Nozzles & Accessories

a) All appurtenances and accessories as shown in the respective tank drawings shall be supplied by the contractor.

b) Nozzle lengths shall be as per code if not indicated on the drawings.
c) Nozzle reinforcing plates shall be provided with ¼” threaded tell tale hole for test purposes.

d) Nozzle shall be welded to shell and roof with the same quality of electrodes as used for welding shell / roof plates.

e) Manholes and nozzles with blind flanges shall be provided with gaskets and bolting.

f) Nozzles and manholes may be shop assembled.

g) Flange faces shall be varnished and protected by wooden discs using at least three bolts.

h) Suction heaters and mixer nozzles shall be provided with stiffeners.

i) All nozzles and accessories shall be prefabricated and attached to the shell plate. The prefabricated assembly shall be stress relieved properly to installation, wherever required as per code and applicable appendices.

### Heating Coils

Coils shall be supported from tank bottom. Coil supports shall not be welded to tank bottom. No screwed or flanged connections shall be used inside the tank. Flattening due to bending shall be as per ANSI B 31.3. Number of joints to be radiographed shall be 25% and interpretation of radiography shall be as per ANSI B 31.3. Heating coil shall also be pressure tested. Approval, from IBR, wherever required shall be contractor’s responsibility.

### Stairways, roof access and Hand Railing.

Each tank shall be provided with stairway and roof access. Handrailing if not indicated otherwise on tank drawings shall be provided all around.

### Settling Marker
Markers shall be provided on the shell, 500 mm from the bottom to check tank settlement. Size shall be 50 x 50 x 5mm angle and 100 mm long. Number of settling markers and their location shall be decided by Engineer-in-charge.

INSPECTION AND TESTING

Inspection shall be co-coordinated by Engineer-in-charge at all stages.

Inspection

a) All tanks shall be offered for inspection at all stages, as desired by Engineer-in-charge.

b) Inspector of owner’s representatives shall have free access to all the contractor’s shops as well as to worksite.

c) The contractor shall provide all facilities, such as access ladder lighting, tools and tackles, instruments, etc. and personnel to inspectors, for proper execution of their inspection.

d) All the inspection shall be carried out in accordance with the relevant codes and requirements of drawings and specifications.

e) Approval of the inspector shall in no way relieve the contractor of his responsibilities for proper execution of work.

Welding Procedure

a) Welding procedure qualification shall be carried out as per ASME Boiler and Pressure Vessel Code Section IX.

b) No welding shall be undertaken without approval of the welding procedure and welder qualification test by the Engineer-in-Charge.

Welder / Operator-Qualification
Welders, before being engaged, must be qualified as per ASME Boiler and Pressure Vessel Code Section IX. The contractor shall make arrangements of such test at his own cost in the presence of Engineer-in-charge.

Radiography and Inspection of Welds

a) All welds shall be inspected and tested as per code and this specification.

b) Tank welds shall be radiographed and interpreted as per code and applicable appendix.

c) The contractor shall be responsible for taking the radiographs by his own equipment at his own cost for the entire job.

d) Weld areas to be radiographed shall be designated by the Engineer-in-charge.

e) Radiographs shall be taken as soon as welding of the joint is completed. If repairs are required, these shall be carried out before starting other welds. New Radiographic examination of such repairs shall also be carried out by the Contractor at his own cost.

f) The butt weld around the periphery of insert plate shall be completely radiographed.

g) Radiographic film length shall be 250 mm min, except if the weld is less that 250 mm long.

h) Radiographic film shall be of approved quality.

Liquid penetrant / magnetic particle examination:

Whenever specified in drawing / code, liquid penetrant / magnetic particle examination shall be carried out as per ASME Boiler and pressure Vessel Code Section V and acceptance criteria shall be as per Section VIII Div. I.
All equipment required for testing shall be supplied by the contractor.

Openings other than those used for hydrostatic test or any other test shall be closed by plugs and blind flanges supplied by the contractor.

Bottom Test

1. A detailed description of the proposed test method shall be first submitted for approval to the Engineer-in-charge.

2. Vacuum box testing shall be carried out for detection of leaks in the bottom.

3. The weld joints under the shell periphery shall be tested before erection and welding of first shell course.

4. Contractor shall test the tank bottom for the entire weld length in the presence of the Engineer-in-charge and test reports shall be issued accordingly.

Shell Test

a) Bottom to shell joints shall be tested as follows:

i) Inner fillet weld shall be inspected and tested prior to welding the outside fillet weld. Leak test shall be performed with penetrating oil after removal of slag. Oil shall be removed before, welding the outer fillet.

ii) Examination for inner fillet to detect cracks shall be performed using either the liquid penetrant or magnetic particle method.

b) All welded lugs and brackets used for erection process shall be carefully removed from inside and outside surface of the tank to the satisfaction of the Engineer-in-charge.

c) Contractor shall perform the hydrostatic test in the presence of Engineer-in-charge on each tank after complete erection. Any defects observed during the test shall be repaired by the Contractor.
d) The filling height, in case of fixed roof or open roof tanks, shall be up to the curb angle and in case of floating roof tanks shall be restricted to the maximum height so that weather shield does not go beyond curb angle.

e) If sea water is used for testing and is to remain in tank for more than 30 days, an oxygen scavenger and corrosion inhibitor shall be added. After testing the tank, water shall be drained and tank shall be thoroughly flushed with clean fresh water. Standing water silt or other dirt left in the tank after hydrostatic testing shall be thoroughly cleaned.

f) Filling of the tank may be restricted by the Engineer-in-charge for preloading of foundation and hydrostatic test may be extended over a period of 4 weeks or more to ensure proper settlement of the tanks.

g) On completion of tank and after cleaning, the tank shall be filled with water as follows. Unless otherwise specified in the bid documents.

Filling shall be in 4 stages, 25%, 50%, 75% and 100%. After each stage a load stabilization period shall be observed.

24 hours between each stage for tanks with a capacity equal or more than 10,000 m3.

12 hours between each stage for tanks with a capacity under 10,000 m3.

h) When the tank is full all the welded joints shall be hammered by contractor the presence of Engineer-in-charge. In case of any defect it shall be repaired and retested by the contractor as per instructions of Engineer-in-charge.

i) Tank shall be emptied at a maximum water level variation rate of 5 meters per day or as per instructions of Engineer-in-charge.

j) All weld repairs shall be done with water level minimum 300 mm below the joint being repaired.

Fixed Roof Test

(a) After filling the tank up to curb angle, all openings in the roof shall be closed and internal air pressure shall be applied equivalent to the weight of roof plates. All welded joints in roof shall be checked with soap-suds for detection of leaks. For tanks with small internal pressure test pressure shall be equal to 1.25 x Design pressure.
(b) For vacuum test the tank shall be emptied up to 1 meter level from the bottom. The openings shall be closed and draining continued with care until the vacuum of 25 mm water gauge is obtained and checked by vacuum gauge. However, for tanks having dia 20 M and above, design check for vacuum shall be made before proceeding with the test.

Floating Roof Test

Floating roof test shall be as recommended in API Standard 650 Appendix C, and also as given below.

a) During flotation test of roof, contractor shall carry out the proof test as follows on each size of the tank selected by Engineer-in-charge who shall also witness the test in presence of design engineer.

i) With primary drains closed, water equivalent to 10" of rainfall over the tank area shall be poured on the deck and in the stabilized state submergence of outer rim shall not exceed 65% of its height at any point.

ii) With primary drains closed, plugs in the two adjacent pontoon compartments and plug in the deck shall be opened. In the stabilized state water level on the deck shall not exceed 65% of inner rim height at any point. Location and size of plug shall be decided by contractor.

iii) Failing to meet the above requirements contractor shall rectify the floating roof and retest at his cost till the above requirements are satisfied.

b) All compartments including buoys shall be tested for water tightness.

c) Sealing device shall be tested to the satisfaction of Engineer-in-Charge. Necessary Test Certificate will be issued by him after completion of tests by contractor.

Heating Coils

Heating coils shall be pressure tested as per engineering drawing.
Nozzle Reinforcing Plates

Nozzle reinforcing plates shall be pneumatically tested at 1.05 kg/cm²g with soap solution. This test shall be carried out before filling the tank for hydrostatic testing.

Primary Drains

Drain pipes in floating roof tanks shall be pressure tested with water at 3.5 kg/cm²g. During the flotation test, the roof drain valve shall be kept open and observed for leakage of the tank contents into tank drain.

CALIBRATION

Strapping and calibration of all tanks shall be done in accordance with IS: 2007 & 2008 (Latest editions)

a) PAINTING

For details of primer and painting, painting specification shall be referred to.

b) TOLERANCES

a. Shell

For tanks to have acceptable appearance and to permit proper functioning of floating roof, they shall have tolerances strictly as specified in applicable codes.

b. Floating Roof Tolerances

Tolerances allowed on the annular clearance between shell and floating roof shall be compatible with the requirement specified by seal manufacturer.

1 IDENTIFICATION, PACKING AND TRANSPORTATION

TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA
a) Identification

Each plate and structural member shall be clearly marked with the specification number, drawing number and assembly number.

b) Packing and Transportation

7.1 All plates shall be transported in tractor or trailer and shall not be dragged.

7.2 All rolled shell plates shall be packed properly to retain the shape and shall be handled carefully to avoid damage during transit.

7.3 Contractor shall be responsible for transportation of material fabricated in his workshop or worksite.

2. GUARANTEE

Guarantee, if not covered by the General conditions of contract, shall be as following:

12.1 All equipment shall be guaranteed in accordance with conditions given in the “Special Conditions of Contract”.

12.2 Any part of tank found defective within 18 months of completion or during 12 months operation and not having been subjected to faulty operations or incorrect service conditions shall be promptly replaced / repaired and reassembled by the contractor at his own cost, failing which owner has the right to get the same replaced / repaired by others and charge the cost incurred to the contractor.
STANDARD

SPECIFICATION FOR

FABRICATION

AND

ERECTION OF PIPING
01.1 General

This specifications covers fabrication and laying of product and firefighting pipelines including painting and allied works.

01.2 Codes Standards to be followed

| ASME B31.3 | : Codes for Pressure piping |
| ASME, BPV Code, Sec II | : Welding Rods, Electrodes and filler materials |
| Part C Material Specification | : Non-Destructive Examination |
| ASME, BPV Code, Section VIII | : Pressure Vessels |
| ASME, BPV Code, Section IX | : Welding & Brazing qualification |

01.3 Specification of the POL products are given below for general guidelines to the tenderers

<table>
<thead>
<tr>
<th>Products</th>
<th>HSD/ULSHSD</th>
<th>MS/ULMS</th>
<th>SKO</th>
<th>FURNACE OIL</th>
<th>BITUMEN</th>
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</thead>
<tbody>
<tr>
<td>Sp. Gravity at 15 Deg. C.</td>
<td>0.87</td>
<td>0.77</td>
<td>0.84</td>
<td>0.94</td>
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</tr>
<tr>
<td>Viscosity, cst at 38°C</td>
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<td>0.51</td>
<td>0.9</td>
<td>180 to 250 cst</td>
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</tr>
<tr>
<td>Vapour Pr., Kg/Cm2 at 38 Deg C.</td>
<td>0.1</td>
<td>0.7</td>
<td>0.3</td>
<td>NIL</td>
<td>NIL</td>
</tr>
</tbody>
</table>

Pipelines are required for distribution of petroleum products and firefighting facilities.

01.4 The intent of this specification is to cover scope of supply, erection, testing, painting and commissioning of the items as specified under scope of work of the tender. Details regarding items, which are supplied as free issue items by the owner, and items to be included in the scope of supply of the tenderer are also indicated in the tender.

01.5 Compliance with this specification will not relieve the tenderer of his responsibility for supplying the equipment / item of proper design, material and workmanship to meet the specified operating requirements and also proper workmanship and performance of the facilities under the contract.

01.6 Any additional material, which are not specifically mentioned in the technical specifications but are required to make the system complete in all respects for
safe operation and guaranteed performance, shall be included in the scope of work of the tenderer.

01.7 All materials supplied shall be new, of best quality and tested in accordance with the latest version of the relevant Indian standards or relevant International standard & codes acceptable to HPCL. The tenderer shall indicate make and grade of all bought out items for approval from HPCL.

01.8 No deviations/ exceptions from this specification shall be permitted without the written approval of HPCL. A complete list of exclusions/ deviations from the Tenderer's scope of work shall be clearly indicated in the offer. Similarly, if any departure, omission or substitution from the stipulated specifications is made, this fact should be clearly indicated in the offer with reasons, for consideration/ written approvals by HPCL.

01.9 All moving parts of erection equipment, which can conceivably cause injury to the operator or other authorised personnel within the vicinity of the working area, shall be suitably guarded. Selection of equipment shall be made with the following in view:

a) Safety of personnel,   c) Long life of equipment,
b) Uninterrupted operation,   d) Easy maintenance

01.10 All drawings and instructions shall be in English language. Dimensions in drawings, technical data, weights and quantities shall be in metric units.

01.11 Drawings accompanying the tender document are indicative of scope of work and issued for tendering purpose only.

01.12 The contractor is expected to visit site to get himself acquainted with prevailing site conditions i.e., availability of water, power, approach road etc., before quoting for this tender. The contractor shall be entirely responsible for provision of all such utilities. No delay shall be entertained on this account.

01.13 The contractor may have to arrange temporary power connection from the local Electric Supply Authority by his effort and cost. Alternatively contractor shall have to carry out the work with his own DG sets within the quoted rates.

01.14 For payment purpose against items of supply, fabrication and erection of steel of all types, the weight shall be calculated based on section given in the standard steel tables and physical verification whichever is less. The net fabricated dimensions edge to edge shall be taken into account. The measurement shall exclude any allowance for wastage, weld metal, etc.

01.15 Measurement of pipeline shall be taken for actual pipeline laid at site as measured along the centerline, through all types of fittings. Valves, flanges, strainers, filters, etc. shall not be included for measurement in pipeline. All fittings
such as bends, elbows, tees, branch connections, reducers etc shall not be measured separately. The erection of these shall be included in the pipe erection rates.

01.16 The contractor may be given old and new steel pipes, fittings, flanges, valves etc available from the existing stock. The contractor will have to clean and service the same and erect the same.

01.17 Site Cleaning

The contractor shall take care to clean the working site from time to time for easy access to work site and for safety. Working site should be always kept clean to the entire satisfaction of the Engineer-in-charge.

Before handing over any work to the owner, the contractor in addition to other formalities to be observed as detailed in the document shall clear the site to the entire Satisfaction of Engineer-in-charge.

01.18 Co-ordination With Other Agencies

Work shall be carried out in such a manner that the work of other agencies operating at the site is not hampered due to any action of the contractor. Proper coordination with other agencies shall be the responsibility of the contractor. In case of any dispute, the decision of Engineer-in-charge shall be final and binding on the contractor.

01.19 Safety Precautions

Contractor shall have to take all safety precautions for carrying out works as directed by the Engineer-in-charge. Necessary safety equipment such as safety belts, helmet, etc. and other safety instruments are to be positioned by the contractor and the same shall be used by the work force as per work requirement. The contractor has to enforce the same.

Safety distance as per CCOE rules and Oil Industry Safety Directorate shall be maintained strictly.

01.20 The suitability and capacity of all equipment used for erection shall be to the satisfaction of the Engineer-in-charge.

02.00 Scope Of Work

This specification covers general requirements of fabrication and erection of above ground and buried piping systems. The specification covers the scope of work of the...
tender, basis of work to be carried out, general guidelines, codes, standards and general practice to be followed during fabrication and erection.

02.01 Free Issue Items

The following items will be issued by HPCL as free issue items to the contractor.

i) **Rotating equipment** – All centrifugal pumps like TTL pumps, Sump tank (Vertical submersible) Pumps, Fire water pumps (diesel engine driven), jockey pumps.

ii) **Pipes** – All pipes 3” and above.

iii) **Valves** – All valves of size 3” and above, Orifice plates

iv) **Fire fighting equipment** : Hydrant posts, Foam cum water /water monitors, portable DCP/CO2 extinguishers, foam tank and inductor

02.02 Supply / Fabrication Items

The contractor shall supply all the items that are required for completion of the job specified in scope of work not limited to the following items.

i) Flanges including matching flanges for valves, pumps etc.(odd size flanges in pump supplier’s scope).

ii) Pipe fittings viz. bends, elbows, reducers/expanders, equal/unequal tees

iii) Valves of size 50mm and below

iv) Strainers (basket and Y type)

v) Unloading hoses with API Adoptors.

vi) Complete fabricated steel pipe supports, like shoes, saddles, clamps, guides, anchors, stops, clips, cradles, hangers, turn buckles, supporting fixtures, brackets, fasteners, etc

vii) Structural such as support columns, platforms, walkways, crossovers, stairs, gratings, ladders, and railings

viii) Gaskets

ix) Stud Bolts, nuts, fasteners

i) Coating and wrapping of buried piping.

ii) Pipes other than issued by HPCL.

iii) Temperature safety valves

iv) Bulk air eliminators
02.03 The scope of work of the contractor shall include but not be limited to the following:

i. Preparation of General Arrangement Drawings and isometric drawings for pipeline network as detailed in Technical specifications and obtain approvals. All supply materials to be based on approved drawings and to be procured after approval from HPCL.

ii. Receiving ‘free issue items’ from the HPCL store, loading and transporting these to the contractor’s store or work place,

iii. Design, manufacture / fabrication, testing, supply, transportation and storage of all ‘supply / fabrication items’ supplied by the contractor.

iv. Erection, alignment, cutting, welding, fitting, testing, painting and commissioning of all items covered above, as per the enclosed tender drawings and specifications. This shall include the complete piping, valves, fittings, pumps, etc. required for handling all products and additives as indicated in the tender drawings and specifications including special instructions to the tenderers.

