| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| | | INDIAN IRON & STEEL CO. LTD | | |
| 55. | CS PIPE (ASTM A 106 GR. B) | INDIAN SEAMLESS METAL TUBES | AHMEDABAD | UPTO 150 NB |
| | | MAHARASHTRA SEAMLESS | RAIGAD | UPTO 350 NB |
| | | | | |
| 56. | MS PIPES (IS: 1239 & 3589) | SAIL | ROURKELA | |
| | | JINDAL | GHAZIBAD/HISSAR | |
| | | SURYA ROSHNI | BAHADUR GARH | |
| | | TATA TUBE | JAMSHEDPUR | |
| | | PSL | CHENNAI/VIZAG/KUTCH/ DAMAN | |
| | | LALIT PROFILE | THANE | |
| | | SAMSHI PIPES INDUSTRIES | VADODARA | |
| | | MUKUT PIPES | RAJPURA | |
| | | INDUS TUBES | G B NAGAR | |
| | | MANN IND | INDORE | |
| | | SURENDRA ENGG | RAJPURA | |
| | | PRATIBHA PIPES & STRUCTURE PVT LTD | THANE | |
| | | JCO GAS PIPE | CHINDWARA | |
| | | NUKAT TANKS AND VESSELS | TARAPUR | |
| | | DADU PIPES | SIKRANDRABAD | |
| | | GOOD LUCK TUBES | SIKANDRABAD | |
| | | ADVANCE STEEL TUBES | SAHIBABAD | |
| | | BIHAR TUBES | SIKANDRABAD | |
| | | HI TECH PIPES | SIKANDRABAD | |
| | | RATNAMANI | KUTCH/AHMEDABAD/CH HATRAL | |
| | | MAHARASHTRA SEAMLESS | RAIGAD | |
| | | WELSPUN | ANJAR/BHARUCH | |
| | | | | |
| 57. | SS PIPES / TUBES | APEX TUBES | BEHROR (ALWAR) | |
| | | RATNAMANI | CHATTRAL | |
| | | REMI | TARAPUR | |
| | | PRAKASH STEELAGE | - | |
| 58. | POWER/CONTROL/INSTRUMENT CABLE | CORDS CABLE | BHIWADI | |
| | | RADIANT CABLES | HYDERABAD | |
| | | POLYCAB | DAMAN | |
| | | KEI | BHIWADI | |
| | | NICCO | KOLKATA | |
| | | RAVIN CABLES | PUNE | |
| | | INCAB | PUNE | |
| | | HVPL | FARIDABAD | |
| | | TORRENT CABLE | NADIAD | |
| | | HAVELLS | ALWAR | |

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| | | PARAMOUNT | KHUSHKHERA | |
| | | SRI RAM CABLES | BHIWADI | |
| | | THERMOCABLES | HYDERABAD | |
| | | TORRENT CABLE | NADIAD | |
| | | UNIVERSAL CABLES | SATNA | |
| | | GEMSCAB | BHIWADI | |
| | | DELTON | FARIDABAD | |
| 59. | SAFETY SHOWER | UNICARE | - | |
| | | MOHAN INDUSTRIES | - | |
| | | SUPER SAFETY SERVICES | - | |
| 60. | FRP TANKS & FITTINGS | GLOBAL COMPOSITE | - | |
| | | EPP | - | |
| | | DEEPA COMPOSITE | - | |
| | | COROSEAL INDUSTRIES | - | |
| | | CHEMICAL PROCESS & EQUIPMENT PVT LTD | - | |
| | | J.R FIBRE INDUSTRIES PVT LTD | - | |
| | | POLYPLAST | - | |
| 61. | EJECTOR | ESSEM TECHNOLOGIES | - | |
| | | RATNA PRASAD | - | |
| 62. | LOCAL CONTROL PANEL | INDUSTRIAL SWITCHGEAR & CONTROL | - | |
| | | POSITRONICS | - | |
| | | DELTA CONTROL | - | |
| | | L & T | - | |
| | | GE POWER | - | |
| | | PYROTECH | - | |
| | | **C& S** | - | |
| 63. | TANK (FRP) | INDUSTRIAL SERVICE | KOLKATA | |
| | | SUNRISE | BARODA | |
| | | GANDHI & ASSOCIATES | AHMEDABAD | |
| | | MODERN EQUIPMENTS | CHENNAI | |
| | | EAGLE PLAST | PUNE | |
| | | OMEGA PLAST | MUMBAI | |
| 64. | STROKE CONTROLLER | V K PUMPS | NASIK | |
| | | METACHEM | MUMBAI | |
| | | SWELORE | AHMEDABAD | |
| | | MILTON ROY INDIA | CHENNAI | |
| 65. | SAFETY VALVES/RELIEF VALVES | METACHEM | MUMBAI | |
| | | KEYSTONE | BARODA | |
| | | V K PUMPS | NASIK | |
| | | MILTON ROY | CHENNAI | |
| 66. | DUPLEX STRAINER | JAYPEE INDUSTRIES PVT. LTD. | NEW DELHI | |
| | | MULTITEX FILTRATION ENGINEERS LIMITED, | NEW DELHI | |

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| | | OTOKLIN GLOBAL BUSINESS LIMITED | MUMBAI | |
| | | SUNGOV ENGINEERING PVT. LTD. | CHENNAI | |
| 67. | ORIFICE PLATE | MICRO PRECISION | FARIDABAD | |
| | | INSTRUMENTAION LTD | PALGHAT | |
| | | CARLO DYNAMICS | HYDERABAD | |
| 68. | STEEL GATE/GLOBE/NR VALVES | A.V. VALVES LTD | AGRA | |
| | | ATAM VALVES PVT. LTD. | JALANDHAR | (1) CARBON STEEL GATE VALVES & NON RETURN VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 300 NB (#150) (2) CARBON STEEL GLOBE VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 200 NB (#150) |
| | | FLUIDLINE VALVES COMPANY PVT.LTD. | KAUSHAMBI | |
| | | M/S GM ENGINEERING | RAJKOT | |
| | | INTERVALVE (INDIA) LTD. | PUNE | A) STEEL GATE VALVES: UPTO 50NB, #800 AND 65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C)SUPPLIER NOT REGISTERED FOR NR VALVES |
| | | LEADER VALVES LTD. | JALANDHAR | |
| | | NITON VALVE INDUSTRIES PVT LTD | MUMBAI | |
| | | NSSL LIMITED. | NAGPUR | |
| | | STEEL STRONG VALVES (I) PVT.LTD., | NAVI MUMBAI | LIMITED TO RANGES & CLASSES AS AVAILABE IN VD FILE. |
| | | VENUS PUMPS AND ENGG. WORKS | KOLKATA | CC/CSS-GATE-BBT-UPTO600NB CL UPTO300,GATE-PSBT UPTO250NB CL 1500,GLV-BBT-UPTO300NB CL UPTO600,SCNRV-BBT-UPTO600NB CL UPTO150,SCNRV- |

