

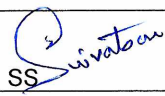
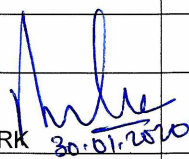


SPECIFICATION FOR
PRE - TREATMENT SYSTEM

SPEC.NO.ROS: 6260
REV.: 00

**BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET- 632 406.**

**TECHNICAL SPECIFICATION
FOR
PRE - TREATMENT SYSTEM**

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1.0 SCOPE OF SUPPLY & SERVICES

The intent of this specification is to cover Design, Engineering, Manufacturing, shop testing, supply, Transportation, erection & commissioning, performance guarantee test and handing over of **Pre-Treatment system** as mentioned below.

The scope shall fully cover the requirement of Design Criteria and Technical requirement of this specification for treating raw seawater. The scope of supply & services shall include but not limited to the following.

It may be noted & understood that all major Site civil works of the PT plant System are in the scope of BHEL. The scope of the successful bidder includes complete design & analysis of the civil items and submission of the same to BHEL for approval up to RFC to site. Successful bidder shall furnish all the requisite drawings of the civil construction. Failure to comply with this requirement shall render the offer unacceptable.

Scope of supply:

- a. Flow control station consisting 1no. Motorized inching type butterfly valve with isolation (manual butterfly) valves in upstream and downstream along with bypass line with isolation (manual butterfly) valve at the inlet to stilling chamber.
- b. 1 no. stilling chamber (RCC) – in BHEL Scope
- c. 2 nos. Parshall flume (one per stream) for flow measurement
- d. 2 x 60% Flash mixer tanks (RCC) - in BHEL Scope, Agitators, motor & acc – in Bidder's scope of supply.
- e. 2 x 60% Flocculators tanks (RCC) - in BHEL Scope, Agitators, motor & acc.- in Bidder's scope of supply
- f. 2 x 60% Lamella clarifiers/ tube settlers (RCC) - in BHEL Scope, All internals with accessories & mechanical items in Bidder's scope
- g. 1 no. Sludge pit (RCC) – in BHEL Scope
- h. 2 x 100% Sludge pit air blowers, motor & acc.
- i. 1 x 100% diffusers for Sludge pit
- j. 2 x 100% Sludge transfer pumps, motor & acc.
- k. 2 nos. Ferric Chloride Dosing Tank (RCC) - in BHEL Scope, Agitators, motor & acc.- in bidder's scope of supply.
- l. 4 x 50% Ferric Chloride dosing pumps with motor & acc.
- m. 2 nos. Polyelectrolyte dosing tank (RCC) - in BHEL Scope, with agitators, motor & acc- in bidder's scope of supply.
- n. 4 x 50% Polyelectrolyte dosing pumps with motor & acc.
- o. 1 Lot of piping system for interconnecting from raw sea water piping terminal point, flow control station, stilling chamber, flash mixer, flocculator, lamella clarifier/ tube settler, clarified water storage tank (tank in BHEL scope), drain piping from above systems to Sludge pit, sludge pit air blowers piping to sludge pit including diffusers,
- p. 1 Lot of Valves for the scope of piping
- q. 1 Lot of Gate valves for clarified water storage tank as indicated in P& ID.

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- r. 1 Lot of puddle pipes for all the tanks and structures
- s. 1 Lot of miscellaneous items such as Foundation bolts for all the equipment, pumps, agitators, gaskets, fasteners, bellows etc.,
- t. 1 set of Electricals, controls & instrumentation as per enclosed tender P&ID
- u. 1 set of commissioning spares
- v. 1 set of mandatory spares

Scope of services:

- w. Design and engineering of entire pretreatment plant
- x. Complete civil design of Entire pretreatment plant (excluding chemical house building).
- y. Minor civil work including chipping of foundation, grouting below base plate for all structures, equipment, grouting of anchor bolts wherever these are not placed in the foundation during casting of foundation itself etc. To the extent possible, vendor shall ensure to supply all foundation bolts timely so as to facilitate placement of these bolts while casting the foundation. Wrapping, coating and protection of all the buried pipe shall be as per IS 10221.
- z. Precommissioning work such as flushing, hydraulic testing etc. Necessary consumables as required for inspection and testing at works as well as at site including precommissioning activities shall be arranged by the successful bidder at their own cost.
- aa. Supervision of all works of clarifier.
- bb. Preparation of civil assignment drawings i.e. pedestals details; insert plates / embedment's plates required for supporting pipes and equipment etc. In case any modification is required in the civil work already done based on civil inputs given by vendor, rework shall be done at the cost and risk of the bidder.
- cc. Erection, Commissioning, PG test & handing over as per ROS 9064.

Items though not mentioned but required to make the system complete as stipulated under these specifications shall be supplied unless otherwise specifically excluded. Bidder to list out the same in their offer.

- 1.1 It is not the intent to specify all details of the design & manufacture. However, the equipment shall conform in all respects to standard of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Engineer / Customer, who will interpret meaning of drawing & the specification and shall be entitled to reject any work or material, which is not in accordance herewith.
- 1.2 In case of any deviation, Bidder shall indicate the same, referring to specific clause in the deviation schedule. In the absence of filled in "Deviation Schedule", it shall be construed that bid conforms strictly to the specification.
- 1.3 General terms & conditions, instructions to the bidder & other attachments referred to elsewhere are part of this specification.