  Welding of the pipelines at the battery limits with other agencies also shall be included in the scope work of the tenderer.

v. Construction of civil pedestals for supporting the pipelines.

vi. Design, supply, fabrication, erection, alignment, grouting, (including supply of non-shrink grouting material), and painting of the pipelines, support structures, crossovers, walkways, ladders and platforms including gratings in the pump house, manifold area, tank farm area and any other location in the pipe routing network where these are required.

vii. Erection, alignment, grouting (including supply of grouting material), testing, touch-up painting of pumps and motors and commissioning of the same as per the instructions of pump supplier. Supply of necessary shims, wedges, packing plates, non shrink cementitous grout, cleaning/flushing agents, etc required for grouting.

viii. Supply of all inserts, anchor bolts, final adjustment of foundation levels, dressing of foundation surfaces, bedding and grouting of anchor bolts in to the constructed civil works, cutting and patching up of the existing concrete structure, as may be required for the erection of the equipment. Any civil work if damaged by the tenderer during the erection work shall be rectified by the tenderer at his own cost, to the satisfaction of HPCL.

ix. Excavation to the required depth in all types of soil, alignment, welding, fitting, testing, laying buried pipes and refilling the trench as per the specification.
x. Wrapping and coating buried pipes as per specification for protection from corrosion.

xiii. Bitumen padding for the foundations for the foam tanks.

xvi. Procurement and laying of buried MS pipes for conveying the oil free water from the discharge pipe of the submersible drain pump installed in the outlet chamber of the oil water separator, to the ETP.

xix. The contractor shall supply at his cost, all necessary skilled and unskilled personnel, cranes, hoists, tools and tackles, instruments, safety implements & barriers and other accessories required for assembly, erection, testing and commissioning of the system.

xx. Safe custody of all the equipment and materials till the same are handed over to HPCL after completion of commissioning.

xxi. Successful tenderer shall be agreeable to include any other jobs not covered in the tender but required for completion/ commissioning of the items covered under this contract. The rates quoted shall be deemed to include all jobs required for completion/ commissioning.

xxii. The tenderer shall give complete technical specification of the equipment / items offered and general arrangement and schematic drawings for the approval of HPCL or his representative, sufficiently in advance of the commencement of manufacture. Such approval, when accorded, shall however, not relieve the tenderer of his responsibilities towards satisfactory and trouble free performance of the installations.

xxiii. All the equipment / items shall be shop tested according to the relevant standards. The particulars of the proposed tests shall be submitted to HPCL for approval before conducting the tests. HPCL or their representative shall be given full access to all the tests. The supplier shall inform HPCL sufficiently in advance so that if HPCL desires, their representative can witness the tests. All the certificates shall be submitted for the approval of HPCL before clearance for dispatch of the equipment can be given.

xxiv. The tenderer shall quote for a set of necessary spare parts required for 2 years smooth and satisfactory operation of the equipment supplied by him. These spares shall be listed separately for each item of equipment with itemised weights and prices.

xxv. The tenderer shall be responsible for safe custody of all mandatory spares, spares required during commissioning & guarantee tests, all materials/equipment, drawings, catalogues till handing over to HPCL.
xxvi. The tenderer shall furnish to HPCL the complete drawings, documents, test certificates, etc. as indicated in this technical specification for approval / information and record.

03.00 Inspection

The items under the scope of supply of this tender shall be inspected by HPCL at the manufacturers’ or his sub contractor’s works. The tenderer shall furnish in his offer, Quality Assurance Plan (QAP) he proposes to follow at the factory and the tests to be conducted. This shall clearly define and identify the stages of inspection, scope of test, list of documents to be furnished. Inspection requirements and sample QAP format are enclosed as Annexure-III.

The tenderer shall arrange all facilities required during inspection and testing at his cost.

HPCL shall have the right to inspect/ witness the tests at various stages of fabrication /manufacture/ installation. The inspection shall be carried out at suppliers’ works /his subcontractor’s works/ site. Inspection of the item shall be done only with a view to ensuring that the same is manufactured, tested and supplied as per prescribed specifications.

The inspection shall in no way relieve the supplier of his responsibility as per the contract and shall in no way be binding on HCPL.

The supplier shall not despatch any item from his works until they have been inspected & accepted by issue of provisional acceptance certificate.

Manufacturer’s test certificate shall be furnished for all bought out materials. Wherever such certificates are not available, the tenderer shall get the items tested at his expense at government-recognised laboratories, mutually agreed upon with HPCL.

All the items in scope of supply shall be carefully examined to determine their conformance with the specification with respect to material and workmanship, finish, marking, ratings, dimensions, etc. and to assess their conformance with other requirements stated or reasonably implied but not covered by the specific tests.

Any defects noticed during the inspection/ testing at site shall be rectified by the contractor at his cost as advised by the site engineer and inspection/ testing carried out for fool proof working.

04.00 Ability and experience of tenderer

The tenderer shall be capable of executing the entire scope of work, supply of the specified items and erection work, within specified period. In this regard, the tenderer shall submit a list of various shop facilities, annual manufacturing/ fabrication capacity, manpower availability, testing facilities and list of clients for whom similar jobs have been executed.
05.00 **Incomplete information**

Tenders with incomplete information are liable to be rejected. Hence, tenderers are requested to go through entire tender document and fulfil all the requirements.

06.00 **Guarantee**

The tenderer shall guarantee the material, workmanship, and satisfactory performance of the complete facilities/items under his scope of work for a period of 12 months from the date of handing over. The tenderer shall replace defective items or rectify any defect observed during this period at his cost.

II **TECHNICAL SPECIFICATION**

**Preparation of drawings**

The Contractor has to prepare General Arrangement Drawings (GADs) and Isometric drawings for the proposed product piping as directed by HPCL. However, given below is the indicative philosophy for GADs & Isometric Drawings to enable to comprehend the work:

- a) Tank Receipt lines
- b) Proposed Tanks to Tank Truck Loading Pump House
- c) Tank Truck Loading Pump House to Tank Truck Loading Gantry
- d) Fire fighting and Foam net work

**PREPARATION OF GADs FOR THE PRODUCT PIPING NETWORK**

The Plot Plan for the entire facilities are enclosed herewith the tender document. Contractor will have to carry out engineering and prepare a detailed General Arrangement Drawings as per the sound engineering practice and in accordance with the directions of Engineer in charge. The number of pipeline areas shall be advised to the Contractor and the GAD should cover all the facilities in such areas including structural platforms. Contractor will then have to generate Isometrics accordingly and generate MTOs(Material Take Off) from these drawings and submit to HPCL for their approval. Procurement action for supply items can be taken up by Contractor based on these MTOs. However, in case of any error by contractor in either carrying out engineering or generating drawings/MTO, contractor will be solely responsible. HPCL’s approval in no way will absolve Contractor of their failure.
01.0 Specification of supply items for piping and related items.

01.1 Flanges

i) Slip on welding flanges  

ii) Blind flanges  

a) Flanges shall conform to ASME B 16.5 class 150 for size up to 600mm NB and MSS-SP-44 for sizes more than 600NB.

b) Flanges shall have 1.5mm raised face and serrated finish to 125 AARH.

c) Material of flange shall conform to A105 up to 250mm NB and to IS 2002 Gr 2A above 250mm NB.

01.02 Studs And Nuts

Studs and nuts shall conform to A193 Gr B7 and A194 Gr 2H respectively. Washers shall conform to IS 2016-1967

01.03 Metallic Gaskets

Gaskets shall conform to IS: 7719-75 metallic spiral wound gaskets for product lines. For water lines gaskets as per IS: 2712-79 Gr.W/1. Thickness of gaskets shall be 2.0 mm upto 300mm NB and 3.0mm for above 300mm NB.

01.04 Strainers

Basket Type strainer :

i) Strainers shall be provided on the suction side of the pumps.

ii) Strainers shall be of 40 mesh.

iii) Strainers shall be of rating class 150.

iv) Strainers shall be with flanged ends.

v) Vent and drain connections with valves shall be provided.

vi) Maximum pressure drop across the strainers at maximum flow of the product shall not exceed the following values.

a) On the suction side – 0.05 kg/cm²

b) On the discharge side – 0.1 kg/cm²

Effective filtering area on the strainer shall be at least six times the inlet pipe cross sectional area. (Refer attached sketch)

vii) Required quantities are listed in schedule of quantities.
### ‘Y’ Type Strainer

#### 1.0 DESIGN PARTICULARS

<table>
<thead>
<tr>
<th>a)</th>
<th>Fluid to be handled</th>
<th>Raw water</th>
</tr>
</thead>
<tbody>
<tr>
<td>b)</td>
<td>Type</td>
<td>‘Y’ type</td>
</tr>
<tr>
<td>c)</td>
<td>Screen open area compared</td>
<td>6 times cross sectional area at inlet to cross section in inlet (Min.)</td>
</tr>
<tr>
<td>d)</td>
<td>End connection</td>
<td>Flanged, raised face conforming to IS:6392</td>
</tr>
<tr>
<td>e)</td>
<td>Pressure drop across</td>
<td>0.5 Kg/cm²</td>
</tr>
</tbody>
</table>

#### 2.0 MATERIAL OF CONSTRUCTION

<table>
<thead>
<tr>
<th>a)</th>
<th>Body</th>
<th>Carbon Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>b)</td>
<td>Filter element</td>
<td>SS 304, 40 mesh</td>
</tr>
<tr>
<td>c)</td>
<td>Gasket</td>
<td>IS 2717 W/1</td>
</tr>
<tr>
<td>d)</td>
<td>Bolts, nuts and washers</td>
<td>IS 1367, CL. 4.6/4</td>
</tr>
</tbody>
</table>

#### 3.0 TEST TO BE WITNESSED BY HPCL

<table>
<thead>
<tr>
<th>a)</th>
<th>Hydro test</th>
<th>Body 15 Kg/cm²</th>
</tr>
</thead>
</table>

#### 4.0 FINISH AND PAINT

<table>
<thead>
<tr>
<th>a)</th>
<th>Finish</th>
<th>All burrs and sharp edges shall be removed and the inside surface should be smooth finish.</th>
</tr>
</thead>
<tbody>
<tr>
<td>b)</td>
<td>Painting</td>
<td>Fire red, shade no.536 as per IS:5</td>
</tr>
</tbody>
</table>

#### 5.0 MARKING

The valves shall be clearly and permanently marked with the following:

<table>
<thead>
<tr>
<th>a)</th>
<th>Manufacturers name and trade mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>b)</td>
<td>Year of manufacture</td>
</tr>
<tr>
<td>c)</td>
<td>Size</td>
</tr>
</tbody>
</table>

#### 6.0 DOCUMENTATION TO BE SUBMITTED WITH OFFER
7.0 DOCUMENT TO BE SUBMITTED AFTER OFFER

Cross sectional drawing with part number material of construction and major dimensions for approval from HPCL

8.0 DOCUMENT TO BE SUBMITTED DURING INSPECTION TO HPCL

a) Approved QAP
b) Hydrotest certificate
c) Performance Test certificate
d) Chemical Test certificate
e) Warranty certificate
f) Mechanical Test certificate

01.05 Pipe Fittings

i) The following types of pipe fittings are required

   a. Butt welded long radius (1.5 d) elbows (90°)
   b. Butt welded long radius elbows (45°)
   c. Straight (equal) Tees
   d. Reducing outlet Tees (Stub in)
   e. Eccentric reducers
   f. Concentric reducers
   g. Short radius elbows conforming to ANSI B 16.28 shall be used where long radius elbows cannot be used due to space restriction.

ii) The fittings shall be wrought steel butt welding fittings conforming to ANSI B 16.9 ASTM A 234 WPB upto 300 mm and WPBW for above 300 mm, Std. Socket welded fittings ANSI B16.11 shall be used for pipes OD less than 50 mm and material of construction ASTM A 105, class 3000.
01.06 Unloading hoses with couplings

Synthetic flexible rubber hose 80mm nominal diameter and 6m length and 2.5m length for oil service (IS: 10733-1983 Type 2B) shall be embedded with GI wire cotton canvas plies and copper wire for electrical continuity. Inside of the hose shall have smooth surface and shall be resistant to the oil. Outer cover shall be resistant to abrasion. Hoses shall be provided with flange coupling matching with railway wagon/tank truck outlet valves/unloading header valves.

01.07 Pipes

a. This specification covers MS pipes (ERW) plain/bevel ended intended primarily for piping in storage unit for Petroleum product services. The pipes for petroleum products shall conform to API 5L Gr. B (PSL-1) 2004/IS 1978 Yst 210: 1982 and for water services IS:1239 (Heavy), IS 3589:2001 Fe 410 / IS 1239:2004 (Heavy). ASTM A 106, Grade ‘B’ pipes also may be used for product pipes of Φ50mm and less.

b. HPCL shall carry out inspection as per the scope of inspection detailed in Technical specification and relevant standard for which all arrangements/facilities shall be made by successful tenderer.

c. Makes of Pipes shall be SAIL, Maharashtra seamless ltd, Jindal pipes ltd, TISCO, MAN, Welspun, PSL or any other reputed make with prior approval of HPCL.

d. Material and workmanship

i. The pipes shall be new and the best of its kind. All pipes and their dimensions, tolerances, chemical composition, physical properties, heat treatment, hydro test and other testing and marking shall conform to the respective codes indicated against each category of pipes in the schedule of quantity. Deviation(s), if any, shall be clearly highlighted in the offer.

ii. All the materials used shall be free from injurious defects and surface defects like scale, burns, fins, rusts, cracks and deformation etc. The inside surface shall be free from weld spatter, foreign matter or other obstruction. Reconditioning/repair of pipes by welding shall not be permitted.

iii. Pipes shall be supplied in standard single/double random length of 4.0 m to 12.4 m. Pipes having OD more than 50mm shall be supplied with bevelled ends and less than 50mm with square ends.

iv. Necessary test certificates with correlation shall be submitted to HPCL for checking compliance to specified grade of materials/standards.

01.08 Valves:
a.) This specification covers the following types of valves as per standards mentioned against each type, intended for different products at different locations HPCL.

i. Gate valves
ii. Ball valves
iii. Non return valves
iv. Temperature Safety Valves

i. GATE VALVES

The gate valves shall be of forged steel construction of class 800 shall conform to API 602, outside screw and yoke type, bolted bonnet, solid wedge, rising stem, renewable seat ring and hand wheel operated. The valves shall be suitable for both horizontal and vertical installation without any modification at site. End connection shall be socket welded conforming to ANSI B16.11. Testing of valves shall conform to API 598.

ii. BALL VALVES

Ball valves shall be of forged steel construction of class 800 and shall conform to BS: 5351. The valves shall be of Full bore type, handle operated with anti blow out stem single piece construction, with antistatic device and fire safe to API 607, Socket welded type conforming to ANSI B16.11 Testing shall be as per BS: 6755-Part I.

iii. NON RETURN VALVE

Lift check valves of forged steel construction of class 800 shall conform to BS: 1868. End connections shall be of socket welded conforming to ANSI B16.11. Testing of valves shall be as per BS 6755 Part I.

b.) The following makes of valves are acceptable:

Econo valves Pvt. Ltd., BDK Engineering Industries Ltd., Fouress Engineering (I) Ltd., Audco India Ltd, KSB pumps Ltd or Any other reputed make with prior approval of HPCL.

c.) Inspection and testing

All the tests furnished below and as indicated in API 598 for gate valves, BS 6755 Part. I for NRV and Ball valves shall be carried out for each valve.

a. Visual examination of all assembled valves for surface defects, if any.
b. Overall dimensional check for all valves.
c. Operation of all valves for easy opening and closing.
d. Shell test (hydrostatic) for all valves.
e. Seat and back seat test (hydrostatic) for all valves.
f. Low pressure (6.0 kg/cm\(^2\)) air seat test.

iv. **TEMPERATURE SAFETY VALVES:**

Safety pressure relief valves shall be mounted on the product pipeline header between the valves. These valves shall take care of the excess pressure developed in the header due to rise in temperature of the product, if any, during daytime. The specification of the valve shall be as follows:

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>General</td>
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<tr>
<td></td>
<td>Valve Type</td>
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<td>2</td>
<td>Valve</td>
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<tr>
<td></td>
<td>Bonnet Type</td>
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<tr>
<td></td>
<td>Conventional/Bellows/Pilot Operated</td>
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<tr>
<td></td>
<td>Inlet Connection</td>
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<tr>
<td></td>
<td>Outlet Connection</td>
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<tr>
<td></td>
<td>Cap over adjustment Bolt</td>
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<tr>
<td></td>
<td>Applicable Code</td>
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<tr>
<td>3</td>
<td>Material</td>
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<tr>
<td></td>
<td>Body and Bonnet</td>
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<tr>
<td></td>
<td>Nozzle &amp; Disc</td>
</tr>
<tr>
<td></td>
<td>Spring</td>
</tr>
<tr>
<td>4</td>
<td>Basis</td>
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<tr>
<td></td>
<td>Basis of Selection</td>
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<tr>
<td>5</td>
<td>Service Conditions</td>
</tr>
<tr>
<td></td>
<td>Fluid / State</td>
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<tr>
<td></td>
<td>Required Flow Capacity</td>
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<tr>
<td></td>
<td>Specific Gravity</td>
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<tr>
<td></td>
<td>Operating Temperature: deg C</td>
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<td></td>
<td>Back Pressure</td>
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<td></td>
<td>Set Pressure</td>
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<tr>
<td></td>
<td>Viscosity (CST)</td>
</tr>
<tr>
<td>6</td>
<td>Orifice area</td>
</tr>
<tr>
<td>7</td>
<td>Quantity</td>
</tr>
<tr>
<td>8</td>
<td>Make</td>
</tr>
</tbody>
</table>
01.09 **Structurals for supports, platforms and etc:**

a. All structural steel plates will conform to IS 2062 – 1999, Fe 410W, Grade A, for thickness up to and including 20 mm and to IS 2062-1999 Fe 410W Grade B for thickness above 20mm.

b. All structural steel rolled sections will conform to IS 2062 Fe 410W Grade A

c. All structural steel for hollow sections will conform to IS 4923 grade Yst 240.

d. Electrodes for mild steel will conform to IS 814 – 1991(ASME, BPV, Sec. II Part C). The electrodes will be chosen according to the welding procedure to be adopted, and the quality of metal to be welded. The strength of the weld metal will not be less than that of the parent metal.

e. Hexagonal head bolts will generally conform to the property class 4.6 as specified in IS 1367 – (Part 3) – 1991 unless otherwise noted.

f. Bolts and nuts of property class 4.6 will conform to IS 1363 Part 3, - 2002

g. Size of permanent bolts will not be less than 16 mm

h. Minimum size of fillet weld will be as per recommendation of clause A – 2.1.8 of IS 9595 – 1996 except that leg size will not be lower than 6 mm. However for nominal fillet weld as required, for example, between chequered plates and their stiffeners or supporting members, the leg size will not be less than 4 mm.

i. Hook bolts for corrugated sheet covering will conform to IS 730 – 1978.

j. Washers for corrugated sheet covering will conform to IS 8869 – 1978.

k. Material for roof and sidewall sheeting shall be of 20 gauge and 22 gauge CGI sheets respectively. The CGI sheets shall conform to IS: 277-1992. Translucent sheeting shall be provided to meet the lighting requirement. This shall conform to IS: 12866-1989.

l. Steel sheets shall conform to IS : 1079-1994

m. Steel tubes for structural purposes shall conform to IS: 1161-1998(Gr Yst-210)

n. The following makes of steel are acceptable: SAIL, TISCO, RINL or any other reputed makes with the approval of HPCL.