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| | | | | BBT-UPTO300NB CL 300,SCNRV-PSBT-UPTO150NB CL UPTO900 |
| | | VALTECH INDUSTRIES | MUMBAI | CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE - GV/150/900,GV/300/400, GV/600/300 , GV/GLV/NRV/900/250 , GLV/300/300,GLV/150/350/ , SCNRV/150/700, SCNRV/300/350, SCNRV/600/250. |
| | | V.K. VALVES PVT. LTD., | JALANDHAR | |
| | | WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD. | NEW DELHI | |
| 69. | SLUICE GATE | H SARKAR | KOLKATA | |
| | | JASH ENGINEERING | - | |
| | | YASHWANT INDUSTRIES | - | |
| 70. | 3 WAY VALVE | HI TECH | AHMEDABAD | |
| | | ADVANCE VALVES PVT.LTD | NOIDA | |
| | | BDK | HUBLI | |
| | | FOURESS ENGG.INDIA LTD. | MUMBAI | |
| | | FLUIDLINEVALVES COMPANY PRIVATE LTD., | MUMBAI | |
| | | INSTRUMENTATION LTD. | PALAKAD | |
| | | KIRLOSKAR BROTHERS LTD. | PUNE | |
| | | VENUS PUMP & ENGG. WORKS | KOLKATA | |
| | | SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY | CHENNAI | |
| | | STAFFORD CONTROLS LIMITED | PUNE | |
| | | MICON VALVES (INDIA) PVT.LTD | MUMBAI | |
| 71. | PLUG VALVE(MANUAL) | BDK | HUBLI | |
| | | HAWA ENGINEERS / MARCK & CARE | - | |
| | | MICON VALVES | - | |
| | | MICON VALVES (INDIA) PVT.LTD | MUMBAI | |
| 72. | FITTINGS (CS/SS) | M.S. FITTINGS | KOLKATA | |
| | | METAL LLOYDS | MUMBAI | |
| | | TRUE FORGE | FARIDABAD | |
| | | TUBE PRODUCTS | BARODA | |
| | | NL HAZRA | KOLKATA | |
| | | GUJRAT INFRA PIPES | BARODA | |

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| | | EDWARDS | USA | |
| | | PIPEFIT ENGINEERS | BARODA | |
| | | SIDDARTH & GAUTAM | FARIDABAD | |
| | | EBY | MUMBAI | |
| 73. | FLANGES (SS/CS) | PRADEEP METALS LTD | MUMBAI | |
| | | TUBE PRODUCT INCOROPORATION | BARODA | |
| | | MS FITTINGS | KOLKATA | |
| | | HAWA ENGINEERING | - | |
| | | ALIANCE PIPE & PLANGES | KOLKATA | |
| | | JAI AMBE | MUMBAI | |
| 74. | PIPE & FILLTING (PP,HDPE,PVC & CPVC) | GEROGE FISHCHER | DELHI | |
| | | ASTROL PLYTECHINC LTD | AHMEDABAD | |
| | | JAIN IRRIGATION | - | |
| | | ORIPLAST | - | |
| 75. | VALVES (GATE/GLOBE/NRV/BALL)- (PP,HDPE,PVC & CPVC) | GEROGE FISHCHER IPING SYSTEMS PVT LTD | DELHI | |
| | | ASTROL PLYTECHINC LTD | AHMEDABAD | |
| | | JAIN IRRIGATION | - | |
| | | ORIPLAST | - | |
| 76. | AIR FILTER REGULATOR | SHAVO NORGEN | - | |
| | | PLACKA INSTRUMENTS | - | |
| 77. | FILTER MEDIA | GLOBAL ABSORBENT | KOLKATA | |
| | | BHARAT MINERALS | | |
| 78. | DC LEAD ACID / NI-CD BATTERIES | AMCO SAFT INDIA LTD | BANGALORE | NI-CD BATTERIES ONLY |
| | | EXIDE INDUSTRIES LTD | NEW DELHI | LEAD ACID BATTERIES ONLY. |
| | | HBL POWER SYSTEMS LTD | HYDERABAD | NI/CD AND TUBULAR TYPE FOR LEAD ACID |
| | | HOPPECKE BATTERIEN GMBH & CO.KG, | GERMANY | |
| 79. | DC LEAD ACID BATTERIES | EXIDE INDUSTRIES LTD | NEW DELHI | |
| | | HBL POWER SYSTEMS LTD | HYDERABAD | TUBULAR TYPE |
| | | HOPPECKE BATTERIEN GMBH & CO.KG, | GERMANY | |
| 80. | DC NI CD BATTERIES | AMCO SAFT INDIA LTD | BANGALORE | |
| | | HBL POWER SYSTEMS LTD | HYDERABAD | |
| | | HOPPECKE BATTERIEN GMBH & CO.KG, | GERMANY | |
| 81. | SIGHT FLOW INDICATORS | B.K.EQUIPMENTS PVT.LTD. | CHENNAI | |
| | | BLISS ANAND PVT. LTD. | GURGAON | |
| | | FLOWTECH INSTRUMENTS SERVICRS | VADODARA | |

| SR. NO. | ITEM | SUPPLIERS | PLACE | REMARKS |
|---|---|---|---|---|
| | | INSTRUMENTATION ENGINEERS PVT LTD | TELANGANA | |
| | | SIGMA INSTRUMENTS CO. | MUMBAI | |
| | | SCIENTIFIC DEVICES (BOMBAY) PVT LTD, | NAVI MUMBAI | |
| | | TELACE EQUIPMENT PVT.LTD. | CHENNAI | |
| 82. | PAINT | ASIAN PAINTS (I) LTD. | | |
| | | BERGER PAINTS INDIA LTD | | |
| | | GOODLASS NEROLAC | | |
| | | JENSON & NICHOLSON (I) LTD | | |
| | | CDC CARBOLINE (I) LTD. | | |
| | | SHALIMAR PAINTS LTD. | | |
| | | ADDISON PAINTS LTD | | |
| | | GRAND POLYCOAT | | |
| | | BOMBAY PAINTS | | |
| | | HEMPLE PAINTS (SINGAPORE) | | |
| | | JOTUN PAINTS | | |
| 83. | PNEUMATIC ACTUATOR | PROCON ENGINEERS | - | |
| | | TYCO | - | |
| | | CRANE PROCESS | - | |
| | | BDK | - | |
| | | INTERVALVE | - | |
| | | BRAY CONTROL | - | |
| 84. | MOTORISED ACTUATOR | ROTARK | - | |
| | | AUMA | - | |
| | | LIMITORK | - | |

**NOTE:**

Bidder to note that sub-vendors shall be as per above Sub-Vendor list enclosed in this Specification and:

I. Any additional Sub Vendor (not specified in the list) shall subject to BHEL, & Customer/Consultant, approval during detailed engineering without any delivery/ commercial implications to BHEL & Customer/Consultant.

II. All the finally selected Sub vendor shall be subject to BHEL, & Customer/Consultant approval during detailed engineering without any delivery/ commercial implications.

III. Credentials required for finally selected/ proposed Sub-vendor shall be provided by the bidder. Non-acceptance of any Sub-Vendor by Customer/Consultant & BHEL shall not have any commercial & delivery implication to BHEL & Customer/Consultant.

IV. Bidder shall submit all the Quality plans/ Check list during detail engineering for Customer/Consultant & BHEL approval. All comments as given by Customer/Consultant & BHEL shall be taken care by bidder without any commercial & delivery implication.

V. The inspection category will be intimated after award of contract by Customer/Consultant & BHEL. However, the same will be adhered by the bidder without any commercial and delivery implication to Customer/Consultant & BHEL.

VI. Bidder to propose sub vendor within 4 weeks of placement of LOI. Thereafter no request for additional sub-vendor shall be entertained.

VII. Dealers are not acceptable for any item of the package. Bidder shall procure all items including plates, structural, flanges; counter flanges etc. From approved sub vendor only.

# ANNEXURE III

## DRAWING DOCUMNTS SUBMISSION PROCEDURE

- Bidder shall submit soft copy/hard copy/CD ROMs of all the finally approved drawings and O&M Manuals as required by Customer/Customer consultant/BHEL-site/BHEL-PEM. The exact number of hard copies/CD ROMs of these documents to be submitted shall be notified to the bidder at the time of detailed engineering and bidder shall submit the same without any commercial/delivery implications to BHEL/Customer.
- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.
- Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and a[approval.
- Editable copy of all the drawings and documents shall be provided.
- The date of submission of drawing documents shall be considered as the date of submission of hard and soft copes whichever is later.
- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying to the requirement shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required.
- Vendor to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.
- Bidder to submit instrument schedule, cable schedule and valve schedule in MS- Excel format during detailed engineering.
- Bidder to also furnish the auto cad copy/MS-Excel/MS-word (as applicable) of the following documents after award of contract. However any other auto cad copy/MS-Excel/MS-word of any other document as per the insistence of BHEL and customer will also be submitted by the bidder without any delivery and commercial implication to BHEL and customer.
    - P&IDs.
    - Equipment lay out of the service vessel area and regeneration area.
    - Equipment Cable tray layout for service vessel area and regeneration area
    - Equipment earthing layout service vessel area and regeneration area
    - Civil scope drawings.
    - Piping lay out drawing for Service vessel area, regenerative area and yard piping layout.
    - Valve schedule
    - Instrument schedule
    - Cable Schedule

**ii) Other requirements**

- Successful bidder shall furnish detailed erection manual for each of the equipment as well as complete system supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account.

**DISTRIBUTION SCHEDULE**

| S. No | Description | TSGENCO | | | | | | | | M/S DCPL, KOLKATA | | | Equipment Vendor | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Director Projects | Director Technical | CE/Civil Thermal Projects Hyd. | CE/ TPC-1, Hyd | CE/ O&M/ KTPS | SE/ Civil KTPS | SE/E&M / KTPS | DE Constr. KTPS | Kolkata | HYD | KTPS | | |
| A | **Letter Of Intent or Contract Documents** | 1 | 1 | 1 | S | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | |
| B | **Vendor Drawings** | | | | | | | | | | | | | |
| 1. | Preliminary | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 12 | 1 | - | S | |
| 2. | Return preliminary with comments | - | - | 1 | 2 | 1 | 1 | 1 | 1 | S | 1 | - | 1 | |
| 3. | Final and any revision thereof | | | | | | | | | | | | | |
| | a. Civil | 1 | 1 | 6+1T | 1 | 1 | 6+1T | 1 | - | 2+1T | 1 | 1 | S | |
| | b. E&M | 1 | 1 | 1 | 6+1T | 1 | 1 | 6+1T | 1 | 2+1T | 1 | 1 | S | |
| C. | **Design Drawings** | | | | | | | | | | | | | |
| 1. | Preliminary | | | | | | | | | | | | | |
| | a. Civil | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 4 | 1 | 1 | S | |
| | b. E&M | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 4 | 1 | 1 | S | |
| 2. | Released for construction | | | | | | | | | | | | | |
| | a. Civil | 1 | 1 | 2 | 1 | 1 | 6 | 1 | 1 | 1 | 1 | 2 | S | |
| | b. E&M | 1 | 1 | 1 | 1 | 2 | 1 | 6 | 1 | 1 | 1 | 2 | S | |
| 3. | Return marked 'As built' | | | | | | | | | | | | | |
| | a. Civil | - | - | 1 | - | - | 1 | - | - | 1 | 1 | S | 1 | |
| | b. E&M | - | - | - | 1 | - | - | 1 | 1 | 1 | 1 | S | 1 | |
| 4. | As built drawings | | | | | | | | | | | | | |
| | a. Civil | - | - | 1+1T | - | 2+1T | 5+1T | - | 1 | 1+1T | - | 1 | S | |
| | b. E&M | - | - | 1 | 2+1T | 2+1T | - | 5+1T | 1+1T | 1+1T | - | 1 | S | |

| S. No | Description | TSGENCO | | | | | | | | M/S DCPL, KOLKATA | | | Equipment Vendor | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Director Projects | Director Technical | CE/Civil Thermal Projects Hyd. | CE/ TPC-I, Hyd | CE/ O&M/ KTPS | SE/ Civil KTPS | SE/E&M / KTPS | DE Constr. KTPS | Kolkata | HYD | KTPS | | |
| D | Progress Report Monthly | | | | | | | | | | | | | |
| 1. | Equipment vendor | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | S | |
| 2. | M/s DCPL, Kolkata | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | S | 1 | 1 | Nil | |
| E | Test & Inspection Reports | | | | | | | | | | | | | |
| 1. | Equipment manufacturer | | | | | | | | | | | | | |
| | a. Civil | 1 | 1 | 1 | 2 | 1 | 1 | 1 | - | 11 | 1 | 1 | S | |
| | b. E&M | 1 | 1 | - | 2 | 1 | - | 1 | 1 | 11 | 1 | 1 | S | |
| 2. | M/s DCPL, Kolkata | 1 | 1 | - | 2 | 1 | - | 1 | 1 | S | - | 1 | - | |
| F | Instruction Manuals/Data Books | | | | | | | | | | | | | |
| 1. | Equipment manufacturer | | | | | | | | | | | | | |
| | a. Civil | 1 | 1 | 1+1T | 1 | 1 | 6+1T | 1 | 1 | 2+1T | 1 | 1 | S | |
| | b. E&M | 1 | 1 | - | 3+1T | 1 | - | 6+1T | 2 | 3+1T | 1 | 1 | S | |
| 2. | M/s DCPL, Kolkata | 1 | 1 | - | 10+1T | 1 | - | 15+1T | - | S | 1 | 1 | Nil | |
| G | M/s DCPL, Kolkata Criteria | 1 | 1 | 1 | 8+1T | 1 | 1 | 2 | 1 | 1 | 1 | 1 | S | |
| H | Design Calculations | 1 | 1 | 1 | 8+1T | 1 | 1 | 2 | 1 | 1 | 1 | 1 | S | |
| I | Final consulting Engineering Report | 1 | 1 | 1 | 10 | 1 | 1 | 2 | 1 | S | 1 | 1 | Nil | |

S – Source, T – Transparency & Soft Copy on CD,

TSGENCO : Telangana State Power Generation Corporation Limited

Director, Projects, Hyd : Director/ Projects, TSGENCO, Vidyut Soudha, Hyderabad – 500 082

**NOTES:**

- The above schedule of submission does not include Docs/Drgs. of quality assurance/inspection and delivery/dispatches.
- All documents & drawings shall be in English and in metric units.

## ANNEXURE-IV

# PAINTING SPECIFICATION

ANNEXURE-IV

# TECHNICAL SPECIFICATION

# FOR

# PROTECTIVE LINING AND PAINTING

# TECHNICAL SPECIFICATION

# FOR

# PROTECTIVE LINING AND PAINTING

## C O N T E N T S

# TECHNICAL SPECIFICATION

# FOR

# PROTECTIVE LINING AND PAINTING

## 1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Package.

1.02.00 The Bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

## 2.00.00 CODES & STANDARDS

2.01.00 The Bidder shall follow relevant Indian and International Standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).

| | | |
|---|---|---|
| a) SSPC SP 10 / NACE 2 / | : | Near White Blast Cleaning |
| b) SSPC PA 2 | : | Measurement of dry film Coating Thickness with magnetic gauges. |
| c) ASTM D 4541 | : | Method for pull off strength using portable Adhesion Tester. |
| d) NACE RP 0274 – 2004 | : | High-Voltage Electrical Inspection of Pipeline Coatings |
| e) NACE SP 0188 – 2006 | : | Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates |

| | | | |
|---|---|---|---|
| f) | NACE RP 0169 – 2002 | : | Control of External Corrosion on Underground or Submerged Metallic Piping Systems |
| g) | AWWA C 210 – 2007 | : | Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines |
| h) | IS 3589:2001 Annexure B | : | Steel Pipes for Water and Sewage Specification. |
| i) | AWWA C222-2000 | : | Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings. |
| j) | IS 13213 : 2000 | : | Polyurethane Full Gloss Enamel (Two pack) |

**3.00.00 GENERAL REQUIREMENTS**

**3.01.00** The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.

3.02.00 The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.

3.03.00 The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.

3.04.00 The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.

3.05.00 Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.