1.10 **Bulk Air eliminators**
The Bulk air eliminators are installed on product pipeline, in the metering system for elimination of entrapped air to enable fluid measurement in accordance with OIMLR117

<table>
<thead>
<tr>
<th>Material of Construction</th>
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<tbody>
<tr>
<td>Shell</td>
</tr>
<tr>
<td>Heads</td>
</tr>
<tr>
<td>Nozzle Flange</td>
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<tr>
<td>Nozzle pipe</td>
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<tr>
<td>Float and Accessories</td>
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<tr>
<td>Bolts</td>
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<tr>
<td>Nuts</td>
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<tr>
<td>Gasket</td>
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<tr>
<td>Support</td>
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<td>Nozzle</td>
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<td>Inlet</td>
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<tr>
<td>Outlet</td>
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<tr>
<td>Vent Cover</td>
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<tr>
<td>Drain</td>
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<tr>
<td>Vent</td>
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<tr>
<td>Safety Valve</td>
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<tr>
<td>Others</td>
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<tr>
<td>Air Vent Material</td>
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<tr>
<td>Seal Material</td>
</tr>
<tr>
<td>Painting specification</td>
</tr>
<tr>
<td>Code of construction</td>
</tr>
<tr>
<td>Required Retention time</td>
</tr>
<tr>
<td>Pressure drop at design flow</td>
</tr>
</tbody>
</table>

Specifications for erection

TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA
02.01.01 Erection of Equipment

Major activities involved in erection, testing & commissioning are enumerated below. However, any other activity not mentioned but required for total work execution shall be included in the scope of work of the tenderer.

i. Receiving of equipment/material, unpacking, storage, transporting the same to respective erection site.

ii. Safe custody of equipment/material from time of receipt till these are installed and handed over.

iii. Cleaning, flushing and lubricating equipment/material before assembly, erection and testing. Servicing, greasing, packing the supplied valves as required by HPCL

iv. Checking of foundation levels, centre lines, orientation, locations etc.

v. Carrying out minor leveling and alignment of equipment foundation and supports including chipping of concrete foundation, if required.

vi. Assembling, coupling, fitting, fixing, jointing, aligning various sections of equipment etc. by welding/bolting etc. as per the drawings.

vii. Servicing of anchor bolts.

viii. Supply and fabrication of liner plates, shim plates.

ix. Installing the equipment on foundation/structures/platforms/walls/columns as the case may be in proper orientation.

x. Orienting and leveling the equipment including supply and fabrication of packing plates if required.

xi. Construction of civil pedestals for supporting the pipelines and construction of foundations for structural columns of pipe bridge.

xii. Fixing and grouting of anchor bolts and base frame for pumps including supply of non-shrink grouting mix.

xiii. Supply, Assembly, positioning, fixing of all accessories (platform, ladder, internals) on the main equipment.

xiv. Providing temporary supports, scaffolding, staging around the equipment as required during the construction, installation, and erection or testing. Removing the same after the job completion and keeping the area clean. Wooden ladders are not acceptable. Contractor shall use metallic ladders only.

xv. Protecting properly all installed and uninstalled equipment/material from theft, damage, pilferage and becoming a hazard to life and property. Protecting nozzles, flanges, machined parts, open pipe ends etc. by covering with plastic pipe caps/flange caps, wooden blanks, etc.

xvi. Fabrication and erecting of all temporary or secondary supports, assemblies etc. that are required for supporting, fixing equipment, pipes, ducts etc.

xvii. Cleaning of equipment (internal & external) before testing.

xviii. Testing of pipelines, equipment as per the requirement, specifications and standards.
xix. Draining, emptying and cleaning the pipelines, equipment after testing and painting providing necessary drain points.

xx. Opening/closing manholes/ nozzles etc. as required during pre-commissioning.

xxi. The following jobs are also included under tenderer’s scope for pumps, motors. (Fixing, aligning of equipment shall be done only by skilled millwright fitter who will be approved by HPCL before commencement of such work in case felt necessary).

a. Servicing of coupling, stuffing box, and bearings.

b. Installing of equipment / motor on the base frame.

c. Checking the motor / equipment for free rotation.

d. Aligning and coupling equipment with motor before piping and alignment after piping.

e. Decoupling for testing motor.

f. Re-coupling of equipment with motor after testing.

g. Hot alignment during trial run.
h. Installation of mechanical seal and pump/ seal accessories to be carried out under the supervision of manufacturer.

02.01.02 Erection of Pump sets

i. The pumps shall be erected as per the procedure given in the erection manual of the pump supplier. However the following guidelines shall be taken care of. The pump base frame shall be erected on prepared foundation and leveled with shims and wedges with the help of precision levels and other instruments. After leveling, grouting of foundation bolts shall be completed. When tightening the foundation bolts, the base plate levels should not get affected. Final level achieved should be of the order of 0.05 mm per meter.

ii. The pump and driver shall be placed on their respective machined pads ensuring that their feet make lull contact. Normally a 0.002 inch feeler strip should not pass between the feet and the pad when the pump and motor are freely placed.

iii. The coupling if not supplied fitted with the pump and drive unit, should be carefully fitted with a pusher or by means of heating in an oil bath of approximately 180 deg F. The coupling shall never be hammered onto the shaft as this may cause serious damage to bearings and mechanical seals. Run-out on a coupling after fitment should be between 0.05 mm and 0.1 mm TIR. Before proceeding with any alignment, the pump and driver bearings should be thoroughly cleaned and flushed with recommended grade of
lubricant and the individual units should be checked for freeness of rotation. The coupling shall be aligned radially and angularly using two dial gauges.

iv. Connection of suction and delivery pipes shall be made in such a manner that the connection to the pump flanges does not develop any undue stress and the weight of the pipes is not transmitted to the pump.

v. After completion of the pipe work, the pump set shall be grouted upto the flanges of the base frame. Grouting should be filled from inside the base frame and all cavities filled up. After the grout has set the alignment should be re-checked and compared with the values recorded prior to grouting.

vi. During manual rotation, it shall be ensured that the shaft assembly moves freely and no noise develops from bearings.

vii. Before coupling the driver to the pump, it shall be ensured that the direction of rotation of the motor corresponds to that of the pump as indicated in its casings shall be removed.

Additional activities for fire fighting pumps:

The scope also includes erection of day tank, silencer, connected piping and miscellaneous civil works, not limited to the following:

- Installation of connected piping from & to diesel engine and its fuel tank. Small bore piping will be paid in respective piping item of SOR.

- Installation of day tank, exhaust / silencer piping, provision of safety insulation. Structural supports will be paid under relevant item.

- Minor civil works.

02.02 Erection Of Pipeline

02.02.01 General

The handling, laying and welding of pipelines shall be carried out conforming to relevant codes / standards unless otherwise stated in the specification given below. There may be variation between dimensions shown in drawings and actually existing at site due to minor variations in the location of equipment, inserts, structures, etc. To take care of these variations “Field welds” shall be provided during piping fabrication. An extra pipe length of 100 mm over and above the dimensions indicated in the drawings may be left on one side of the pipe at each of the field welds. During erection, the pipe end with extra length at each field weld, shall be cut to obtain the actual dimension.
occurring at site. Isometrics, if supplied may have the field welds marked on them. However, it is the responsibility of the contractor to provide adequate number of field welds. In any case no extra claims will be entertained from the contractor on this account.

Wherever errors / omissions occur in drawings and Bills of materials it shall be the contractor’s responsibility to notify the Engineer-in-charge prior to fabrication or erection.

Based on the site conditions, the routing of pipelines shown in the drawings may require modifications. The tenderer shall execute the work under his scope of work accordingly as directed by the site in charge. The measurement for laying of pipelines shall be based on measurement along the centre line of the pipeline, inclusive of fittings but exclusive of items such as valves, strainers, etc.

The anti-corrosive treatment to the pipes to be laid underground shall be as per specifications given in the subsequent paragraphs.

02.02.02 Erection of pipe above ground

i. All piping shall be routed and located as per final approved piping drawing keeping in view the piping specifications. No deviations from the arrangement shown shall be permitted without the written consent of HPCL.

ii. In general, pipelines shall be routed above ground. However, where road crossing is involved as indicated in the layout drawing, the pipelines shall be routed under ground. Pipelines shall be routed in a pipe bridge at about 6.5m height between the pump house and Road Loading pump house. At the Road Loading shed, the pipelines shall be laid at around 4.0 m level supported by building structures.

iii. All pipe work shall be designed with sufficient flexibility to prevent development of undesirable forces or movements at the point of connection to equipment at anchorage or due to thermal expansion. Flexibility shall be provided by change of direction or by use of bends, loops or offsets.

iv. Location and design of pipe supports shown in approved arrangement drawings/support drawings should be strictly adhered to. Pipe supports i.e. restraints, such as guides, stops, anchors must be made in such a manner that they will not contribute to the over stressing of a line, while protecting a weaker or more sensitive component. e.g. pump.

v. Flanged joint shall be used for connections to vessels, equipment, flanged valves and road crossings and also on suitable straight lengths of pipelines at strategic points to facilitate erection and subsequent maintenance work.

vi. While fitting/ welding of matching flanges care shall be exercised to properly align the pipes and to check the flanges for trueness, so that faces of the flanges can be pulled up together without inducing any stress at the pipes and equipment nozzles.
vii. All flange facings shall be true and perpendicular to the axis of pipe to which they are attached. Bolt holes of the flanges shall straddle the normal centerlines unless different orientation is shown in the drawing.

viii. Wherever a spectacle blind is to be provided, drilling and tapping for the jackscrews in the flange shall be done before welding it to the pipe.

ix. Steel to cast iron flange joints shall be made up with extreme care, tightening the bolts uniformly after bringing flange flush with gaskets with accurate pattern and lateral alignment.

Anti-static jumpers shall be provided with 8 gauge copper wire at the flanged joints in piping network to maintain electrical continuity. Piping shall be earthed.

xi. Flanged connections at the pumps, fittings, accessories, etc. shall be made in such a way as not to induce any stress due to misalignment, excessive gap etc. The final tightening shall be carried out when the machines are aligned completely and specifically authorised by Engineer-in-Charge. Temporary protection covers shall be provided at all flanged connections of pumps, until the piping is finally connected.

xii. Pipelines shall be laid sloping towards drainage points.

xiii. The contractor shall maintain slopes specified for various lines in the drawing. Corrective action shall be taken by the contractor in consultation with Engineer-in-Charge wherever the contractor is not able to maintain the specified slope.

xiv. Vents and drains shall be provided on each line at the highest and lowest points to release the trapped air during hydraulic testing and to drain out the test fluid after testing. These openings shall be plugged and welded after the test.

xv. After the piping is erected in final position, it shall be cleaned, tested for tightness and kept dry as described in the specification.

xvi. All valves shall be provided with the operating handle/ lever/ wrench within easy reach. Wherever necessary, operating platforms shall be provided.

xvii. Installation of line mounted equipment / items like filters, strainers sight glasses, etc., including their supporting arrangements shall form part of piping erection work and no separate payment shall be made for this work.

xviii. The tenderer shall provide all required supports, anchors, saddles, hangers, rollers, clamps, u-bolts, guides, spring supports, sway bracings, vibration dampers etc for aligning and controlling the pipe work. Supports shall prevent under operating conditions, excessive stresses and excessive vibration of supporting elements from possible resonance with imposed vibrations.
xix. Wherever additional flange joints/valve fittings are required, the same shall be
provided after taking approval of site engineer on drawings.

xx. All suitable hoisting tackles/ equipment should be used for speedy and safe
handling of pipes while laying the pipes on supports, specifically in case of surface
coated pipes. Such tackles/ equipment shall be provided with cushioning material
to avoid damage to the lining / coating of the pipes.

xxi. The inside of the pipes shall be cleaned of stones, sand, dirt, oil, grease etc.
thoroughly before laying. The cleaning process shall include removal of foreign
matter such as scale, sand, weld, spatter, cutting chips, etc. by wire brushes,
cleaning tools, etc and blowing out with compressed air and / or flushing out by
water.

02.02.03 Erection of water pipe lines

The handling, laying and welding of pipelines shall be generally carried out as per the
specifications given elsewhere in this document. The special requirements of water piping
are given below:

i) Welded MS piping (DN 80mm and above) : MS water pipes for fire hydrant
service conforming to IS 3589 / IS 1239 will be issued to contractor for laying.
The welding will be butt welding as per specifications mentioned in this section.
No radiography is considered for this item.

02.02.04 Buried Pipe

i. All buried pipe work shall be laid with earth cover sufficient to avoid damage from
pressure of vibration caused by surface traffic. Minimum earth covering over the pipe
shall be 1200 mm from the finished ground level area in areas subject to temporary
loads and 1000 mm from finished ground level in areas not subject to temporary loads.
Where the buried depth is less than these limits, permission from the Engineer in
charge shall be taken. All buried pipelines shall be provided with anti corrosion
wrapping and coating as specified.

ii. The excavation of trenches shall be so carried out that the digging of trenches does not
go far ahead of the pipe laying operations, so as to prevent risk of landslide. All work
shall be so organized that trench digging, pipe laying, testing and back filling of
trenches follow one another closely.

iii. All buried pipes shall be hydro tested before wrapping and coating.

iv. Where loose earth is met during excavation or where trench is very deep, side walls
shall be shored properly with timber or other means.

v. The trench shall be excavated to proper width (min. for single pipe 800mm) and
depth. In case of pipeline passing through existing RCC/ asphalt driveway, contractor
shall refill the excavated driveway and complete it to its original finish. No additional
claim for such shall be entertained.
vi. All underground pipelines crossing rail tracks or roads shall be through culverts or hume pipes as indicated in the drawings to suit the site.

vii. It should be ensured that while laying the pipes no foreign materials like stones, sand, gunny bags, bits of welding rods, muck, weld materials etc. are left inside the laid pipes. The contractor should ensure that the coating / wrapping of the pipes are not damaged while drawing the pipes through RCC pipes. If there is any damage, it shall be rectified by the contractor at his cost.

viii. At the end of each day of work, the free ends of the laid pipes must be kept properly sealed.

ix. Special care shall be taken to place the pipes in the trenches. If any damages are caused during laying/ residual welding of pipes in trenches, floating of pipes in water in trenches, it shall be the contractor's responsibility to get them repaired and no claim whatsoever on this account shall be entertained by HPCL.

x. On completion of testing and painting of pipelines, the trenches shall be filled as per specification. The entire responsibility lies with the contractor for taking care of the pipes including lining/ coating of the pipes.

**02.02.05 Pipe Sleeves**

Pipe sleeves shall be provided for pipes passing through foundations, walls, floors, roofs etc., They shall be of sufficient size to permit the passage of flanges or fittings assembled with the line. The annular space at the ends between the sleeve and the pipe shall be sealed with cement concrete.

All required operating platforms, valve stands, access ladders, handrails etc shall be erected after the piping has been installed. Structural steelwork in connection with those items shall conform to the relevant Indian Standards for structural steel work.

**02.02.06 Valves**

i. The valve spindle positions shall be marked in piping drawings and installed accordingly. In no case valves shall be installed with the stem below the horizontal.

ii. Check valve, Strainers etc. shall be installed in the correct sequence and in the direction as shown in piping drawings.

iii. In case the direction of flow is not given on the valve body the same shall be checked and the correct direction thereon shall be punched prior to their installation.

iv. Before erection of valves, it shall be ensured that:
   
   a) All grit and foreign matter are removed from the inside of the valves before connecting the pipes.
b) All the faces are thoroughly cleaned and coated with a thin layer of mineral grease.

c) It shall be ensured that adequate support is provided for the pipeline and valve. The valve should never carry the weight of the pipeline. Hangers or supports placed near the valve will provide better supports.

d) The connecting pipeline should be cleaned and flushed of sediments, sand and other foreign matter before installing the valves.

e) The valves should be tightly closed when being installed, to prevent any foreign matter from getting in between the working parts of valves.

f) The gasket shall be lubricated with graphite or other recommended lubricant.

g) It shall be ensured that the joining material sits squarely between the flanges of valves and pipelines without obstructing the waterway.

h) Valves and other appurtenances shall be so located that they are easily accessible for operation, repairs and maintenance.

02.02.07 Fixed Foam System

a) Transportation and erection of pipes, fittings including inline inductor, isolation valves, strainers etc. upto the erection limit defined near each tankage.

b) Transportation of the foam tank from the storage area and erection of the same on a machinery (well finished) platform to an elevation of 2m from the ground level. The platform with steps to climb on shall be constructed as per details furnished.

c) Foam solution of 3% concentrate shall be procured for commissioning purposes of the individual systems.

02.02.08 Fire hydrants / monitors

a) The hydrants (landing valve) outlets shall be situated 1m above ground level.
b) The hydrants/monitors shall be erected in such a location that they will be easily accessible. Storage of any kind on or around the hydrant is prohibited.

c) Hydrants / monitors located in places where they are likely to be damaged by vehicular traffic shall be suitably protected on all sides against possible damage.

d) Advantage shall be taken of convenient door and / or window openings to place hydrants so that only a minimum length of hose is required to reach the openings through which fire may be attacked. In case of continuous blank walls, suitable provision shall be made on the walls near hydrant posts for easy access inside the premises.

c) Hydrants heads shall be located not less than 7.5m from the face of the buildings / structures or edge of the storage plot.

02.02.09 Fire Extinguishers

a) The extinguishers shall be installed along columns / walls near entry / exit and at a height approximately 1200mm from the finished floor level.

b) Wherever the extinguishers are required to be installed on steel columns of the building, welding of the supporting fixtures to the columns shall be done by the tenderer.

02.02.10 Supports, Guides and Anchors

Correct installation of supports, restraint guide at pumps and other equipment maintaining clearances as per support drawing shall be ensured.

Pipe supports are designed and located to effectively sustain the weight and thermal effects of the piping system and to prevent its vibrations. Location and design of pipe supports will be shown in drawings for lines 3” NB and above. For line below 3” NB contractor shall locate and design pipe supports in line with standard practice and obtain approval of Engineer – in – charge. However any extra support desired by Engineer-in-charge shall also be installed.

No pipe shoe / cradle shall be offset unless specifically shown in the drawings. Hanger rod shall be installed inclined in a direction opposite to the direction in which the pipe moves during expansion.