3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.

3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.

3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.

3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.

3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.

3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti corrosive painting.

3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.

3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.

3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).

3.16.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.

3.17.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.

3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.

3.19.00 All insulated piping shall have aluminium sheet jacketing.

**4.00.00 EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER**

**4.01.00** After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.

All factory finished paints shall be touched up at site as required.

All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.

**4.02.00 Surface Preparation**

4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting to Sa 2-1/2 Swiss Standard before applying the primer.

4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.

4.02.03 The minimum degree of surface preparations for all equipment, piping, fittings, valves, structures etc. shall be "Near White" according to Steel Structure, Painting Council-SSPC-SP-10 before application of any primer/paint.

**4.03.00 Painting**

4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc. to be installed indoor shall be as follows :

a) Surface preparation shall be done either manually or by any other approved method.

b) Primer Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based zinc phosphate.

c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based paint pigmented with Titanium Dioxide.

d) Top Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber paint of approved shade and colour with glossy finish.

e) Total DFT of paint system shall not be less than 150 microns.

4.03.02 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc to be installed **outdoor** shall be as follows :

a) Surface preparation shall be done by means of sand blasting, which shall conform to Sa 2-1/2 Swiss Standard.

b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.

c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.

d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.

e) Total DFT of paint system shall not be less than 300 microns.

4.03.03 Specification for application of paints for external surfaces protection of steel pipes and fittings which are **buried underground / laid inside a hume pipe & or submerged Under Water and laid under Pipe Trenches** (in road/rail/pipe or trench crossings) shall be as follows :

External surface of the pipe, fittings, specialties etc. handling raw water/clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 2000 micron including primer coat.

4.03.04 Specification for application of paints for **internal surface protection of large diameter pipes** (sizes above 600 mm NB and above) if any, shall be as follows :

a) All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.

b) Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.

c) The minimum dry film thickness (DFT) of internal lining shall be 600 micron.

4.03.05 Specification for application of paints for protection of **internal surfaces of DM Water Storage Tank(s)** shall be as follows :

a) Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.

b) Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.

c) Total thickness of primer and paint should not be less than 500 microns.

4.03.06 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.

4.03.07 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.

4.03.08 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

4.03.09 All machined surfaces shall have two (2) coats of water repellant grease after thorough cleaning.

## 5.00.00 COATING PROCEDURE AND APPLICATION

5.01.00 Surface Preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 / NACE 2 / Sa2½ of ISO 8501 (near white metal)

a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.

b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 Application of Epoxy Coating

a) Coating shall be applied when

i) When the pipe surface temperature shall be atleast 3°C above dew point temperature.
ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater that 50°C.

b) Material preparation shall be in accordance with manufacturer's recommendations.

c) Application of epoxy coating system :

The epoxy coating system shall be applied as per recommendation of the manufacturer and shall be applied by airless spray / plural component spray machine. For more than one coat, the second shall be applied with the time limits as recommended by the manufacturer.

5.03.00 Application of PU Coating

a) PU coating shall be applied when the pipe surface temperature atleast 3°C above dew point temperature (when R.H is more than 85%).

b) Material preparation and application shall be done as per manufacturer recommendation.

## 6.00.00 TEST REQUIREMENTS :

### 6.01.00 Measurement of dry film thickness

Measurement of dry film thickness of coating : Coating thickness shall be in the range of ±20% and as per SSPC PA 2.

6.01.01 Apparatus / Instrument:-

The instrument used for dry film thickness may be Type 1 pull of gauges or Type 2 electronic gauges.

6.01.02 Procedures:-

a) Number of measurements:
For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).

b) If the structure is less than 300 square feet, each 100 square feet should be measured.

c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.

d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet

e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness. Area measurement must be within specified range.

### 6.02.00 Electrical Inspection (Holiday) Test

6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.

6.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.

6.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.

The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)

Testing Voltage V = 7900 $\sqrt{T}$ ± 10 percent where T is the average coating thickness in mm.

6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.

**6.03.00 Adhesion Pull off Test :**

After holiday the coated surface is subjected to adhesion pull off test as per ASTMD 4541.

6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:

A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling “Jaw” at the bottom and also dollies.

6.03.02 Prepare the test surface :

Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.

6.03.03 Prepare Dolly (Test Pull Stub) :

The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.

6.03.04 Select an adhesive:

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

6.03.05 Attach the dolly to the surface.

a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.

b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.

c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.

d) Push the dolly inward against the surface, then apply tape across the head of the dolly.

6.03.06 Adhesion Test Procedure

a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.

b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.

c) Slide the dragging indicator pin on the black column to zero by pushing it downward.

d) Firmly hold the base of the instrument in one hand and rotate the handwheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.

e) Read the scale and record the adhesion value.

**6.04.00 Coating Repair**

Defective Coating shall be repaired in accordance with the following subsections.

6.04.01 Surface Preparation:

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

6.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

6.04.03 Coating Application :

The coating system shall be applied to the prepared areas in accordance with procedure.

6.04.04 Repair Inspection :

Repaired portion shall be electrically inspected using a holiday detector.

**6.05.00 Welded Field Joints**

6.05.01 Preparation :

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid Epoxy / PU coating shall be feathered by abrading the coating surface for a distance of 25 mm.

6.05.02 Electrical Inspection :

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.

## 7.00.00 INFORMATION/DATA REQUIRED

The Bidder shall submit complete list of paints and primers proposed, giving detail information, such as, chemical composition, drying time etc. and also unit rates for application of each type of paint along with supply shall be furnished.

**NOTE-**

Bidder to note that the paint shade shall be informed/finalized during detailed engineering. The same shall be complied by bidder without any price & delivery implication to BHEL & Customer.

**ANNEXURE-V**

# LIST OF MANDATORY SPARES

| S.No. | Equipment/Package Name | Quantity |
|---|---|---|
| 1 | Spares for Horizontal Centrifugal Pumps | |
| 1.1 | Shaft | 1 No. |
| 1.2 | Shaft Sleeve | 2 Nos. |
| 1.3 | Impeller | 1 No. |
| 1.4 | Impeller locking nut and bolt | 4 Nos. |
| 1.5 | Impeller wear ring | 4 Nos. |
| 1.6 | Casing wear ring | 4 Nos. |
| 1.7 | Oil Seal | 4 Nos. |
| 1.8 | Oil Deflector | 3 Nos. |
| 1.9 | Oil Ring | 3 Nos. |
| 1.1 | Gland Packing | 4 Nos. |
| 1.11 | Lantern Ring | 3 Nos. |
| 1.12 | Mech Seal Assembly | 1 No. |
| 1.13 | Stationary/Carbon Packing and O “Ring for Mechanical Seal" | 3 Sets |
| 1.14 | Oil Level Gauge | 3 Nos. |
| 1.15 | Coupling | 2 Nos. |
| 1.16 | Rubber Bush for Coupling | 2 Nos. |
| 1.17 | O Rings " " | 2 Sets |
| 1.18 | Suction Strainers Element | 3 Nos. |
| 1.19 | Bearing for Pump Motor | 2 Sets |
| 2 | Spares for Vertical Type Centrifugal Pumps (at Neutralising Pit) | |
| 2.1 | Complete Bowl assembly | 1 Set |
| 2.2 | Impeller (s) | 1 Set |
| 2.3 | Shafts | 1 Set |
| 2.4 | Casing wearing (s) | 1 Set |
| 2.5 | Impeller wear ring (s) | 1 Set |
| 2.6 | Shaft Sleeves | 2 Sets |
| 2.7 | Shaft Couplings | 1 Set |
| 2.8 | Shaft nuts & keys | 1 Set |
| 2.9 | Lantern rings | 1 Set |
| 2.1 | Bell mouth liner | 1 Set |
| 2.11 | Bearings | 1 Set |
| 2.12 | Pump motor coupling | 1 Set |
| 3 | Spares for Agitators | |
| 3.1 | Gear Box Unit Complete | 1 No. |
| 3.2 | Bearing for Gear Box Unit | 1 Set |
| 3.3 | Coupling complete (Motor/Gear box and gear box/agitator) | 1 Set |
| 3.4 | Coupling Bolts | 1 Set |
| 3.5 | Coupling shim pack (if applicable) | 4 Sets |
| 3.6 | Oil seals | 4 Sets |
| 4 | Spares for Valves | |
| 4.1 | i) Diaphragm valves | 10% of total quantity used for each type and size with minimum no. two (2) for each type, size and rating. |

| | | |
|---|---|---|
| | ii) Spare Diaphragm for above | 10% of total quantity used for each type and size with minimum no. two (2) for each type and size. |
| 4.2 | i) Non return valves (NRV) | 2 nos. of each size & type |
| | ii) Flaps for above NRV | 2 nos. of each size |
| 4.3 | Gate/Globe/Ball valves/plug valve/needle valve | |
| | i) Up to 4” | 10% of total quantity used for each type and size with minimum no. two (2) for each type and size. |
| | ii) Above 4” | 1 no. each type and size. |
| 4.4 | Butter fly valve | |
| | i) Up to 4” | 10% of total quantity used for each type and size with minimum no. two (2) for each type and size. |
| | ii) Above 4” | 1 no. each type and size |
| 5 | Spares for Filter Media/ ION Exchange Resins | |
| 5.1 | Media for Activated Carbon Filters | 10% of total quantity |
| 5.2 | Resins for each type of exchangers | 10% of total quantity |
| 5.3 | Ejectors | Two (2)nos. of each type including chlorination application. |
| 6 | Spares for Air Blowers | |
| 6.1 | Impeller with shaft | 1 Set |
| 6.2 | Bearings | 1 Set |
| 6.3 | Oil seals | 5 Sets |
| 6.4 | Filter | 1 Set |
| 7 | Pneumatic Control Valve | |
| 7.1 | Pneumatic Diaphragm for Diaphragm actuated valve | 2 Nos. for each type of Actuator |
| 7.2 | Gland Packing | 1 set for each type of Control Valve |
| 7.3 | Plug, Seat, Cage, Stem etc. | 1 set for each type of Control Valve |
| 7.4 | Retainer Ring, Seal Ring etc. | 1 set for each type of Control Valve |
| 7.5 | Gasket | 2 Sets. for each type of Control Valve |
| 7.6 | Position Transmitter complete set | 10% of total quantity used in the system for each type and model. |
| 7.7 | Control Valve E/P Positioner complete Set | 10% of total quantity used in the system for each type and model. |
| 7.8 | Complete Set of Solenoid Valve for Pneumatic type On/Off Valve | 2 Nos. for each type & ratings |
| 7.9 | Solenoid Coil for Pneumatic type On/Off Valve | 5 Nos. for each type & ratings |
| 7.1 | Position Limit Switch for Pneumatic type On/Off Valve | 10 Nos. for each type & ratings |
| 8 | C&I Items | |
| 8.1 | Transmitters/ Gauges/Switches etc. along with relevant accessories | 10% of total or at least two (whichever is higher) for Each type along with accessories. |
| 8.2 | Temperature Element (RTD/Thermo-couple) with thermo well | 10% of each type, range and immersion length. Minimum 5 nos. |
| 9 | Electrical Items | |
| 10 | Motor | |
| 10.1 | HT Motor (other than BFP Motor) | |
| 10.1.1 | Driving End Bearing | 1No. (or 1Set as applicable) for each type and rating of Motor |
| 10.1.2 | Non-Driving End Bearing | 1No. (or 1Set as applicable) for each type and rating of Motor |

| | | |
|---|---|---|
| 10.1.3 | Cooling Fan Internal & External | 1Set for each type and rating of Motor |
| 10.1.4 | Bearing Temperature Gauge Driving & Non-Driving End | 1Set for each type and rating of Motor |
| 10.1.5 | Phase-Segregated Terminal Box | 1Set for each type and rating of Motor |
| 10.1.6 | Neutral End Terminal Bushing with Fasteners | 1No. for each type and rating of Motor |
| 10.1.7 | RTD for Bearing Temperature | 1No. for each type and rating of Motor |
| 10.1.8 | Motor Space Heater | 1No. for each type and rating of Motor |
| 10.1.9 | Complete Set of Coupling | 1Set for each Application |
| 10.2 | 415 Volt Motor (above 30KW Rating upto 200KW) | |
| 10.2.1 | End Shield Cover Driving & Non-Driving End | 1Set for each type and rating of Motor |
| 10.2.2 | Driving End & Non-Driving End Bearing | 1Set for each type and rating of Motor |
| 10.2.3 | Cooling Fan | 1No. for each type and rating of Motor |
| 0.2.4 | Motor Space Heater | 1No. for each type and rating of Motor |
| 10.2.5 | Motor Terminal Block | 1No. for each type and rating of Motor |
| 10.2.6 | Complete Set of Coupling | 1Set for each Application |
| 10.3 | 415 Volt Motor (Upto 30KW Rating) | |
| 10.3.1 | Driving End & Non-Driving End Bearing | 3Set for each type and rating of Motor |
| 10.3.2 | Cooling Fan | 2No. for each type and rating of Motor |
| 10.3.3 | Motor Terminal Block | 5No. for each type and rating of Motor |
| 10.3.4 | Complete Set of Coupling | 1Set for each Application |
| 10.4 | D C Motors | |
| 10.4.1 | Carbon brushes | 10 sets each type |
| 10.4.2 | Brush assemblies | 2 sets each type |
| 10.4.3 | Terminal blocks | 2 sets each type |
| 10.4.4 | Heaters | 2 sets each type |
| 10.4.5 | Pulleys | 2 sets each type |
| 10.4.6 | Bearings (DE and NDE) for each type and rating of motor | 4 sets |

**ANNEXURE-VI**

# PERFORMANCE GUARANTEES

1.01.0 **PERFORMANCE GUARANTEES, PERFORMANCE/ACCEPTANCE TESTS & LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE**

1.02.0 The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in this specification. The guarantees are categorised as:

a. Those which attract liquidated damages, as listed below (Category-"A"). The Bidder shall furnish signed declarations in the manner prescribed in the bid proposal schedules for these guarantees.

b. Those which do not attract liquidated damages, as listed below (Category-"B"). This guarantee list indicated in this section is not exhaustive and the Owner reserves the right to call upon the Bidder to demonstrate any parameter, operation, etc. of any equipment as specified and as required to meet the duty conditions.

1.03.0 The guaranteed parameters shall be without any tolerance values. The Bidder shall demonstrate all the guarantees covered in various volumes and sections of this specification during Performance/Acceptance test. In case during tests it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modification to make the equipment/system comply with guaranteed requirements. However, if the Contractor is not able to demonstrate the guarantees, even after the modifications, the Owner will at his discretion :

**i.** Reject the equipment and recover the payment already made or accept the equipment only after levying liquidated damages as identified in this section for those guarantees which are covered under **Category "A".**

**OR**

ii. Reject the equipment and recover the payment already made or accept the equipment only after assessing and deducting from the contract price an amount equivalent to the deficiency of the equipment/system as assessed by the Owner, for those guarantees which are covered under **Category ”B”.**

1.04.0 All guaranteed parameters shall necessarily be quoted by the Bidder based on the established proven results obtained from similar units in successful operation. Evidence for this shall necessarily include the test codes used, acceptance test results, accuracies of various instruments used for the performance test, details of tolerances, if allowed, etc. While quoting the guaranteed parameters, the Bidder shall keep in view the requirements specified in the specification especially regarding the reliability, operability and maintainability of the equipment proposed. The Owner reserves the right to evaluate the parameters quoted by the Bidder based on his experience and published material available.