Preset pins of all spring supports shall be removed only after hydrostatic testing and insulation is over. Spring shall be checked for the range of movement and adjusted if necessary to obtain the correct positioning in cold condition. These shall be subsequently adjusted to hot setting in operating condition. The following points shall be checked after installation, with the Engineer – in –charge and necessary confirmation in writing obtained certifying that:

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- All restraints have been installed correctly.
- Clearance has been maintained as per support drawings.
- Insulation does not restrict thermal expansion.
- All temporary tack welds provided during erection have been fully removed.
- All welded supports have been fully welded.

Fabrication and erection of supporting elements and structural fixtures wherever required and pointed out by HPCL whether indicated in drawing or not, to prevent vibration, excess sag etc. shall be carried out by the contractor.

02.02.11 Stud Bolts and Nuts

Proper number and size of bolts and nuts as per drawings and specifications shall be provided. Approved quality of grease mixed with graphite powder shall be applied thoroughly on all the bolts and nuts during storage.

02.02.12 Assembly

The assembly of various piping components shall be done so that the completely erected piping conforms to the requirements of the specification as well as the arrangement and details shown in construction drawings.

All flanged joints shall be so fitted that the gasket contact faces bear uniformly on the gasket and then made up with relatively uniform bolt stress.

Tightening of bolts in flanged joint shall be done in such a sequence that the gaskets shall be properly compressed in accordance with the design principles applicable to the types of gaskets used. All bolts shall extend completely through their nuts/studs, but not more than 15 mm.

Steel to CI flange joints shall be made with extreme care, tightening the bolts uniformly after bringing flanges flush with gaskets with accurate parallel and lateral alignment.

02.02.13 Instruments

Line mounted equipment, tapping points:

Installation and hookup of all field instruments except line mounted flow measuring elements (such as Orifice plate, Venturi, Coriolis), Set Stop valves, ON / OFF valves etc. are included in the scope of work of turnkey Instrumentation package tenderer. Flow elements shall be supplied by Instrumentation tenderer along with matching flanges, reducers, expanders and other accessories. These flow elements and valves
shall be installed on the pipeline by pipeline contractor under the supervision of instrumentation contractor. All the cabling, cable termination etc. shall be done by instrumentation contractor. For additive dosing system, piping and installation of equipment on the pipeline is included in the scope of instrumentation vendor.

For measurement of pressure, flow etc pipeline contractor shall provide instrument tapping points and root valves on the pipeline as per specification and location given by instrumentation contractor. The process tapping shall be 1/2” in dia unless otherwise specified. Root valves shall be 1/2” stainless steel ball or gate valves, suitable for the maximum pressure and temperature. Pressure testing of piping shall be done after provision of Instrumentation tapping points and closing root valves.

For installation of temperature elements/gauges, suitable tapping on pipeline, welding of boss with threads or flange shall be provided for accommodating thermo wells supplied by instrumentation tenderer. Pressure testing of pipelines shall be done by the tenderer after installation of thermo wells. The details of mounting arrangement required will be given to pipeline tenderer during engineering.

Impulse tube shall be 1/2” Seamless SS tube of 0.065” thickness of cold drawn and soft annealed type.

02.02.14   Welding

All pipe work shall be of butt weld construction of radiographic quality. Flanged joints shall also be provided to match the connecting ends of equipment, valves or where specified. Where specific equipment-piping connection necessitates several joints, unions shall also be provided. Only qualified welders proficient in welding in the vertical and overhead positions shall be allowed to weld these pipelines. Preferably welders with proficiency certificate from Govt. Test House or equivalent recognized authority should be put on the job. It shall be contractor’s responsibility to arrange for and bear all costs towards testing of welders.

The following steps shall be taken besides controlling quality in general, to make effective control in carrying out welding:

i.  Welding procedure (PQR & WPS) shall be prepared in line with ASME SEC. IX and tests shall be carried out to qualify the procedures. Number of procedures will depend on variables like positions of welding, thickness range, etc. Once a welding procedure is qualified, strict adherence to it shall be made during actual welding.

ii. Welders employed shall be qualified as per ASME SEC. IX.. HPCL will have the right to check/ witness the certificate(s) / test(s) before and / or during execution of work.

iii. Makes of welding consumables such as electrodes, filler wires, argon, etc. shall be approved by HPCL before using it. Such consumables are, however, subject to qualifying initial check tests as per ASME codes.
iv. The contractor shall submit batch test certificates, from the electrode manufacturers, giving details of physical and chemical tests carried out by them, for each batch of electrodes to be used.

v. Guidelines for acceptance of weld defects detected by radiographic / ultrasonic tests, wherever applicable, shall be governed by ASME SEC.VIII, Div-I.

vi. All electrodes shall be purchased in sealed containers and stored properly to prevent deterioration. The electrodes removed from the containers shall be kept in holding oven at temperatures recommended by the electrode manufacturer. “Out of the oven time” for electrodes, before they are consumed, shall not exceed the limits recommended by the electrode manufacturer. The electrode shall be handled with care to avoid any damage to the flux covering.

vii. All low hydrogen type of electrodes shall be rebaked at 350°C for 1-hour minimum and stored in ovens kept at 80-100°C before use. Recommendation of the electrode manufacturer shall be followed if available.

viii. The electrodes, filler wire and flux used shall be free from rust, oil, grease, earth and other foreign matter, which affect the quality of welding.

Welder’s qualification test report as per IS: 817, electrode and material test certificate from manufacturer shall be furnished.

Welding process shall be manual shielded metal arc process. Standard quality line up jigs and fixtures should be used to ensure sound welds. The cutting of pipes and welding shall conform to specifications and to the satisfaction of HPCL site engineers.

Welding shall not be performed when surfaces to be welded are wet, when rain is falling on such surfaces or during the period of high winds unless the welder and the works are shielded in an approved manner.

Joint preparation for welding shall be so as to leave a smooth finished profile free of cavities and conforming to standard practice. Edges shall be cleaned of paint, rust, scale, slag, dirt and other foreign matter before welding.

The throat thickness of the tack welds shall be similar to that of the initial root to be deposited in the groove and where necessary the extremities of the tack welds shall be dressed by grinding, chipping and flame gauging to facilitate proper fusion when they are incorporated in the initial root run. Bridge tacks (above the weld) shall be removed.

All slag and scales etc. shall be removed from the surfaces of each completed bead before depositing the next bead.

The finished weld shall present a smooth bright and shiny surface of constant width and uniformly spaced ripples. The welds shall be free from slag pockets, porosity, undercutting, incomplete penetration and fusion and other weld defects.
The weld protrusions, spatter etc., on the weld surface and adjacent area shall be removed so as to leave the surface smooth and clean.

The weld shall not project beyond the plain surface in butt weld by more than 2mm. All valves, flanges, risers, bends and other fittings shall be in perfect plumb and care shall be taken to align the pipelines and bends properly to keep the symmetry of the pipeline layout.

To maintain the specified alignment and gap during welding the pipes shall be securely held in position by technical means, tack welding or by welding on bridge pieces. Electrodes or filler rods used for tack welding shall be of the same quality as those for completing the first run of the weld. Welding electrodes used shall have approval from HPCL. The following make of electrodes are acceptable:

- Advani Oerlikon
- Philips
- D & H Sechron
- GEE
- Esab
- Honavar Electrode Ltd.
- Mailam

Any other reputed make with the approval of HPCL

Welding Electrodes for wall thickness upto 14mm shall be 6013 AWS and for wall thickness more than 14mm the electrode shall conform to 7018 AWS.

For root welding of pipe joints shall be electrodes 6010 AWS

All electrodes shall be purchased in sealed containers and stored properly to prevent deterioration. The electrodes removed from the container shall be kept in holding ovens at temperature recommended by the manufacturer.

02.02.15 Visual Inspection

Inspection of all welds shall be carried out as per the latest editions of the applicable codes and specifications. All finished welds shall be visually inspected for parallel and axial alignment of the work, excessive reinforcement, concavity of welds, shrinkage cracks, inadequate penetration, unrepaird burn-through, under cuts, dimensions of the weld, surface porosity and other surface defects. Undercutting adjacent to the completed weld shall not exceed the limits specified in the applicable standard/code.

02.02.16 Radiography and inspection of welds
Radiographic examination shall be carried out by approved agency (having min level 2 certification) arranged by the contractor at his cost.

Weld areas to be radiographed shall be designated by the Engineer-in-charge or his representative. **Overall 10% of the joints shall be radiographed.** Cost towards radiography of the pipelines shall be included in the erection cost of pipeline. However, for fire fighting hydrant / foam lines, **radiography is not envisaged.**

Radiographs of the welds shall be taken as soon as the welding of joint is completed. If repairs are required they shall be carried out before continuing the other welds.

Repeat radiography due to contractors fault or additional radiography necessitated due to poor performance of contractor/welders shall be done at contractor's cost.

Welds found faulty as a result of radiographic, visual or other tests must be chipped off to the satisfaction of the Engineer-in-Charge or his representative and welded as per specifications and instructions. The welded portion shall be re-tested as per the instructions of the Engineer-in-Charge or his representative. No claims for compensation whatsoever shall be entertained on this account.

For each weld performed by a welder found unacceptable, two additional checks shall be carried out on welds performed by the same welder. This operation is iterative and that of the two additional welds for each weld deemed unsatisfactory shall be continued till such time that two consecutive welds of satisfactory quality are found for every defective weld.

The contractor shall carry out these additional radiographic testing at his own expense. To avoid the possibility of too many defective welds by a single welder remaining undetected for a long period to time, the contractor shall promptly arrange for radiographic examination so that there is no accumulation of defective joints.

**02.02.17 Preparation of pipe ends**

For pipes intended to be in axial alignment, the plane of the pipe ends shall be square with the axis of the pipe.

The pipes, which were intentionally out of the axial alignment, the plane of the joint shall bisect the angle between adjacent pipes.

All tack welded butt joint assemblies shall be inspected to ensure root gap alignment, quality of tack welds, their root penetration section and cleaning and freedom from crack. Any substandard tack weld shall be cut out and remade up to the standard before starting the welding.

**02.02.18 MS pipe joints**

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The ends of pipe having 4.5mm and under in wall thickness need not to be beveled. The ends of all pipes over 4.5mm wall thickness shall be beveled to an angle of 30 Degree for electric arc welding and to an angle $37\frac{1}{2}$ Degree for gas welding. Suitable instrument for checking the bevel angle shall be provided by the vendor and shall be kept at site at all times.

In aligning the ends of pipe for welding a space at the root of the joint about 2.0mm shall be allowed before tack welding.

A wire spacer of suitable diameter may be used for maintaining the weld root opening while tacking, but it must be removed after tack welding and before laying the root bead.

For pipes of wall thickness 5 mm and above, the ends to be welded shall be secured in position with the aid of couplers, yokes and ‘C’ clamps, to maintain perfect alignment. Yokes shall be detached after the completion of weld, without causing any surface irregularity on the pipe. Any irregularity caused on the pipe surface must be suitably repaired to the satisfaction of the Engineer –in – charge.

Tack welds, for maintaining the alignment, of pipe joints shall be made only by qualified welders using approved WPS. Since the tack welds become part of the final weldment they shall be executed carefully and shall be free from defects. Defective tack welds must be removed prior to the actual welding of the joints.

While practical aligning, clamps should be used and the ends shall be tack welded to retain their position during welding. The number of tack welds shall be not less than:

- 3 tacks - for pipe sizes smaller than 50mm NB.
- 4 tacks - for pipe sizes more than 50mm NB upto 300mm NB
- 6 tacks - for pipe sizes more than 350mm NB.

The tack welds shall be approximately 25mm long and well fused along with sides of end to the bottom of "V" or groove.

Welding shall commence only after approval of fit-up by the Engineer – in – charge.

02.02.19 Welding Techniques

i) Root Pass

a) Root pass shall be made with electrodes / filler wires recommended in the welding specification chart. For fillet welding, root welding shall be done with consumables recommended for filler passes. The preferred size of the electrodes is 2.5mm diameter.
b) Upward technique shall be adopted for welding pipe held fixed with its axis horizontal.

c) The root pass of butt joints should be executed so as to achieve full penetration with complete fusion of the root edges. Weld projection inside the pipe shall be as per applicable code. It shall be limited to 3mm maximum. When the applicable code does not place any restriction.

d) Any deviation desired from the recommended welding technique and electrodes indicated in the welding specification chart should be adopted only after obtaining express approval of the Engineer in charge.

e) Welding shall be uninterrupted.

f) While the welding is in progress care should be taken to avoid any kind of movement of the components, shocks, vibrations and stresses to prevent occurrence of weld cracks.

g) Peening shall not be used

ii) Joint Completion

a) Joint shall be completed using the class of electrodes, recommended in the welding specification chart. Size of the electrode shall not exceed 4mm in diameter for stainless steel and alloy steels used for low temperature applications.

b) Two weld beads shall not be started at the same point in different layers.

c) Butt joint shall be completed with a cover layer that would ensure good fusion at the joint edges and a gradual notch free surface.

d) Each weld joint shall have a workmanship like finish. Weld identification mark shall be stamped clearly at each joint, just adjacent to the weld. Metal stamping shall not be used on thin pipe having wall thickness less than 3.5mm. Suitable paint shall be used on thin wall pipes for identification.

e) Rust preventive / protective painting shall be done after the weld joint has been approved.

The weld shall be thoroughly fused to both sides of the "V" or groove and through the bottom of the joint. The pipes shall be welded with three runs of weld. There shall be good fusion between each run and scale shall be thoroughly removed from the surface of each bead or layer of scaling or moderately peeling before the next one is applied. In the event of any cracks occurring, tack welds shall be chipped out before welding is continued. Special care shall be exercised to remelt the tack welds to fuse them with the weld.
Where the pipe can be turned, all welding shall be carried out in the down hand position. The finished weld shall be uniform and of smooth finish. There shall be no overlapping or excessive undercutting of the pipe at the edge of the weld.

02.02.20 Repairs of welds

i. Defects ascertained, through the inspection methods, which are beyond acceptable limits shall be removed after the joint is completely radiographed by the process of chipping and grinding.

ii. When the entire joint is judged unacceptable, the welding shall be completely cut and edges suitably prepared as per required alignment tolerances. The rewelded joint shall again be examined following standard practices.

iii. No repair shall be carried out without prior permission of the Owner’s inspector.

iv. Repairs and / or rework of defective welds shall be done in time to avoid difficulties in meeting the construction schedules.

02.02.21 Riser And Branch Connections

The end of the riser or branch connection and the opening in the line or header shall be prepared by gas cutting or machining along templates lines to ensure accurate cutting and proper fitup. After gas cutting the edge forming the pipes, opening shall be beveled so as to permit welding completely around the joint for connections. Any rough gas cut edges shall be cleaned and or removed by chipping or other mechanical means. The riser may be fitted inside the opening in the header, or set in top. In the latter case the branch shall be beveled for welding. It is preferable to have the riser at least one size smaller than the header but risers of the same sizes as the header are permitted. The use of welding toes in such case is recommended.

After beveling the work shall be assembled and checked as regards matching of ends, uniformity of spacing and bevel angle and any defects noted shall be corrected prior to welding.

The joint shall be tack welded in manner similar to that required for ‘Pipe line joint’.

Where the riser is set in, the weld shall be thoroughly fused to both the beveled edge of the header and to the sidewalls of the riser. Where the branch or riser is beveled for setting on top of the opening care shall be exercised to penetrate well, metal shall be fused through at the root. Where the riser is placed on top of the header it should be back welded on the inside, wherever possible.

All set in connections shall be prepared so that the ends are at least flush with the inside wall of the header.
In the case of an off set riser subjected to excessive stresses, knee braces gaskets shall be used.

**02.02.22 Supports**

Cement concrete/ brick masonry pedestal supports with metal inserts shall be provided for yard piping by the civil works contractor. Sliding contact between the support and the pipe is achieved by providing 25mm dia MS rod supplied and erected by the contractor. This rod shall be welded to the insert plate. If the level of the top of the rod does not match the required level, proper level of the bottom of the pipe is achieved by raising the rod by means of packing plates between the rod and insert plate. After leveling, the packing plate is welded to the insert and the rod in turn welded to the packing plate.

The heights of the supports shall be adjusted so as to suit the pipeline gradient required and also the pipe work installed. The underside of the pipe should have a minimum distance of 300mm from the ground level. This enables easy maintenance of the pipelines and fittings. Special consideration should be given to the control valves etc. in the pipe run.

Grade stakes set to correct levels shall be provided along the pipeline alignment at suitable intervals for checking the levels of the pipe supports/ pipeline during construction of supports/ laying of pipelines.

Due care shall be taken while laying the pipeline on the supports. The contractor shall correct any damage caused to supports. No claims whatsoever will be entertained by HPCL on this account.

The contractor shall provide pipe supports on steel structures:

i. Near changes in direction, branch lines and particularly near valves

ii. On pipe and not on valves, fittings or expansion joints

iii. On pipe and not on sharp radius bends or elbows

iv. On runs which do not require frequent removal for maintenance

v. As close as practical to heavy load concentrations such as vertical runs which do not require removal for maintenance.

vi. As close as practical to heavy load concentrations such as vertical runs, branch lines, heavy valves, separators, strainers etc. and as per direction of site engineer.
In establishing the location of pipe supports, the Contractor should be guided by two requirements

i. The horizontal span must not be so long that sag in the pipe will impose an excessive stress in the pipe wall

ii. The pipeline must be pitched downward so that outlet of such span is lower than maximum sag in the span in order to facilitate drainage.

02.02.23 Flushing

Flushing of all lines shall be done before pressure testing.

Flushing shall be done by fresh potable water or dry compressed air, wherever water flushing is not desirable, to clean the pipe of all dirt, debris or loose foreign material.

Required pressure for water flushing shall meet the fire hydrant pressure or utility water pressure. For air flushing, the line / system will be pressurised by compressed air at the required pressure which shall be 50psi maximum. The pressure shall then be released by quick opening of a valve, already in line or installed temporarily for this purpose. This procedure shall be repeated as many times as required till the inside of the pipe is fully cleaned.

In line instruments like control valves, orifice plates, rotameters, safety valves and other instruments like thermo wells, which may interfere with flushing, shall not be included in flushing circuit.

The screens / meshes shall be removed from all permanent strainers before flushing. Screens / meshes shall be reinstalled after flushing but before testing.

During flushing temporary strainers shall be retained. These shall be removed, cleaned and reinstalled after flushing but before testing.

In case equipment such as column, vessel, exchanger etc. form part of a piping circuit during flushing, this shall be done with the approval of Engineer – in – charge. However, equipments thus included in circuit shall be completely drained and dried with compressed air after flushing is completed.

During flushing discharged water / air shall be drained to the place directed by the Engineer – in – charge. If necessary, proper temporary drainage shall be provided by the contractor.