1.05.0 The liquidated damages shall be calculated prorata for the fractional parts of the unit unless stated otherwise.

1.06.0 The turbine generator, boiler, auxiliaries, and all other plant equipment and system shall perform continuously without the noise level (individual or collectively) exceeding the values specified in respective equipment specification over the entire range of output and operating frequencies.

1.07.0 **Performance/Acceptance Tests**

1.07.01 The performance/acceptance tests for various equipment and systems shall be carried out as specified under the respective equipment specifications and those specified below shall be specifically applicable. All the guarantees shall be tested together as far as practicable.

1.07.02 In case of systems with stand-by equipment the liquidated damages for non-performance will be levied for normal operating number of equipment only. However, for this purpose all the equipment including standby equipment shall be tested and average values arrived at.

1.07.03 For instrument inaccuracies during PG Test, refer subsequent clauses of this section.

1.07.04 For Total Auxiliary Power Consumption, the transformers listed under the respective clauses, shall be taken together for purposes of guarantee and not individually.

**2.01.00 SCHEDULE OF GUARANTEES WHICH ATTRACT LIQUIDATED DAMAGES [CATEGORY-A]**

NOT APPLICABLE

**2.02.00 SCHEDULE OF GUARANTEES WHICH DO NOT ATTRACT LIQUIDATED DAMAGES FOR VARIOUS EQUIPMENT WHICH INCLUDE BUT ARE NOT LIMITED TO THE FOLLOWING [CATEGORY-B]:**

**2.02.00 CONDENSATE POLISHING UNIT (CATEGORY-B)**

2.02.01 The design flow (through working vessels) for each condensate polishing plant shall be the corresponding condensate flow of TG unit at VWO (Valve wide open) condition at 1% cycle make-up.

2.02.02 During Normal Operation, the following dissolved solids concentration and conditions shall be used as a basis of design for the condensate polishing system. The ionic concentrations indicated below are as such.

| CONTAMINANT | UNIT | INFLUENT | EFFLUENT |
|---|---|---|---|
| Ammonia | ppb | 250 | Below detectable limit. |
| Total dissolved solids (TDS, ammonia excluded) | ppb | --- * | < 25 |
| Conductivity (at 25$^{O}$C) (After removal of all amines) | Micro S/cm | -- | < 0.1 (after hydrogen column at 25 $^{O}$ C) |
| Silica (as $SiO_2$ ) | ppb | 30 | < 5 (Refer note # 1) |
| Total Ferric Iron (Dissolved) | ppb | 50 | < 2 |
| Sodium(as Na) | ppb | 10 | < 2 |
| Chloride (as Cl) | ppb | 20 | < 2 |
| pH (polisher runs at 25$^{O}$C with H/OH mode) | | 8.5-9.0 | 6.5-7.5 |
| Crud (mostly black oxide of iron) | ppb | 50 | < 5 |

**Note : 1. Silica value shall be 7 ppb in case the temperature of the condensate is 50 deg C & above.**

* Bidder to derive Total dissolved solids at influent from the influent contaminants stated above.

Under the Normal Condition, each Condensate Polisher Mixed Bed shall be designed to operate in hydrogen cycle for not less than 240 hours of continuous operation, while maintaining the above treated condensate quality.

2.02.03 During start up conditions, quality of the influent may deteriorate to –

| CONTAMINANT | UNIT | INFLUENT | EFFLUENT |
|---|---|---|---|
| Ammonia | ppb | 1500 | Below detectable limit. |
| Total dissolved solids (TDS, ammonia excluded) | Ppb | -- * | < 50 |
| Conductivity(at 25$^{O}$C) (After removal of all amines) | Micro S/cm | -- | < 0.2 (after hydrogen column at 25 $^{O}$ C) |
| Silica (as $SiO_2$ ) | ppb | 500 | < 20 (Refer note # 1) |
| Crud (mostly black oxide of iron) | ppb | 1000 | < 100 |
| pH(polisher runs at 25$^{O}$C with H/OH mode) | | 9.0-9.6 | 6.5-7.5 |
| Total Ferric Iron (Dissolved) | ppb | 1000 | < 10 |
| Sodium(as Na) | ppb | 20 | < 5 |
| Chloride (as Cl) | ppb | 100 | < 10 |

**Note : 1. Silica value shall be 7 ppb in case the temperature of the condensate is 50 deg C & above.**

* Bidder to derive Total dissolved solids at influent from the influent contaminants stated above.

Useful service run under this condition shall be 48 hours before regeneration.

2.02.04 Under condenser tube-leakage condition, the plant shall be designed for 2000 ppb TDS in addition to the normal influent contaminants stated in as specified at clause no 2.02.02 of this Sub-section above. The cation and anion load in 2000 ppb TDS shall be based on the circulating water analysis furnished as section B of the specification. Under such condition, both sodium content and silica content of the effluent shall be limited to less than 20 ppb. Useful service run between regeneration under the Startup conditions and under condenser tube leakage condition shall not be less than 48 hours each.

2.02.05 Influent water quality as indicated in the above clauses is minimum only. Bidder to check the same and higher values, if felt by them, shall be considered in the design so as to meet the specified effluent quality.

2.02.06 The bed cross section shall be such that the velocity of condensate through it, shall not exceed 1.75 meters/min at the design flow rate. Internal diameter of the service vessels (excluding the rubber lining) of spherical type shall be selected meeting the above mentioned velocity criteria.The effective depth of the mixed resin bed in the condensate polisher service vessels shall not be less than 1100 mm.

2.02.07 At the design flow rate, the pressure drop across the polisher service vessels with clean resin bed shall not exceed 2.0 bar.. This pressure drop shall include losses due to entrance and exit nozzles, distributors, under drains, resins and the effluent resin traps. Maximum pressure drop under dirty conditions will be restricted to 3.5 bar including the pressure drop across effluent resin traps.

2.02.08 Cation resins shall be regenerated by technical grade hydrochloric acid to IS:265 (concentration 30-33% by volume) and anion resins by sodium hydroxide, rayon grade to IS:252 available as 40-48% lye or as flakes.For calculations regeneration temperature should be taken as 25 Deg. C.

In no case, the regeneration levels cannot be lower than the values indicated below:

a) Cation resin : 125 kg of 100% HCl per cubic meter of resin

b) Anion resin : 160 kg of 100% NaOH per cubic meter of resin.

2.02.09 Each rinse water outlet header of condensate polishing unit shall be provided with a pressure reducing station with isolating valves, suitably designed to enable the water entry to the both condenser's hot well which is operating under vacuum. Each pressure reducing station shall consist of either a pressure reducing valve from design pressure of service vessel to condenser vacuum or a combination of orifice plates to reduce pressure from design pressure of service vessel to 2 kg/cm2 and a pressure reducing valve from 2 kg/cm2 to condenser vacuum.

2.02.010 While calculating pump head, 10% margin (minimum) shall be considered of the value of friction losses. Pipe friction loss shall be calculated as per Willam-Hazen formula and "C" value to be adopted shall be as below:-

1. Carbon Steel pipe : 100
2. CI pipe/ductile Iron : 100
3. Rubber lines steel pipe : 120
4. Stainless steel pipe : 100

2.02.011 Pump recirculation with a regulating valve shall be provided for all the pumping system.

2.02.012 Each Pump shall be guaranteed for capacity, total dynamic head and power consumption.

2.02.013 All blowers shall be guaranteed for head and power consumption.

2.02.014 Each Condensate Polisher Mixed Bed will have a rated continuous treated water output capacity of not less than design value. Each Condensate Polisher Mixed Bed Unit shall be regenerated once after every 240 hours of continuous service run during normal operation.

2.02.015 Net output from each of Condensate Polisher Mixed Beds shall be not less than design volume of treated water for the design water analysis as exhibited in cl. no. 2.02.02, 2.02.03 & 2.02.04.In case water analysis is different from the design values, guaranteed quantity shall be calculated as indicated elsewhere in this Specification and guarantee shall be applicable on this calculated quantity.

2.02.016 Chemical consumption of the Condensate Polisher Mixed Bed as indicated by the Bidder shall be guaranteed against the regeneration level employed and resin volume provided without any tolerance.

2.02.017 Qualities of treated water from Condensate Polisher Mixed Bed shall be as per treated water analysis as exhibited in cl. no. 2.02.02, 2.02.03 & 2.02.04.

**2.02.018 Liquidate Damages (LD) for Non Achievement of Specific Performance:**

The performance Guarantee parameters for Condensate Polishing System have been indicated in above clauses.

No negative tolerance in respect flow, head and other performance guarantee parameters are acceptable to the Purchaser. In case, any equipment of Condensate Polishing System is not able to achieve the performance guarantee parameters during the Performance Guarantee Tests, Bidder shall make necessary modifications or replace the Equipment/ Plant or any part. If even after rectification, the Equipment/Plant is not able to achieve the guaranteed performance parameters, the Purchaser shall have right to reject the Equipment/Plant. In such case, the Bidder shall pay back the total amount paid to them with reference to the Equipment/Plant (with all taxes and duties as applicable) to the Purchaser.

# DATA SHEET-A

| | | | |
|---|---|---|---|
| **1.0** | **DESCRIPTION OF TG UNIT FOR WHICH CONDENSATE POLISHING IS TO BE PROVIDED :** | | |
| (i) | No. of units | One (1) | |
| (ii) | Capacity of unit | 800 MW | |
| (iii) | Total flow in all the service vessels of units | 1648.061 t/hr (VWO, 1% Make Up condition) | |
| **2.0** | **CONDENSATE POLISHER SERVICE VESSELS PER UNIT :** | | |
| (i) | No. of condensate polisher service vessel | Three (3X50%) | |
| (ii) | Capacity of each condensate polisher service vessel | 50% of total condensate flow per unit | |
| (iii) | Flow through each condensate polisher service vessel per unit | 825 Tones per hour | |
| (iv) | Operating pressure of each condensate polisher service vessel | 37.0 kg/cm $^2$ (a) | |
| (v) | Design pressure of each condensate polisher service vessel | 47.0 kg/cm $^2$ (g) | |
| (vi) | Design code of each condensate polisher service vessel | ASME sec VIII div 1 (Latest edition) | |
| (vii) | Design Temp. | 60 $^0$C | |
| (viii) | Type of vessels | Spherical | |
| (ix) | Material of construction | | |
| | Shell | Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. | |
| | Head | Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. | |
| (x) | Inside protection | Inside lined with Natural Rubber [4.5 mm thick in (3) layers] | |
| **2.1** | **RINSE RECIRCULATION PUMPS PER UNIT** | | |
| (i) | Number | Two (2x100%) | |
| (ii) | Type | Horizontal, centrifugal | |
| (iii) | Operation | Intermittent | |
| (iv) | Capacity & head | As required | |
| (v) | Suction condition | Flooded | |
| (vi) | Material of construction | | |
| • | casing, impeller | SS 316 | |
| • | Shaft | SS 410 | |
| • | shaft sleeve material | SS 410 | |
| (vii) | Packing seal | Mechanical type | |
| (viii) | Pump Speed | Maximum 1500 rpm | |
| (ix) | Accessories required for each | Common base plate, coupling guards, drain plug, vent valve, suction hoses, isolation valves, Y-type strainers etc. | |
| **2.2** | **AIR-BLOWERS FOR RESIN MIXING (SERVICE VESSELS AREA)** | | |
| (i) | Number per unit | Two (2x100%) with acoustic enclosure. | |
| (ii) | Type | Rotary, Twin Lobe, oil free, positive displacement | |
| (iii) | Duty | Intermittent | |

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|---|---|---|
| (iv) | Capacity and head | As required |
| (v) | Pressure gauge | One per blower |
| (vi) | Capacity and head/Noise Level | As required/80 dB (A) Max. at one meter |
| (vii) | Material of construction | Casing – Cast Iron GR FG 260 to IS 210<br>Lobe – Cast Iron GR FG 260 to IS 210<br>Shaft – Carbon Steel to EN 8 |
| **3.0** | **EXTERNAL REGENERATION FACILITIES** | |
| **3.1** | **REGENERATION VESSELS** | |
| a. | **RESIN SEPARATION AND CATION RESIN REGENERATION VESSEL** | |
| (i) | Number | One (1) no. vessel |
| (ii) | Design Temperature | $60^0$C |
| (iii) | Design Pressure | Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction.( Min.8 kg/cm2(g).) |
| (iv) | Material of construction | |
| | Shell | Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. |
| | Head | Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. |
| (v) | Inside protection | Inside lined with Natural Rubber [4.5 mm thick in (3) layers] |
| (vi) | Design code | ASME sec VIII div 1 (Latest edition) |
| b. | **ANOIN RESIN REGENERATION VESSEL** | |
| (i) | Number | One (1) no. vessel. |
| (ii) | Design Temperature | $60^0$C |
| (iii) | Design Pressure | Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction. .( Min.8 kg/cm2(g).) |
| (iv) | Material of construction | |
| | Shell | Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. |
| | Head | Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. |
| (v) | Inside protection | Inside lined with Natural Rubber [4.5 mm thick in (3) layers] |
| (vi) | Design code | ASME sec VIII div 1 (Latest edition) |
| c. | **MIXED RESIN STORAGE VESSEL** | |
| (i) | Number | One (1) no. vessel. |
| (ii) | Design Temperature | $60^0$C |
| (iii) | Design Pressure | Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction. .( Min.8 kg/cm2(g)) |
| (iv) | Material of construction | |
| | Shell | Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. |
| | Head | Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. |
| (v) | Inside protection | Inside lined with Natural Rubber [4.5 mm thick in (3) layers] |
| (vi) | Design code | ASME sec VIII div 1 (Latest edition) |