Care shall be taken during flushing so as not to damage / spoil work of other agencies. Precautions shall also be taken to prevent entry of water / foreign matter into equipments, electric motors, instruments, electrical installation etc. in the vicinity of lines being flushed.
The contractor shall carry out all the activities required before, during and after the flushing operation, arising because of flushing requirements, such as but not limited to the following:

Dropping of valves, specials, distance pieces, inline instruments and any other piping part before flushing. The flanges to be disengaged for this purpose shall be envisaged by the contractor and approved by the Engineer – in - charge. These flanges shall be provided with temporary gaskets at the time of flushing.

After flushing is completed and approved, the valve distance pieces, piping specials, etc. shall be reinstalled by the contractor with permanent gaskets. However, flanges at equipment nozzles and other places where isolation is required during testing, only temporary gaskets shall be provided. Temporary gaskets shall be replaced with permanent ones and record of such replacement maintained.

Records in triplicate shall be prepared and submitted by the contractor for each piping system for the flushing done.

02.02.24 Testing

i) General:

a. Soundness of the welds shall be tested by means of hydrostatic tests. The test shall be conducted only after fulfilling the requirements of visual inspection, radiography, etc. and when the entire work is certified by the engineer-in-charge for performance of such tests.

b. This specification covers the hydrostatic testing of petroleum pipelines. It recommends minimum procedure to be followed, equipment to be used and conditions to be considered during the hydrostatic testing of pipelines.

c. Nothing in this recommended procedure should be considered as a fixed rule for application without regard to sound engineering judgment. Certain Governmental requirements may differ from the criteria set forth in this recommended procedure and its issuance is not intended to supersede/override such requirements.

ii) Extent of testing
With the exclusion of instrumentation, piping systems fabricated or assembled in the field shall be tested irrespective of whether or not they have been pressure tested prior to site welding or fabrication.

To facilitate the testing of piping systems, vessels and other equipments may be included in the system with the prior approval of Engineer – in – charge if the test pressure specified is equal to or less than that for the vessel and other equipments.

Pumps, Compressors and other rotary equipments shall not be subjected to field test pressure.

Lines, which are directly open to atmosphere such as vents, drains, safety valves discharge need not be tested, but all joints shall be visually inspected. Wherever necessary, such lines shall be tested by continuous flow of fluid to eliminate the possibility of blockade. However, such lines if provided with block valve shall be pressure tested up to the first block valves.

Seats of all valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Test pressure applied to valves shall not be greater than the manufacturer’s recommendation nor less than that required by the applicable code. Where allowable seat pressure is less than test pressure, test shall be made through an open valve.

Instruments in the system to be tested shall be excluded from the test by isolation or removals, unless approved otherwise by the Engineer – in – charge.

Restrictions, which interfere with filling, venting and draining such as orifice plates etc. shall not be installed unless testing is complete.

Control valves shall not to be included in the test system. Where bypasses are provided test shall be performed through the bypass and / or necessary spool pieces shall be used in place of the control valve.

Pressure gauges, which are part of the finished system, but cannot withstand test pressure, shall not be installed until the system has been tested. Where piping systems to be tested are directly connected at the battery limits to piping for which the responsibility rests with other agencies, the piping to be tested shall be isolated from such piping by physical disconnection such as valve or blinds.

iii) General Requirement / Test Preparation For Testing

Testing shall be carried out with permanent gaskets installed unless specified otherwise or instructed by the Engineer – in – charge

No pressure test shall be carried out against closed valve unless approved by the Engineer – in – charge.
The Engineer-in-charge shall be notified in advance by the contractor, of the testing sequence and programme, to enable him to be present for witnessing the test. The contractor shall be fully responsible for making arrangement with the local boiler inspector to witness the test for steam lines falling under IBR. IBR certificates for these tests shall be obtained in the relevant IBR forms and furnished to the Engineer-in-charge.

Before testing, all piping shall be cleaned by flushing to make it free from dirt, loose scale debris and other loose foreign materials.

All piping system to be hydrostatically tested shall be vented at the high points and the systems purged of air before the test pressure is applied.

Wherever in the line any void exist due to any reasons, like absence of control valves, safety valves check valves etc. it shall be filled with temporary spool pieces.

All joints welded, screwed or flanged shall be left exposed for examination during the test. Before pressuring the lines, each weld joint shall be cleaned by wire brush to free it from rust and any other foreign matter.

Where a system is to be isolated at a pair of companion flanges, a blank shall be inserted between the companion flanges. Minimum thickness of the blank shall be designed in accordance with applicable design code.

Open ends of piping system where blanks cannot be used, such as pumps, compressors, turbines or wherever equipment or pipe spool pieces have been removed or disconnected prior to hydrostatic testing, shall be blinded off by using standard blind flanges of same rating as the piping system being tested.

Pressure gauges used in testing shall be installed as close as possible to the lowest point in the piping system to be tested, to avoid overstressing of any of the lower portions of the system. For longer lines and vertical lines two or more pressure gauges shall be installed at locations decided by the Engineer-in-charge.

For lines containing check valves any of the following alternatives shall be adopted for pressure testing:

Wherever possible pressurise up-streamside of valve.

Replace the valve by a temporary spool pieces and reinstall the valve after testing.

Provide blind on valve flanges and test the upstream and downstream of the line separately and remove the blind after testing. At these flanges, temporary gaskets shall be provided during testing and shall be replaced by permanent gaskets subsequently.
For check valves in lines 1½ " and below flapper or seat shall be removed during testing (if possible). After completion of testing the flapper / seat shall be refitted.

Gas lines when hydrostatically tested shall be provided with additional temporary supports during testing as directed by the Engineer – in – charge.

Piping which is spring or counter weight supported shall be temporarily supported, where the weight of the fluid would overload the support. Retaining pins for spring supports shall be removed only after testing is completed and test fluid is completely drained.

When testing any piping system, air or steam of approximately 2 kg / cm$^2$ g may be used as preliminary test to detect missing gaskets etc. as this avoids the necessity of draining the line to make repairs. However, steam shall not be used for this purpose, if the steam temperature is more than the design temperature of the line.

For jacketed pipes testing of core pipes shall be done on individual pieces where the pipe is continuously jacketed, before it is jacketed. The outer jacket shall be tested separately as a system. For piping with discontinuous jacketing the core pipe and the jacket shall be tested as separate continuous system.

iv) Testing media, test pressure and test pressure gauges

a) Testing Media

In general all pressure test shall be hydrostatic using iron free water, which is clean and free of silt. Maximum chlorine content in water for hydrostatic testing for SS piping shall be 15 – 20 PPM.

Air shall be used for testing only if water would cause corrosion of the system or overloading of supports etc. in special cases as directed by Engineer – in – charge.

Where air / water tests are undesirable, substitute fluid such as gas oil, kerosene, methanol etc. shall be used as testing medium, with due consideration to the hazards involved. Contractors shall specify the test fluids in the line list.

b) Test Pressure

The hydrostatic / pneumatic test pressure shall be as indicated in the line list or as per the instruction of Engineer – in – charge.

The selection of the piping system for one individual test shall be based on the following:

Test pressure required as per line list.

TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA
Maximum allowable pressure for the material of construction of piping.

Depending upon the above requirements and based on construction progress, maximum length of piping shall be included in each test.

c) Test Pressure Gauge

All gauges used for field testing shall have suitable range so that the test pressure of the various systems falls in 40 % to 80 % of gauge scale range. Gauge shall be of a good quality and in first class working condition.

Prior to the start of any test or periodically during the field test programme, all test gauges shall be calibrated using a standard dead weight gauge tester or other suitable approved testing apparatus. Any gauge showing an incorrect zero reading or error of more than +2% of full scale range shall be discarded. The Engineer – in – charge shall check the accuracy of master pressure gauge used for calibration.

d) Testing Procedure

Air Test

When testing with air, pressure shall be supplied by means of a compressor. The compressor shall be portable type with a receiver, after cooler and oil separator.

Piping to be tested by air shall have joints covered with a soap and water solution so that the joint can be examined for leaks.

All other details shall be same as per hydrotesting procedure (specified above)

e) Completion of Testing

After the hydrostatic test has been completed, pressure shall be released in a manner and at a rate so as not to endanger personnel or damage equipments.

All vents and drains shall be opened before the system is to be drained and shall remain open till all draining is complete, so as to prevent formation of vacuum in the system. After draining, lines / systems shall be dried by air.

After testing is completed the test blinds shall be removed and equipment / piping isolated during testing shall be connected using the specified gaskets, bolts, and nuts. These connections shall be checked for tightness in subsequent pneumatic tests to be carried out by the contractor for complete loop / circuit including equipments ( except rotary equipments).

Pressure test shall be considered complete only after approved by the Engineer – in – charge. Defects, if any, noticed during testing shall be rectified immediately and retesting of the system / line shall be done by the contractor at his cost.
f) **Test Records**

Records in triplicate shall be prepared and submitted by the contractor for each piping system, for the pressure test done.

**02.02.25 Hydrostatic test**

The Contractor shall ensure that the pipelines have been thoroughly cleaned up by flushing with clean water/ compressed air of any foreign matter inside the pipes and dried before taking up for hydro test. The procedure adopted for cleaning shall be indicated by the tenderer and subject to approval by HPCL.

All equipments materials, consumables including water and services required for carrying out the pressure testing of piping system shall be provided by the contractor at his own cost.

In case of buried pipes the trenches shall be kept free of water and the pipeline surfaces dry. The pipeline shall be filled with water and the pressure built up by means of test pump with a gauge to the specified pressure.

With the exclusion of instrumentation, piping systems fabrication or assembled in the shop / factories shall be tested at the site, irrespective of whether or not they have been pressure tested prior to site welding or fabrication.

The site – in – charge shall be notified in advance by the contractor of testing sequence / Programme, to enable him to be present for witnessing the test.

i) All vents and other connections used as vents shall be left open while filling the line with test fluid for complete removal of air. In all lines for pressurising and depressurising the system, temporary isolating valves shall be provided if valved vents, drains do not exist in the system.

Pressure shall be applied only after the system / line is ready and approved by the Engineer – in – charge.

Pressure shall be applied by means of a suitable test pump or other pressure source, which shall be isolated from the system, as soon as test pressure is reached and stabilized in the system.

A pressure gauge shall be provided at the test pump discharge for guidance in bringing the system to the required pressure.

The test pump shall be attended constantly during the test by an authorized person. The pump shall be isolated from the system whenever the pump is to be left unattended.

Test pressure shall be maintained for a sufficient length of time to permit thorough inspection of all joints for leakage or signs of failure. Any joint found leaking during a
pressure test shall be retested to the specified pressure after repair. Test pressure shall be maintained for a minimum of three hours.

The pump and the piping system to be tested are to be provided with separate pressure indicating test gauge. These gauges are to be checked by the standard test gauge before each pressure test.

Care shall be taken to avoid increase in the pressure due to temperature variation during the test.

ii) **Equipment for a Hydrostatic Test**

Equipment for the hydrostatic test should be properly selected and in good working order. Equipment affecting the accuracy of the measurements used to validate the specified test pressure should be designed to measure the pressures to be encountered during the hydrostatic test.

Equipment for conducting the hydrostatic test may include the following:

a) A high volume pump capable of filling the line at minimum velocity of 2 km/h (approximately 1 mph)

b) A test medium supply line filter capable of ensuring a clean test medium.

c) An injection pump to introduce corrosion inhibitors or other chemicals into the test segment, if their use is required.

d) A meter or other comparable means of measuring line fill.

e) A variable speed positive displacement pump capable of pressurising the line at 7 kg/cm² (approximately 100 psi) in excess of the specified test pressure. The pump should have a known volume per stroke and should be equipped with a stroke counter (a constant speed pump having a variable flow rate control may be used in lieu of the above if the liquid test medium injected into the pipeline is measured during pressurisation).

f) Portable tank, if required, capable of providing a source of liquid test medium.

g) A large diameter bourdon tube type pressure gauge with a pressure range and increment divisions necessary to indicate anticipated test pressures.

h) deleted

i) deleted.

j) deleted.

k) deleted.
l) deleted.

m) Temporary manifolds and connections as necessary.

n) Equipment, materials and fluids needed to displace the test medium from the test segment.

o) The test pressure shall hold for about 4 hours after which the weld joints shall be inspected. Hammer test shall be carried out on the side of the joints if required.

iii) Test Plan

The following factors should be considered in planning a hydrostatic test:

a) Maximum operating pressure anticipated through the life of the facility.

b) Location of pipe and other piping components in the test segment by size, wall thickness, grade type and internal design pressure(s).

c) Shell pressure rating and location of pipeline valves, air vents and connections to the segment.

d) Anticipated temperature of test medium, atmosphere and ground.

e) Source(s) of test medium and any inhibiting or other treating requirements

f) Locations and requirements for test medium disposal.

g) Profile and alignment drawing maps.

h) Safety precautions and procedures.

iv) Test Procedures

A hydrostatic test procedure diagram with explanatory notes and data should be prepared prior to testing and should indicate in a detailed fashion the following:

a) The length and location of the test segment(s).

b) Test medium to be used.

c) Procedures for cleaning and filling the line.
d) Procedures for the pressurisation of test segment(s) including the locations of the injection points and the specified minimum and maximum test pressures.

e) Minimum test duration for test segment(s).

f) Procedures for removal and disposal of test medium.

g) Safety precautions and procedures.

A specified test pressure is defined as the minimum test pressure, which should be applied to the most elevated point in the test segment. A detailed analysis of the profile to determine static and dynamic pressures while the pipeline is being tested should be performed so that the pipeline will not be over pressurized at points, which are at low elevations.

v) Line fill And Cleaning

The line fill operation should serve the dual function of cleaning the line and introducing the necessary test medium into the test segment. Screens or filters should be installed in the test medium supply line to control the contamination of the test medium by debris or sediment. The quality and source of water should be determined. Water, which is not free of sediments and may be injurious to the pipe, valves, equipments, etc., should not be used unless it is filtered. The filling operation should be planned and executed in a manner, which prevents the infusion of air into segment to permit the purging of trapped air. Pumping of the test medium should continue until the pigging devices have been received at the receiving scraper trap, or until they passed the block valve terminating the test segment.

vi) Pressurization

Personnel conducting the test should maintain continuous surveillance over the operation and ensure that it is carefully controlled.

The test segment should be pressurised at a moderate and constant rate. When approximately 70% of the specified test pressure is reached, the pumping rate should be regulated to minimise pressure variations and to ensure that increments of no greater than 1 kg/cm² may be accurately read and recorded. Pipe connections should be periodically checked for leaks during pressurization.

vii) The Test Hold

When the test pressure is reached, pumping should be stopped and all valves and connections to the line should be inspected for leakage, a period of conservation to the line should follow during which test personnel verify that specified test pressure is being maintained at the line pressure and temperature have stabilized. Upon the completion, the injection pump should be disconnected of its connection to the pipelines and checked for leakage. Pressure should be monitored and record continuously during the duration of the test.
viii) Displacement of test medium

Water should be completely drained off. This can be accomplished with spheres, squeegees and / or other pigging devices wherever practical. Water should be disposed of at approved locations in a manner that will cause minimal environment effects. The pressure shall be maintained for a minimum period of 8 hours unless otherwise specified. The hydrostatic test shall be considered positive only if there is no drop in pressure at the end of the specified period.

All welded and flange joints and the seam welds on the ERW pipe shall be inspected for leaks.

Leaky joints shall be repaired by chipping or gauging out such defects as required and re-welded. The cut out of joints shall be just sufficient to correct the defects. After repairing the leaky joints, the line shall be tested to prescribed pressure. No claims for expenditure incurred by the contractor towards such repairs of defective work and testing shall be entertained.

Test pressure shall be 15 kg/cm² (g) or as decided by Engineer in charge.

After test, the water shall be completely emptied out and the line shall be made free of water.

All underground piping shall be tested and ensured of no leakage at test pressure before filling up trenches.

No painting shall be done at weld joints till the system is accepted in all respects.

03.0 Painting

03.1 General

This specification covers the requirement of selection, supply, application and workmanship of protective coating system for piping.

It is deemed that the work will be carried out by the contractor with the best quality of specified material and workmanship at his own cost.

Adequate numbers of required tools, blast material, scaffolding, shot / sand blasting equipment, air compressors, spray gun suitable for air/airless spay etc., shall be arranged by the contractor at site.

During storage and application of paints, the paint manufacturer’s instructions shall be strictly followed. Particular attention shall be paid to the following:

- Proper storage avoiding exposure and extreme temperature.
Specified surface preparation.

Mixing and thinning.

Application of paints and the recommended time intervals between consecutive paint coats (overcoats).

Two pack paint system will be mixed by mechanical means. The Engineer – in – charge may allow hand mixing of small quantities at his discretion.

Painting of pipelines / structural steel works shall be done only after the mechanical completion and testing of the system are completed.

The ‘Fire Red’ colour paint shall be used for painting firewater network, hydrant monitors, hoses, boxes, etc.

Colour schemes shall be in line with standard industrial codes in line with HPCL practices, which will be indicated to the successful tenderer.

Scope of pipeline painting work covered in the specification shall include:

i. Structural steel work, walkways, pipes supports, ladders, etc.

ii. All above ground piping and fittings including identification marks.

iii. Painting of valves.

iv. Identification colour bands and directions on all piping as required.

v. Supply of all primers, paints and all other materials.

vi. Coating and wrapping of underground pipelines.

Equipment like pump sets if not painted as per colour coding, shall be painted as directed. Two colour bands of 100mm width as per HPCL Codes for each product shall be painted over final paint on the pipeline at every 30m C/C with arrow heads painted in black indicating the direction of flow. As the number of bands and arrow heads in the manifold will be more, the same shall be painted as directed at site.

Surface Preparation

All rough welds, burrs, weld splatter, indentations and all other sharp surface projections shall be ground smooth prior to further surface preparation. Surface shall be blast...
cleaned to SA 2 ½. Maximum peak of surface profile shall be less by 5 – 10 microns from the primer DFT. Any protective coating used by the pipe manufacturer/ supplier shall be removed during blast cleaning.

All bolt holes shall be drilled and smoothened before cleaning.

Any oil, grease, dust or foreign matter deposited on the surface after the surface preparation is completed shall be removed prior to painting. In the event rusting occurs after completion of surface preparation and before application of the primer the surfaces shall again be cleaned in accordance with the specified method.

Name plates, Manufacturer’s identification tags, machined surfaces, instrument glass, control valve stems and other items in contact with or near the surface being coated shall be removed or marked as appropriate for protection, prior to protective coating application.

In order to achieve maximum durability, one or more of following methods of surface preparation shall be followed before blast cleaning:

03.03.1 Manual Or Hand Tool Cleaning

This normally consists of hand descaling and / or hammering, hand scraping and hand wire brushing. Rust, mill scales, weld spatters, old coatings and other foreign matter shall be removed by hammering, scraping tools, emery paper cleaning, wire brushing or combination of the above methods. On completion of cleaning, loose material shall be removed from the surface by clean rags and the surface shall be brushed swept, re-dusted and blown off with compressed air to remove all loose matter.

03.03.2 Mechanical or Power Tool Cleaning

Power tool cleaning shall be done by mechanical striking tools, chipping hammers, grinding wheels or rotating steel wire brushes. Excessive brushing of surface shall be avoided as it can reduce paint adhesion. On completion of cleaning, the detached rust, mill scale, etc. shall be removed by clean rags and / or washed by water or steam and thoroughly dried with compressed air jet before application of paint.

03.03.3 Blast Cleaning

The sand / shots used for blasting shall be free from moisture, salt. Sand size should be 16 mesh to 30 mesh in order to have surface profile range 55 – 65 microns.

Size of abrasive: 16 – 30 mesh. The particle should pass through 100% when sieved with 16 mesh and nothing to pass through when sieved with 30 mesh i.e., size below 16 and above 30 mesh are not recommended.
Shape of abrasive: Shape, semi-sharp, spherical or near spherical. Semi-sharp means some sharp as well as round edge in one particle grit.

The total surface shall then be blast cleaned to Swedish standard SA 2 ½.

The blasting has to be carried out at a pressure of 7 kg/cm² at the nozzle tip. Compressed air is to be free from moisture and oil.

On completion of blasting operation, the blasted surface shall be made clean and free from any dust and scale or rust and must show a grey white metallic lustre as demonstrated in SA 2 ½.

Blast cleaning shall not be done in bad weather without adequate protection or when there is dew on the metal, which is to be cleaned, or humidity exceeding 85%. Surface profile shall be uniform to provide good key to the paint.

Primer or first coat of paint shall be applied within 3 hours of sand blasting or as directed by Engineer – in – charge depending on weather conditions.

03.04 Coating Procedure

i) Coating System

Painting system for the pipelines and other structures shall be as indicated in this specification.

ii. Application

Before application of primer, the surface shall be cleaned of dust etc. Surfaces shall not be coated in adverse weather conditions, rain, wind, snow, fog, mist, or / and in areas where injurious airborne elements exist.

Cleaned surfaces shall be coated with one complete application of primer as soon as practicable but in no case more than three hours after surface preparation.

Application of coats shall not be carried out if the atmospheric temperature is less than 5°C or if the temperature exceeds 40°C in the shadow, 50°C due to the influence of sun or if relative humidity exceeds 85% or in case of adverse weather conditions like rain, fog, dust storm etc.

All paints shall be thoroughly stirred up prior to and during their application.

To the maximum extent practicable, each coat of material shall be applied as a continuous film of uniform thickness free of pores.
Coating media shall be applied in uniform thickness. All slots, recesses, grooves, corners, angles and interstices shall be covered by paint. Sag and runs shall be distributed or removed and new paint shall be applied uniformly.

Any thin spots or area missed in the application shall be recoated and allowed to dry before the next coat is applied.

Each coat shall be in proper state of cure / dryness before the application of the succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without development of any detrimental line irregularities, such as lifting or loss of adhesion of the undercoat.

When successive coats of the same colour have been specified, alternate coats shall be tinted, when practical, sufficient to produce enough contrast to indicate complete coverage of the surface. When the material is of the same colour as of the steel, or when the tinting of the final coat is objectionable, the first coat to be applied shall be tinted. The tinting material shall be compatible with the material and not detrimental to its service life. Shade of each coat shall be got approved by Engineer – in – charge.

All containers of coating material shall remain as unopened original Manufacturer's containers until required for use. Coating materials that have jelled or deteriorated during storage shall not be used.

Paint containers shall be opened only prior to utilisation and shall be carefully closed immediately after withdrawal of paint. Expiry date of the paint should be checked before opening the container. Paints, which have become unserviceable during storage, shall not be applied. All painting material shall be kept in weatherproof barracks and shall be kept cool and dry.

All ingredients shall be thoroughly mixed before use to a smooth and uniform consistency using mechanical means. No air bubbling shall be used for this purpose.

All pigmented material shall be strained after mixing so as to remove any skin, etc. before use. Coating material shall not remain in spray pots or buckets over night but shall be gathered into a closed container and remixed before use.

All thinning and mixing shall be done strictly in accordance with the Manufacturer's instructions for the particular materials and under the supervision and direction of the engineer-in-charge or his representative.

Paint shall normally be applied by conventional spray / airless spray. During spraying the paint shall be maintained thoroughly mixed in the spray gun.

Where brush coating is approved, brushes shall be of a style and quality that will enable proper application of paint. Wide flat brushes are suitable for large flat areas but they shall not have width over five inches. Rough or oval shaped
Brushes shall be used for irregular and rough surfaces. The brushes shall conform to IS: 384. The width of the brushes shall not be more than 15 cms.

Contractor shall obtain approval for specification for spraying installation concerned, the type of equipment, nozzle diameter, pressure setting etc. the paint shall be sprayed uniformly. Surfaces impossible to be coated by spraying must be painted by brush. Painting work shall be done in daytime only preferable between 9 am to 5 pm.

iii) Repair of damaged paint surface

The contractor shall rectify painting work found defective under this specification at no additional cost to HPCL.

Where shop paint has been damaged in handling, all damaged and loosely adhering paint shall be removed and the surface thoroughly cleaned. Edges of the breaks shall be lathered and the designated number of prime and finish coats applied.

03.05 Paint Material

Primer and finish coats shall be of first class quality and shall conform to the specification indicated below:

03.05.01 Specification for paints:

i) Zinc Ethyl Silicate Primer (P1)

The zinc ethyl silicate consists of two packs. One pack contains the ethyl silicate binder with suitable solvents. The other pack contains zinc dust with additives. They have to be mixed in suitable proportions before application as recommended by the manufacturer.

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>Grey</td>
</tr>
<tr>
<td>Application</td>
<td>Spray (airless/air)</td>
</tr>
<tr>
<td>Dry film thickness per coat</td>
<td>65-75 microns</td>
</tr>
<tr>
<td>Theoretical coverage</td>
<td>8 sq.m / ltr</td>
</tr>
<tr>
<td>Drying time</td>
<td>4 hours</td>
</tr>
<tr>
<td>Re-coating time</td>
<td>10 hrs (min)</td>
</tr>
<tr>
<td>% of total metallic zinc in dry film</td>
<td>85 – 90% by wt.</td>
</tr>
<tr>
<td>(As per the ASTM D520 – Spherical Size storage life)</td>
<td>4 months under sealed conditions.</td>
</tr>
</tbody>
</table>
ii) **Epoxy primer (P2)**

The primer is a two pack anti corrosive epoxy primer for use on steel surfaces.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of solids</td>
<td>$40 \pm 2%$</td>
</tr>
<tr>
<td>Composition</td>
<td>Epoxy rein/Zinc phosphate</td>
</tr>
<tr>
<td>Colour</td>
<td>Yellow/Grey</td>
</tr>
<tr>
<td>Pigment volume concentration</td>
<td>25-35%</td>
</tr>
<tr>
<td>Application</td>
<td>Brush or spray</td>
</tr>
<tr>
<td>Dry film thickness per coat</td>
<td>40-50 um</td>
</tr>
<tr>
<td>Theoretical coverage</td>
<td>8-10 sq.m/lttr</td>
</tr>
<tr>
<td>Drying time</td>
<td>Touch dry – 1 hour, hard dry – overnight</td>
</tr>
<tr>
<td>Storage life</td>
<td>9 months under sealed conditions</td>
</tr>
</tbody>
</table>

ii) **Two pack epoxy – polyamid MIO undercoat (U1)**

These coatings are high build paints based on cold cured epoxy polyamide system pigmented with chemically inert pigment and extenders formulated to permit application at a DFT higher than 100 microns per coat.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of epoxy</td>
<td>Condensation product of bisphenol A &amp; epichlorohydrin with terminal epoxides groups</td>
</tr>
<tr>
<td>Epoxide equivalent</td>
<td>$450 – 500$</td>
</tr>
<tr>
<td>Curing agent</td>
<td>Polyamide</td>
</tr>
<tr>
<td>Volume of solids</td>
<td>$55 – 60%$</td>
</tr>
<tr>
<td>Pigment</td>
<td>The main pigment shall be</td>
</tr>
</tbody>
</table>
micaceous iron oxide (MIO – Lamellar) constituting a min. of about 65% w/w of total pigments.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigment volume concentration</td>
<td>40 – 45%</td>
</tr>
<tr>
<td>Application</td>
<td>Airless spray</td>
</tr>
<tr>
<td>Dry film thickness/coat</td>
<td>110 – 120 microns</td>
</tr>
<tr>
<td>Spreading rate</td>
<td>5 – 5.5 sq.m/ ltr</td>
</tr>
<tr>
<td>Drying time</td>
<td>Touch dry in 2 hrs, hard dry in 48 hr</td>
</tr>
<tr>
<td>Overcoating time</td>
<td>24-48 hrs. This should be very strictly adhered in order to avoid peeling of subsequent coat.</td>
</tr>
<tr>
<td>Storage life</td>
<td>12 months under sealed conditions.</td>
</tr>
</tbody>
</table>

**iv) Epoxy high build finish paint (F1)**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type &amp; composition</td>
<td>Two pack poly amide/polyamine cured epoxy resin medium suitably pigmented.</td>
</tr>
<tr>
<td>Volume of solids</td>
<td>62%</td>
</tr>
<tr>
<td>DFT (dry film thickness)</td>
<td>100-125 microns</td>
</tr>
<tr>
<td>Theoretical coating capacity</td>
<td>5-6</td>
</tr>
<tr>
<td>Weight per ltr (appr) kgs / ltr</td>
<td>1.4</td>
</tr>
<tr>
<td>Touch dry at 30 Deg C</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Hard dry at 30 Deg C</td>
<td>overnight</td>
</tr>
<tr>
<td>Over coating interval</td>
<td>Min : overnight, Max : 5 days</td>
</tr>
<tr>
<td>Pot life at 30 Deg C for two</td>
<td>4 – 6 hrs</td>
</tr>
<tr>
<td>Component paints (app)</td>
<td></td>
</tr>
</tbody>
</table>
v) Two pack aliphatic acrylic polyurethane finish paint (F2)

**Part-A**: Part A consists of polyacrylate polyol with appropriate primary extenders, solvent and additives.

**Part-B**: Part B consists of an aliphatic polyisocyanate with appropriate solvents and additives.

**Part A & B** are to be mixed together to form a pigmented polyurethane paint in suitable proportions as recommended by manufacturer.

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of solids</td>
<td>45%</td>
</tr>
<tr>
<td>Main pigment</td>
<td>Rutile TiO2 (min 80% w/w on total Pigment weight) and extenders with suitable pigment to get the desired colour</td>
</tr>
<tr>
<td>Colour</td>
<td>As desired</td>
</tr>
<tr>
<td>Pigment volume concentration</td>
<td>15 – 20%</td>
</tr>
<tr>
<td>Application</td>
<td>Brush or spray</td>
</tr>
<tr>
<td>Dry film thickness per coat</td>
<td>40-50 microns</td>
</tr>
<tr>
<td>Theoretical coverage</td>
<td>11 – 13 sq.m/ltre</td>
</tr>
<tr>
<td>Drying time</td>
<td>Surface dry 1 hr, full cure 7 days</td>
</tr>
<tr>
<td>Storage life</td>
<td>3 months under sealed conditions.</td>
</tr>
</tbody>
</table>

v) Synthetic Enamel (F3)

A high quality enamel based on synthetic resign vehicle stable weather resistant pigment designed for both protection and decoration.

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of solids</td>
<td>38-40%</td>
</tr>
<tr>
<td>Application</td>
<td>by brush or conventional spray</td>
</tr>
</tbody>
</table>
DFT/coat : 30-35 microns
Spreading rate : 11-13 sq.m. / ltr
Drying time : Surface dry 4 hrs, hard dry 18 hrs
Storage life : 12 months under sealed conditions.

03.06 Painting System

03.06.01 For non-coastal area

a) Painting system for piping (Product & Fire Water) and other connected item. Colour /shade shall be approved by Engineer in Charge

<table>
<thead>
<tr>
<th>Surface preparation</th>
<th>Blast clean to SA 2½</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paint system recommended</td>
<td>One coat of P1 (65-75 µm each) + One coat of F1 (100-125 µm each) + Two coats of F2 (40-50µm each)</td>
</tr>
<tr>
<td>Total DFT (Min)</td>
<td>275 µm</td>
</tr>
</tbody>
</table>

b) For Structurals

<table>
<thead>
<tr>
<th>Surface preparation</th>
<th>Blast cleaning to SA 2½</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paint system recommended</td>
<td>One coat of P1 (65-75 µm) + one coat of U1 (110-120 µm) + two coats of F2 (40-50µm)</td>
</tr>
<tr>
<td>Total DFT(min)</td>
<td>275 µm</td>
</tr>
</tbody>
</table>
03.07 Paint Manufacturers

An indicative list given below of the paint manufacturers whose product conforming to the respective qualities specified herein may be considered for use. However, the site engineer has the right to reject any material of these manufacturers, which do not conform to the specifications.

a) M/s Asian Paints India Ltd.
c) M/s Berger Paints India Ltd. Mumbai.
f) M/s CDC Carboline, Madras.
g) M/s Shalimar Paints Ltd. Mumbai.
h) M/s Solvo-Sol Paints (P) Ltd. Hyderabad.
j) Sigma Coatings Mumbai
k) Akzo Noble coatings India Ltd., Bangalore or

Any other reputed make with the approval of HPCL/

03.08 Inspection and final acceptance

Required painting materials for application shall be procured directly from manufacturers as per specification. Manufacturer’s test certificates for every batch should be submitted to Engineer – in – charge without which paints will not be accepted.

Engineer – in – charge at his discretion may call for tests for paint formulation. Contractor shall arrange to have tests performed including batch wise test of wet paints for physical and chemical analysis at no extra costs to HPCL.

Painting work shall be subject to inspection and approval by HPCL.

The painting work shall be subject to inspection by Engineer – in – charge at all times. Following aspects will be considered during inspection and contractor shall offer the work for inspection and approval of site Engineer before proceeding with the next stage. Stages of inspection are as follows.

• Surface preparation
• Primer Application
• Each coat of paint

Any defect noticed during the inspection is to be rectified by the contractor to the satisfaction of Engineer – in – charge before proceeding further.
Each batch of paint shall be offered to him for approval before commencing application. Preparation of surface shall be subject to spot examination and approval, and where it is evident that surface preparation has been inadequate, the Engineer may require the surface to be stripped, cleaned etc. as necessary. Paint film thickness shall be examined at random locations after completion of primary coat, and also as completion of the final finishing coat.

Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make up the DFT specified without any extra cost to the contractor.

The contractor has to position an ELCOMETER at site for checking the paint thickness by the site engineer.

The contractor shall arrange and keep a Holiday Detector at site for testing of wrapping coating of underground pipelines.

Paint operations shall be aimed at producing smooth and neat finished surfaces and inspection of edge and lining details will take this requirement into consideration in accepting each part of the work. All splashes shall be cleaned up as they occur, and empty paint containers and other debris shall be removed from site.

All inspecting and examining instruments shall be calibrated and checked to indicate their proper functioning.

Irrespective of the inspection, repair and approval at intermediate stages of work, contractor shall be responsible for making good any defects found during the final inspection / guarantee period / defect liability period as defined in general conditions of contract.

03.09  Treatment of underground pipelines

03.09.01 Coating and wrapping of underground pipeline

i. Scope

This procedure deals with the widely used method of wrapping / coating of MS pipes with 4mm thick polymeric corrosion protection tape, which shall conform to IS: 10221-1982 / AWWA C 203.

Polymeric protection tape shall incorporate a center core of approx. 100 micron HDPE film. It shall have a second center core of textile fabric to give mechanical strength and dimensional stability to the tape. 3 layers of polymeric based coal tar, rubber and other
polymers shall be interleaved between the above centre cores. All the seven layers shall be calendered together to create the above protection tape.

ii. Surface Preparation

The surface of the pipeline shall be made free of oil and grease by using clean rags saturated with suitable solvent like Xylene or Trichloroethylene. Then the pipes shall be blast cleaned to Swedish standard of SA 2 ½ (Grayish metal appearance).

iii. Primer and finish coating

Primer shall be applied over the pipe at 150 gm/ sq.m. The primer shall be allowed to dry until the solvent evaporates and the surface become tacky. Polymeric tape (4mm) shall then wound around the pipe in spiral fashion and bonded completely to the pipe by thermofusion process. The overlaps shall be sealed by the same thermo-fusion process. Holiday test shall be conducted over the coated surface.

04.00 Drawings/ Information to be submitted with tender

The following drawings & documents in four copies shall be submitted along with the offer.

a. List of clients, for whom similar works were executed, with value of the jobs.

b. List of deviations, if any.

c. Bar chart showing the time schedules and break up of different activities like design, supply, erection, testing and commissioning.

d. List of special tools & tackles required

e. Erection and testing procedure envisaged. Erection and supervisory personnel and equipment available with the tenderer for execution of the project.


g. Unpriced schedule of quantities.

05.00 Drawings / documents to be submitted after placement of order by the successful tenderer.

The following drawings and documents shall be submitted by the successful tenderer in 6 copies for approval/ information within the time stipulated.
a. Detailed bar chart indicating time schedule for different activities like design, procurement, inspection, erection, testing, commissioning, etc.

b. General Arrangement drawings for Pipeline covering all areas as per directions.

c. Isometric drawings

d. Drawing showing details of operating platforms, crossovers, ladders, etc. along with fabrication details.

e. Complete final bill of materials for fittings, steel structures, supports, fasteners, and other accessories, for each area.

f. Specifications, makes and data sheets of pipe fittings, paints, coating/wrapping and other accessories.

g. Quality Assurance Plan for manufacture/fabrication/errection/testing, inspection and test reports, radiographic films.

h. Manuals/instructions for erection, operation and maintenance, schedule for preventive maintenance, etc.

i. As built drawings and other documents.

j. Weekly progress report.

**06.00 CONDITIONS FOR ISSUE OF MATERIALS**

Whenever any material is issued by Owner, following conditions for issue of material in addition to other conditions specified in the contract shall be applicable:

1.1 Necessary indents will have to be raised by the Contractor as per procedure laid down by the Engineer-in-Charge from time to time, when he requires the above material for incorporation in permanent works.