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| **3.2** | **BULK ACID AND ALKALI STORAGE TANKS** | | |
| (i) | **CHEMICAL TANKS** | **ACID STORAGE TANKS** | **ALKALI STORAGE TANKS** |
| (ii) | Number required | One(1) | One(1) |
| (iii) | Design code | As per BS : 12285 | |
| (iv) | Location | ----------Outdoor---------- | |
| (v) | Useful capacity | Adequate to hold the quantity of acid required for 30 days of operation. | Adequate to hold the quantity of acid required for 30 days of operation. |
| (vi) | Type | --Horizontal cylindrical with dished ends, atmospheric, above ground------- | |
| (vii) | Material of construction | Shell-SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.<br>Dish end – SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. | |
| (viii) | Internal painting / lining | Inside lined with Natural rubber (4.5 mm thick in three layers) | |
| (ix) | Concentration | 30 -33 % HCl | 48 % NaOH |
| (x) | Accessories for each tank | Fume absorbers (for acid storage tank), carbon dioxide absorber (for alkali storage tank), manhole (2 Nos. Minimum.) , vent, overflow, drain, sample connection, operating platform, ladders, lifting lugs (4 nos. Minimum) etc. | |
| **3.3** | **ACID AND ALKALI UNLOADING / TRANSFER PUMPS** | | |
| (i) | **PUMPS** | **ACID UNLOADING/TRANSFER PUMPS** | **ALKALI UNLOADING PUMPS** |
| (ii) | Number required | Two (2x100%) | Two (2x100%) |
| (iii) | Type | ----------Horizontal Centrifugal---------- | |
| (iv) | Location | ----------Outdoor---------- | |
| (v) | Capacity and head | ----------10 cum / hr and 10 mlc---------- | |
| (vi) | Liquid to be handled | 30 -33 % HCL | 48% NaOH |
| (vii) | Material of construction of wetted parts of pumps | | |
| (viii) | Casing, Impeller | Polypropylene | Stainless Steel (SS) – 304 |
| (ix) | Shaft | Hardened carbon steel EN8 | Stainless Steel -410 |
| (x) | Reinforced rubber hosed | Two nos of size 80 NB | Two nos of size 80 NB |
| (xi) | Accessories required for each pump | Coupling guard, drain plug, vent valve, suction hoses, isolation valves, y- type strainers etc. | |
| (xii) | Pressure Dampener | ----------One per pump---------- | |
| (xiii) | Type of shaft sealing | Mechanical Seal | |
| **3.4** | **CHEMICAL HANDLING, PREPARATION & DOSING SYSTEM** | | |
| **a)** | **ALKALI TRANSFER PUMPS** | | |
| (i) | Nos. required | Two (2x100%) | |
| (ii) | Type | Horizontal, centrifugal | |
| (iii) | Service | Intermittent | |
| (iv) | Concentration of working media. | 5-48% Sodium Hydroxide (NaOH) | |
| (v) | Capacity & head | 10 M3/hr, 10 MWC | |
| (vi) | Suction condition | Flooded | |
| (vii) | Pressure Dampener | One per pump | |
| (viii) | Type of shaft sealing | Mechanical Seal | |
| (ix) | Materials of construction | | |
| 1) | Casing, impeller | Stainless Steel – 304 | |
| 2) | Shaft | Stainless Steel -410 | |
| (ix) | Accessories required | Coupling guard, drain plug, vent valve, suction hoses, isolation valves, y- type strainers | |

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| | for each pump | etc. | | |
| **b)** | **CHEMICAL TANKS** | **ALKALI PRARATION TANK** | **ALKALI MEASURING TANK** | **ACID MEASURING TANK** |
| (i) | Number required | One (1) | | |
| (ii) | Type | ----------Vertical Cylindrical Atmospheric, with dished ends ---------- | | |
| (iii) | Useful capacity | Adequate to hold the quantity of acid & alkali required for single regeneration of a condensate polisher mixed bed + 20% margin | | |
| (iv) | Type of fluid to be handled | 40-48% Sodium Hydroxide | | 30-33% Hydrochloric Acid. |
| (v) | Materials of construction | Shell-SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.<br>Dish end – SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. | | |
| (vi) | Vent, Overflow, drain connection | Required | | |
| (vii) | Stirrer | Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 rpm max<br>Material of Construction of each stirrer and agitator = Stainless Steel – 316. | | NA |
| (viii) | Dissolving Basket per tank | ---------- (50-60 mesh B.S.)----------<br>Material of Construction of each Dissolving Basket = Stainless Steel 316. | | NA |
| (ix) | Accessories | Fume absorbers, carbon dioxide absorber, manhole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs etc. | | |
| (x) | Internal painting / lining | Inside lined with Natural rubber (4.5 mm thick in three layers) | | |
| **c)** | **DOSING PUMPS** | **ACID DOSING PUMPS** | | **ALKALI DOSING PUMPS** |
| (i) | Number | Two (2x100%) | | Two (2x100%) |
| (ii) | Type | Positive displacement hydraulically operated diaphragm type with stroke adjustment. | | |
| (iii) | Duty | Continuous and suitable for parallel operation | | |
| (iv) | Range of operation (%) | 0-100 | | |
| (v) | Whether suction strainer required | ---------- Yes ---------- | | |
| (vi) | Accessories | | | |
| (vii) | Pressure Dampener | One per pump | | One per pump |
| (viii) | External safety relief valve (in addition to inbuilt safety valve) | Two (Polypropylene) | | Two (SS:316) |
| (ix) | Maximum pump stroke speed per minute | ---------- 100 ---------- | | |
| (x) | **MATERIAL OF CONSTRUCTION** | | | |
| (xi) | Liquid End (Pump Head, Valves, Valve housing, valve spring etc.). | polypropylene | | SS316 |
| (xii) | Diaphragm | P.T.F.E | | |
| (xiii) | Packing | P.T.F.E | | |
| (xiv) | Shaft | -------- Hardened steel EN 8 (BS:970)-------- | | |
| (xv) | Worm & worm wheel(if applicable) | ..... Manganese Bronze..... | | |
| (xvi) | Connecting rod | ..... Manganese Bronze..... | | |
| (xvii) | Cross head guide | ..... Bronze..... | | |

| | | |
|---|---|---|
| (xviii) | Capacity & Head | Capable of meeting regeneration of one cation/Anion and one mixed bed unit; head as required (with 20% margin). |
| (xix) | Accessories required for each pump | Coupling guard, drain plug, vent valve, isolation valves, Y- type strainers, pressure gauges, pulsation dampener etc. |
| **3.5** | **ACTIVATED CARBON FILTER FOR ALKALI** | |
| (i) | Number | One (1) |
| (ii) | Type | Vertical cylindrical with dished end bottom |
| (iii) | Design Pressure | Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction. .( Min.8 kg/cm2(g).) |
| (iv) | Design Temperature | $60^0$C |
| (v) | Capacity | Not less than 10 m3/hr |
| (vi) | Velocity | Not more than 15 m/hr |
| (vii) | Bed depth | 1200mm activated carbon + 300mm Gravel support (Min) |
| (viii) | Material of construction | |
| | Shell | Carbon steel plates to IS 2062 / SA 515 Gr. 60 or 70 |
| | Head | Carbon steel plates to IS 2002 Gr. 2A / SA 515 Gr. 60 or 70. |
| (ix) | Inside protection | Inside lined with Natural Rubber [4.5 mm thick in (3) layers] |
| (x) | Design code | ASME sec VIII div 1 / IS 2825 (Latest edition) |
| (xi) | Influent Distributor Material | SS 316 |
| (xii) | Manhole | Two (2) nos minimum each of Davit type and 500 mm dia. |
| (xiii) | Sight Windows | One (1) no. in backwash space |
| (xiv) | Hand hole | One (1) no. of 150 mm dia for removal of activated carbon |
| (xv) | Accessories | Manhole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs (4 Nos minimum) etc. |
| (xvi) | Filter Media | |
| a) | Type | Activated carbon |
| b) | Characteristics of Activated Carbon | Grade : Suitable Grade.<br>Bulk Density : Not less than 400 kg/$m^3$.<br>Particle Density wetted in water : 1.3-1.4 gm/cc.<br>Effective size, mm : 0.8-0.9 mm.<br>Uniformity Coefficient : 1.5-1.6.<br>Mean particle dia : 1.2-1.4 mm.<br>Total surface area : Not less than 850 $m^2$/gm.<br>Iodine no. : Minimum 850.<br>Carbon content : Not less than 90%.<br>Moisture content : 5% (max).<br>Ash content : 8% (max). |
| c) | Bed depth in mm | Activated Carbon - minimum 1200 and Support Gravel - minimum 300. |
| d) | Percentage freeboard | 75 % minimum. |
| (xvii) | Details of Regeneration of Filter Media | |
| a) | Backwash | Backwash by reversible flow of filtered water. |
| b) | Backwash Velocity | As per system req. |
| **3.6** | **ALKALI DILLUENT WATER HEATING TANK (HOT WATER TANK)** | |
| (i) | Number | One (1) |
| (ii) | Type/Capacity | Vertical Cylindrical with dished end with Electric heater / 120% of water required for single |