1.2 Materials will be issued only for permanent works and not for temporary works, enabling works etc. unless specifically approved by the Engineer-in-Charge and the same shall not be taken into account for the purpose of materials reconciliation.

1.3 The Contractor shall bear all other cost including lifting, carting from issue points to work site/Contractor's store, custody and handling etc. and return of surplus/serviceable scrap materials to Owner's storage points to be designated by the Engineer-in-Charge etc. No separate payment for such expenditure will be made.
1.4 No material shall be allowed to be taken outside the plant without a gate pass.

1.5 The Contractor shall be responsible for proper storage, preservation and watch & ward of the materials.

1.6 RETURN OF UNUSED MATERIAL

1.6.1 All unused/scrap materials shall be the property of the Owner and shall be returned in good and acceptable condition size wise, category wise by the Contractor at his own cost to Owner's Store(s).

1.6.2 No credit will be given to the Contractor for return of scrap. The Contractor should quote the rates accordingly.

1.6.3 In case the Contractor fails to return unused/scrap materials, then recovery for such quantity of materials, not returned by the Contractor shall be affected at following penal rates from the Contractor's bills or from any other dues of the Contractor to the Owner. Contractor shall make his own arrangements for weighing the off cuts to be returned to Owner's stores.

1.6.4 Penal Rates for non return of materials:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Material Penal Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Penal rate for non return of Issue of</td>
</tr>
<tr>
<td></td>
<td>accountable scrap Rate + 25% or</td>
</tr>
<tr>
<td></td>
<td>Landed Rate + 25% (in case issue rate are not indicated in the contract)</td>
</tr>
<tr>
<td>(b)</td>
<td>Penal rates for non return of Unused material/excess scrap Twice the Issue Rates or Twice the Landed Rates</td>
</tr>
</tbody>
</table>
NOTE:

1) Landed Rate shall be arrived from the latest Purchase Order of respective material received at site by Owner.

2) In case different penal rates have been indicated in the Contract (based on Project requirement), the same will supersede the above rates.

PIPING MATERIALS

All pipes shall be issued in available lengths/shapes and no claims for extra payments on account of issue of non-standard length & shape will be entertained. Pipes shall be issued on linear measurement basis. All valves, flanges, fittings etc. shall be issued on number(s) basis. Contractor shall store the materials in such a way so as to avoid mixing of different types of material and shall maintain complete identification and traceability at all times.

- The scrap allowance for pipes issued by the Owner shall be 3% (2½% accountable + ½% non accountable) of the actual consumption as incorporated in the works.

- All pipes in length of 2 meters and above shall be considered as serviceable material provided the material is in good and acceptable condition and has clear identification and traceability (Manufacturer’s name, heat number/batch number and test certificates). Pipes in lengths less than 2M shall be treated as scrap.

- For the non account of pipes drawn by the Contractor over and above the actual consumption as determined by the Engineer-in-Charge, plus 3% (2½% accountable + ½% non accountable) thereof to cover the scrap allowance, recovery at penal rate shall be effected from the Contractor's bill(s) or from any other dues of the Contractor to the Owner.

- All unused/scrap pipes, valves, flanges, forged fitting like elbows, reducers tees shall be returned by the Contractor category wise duly cleaned, greased and spec. marked at his own cost to Owner’s stores. In case the Contractor fails to do so then recovery for such quantity of pipes not returned by the Contractor at the penal rates shall be effected from the Contractor’s bill(s) or from any other dues of the Contractor to the Owner.
TECHNICAL SPECIFICATIONS
FOR LOADING ARMS
<table>
<thead>
<tr>
<th>Make</th>
<th>Associate Engineers/ Technika / Ferro Tubes &amp; Alloys or any other make approved by HPCL.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qty</td>
<td>Refer BOQ</td>
</tr>
<tr>
<td>Description</td>
<td>Swivel, Top loading</td>
</tr>
<tr>
<td>Inboard Arm</td>
<td>4&quot; NB Seamless pipes, quality conforming to ASTM-A106 Gr. B Sch.40</td>
</tr>
<tr>
<td>Outboard Arm</td>
<td>4” Aluminium conforming to AA 6063 T6/AISI 63400</td>
</tr>
<tr>
<td>Elbows and Reducers</td>
<td>4” NB 90 Deg SR Elbows , quality conforming to ASTM-A234 Gr. WPB, Sch.40</td>
</tr>
<tr>
<td>Swivel joint</td>
<td>Material conforming to ASTM A 106 Gr.B/ A-105 having High Carbon Steel balls, ball races are to be hardened to min. 500 BHN, sealing rings of material shall be Viton/PTFE. Aluminum swivel joints should have replaceable ball races for longer life. Material of Aluminum Swivel joint shall be aluminum alloy. Aluminum swivel joint should have steel ball races to achieve longer lift</td>
</tr>
<tr>
<td>Type of Swivel joints</td>
<td>Swivel joints have to be split type design so that seals can be replaced without removing the steel balls.</td>
</tr>
<tr>
<td>Aluminum drop pipe</td>
<td>Suitably sized Aluminum pipe (drop nozzle) of 1000 mm long with tapered end on one side &amp; other side screwed for filling tank trucks</td>
</tr>
<tr>
<td><strong>Spring Balancing System</strong></td>
<td>Quality conforming to IS: 1239. Helical Spring box with spring of material conforming to EN 47/45.</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Inlet Flanges</strong></td>
<td>Raised face serrated finish, ASA class 150, with holes drilled according to ANSI B 16.5 face to face as per ANSI B 16.1 made of ASTM A 105 material</td>
</tr>
<tr>
<td><strong>Intermediate Flanges</strong></td>
<td>Flanges other than inlet flanges in the loading arm shall have dimensions as per TTMA &amp; will be made of IS 2062 &amp; aluminum alloy.</td>
</tr>
<tr>
<td><strong>Balancing</strong></td>
<td>Spring Type (Torsion / Compression)</td>
</tr>
<tr>
<td><strong>Design Pressure</strong></td>
<td>15 Kg/ sq.cm</td>
</tr>
<tr>
<td><strong>Working Pressure</strong></td>
<td>2-8 Kg/Sq cm</td>
</tr>
<tr>
<td><strong>Hydrostatic Test Pressure</strong></td>
<td>15 Kg/ Sq Cm</td>
</tr>
<tr>
<td><strong>Operating Temp</strong></td>
<td>0 - 50 deg.C</td>
</tr>
<tr>
<td><strong>End connections</strong></td>
<td>4'' ANSI 150# SORF FLANGED</td>
</tr>
<tr>
<td><strong>Seals</strong></td>
<td>Viton</td>
</tr>
<tr>
<td><strong>Working envelope</strong></td>
<td>Reach 3 - 4 mtr.(Typical). 4 mtr. X 6 mtr. X 1 mtr.(Vertical)</td>
</tr>
<tr>
<td><strong>Vacuum Breaker</strong></td>
<td>½” integral viton Diaphragm type with SS nipple. It shall be at the apex of the system where vacuum is generated</td>
</tr>
<tr>
<td><strong>Filling Position locking Arrangement</strong></td>
<td>A suitable locking arrangement for the outboard arm shall be provided to prevent jerking action of Loading Arm as well as lock the outboard arm at</td>
</tr>
</tbody>
</table>
the operation desired position while filling tankers. Locking chain shall also be provided.

| Parking Lock | : | A suitable locking arrangement for the inboard arm shall be provided to lock the loading arm in parking position so that it remains in parking place. Lock should be spring loaded so that locking in parking place is automatic & should be easy to operate. |
| Loading Arm type | : | Self supported Top Loading. Quantity for Left hand type & Right hand type shall be as per individual location requirement. |
| Inlet Pipe entry | : | To suit the site condition |

**DESIGN REQUIREMENT**

1. Loading Arm shall be self supported type. Extra bearing support which creates obstruction to the movement of manpower & other equipment should not to be required by the Loading Arm i.e. Design of Loading arm should be such that it does not require any extra Bearing support.

2. Base swivel joint should be capable of taking bending load of the loading arm. Loading shall be checked of bending load by applying 40 Kg weight at the end of inboard arm and will be checked for smooth rotation.

3. Swivel Joint should be offered for Cycle testing of 20000 Oscillations of Min. 270 degree and should be checked for pressure testing at 10 Kg under rotation after the same.

4. The swivel joints shall be designed to make the loading arm maneuverable with minimum effort. All swivel joint should be of split type design and have minimum type
rows of chrome steel hardened balls fixed in suitably hardened carbon steel guide ways. Material conforming to ASTM A 106 Gr. B/A-105 having HCS Balls, ball races are to be hardened to 500 BHN, seal of VITON / PTFE. Sealing surfaces of Swivel Joint should have overlay with SS material. Aluminum swivel Joint shall be Aluminum Alloy. Aluminum swivel joint should be hardened Ball races to achieve longer lift. All Swivel joints of steel or Aluminum should be of Split type design. Swivel joint made of Aluminum should have replaceable snap type ball races in which balls moves.

The quantum of force required at the end of outboard arm to move the outboard arm in horizontal place and in vertical plane and the complete loading arm from the base swivel joint in horizontal plane without fluid & checked on shop floor will be as below:

- In Horizontal plane : 1 Kgf
- In Vertical plane (downward pull) : 4 Kgf
- From base swivel in horizontal plane : 2 Kgf

5. Seals of swivel shall be of Metal inserted Viton material. Swivel joints shall be completely leak proof under operating pressure and vacuum. The tightness of seal shall not hinder the easy operation of swivel joint.

6. Spring Balance Assembly:

- The Outboard arm and drop pipe shall counter balanced by spring balancing Mechanism will be of Helical Compression spring type with totally enclosed cover design. Spring box should be such that, setting of the spring tension can be done by any one person at site without any special tools, Helical spring assembly.

- The spring shall have in-build provision to limit downward travel and upward travel of outboard arm.

- The expected life of spring is 2 Lakh cycles. The spring shall be designed with excellent fatigue resistance properties and adequate strength to perform operation throughout the lift of the spring.

**TESTING AND INSPECTION BY TPI**

- Visual and Dimensional inspection and witnessing hydrostatic testing of 100% Loading Arms.
- After assembly, the arms shall be subject to the following tests:

**TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA**
a) Balancing Test:
This will be conducted in loading arm to ensure that the arms are mechanically counterbalanced. Test shall be conducted under no hydrostatic pressure.
Quantum of Check: 100%

b) Performance Test (Maneuverability test of Swivels):

Rotate the swivel joints for three cycles in forward & three cycles in reverse Direction to demonstrate that swivel joints can be easily operated and operating torque required are in following range.

- In horizontal plane : 1 Kgf
- In vertical plane (downward pull) : 4 Kgf
- From base swivel in horizontal plane : 2 Kgf
Quantum of check 100%

c) Hydrostatic Shell Test:

The loading Arm is pressurized to 15 Kg/cm2 using water as test fluid & pressure Held for 15 minutes. Requirement: No leakage is allowed.
Quantum of check: 100%

d) Radiography:
10% of all the carbon steel butt weld joints in a loading arm shall be radiographed.
Quantum of check: 10% quantity

e) Manufacturer of the Loading arms Test Certificate, indicating details of materials for Inboard arm, outboard arm and drop pipe & scope of Inspection indicated above shall be provided along with supplies. Also verification of material of construction (thru mill Test report).
Quantum of check 100%

f) Life cycle testing of swivel joint of each type shall be done & the certificates shall be offered for verification during inspection.

Additionally Aluminum swivel joint shall also be tested for endurance test for 20,000 cycles, which will be witnessed by TPIA.

Quantum of check: 1 No of each type of swivel joint.
g) Bending moment test for springs & base swivel joint shall be done & the certificates shall be offered for verification during inspection. Additionally, bending moment test shall be done for split flange type of swivel joint & witnessed by TPIA.

Quantum of check: 1 No of each type of swivel joint.

h) Forces required for movement of loading arms to be checked for conformity with purchase order requirements.
Witnessed by TPIA - 20%

i) Certificate for chemical analysis of seat ring material
Quantum of check: 1 No. sample per batch.

j) Vacuum test: Closing inside and inlet side. The loading arm assembly to be tested at (-) 0.15 BAR vacuum condition inside and hold for 15 minutes (no drop at vacuum gauge permitted).

PAINTING
- Loading arm and the accessories shall be painted one coat of Zinc rich primer after blast cleaning to SA2.5 followed by one intermediate coat of MIO and two finish coats of approved shade of Polyurethane.
- The painting shall be provided with a spray gun. Aluminium nozzle shall not be painted.

NOTE:
- One extra O ring shall be supplied with each loading arm.
- Locking facility to be provided:
  i) When loading arm in parking position
  ii) When loading arm is inserted in T/T
### SPECIFICATION OF BOURDON TYPE PRESSURE GAUGE

<table>
<thead>
<tr>
<th>Make</th>
<th>Switzer, Gen. Instruments., Warre, AN Instruments, Manometer (I) Ltd, Hirlekar, Bourdon, Forbes Marshall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qty</td>
<td>Refer SOQ</td>
</tr>
<tr>
<td>Type</td>
<td>Bourdon</td>
</tr>
<tr>
<td>Mounting</td>
<td>Local</td>
</tr>
<tr>
<td>Dial size</td>
<td>150 mm</td>
</tr>
<tr>
<td>Color</td>
<td>White dial with black engraving</td>
</tr>
<tr>
<td>Bezel ring</td>
<td>Screwed</td>
</tr>
<tr>
<td>Range</td>
<td>Suction -1 Kg/cm$^2$ to 7 Kg/cm$^2$</td>
</tr>
<tr>
<td></td>
<td>Delivery 0 to 15 Kg/cm$^2$</td>
</tr>
<tr>
<td>Unit of measurement</td>
<td>Kg/cm$^2$</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 1 % of FSD</td>
</tr>
<tr>
<td>Zero adjustment</td>
<td>Through micrometer pointer</td>
</tr>
<tr>
<td>Over range protection</td>
<td>125 % of FSD</td>
</tr>
<tr>
<td>Blow out protection</td>
<td>To be provided</td>
</tr>
<tr>
<td>Process connection</td>
<td>Through 1/2&quot; NPT (M)</td>
</tr>
<tr>
<td>Service</td>
<td>As given in the design criteria</td>
</tr>
<tr>
<td>Materials</td>
<td></td>
</tr>
<tr>
<td>Window</td>
<td>Shatter proof glass</td>
</tr>
<tr>
<td>Case</td>
<td>Cast AL</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Element</td>
<td>SS 316</td>
</tr>
<tr>
<td>Socket</td>
<td>SS 316</td>
</tr>
<tr>
<td>Movement</td>
<td>SS 304</td>
</tr>
<tr>
<td>Snubber</td>
<td>Shall be provided</td>
</tr>
<tr>
<td>3 way isolation valve</td>
<td>Shall be provided of SS material</td>
</tr>
<tr>
<td>Standard</td>
<td>IS 3624</td>
</tr>
</tbody>
</table>
TECHNICAL SPECIFICATIONS FOR ELECTRICAL HEATING OF TANKS AND HEAT TRACING OF TANK AND PIPING SYSTEM
SCOPE

The scope covers the basic requirements, features, general construction, design, fabrication, inspection, testing, delivery to site of an ELECTRICAL HEATING OF TANKS & HEAT TRACING SYSTEM FOR TANKS AND PIPING SYSTEM including heat tracer, accessories, panel, cables, immersion heaters, earthing material and other miscellaneous items that will be required to make the system complete and make it fully operational as required for handling Bitumen at Bihta near Patna, Bihar.

APPLICABLE STANDARDS

- Electrical trace heating system/materials shall be designed, manufactured and tested in accordance with the latest applicable section of codes and standards detailed in later stage of this document. Offered trace heating systems/materials shall have the approval from statutory body of country of origin.

- Electrical equipment for use in a hazardous area shall be in accordance with IEC 79, Electrical Apparatus for Explosive Gas Atmospheres. Electrical equipment manufactured in India for use in a hazardous area shall either be in accordance with the applicable IEC or IS Codes and Standards, relevant statutes, local regulations and safety codes.

REFERENCE DOCUMENTS

- Electric Heating and Tracing for Bitumen Tanks and Piping system (Annexure I)

- Plant layout drawings. Piping GA drawings shall have to made by the successful vendor

DESIGN REQUIREMENTS

- The equipment shall, in all respects, be suitable for operation in service conditions typical of a refinery/ Oil Installation within a coastal environment in the tropics.

- The equipment shall have a design life of minimum 25 years.

- Minimum ambient temperature – 4 deg C

- Maximum ambient temperature – 50 deg C

- Temperature of Bitumen to be maintained in tank and piping system – 135 deg C
• Suitable panel to be provided in the control room so that heating parameters can be monitored. Provision of RS-485 communication port should be available in the panel so that the monitoring data can be transmitted to terminal automation system

• Variation in voltage required to be calculate heat tracing output – 10%

• Microprocessor based temperature controller to be provided for monitoring temperature of Bitumen in tank and piping system

**SCOPE OF DESIGN SUPPLY & INSTALLATION/ERECTION OF FOLLOWING**

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>DESCRIPTION</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Heating &amp; Heat Tracing system complete with Power Distribution System &amp; relevant accessories for Electrical Heat tracing for Tanks as per drawing prepared by the vendor and approved by owner – 2 nos Bitumen Tanks</td>
<td>Lot</td>
</tr>
<tr>
<td>2</td>
<td>Heat Tracing system complete with Power Distribution System &amp; relevant accessories for Electrical Heat tracing for Piping System as per drawing approved by the vendor and approved by HPCL – 6”/4”/3” Piping system for unloading bitumen tank truck to tank and loading of bitumen from tank to tank truck</td>
<td>Lot</td>
</tr>
<tr>
<td>3</td>
<td>Micro processor based temperature controllers &amp; mounting brackets, RTD, Power &amp; End Connectors, Splice connectors, Junction Boxes, cable glands, Power &amp; control cables, cable trays &amp; all installation hardware including end seal, insulation entry kits, T-splices, fixing tapes, Caution labels &amp; earthing material (Wire &amp; Strip)</td>
<td>Lot</td>
</tr>
<tr>
<td>4</td>
<td>Power cables, control cables cable trays from Heat tracing panel to Heaters/Heating Tracers including excavation, supply and embedding properly designed RCC blocks with structural supports on which cable trays to be layout. At Road crossing the cable shall pass thru owner provided ERC/IRC</td>
<td>Lot</td>
</tr>
<tr>
<td>5</td>
<td>Immersion heaters per tank. As per approved design</td>
<td>Lot</td>
</tr>
<tr>
<td>7</td>
<td>Thermal Insulation of Pipelines in Bitumen service</td>
<td>Lot</td>
</tr>
<tr>
<td>8</td>
<td>Thermal Insulation of Tanks (Bitumen Tanks).</td>
<td>Lot</td>
</tr>
</tbody>
</table>
Note: - EHT system items including Electric Heat Tracer, RTD, junction boxes etc shall be suitable for Zone 2, Gas Group IIA/IIB, and Temperature Class T3. Electric Heat Tracers offered should have certification for hazardous area and Temperature Rating specified above by statutory body of India. EHT distribution panel shall be placed in safe area.

POWER SUPPLY SYSTEM

415 V+/-10%, 50+/-5% Hz, three phase, will be provided by HPCL at Motor Control Centre (Sub-Station). 3 Nos feeders (MCCB) of suitable for 51kW (2 Nos for EHT) & 288kW (1 No for heater in Tanks) have been provided in the MCC-Bitumen. Vendor to arrange for distribution of power required for execution of heating and heat tracing system within the quoted rates.

DESCRIPTION OF THE SYSTEM

The heat tracing system shall maintain the normal temperature of the various pipelines & tanks as listed in the Line List. Heat tracing vendor shall design the system also considering information regarding the individual lines like size, insulation type and maximum Tracing temperature as indicated in the scope document.

All heat-traced surfaces shall be insulated in accordance with proper heat transfer and personnel protection practices.

Thermal insulation thickness as mentioned in the scope document should be considered for designing the Heat Tracing System.

List of tanks and piping system for which electrical heat tracing system is required has been provided in ANNEXURE I of this specifications; Vendor shall have to design the system for electrical heating of tanks (in bitumen service) and heat tracing of tanks and piping system (in bitumen service) get the same approved by the owner thereafter prepare of detailed working drawings and calculate the bill of material required for executing the job as per approved design.

The heat tracing system shall be so designed so as to maintain the temperature of BITUMEN at 135 deg C both in tanks and piping system after compensating heat losses to atmosphere. The heat tracing system shall be designed to ensure maximum safety by using suitable thermostat, contactor, relay etc. The heaters installed on tanks will also ensure that in the event of power failure required temperature will be restored within 2-3 hours.

For installations in Zone 1 and Zone 2 areas, the following types of protection shall be used:
Zone 1 Areas: Exd flame-proof or explosion-proof equipment
Zone 2 Areas: Exd flame-proof or explosion-proof equipment
Unclassified areas: Equipment complying with the requirement for Zone 1 & 2 Standard industrial equipment

When the pipe material or content has low thermal conductivity, the heat density of the heating elements shall be such that the temperature limits for pipe or content are exceeded.

The inclusion of spare capacity, i.e., design margin, shall be considered when for critical application the power output is not allowed to drop below the design values.

All electrical equipment subject to operating and maintenance activities shall be easily accessible and shall allow for safe and convenient performance of such activities.

ELECTRIC HEAT TRACER

Heat Tracer shall be Self Limiting/Power Limiting Type having positive temperature co-efficient (PTC) characteristic. PTC characteristic offers regulating features to the tracer. This means that with increase in temperature, there is a drastic increase in resistance resulting in reduction of power output at elevated temperature and vice versa. PTC characteristic enables tracer to respond to local heat demand which is variable at valves, supports, flanges and heat sinks etc.

Heat Tracer shall be low Watt density type. This is required to achieve increased life of the tracer.

Heat Tracer inner and outer jacket material shall be high temperature fluoropolymer having minimum continuous temperature rating of 260 Deg. C. Vendor to confirm type of fluoropolymer of tracer meeting this requirement and provide published data from the manufacturer of fluoropolymer.

The Tracer system shall be such that it should stabilize under all conditions including empty and no flow conditions in case of pipelines, and minimum and stagnated conditions of product level in case of tanks to a temperature below the maximum withstand temperature of the tracer and the classified hazardous area temperature where applicable.

The Heat tracer shall be capable of withstanding maximum continuous exposure temperature of 260 Deg C. This will be supported by certification from statutory authorities of the country of origin.
Heat Tracer shall have a nickel plated copper braiding which has excellent corrosion resistance. Tinned copper braid does not meet this requirement and shall not be offered. Nickel plated braid also provides an effective ground path for fault currents.

Heat Tracer shall be weather-proof type and shall be suitable for outdoor installation.

Heat Tracer shall have cut-to-length feature in order to facilitate the modification re-routing of pipelines. However while terminating into connectors cold terminations shall be preferred to prevent unnecessary heating at the connector ends which could result in tracer failure at these points. Vendor has to submit methodology to achieve this for approval of owner.

Heat tracer offered shall have capability for achieving desired T rating from T6 to T2 on system approach basis. Heat Tracer shall have approval from PESO for use in hazardous area classification.

At least one thermostat per circuit shall be provided for energy savings.

All heater cables shall be powered in strategically located power connection boxes and end cap shall be installed on the cable at the opposite end of the cable. The Tracer terminations shall be done in an End connector box

All heating tape is to be supplied in continuous drum lengths.

Drums are to be non-returnable and of rigid construction, with a metal reinforced center and wood or metal flanges, suitable for shipping and transportation. Heating tape is to be weather protected over the exposed outer coils.

To facilitate ease of identification each drum is to be clearly labeled with the following:

a) Tape Type and Voltage Grade.
b) Tape output (W/M).
c) Length of Tape on Drum.
d) Purchase order and Item Number.
e) Drum No as stated on the Purchase Order.

This identification is to be indelibly stenciled on each outer flange of the drum.
Vendor shall prepare drumming schedules to facilitate material control during installation.

Temperature Control

The selection of temperature control will be dependent on the following criteria:

- Energy saving
- Product requirements;
- Temperature limitation for safety reasons.

Temperature Control for Energy saving

Pipelines with Heat Tracing require heating to compensate the heat loss. The fluid under flow will carry away the heat supplied by the Heat Tracer. Under no or low flow conditions the fluid starts getting heated up. In such case the temp controller should cut off the Power supply to the Tracer. Consequently, the heating system shall only be activated when required.

The number and location of the Temp sensors (RTDs) shall be selected to ensure that the heating requirement of all piping and equipment involved will be maintained under all process conditions.

The RTDs shall be of class 1 accuracy type. They shall be supplied with JBs suitable for use in hazardous areas.

The temp set points for each circuit shall be adjustable from the remote temp controller placed in the distribution panel.

Temperature Control Resulting from product requirements. Pipelines carrying product, which are sensitive to degradation due to overheating, may require a more sophisticated control system than local thermostats.

Temperature control for the compensation heating shall under these conditions be obtained from the process temperature measuring system.

Temperature Limitation for Safety Reason

The assemblies shall be suitable for the service conditions and hazardous area classification in which they are to be installed. Enclosures shall be weather proof with degree of enclosure protection to IP 65 (minimum).
The tracer shall be capable of accommodating field changes and other variations at the job site.

The offered heat tracing system shall have approval from PESO & CMRI including the items manufactured outside India.

Heat loss shall be calculated as per IEEE with an additional 10% safety factor on calculated output to allow for voltage & thermal insulation variables.

**CONTROL AND MONITORING**

The control and monitoring shall be designed to give

1. Safe operations
2. Energy savings
3. Minimum Maintenance

**JUNCTION BOX**

Junction Boxes shall be suitable for Zone 2, Gas Group IIA/IIB, and Temperature Class T3 area with weatherproofing to IP65. Enclosures shall be hot dipped galvanized cast iron or sheet stainless steel, supplied with internal and external earthing studs. Internal terminals shall be fixed within the terminal box. All cable entries shall have ISO metric threads and shall be plugged with removable threaded stopper plugs. All junction boxes for hazardous area installation shall be constructed from die cast Aluminum alloy LM6 & with epoxy powder coated finish.

Junction boxes shall be used for

- The connections between supply cable and heater cable
- The distribution of supply of one circuit of the distribution board to sub circuits. Only the supply of one circuit of the distribution board shall be allowed in a connection box.
- Splitting of a three-phase circuit into 3 single-phase circuits.

Junction boxes shall contain sufficient terminals for all the connection to be made. Individual terminals shall be provided for each conductor. The terminals shall be of non-loosening construction and of the wedge type, obviating the use of cable lugs and constructed in such a way that direct contact between screw and conductor is avoided.
Terminals shall be identified in accordance with the related diagram. In addition, sufficient earth terminals or an earth bar with sufficient earth connection points shall be provided to earth the metal screens of all cables and heaters.

All cables connected to the box shall enter the box through the bottom or the sides.

No entrance from the top is allowed. Sufficient cable glands suitable sized for the associated cable shall be installed.

Heating elements shall be fitted with Power connector kit where they are connected to the power source. Connector kit cable glands shall be brass, waterproof and fitted with special grommet to suit each size of heating tape as required. Each gland shall be supplied complete with lockout, IP washer and termination sleeving wherever necessary.

Remote end sealing and materials of the heat-shrink type shall also be provided. End termination shall be done inside end connector.

Tee connector and jump over connector will be used wherever required for branch connections.

**CONTROL & DISTRIBUTION PANEL**

Power will be made available by purchaser at 415 V, 50 Hz, 3 Phase AC from the nearest substation. The heat Tracer Panel shall be located in safe area. Vendor shall design number of heat tracing circuit required in panel & consider 20% spare feeder in panel.

Each panel shall incorporate:

- Triple-pole Neutral (Fault make/load break) FSU lockable in off position only.

- For each outgoing circuit-one 2-pole ELMCB (30mA Earth Leakage), connected in series.

- It shall be possible to operate & reset devices without isolating the panel.

- One ‘mains-on’ light to indicate voltage present.

- One LED per circuit to indicate ‘POWER ON’.

- One LED per circuit to indicate ‘tripped’ wired to the MCB/RCCB.
• An earth bar with capacity suitable for installed & future circuits.

All inputs & outputs wired to suitably size terminal blocks positioned at the bottom of the enclosure. Terminal blocks shall be shrouded & segregated according to voltage levels & functions.

The heat tracer panel shall be IP 55 minimum.

The vendor shall ensure that circuit inrush currents when starting at minimum ambient temperature & standing earth leakage currents are below the minimum trip level of MCB's except under fault conditions.

Panels shall be painted in accordance with Vendor’s standard. Colour shall be RAL 7032.

TEMPERATURE CONTROLLER

The temperature controller shall be a multi circuit micro-controller based temperature control and monitoring module. The controller shall control each heat tracing circuit based on the RTD input for the respective circuit. The controller should indicate real time data for temperature, heater current and heater ground current for each circuit. It should generate alarms for low & high temperatures, high & low current, high ground current, RTD sensor fault or circuit fault. The controller should have a serial communication port (RS-485) and shall be capable of communicating (Read & Write) with DCS. The communication software, if applicable shall be arranged by the vendor.

ADHESIVE TAPE

Adhesive tape, for securing heating tape to pipe lines shall be glass cloth pressure sensitive with thermo-setting adhesive.

Adhesive tape, for securing heating tape to tanks, valves, flanges or uneven surfaces shall be Aluminum Foil pressure sensitive with thermo-setting adhesive.

CAUTION SIGN

All Pipelines and equipment heated with electrical tracing shall be provided with suitable, durable weatherproof caution sign, visible from all section of a traced system. Signs on traced pipelines shall not be more than 6 meters apart and positioned on alternate sides of the cladding. Caution sign shall be yellow with black lettering.
The elements of a circuit such as thermostats, junction boxes and heaters shall be provided with permanent labels which shall consistently indicate the circuit number to which the elements are connected and the circuit reference. The labels shall be fixed on a non-removable part.

CABLING & EARTHING

Cables shall be PVC insulated, copper conductor & armored 1.1KV grade, Type: YWY.

All electrical equipment, like junction boxes and heat tracings circuit shall be connected to plant’s earthing grid through third conductor of main cable.

THERMAL INSULATION WORK

**Tank Insulation:** Energy efficient pre-fabricated Lloyd – Loc / Therma-Seam or approved equivalent panel system. Prefab insulated panel will be fabricated and assembled at site and then fixed to the tank surface with a suitable mechanical hidden clipping arrangement and zipped with a machine. The clips will be fastened to the tank surface over anchor cables at suitable distance. The prefab panels shall be made from 0.5 mm TCT profile steel sheet (Permanently color coated or Al. finish) and high density Rockwool insulation of max length 12 meter and width 300 to 600 mm. The rockwool insulation shall be slabs of density 100 Kg/m3 and 100 mm & 50 mm thickness. Thickness shall be as per approved design calculations.

**Piping Insulation:** Dual Insulation (25 mm Rocklloyd Pipe Sections – 144 kg/m3 density, followed by 50 mm thick SUPER FOAM PUF Cast-in-situ 40 ± 5 kg/m3 density) of LLOYD or approved equivalent with jacketing of 22G Aluminium Cladding of Grade AA-3003 or AA-3105 Temper AAH14 as per ASTM B209 with 3 mil Polysurlyn Moisture Barrier. Thickness shall be as per approved design. In case the design thickness is more than 75 mm then the insulation shall be carried out in two layers. Suitable insulation material shall also be provided for pipe fittings, valves and pumps.

VENDOR DESIGN PACKAGE

Vendor shall provide design work sheets and drawings to facilitate the design and installation of the trace heating system(s), showing the following information

- Line number, Pipe size, Pipe material, and specification, fluid in pipe and fluid ignition temperature, pipe length, no of valves, no of flanges.
- Heat loss calculation

TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA
• Heater reference and type
• Length of heater per of pipe, valve and pipe support
• Spiral pitch wherever applicable
• Length of heater per circuit
• Temperatures
• Distribution Board and circuit records
• MCB rating, type and characteristics
• Power cable size, type including gland size
• Drawing document references

COMMISSIONING

Heater Distribution

Heaters will be distributed and grouped logically by the client in order to minimize the number of circuits, thermostats and power cabling required. The Vendor shall provide all relevant information to enable a logical and economical circuiting of the trace heating system. In installation where the process flow can follow different routes, each independent part of the system shall be controlled separately. Where in a pipeline the same conditions apply, the heater shall be controlled from one point unless the applied heaters are connected to different circuits.

Heater circuits shall be loaded with maximum 63 A per phase (continuous). For the current rating of self-Regulating/Power-Limiting heaters, the minimum operating temperature shall be taken into account. The local thermostat shall not be loaded with more than 80% of its nominal rating.

To prevent overloading of the tape conductors, the maximum length of a parallel heating tape shall be limited in accordance with the specification of the manufacture. Some heating tapes are available with additional power supply conductors integrated in the tape. This will allow extended heater length without using separate power feeding points.

No through connections or “tee offs” shall be made underneath the pipe insulation. Cold-lead connections shall be made in junction boxes. Sufficient heater capacity shall be installed to ensure that, towards the end of the tape, the output does not drop below the minimum design value owing to the voltage drop in the tape conductors.

**The contractor shall get the electrical heating and heating tracing system from any one of the following manufacturer’s:**

1. RAYCHEM/ TYCO THERMAL
2. THERMON

TANKAGE AND PIPING WORK FOR BLACK OIL FACILITIES AT BIHTA NEAR PATNA
3. THERMOPAD

4. BARTEC

5. XICON

The contractor shall get the thermal insulation from any one of the following manufacturer’s:

1. Lloyds Rock Fibres

2. Minwool Rock Fibres

3. Rockwool India

After award of the job the manufacturer shall submit the design calculations (along with total power requirements) for the proposed electrical heating and heat tracing system with thicknesses of insulation required for tank and piping system along with data sheets of equipments viz. tracers and accessories, control devices and schemes, panel and cables, thermal insulation materials etc. He shall also furnish the bill of materials required for execution of job as per specifications.

Commissioning of the system shall be included in scope of work for electrical heating and heat tracing system.

The Manufacturer shall submit all the relevant Type & Routine Test certificates of all equipments proposed to be used.

Temperature controllers for additional safely if required to be provided after approval of design is also included in the scope of job.

STANDARDS

IEC 79   Electrical Apparatus for Explosive Gas Atmospheres
IEC 529   Degrees of Protection provided by Enclosures (IP Code)
IEC 702   Mineral Insulated Cables and their terminations with Rated Voltage not exceeding 750V
IEC 800   Heating Cables with Rated Voltage of 300/500V for Comfort Heating and Prevention of Ice Formation
BS 6351   Electrical Surface Heating
IEEE 515   IEEE recommended practice for testing, design, installation & maintenance of electrical resistance, heat tracing for industrial application.
## ANNEXURE - I

**LIST OF EQUIPMENT REQUIRING ELECTRICAL HEATING, HEAT TRACING & THERMAL INSULATION**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION – PRODUCT</th>
<th>SIZE</th>
<th>NOS/LENGTH</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CONE ROOF TANK – BITUMEN</td>
<td>9M x 9M</td>
<td>2 Nos</td>
<td>HEATING &amp; HEAT TRACING</td>
</tr>
<tr>
<td>2</td>
<td>A/G Piping 6&quot; NB</td>
<td>6&quot; NB</td>
<td>Refer SOR</td>
<td>HEAT TRACING</td>
</tr>
<tr>
<td>3</td>
<td>A/G Piping 6&quot; NB</td>
<td>4&quot; NB</td>
<td>Refer SOR</td>
<td>HEAT TRACING</td>
</tr>
<tr>
<td>4</td>
<td>A/G Piping 3&quot; NB</td>
<td>3&quot; NB</td>
<td>Refer SOR</td>
<td>HEAT TRACING</td>
</tr>
<tr>
<td>5</td>
<td>U/G Piping 6&quot; NB</td>
<td>6&quot; NB</td>
<td>Refer SOR</td>
<td>HEAT TRACING</td>
</tr>
<tr>
<td>6</td>
<td>U/G Piping 4&quot; NB</td>
<td>4&quot; NB</td>
<td>Refer SOR</td>
<td>HEAT TRACING</td>
</tr>
<tr>
<td>7</td>
<td>U/G Piping 3&quot; NB</td>
<td>3&quot; NB</td>
<td>Refer SOR</td>
<td>HEAT TRACING</td>
</tr>
<tr>
<td>8</td>
<td>PUMPS – BITUMEN</td>
<td>1200 LPM</td>
<td>Refer SOR</td>
<td>HEAT TRACING</td>
</tr>
<tr>
<td>9</td>
<td>HO Valve – BITUMEN</td>
<td>6&quot;/4&quot;/3&quot;</td>
<td>Refer SOR</td>
<td>HEAT TRACING</td>
</tr>
<tr>
<td>10</td>
<td>PIPE FITTINGS</td>
<td>6&quot;/4&quot;/3&quot;</td>
<td>Refer SOR</td>
<td>HEAT TRACING</td>
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