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- 1.4 Any contradiction between various parts or contents of the specification shall be a matter for clarification shall be obtained by the bidder. Customer's decision shall be final. However, as a general guideline, details furnished in this specification shall prevail.
- 1.5 Material shall be dispatched to site as per bidder's shipping list approved by customer. The format for the shipping list & quality plan will be given by customer after order to the successful bidder.

2.0 PROJECT INFORMATION

- 2.1 Owner : Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)
- 2.2 Project Title : 2x660MW Udangudi Supercritical Thermal Power Project Stage-1
- 2.3 Location : Udangudi, Thoothukudi District, Tamil Nadu - 628215
- 2.4 Nearest Railway Station / Access Road : Tiruchendur, Thoothukudi Dist./ East Coast Road – State highway 176

3.0 TECHNICAL REQUIREMENT

3.1. PRE-TREATMENT SYSTEM CAPACITY

- No. of Streams : 2W x 60%
- Lamella Clarifier/Tube settler outlet capacity : 1762m³/hr per stream,
3524 m³/hr (100%) total
~4229 m³/hr (120%) total

3.2. FEED WATER QUALITY

S.No	Description	Unit	Value
1.	General		
a)	pH	---	7.98 - 8.1
b)	Conductivity	μS / cm	53700
c)	Temperature range/ design	Deg C	(25 – 33) / 29
d)	Turbidity	NTU	100

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S.No	Description	Unit	Value
e)	Total Suspended Solids (TSS)	mg/l	100
f)	Total Dissolved Solids (TDS)	mg/l	38000
g)	BOD @ 27 Deg C for 3 days	mg/l	11*
h)	COD	mg/l	62*
i)	Oil and Grease (free)	mg/l	< 1
j)	Phenols	mg/l	Nil
k)	Free residual chlorine	mg/l	< 0.2
2.	Cations		
a)	Calcium	mg/l	409
b)	Magnesium	mg/l	1274
c)	Sodium	mg/l	12600
d)	Potassium	mg/l	380
e)	Ammonia	mg/l	Nil
f)	Strontium	mg/l	2.37
g)	Barium	mg/l	Nil
h)	Zinc	mg/l	0.1
i)	Nickel	mg/l	Nil
j)	Copper as Cu	mg/l	Nil
k)	Cadmium as Cd	mg/l	Nil
l)	Lead as Pb	mg/l	Nil
m)	Mercury as Hg	mg/l	Nil
n)	Aluminium Total	mg/l	Nil
o)	Aluminium Dissolved	mg/l	Nil
p)	Manganese Total	mg/l	Nil
q)	Manganese Dissolved	Micro g/l	Nil
r)	Iron Total	mg/l	0.49
s)	Iron Dissolved	mg/l	0.25
3.	Anions		
a)	Chloride	mg/l	21088
b)	Sulphate	mg/l	3396
c)	Nitrate	mg/l	1.62
d)	Nitrite	mg/l	0.04
e)	Bicarbonate as HCO ₃	mg/l	140
f)	Carbonate	mg/l	Nil
g)	Fluoride	mg/l	1.4
h)	Boron	mg/l	1.38

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S.No	Description	Unit	Value
i)	Phosphate	mg/l	0.16
j)	Sulphide as H ₂ S	mg/l	Nil
k)	Silica Dissolved	mg/l	0.25
4.	Density of Sea water	Kg /m³	1030

Note:

1. * All BOD and COD in suspended form
2. A margin of 10% on TDS shall be considered for accommodating variation (if any) in water quality during execution

3.3. GUARANTEED OUTLET WATER QUALITY

The plant design should meet the outlet water quality at Clarifier outlet as indicated below.

Sl.No	Description	Unit	Water Quality Considered for design
	Physical Parameters		
1	pH		6.5-8.5
2	TSS	ppm	<10
3	Turbidity	NTU	<10

4.0 TECHNICAL SPECIFICATION - MECHANICAL

4.1. DESIGN CRITERIA

Sea water from Sea water intake system with required residual chlorine is pumped to pre-treatment plant boundary by Desalination supply pumps. The sea water shall then be admitted through flow control station, stilling chamber to Clarification system for reduction of suspended solids. Clarified water shall be stored in Clarified water storage tank and the sludge from Clarifiers shall be collected in sludge sump. Sludge shall then be transferred using Sludge transfer pumps for further disposal to Ash pond.

Ferric Chloride and polyelectrolytes dosing systems shall be provided to enhance coagulation and effective settling of solids.

4.2. EQUIPMENT SPECIFICATION:

The technical requirement of the equipment is indicated below. The corresponding P & ID drawing and the layout drawing shall be collectively referred along with this specification. The sizes of the channels, piping & valves shall be as per the velocity guidelines mentioned elsewhere in the specification.

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4.3.1. Flow control station:

a) Motorized Butterfly valve

- 1) Quantity : 1 No.
- 2) Type : Flow control valve'
- 3) MOC
 - a. Body : Ductile iron
 - b. Disc : Duplex SS 2205
 - c. Seat : EPDM
 - d. Actuator : Inching type motorized (Refer spec. **ROS 4263**)

b) Manual Butterfly valve

- 1) Quantity : 3 Nos.
- 2) MOC
 - a. Body : Ductile iron
 - b. Disc : Duplex SS 2205
 - c. Seat : EPDM

4.3.2. Stilling chamber:

- 1) Quantity : 1No.
- 2) Retention time : 1 minute
- 3) Capacity : 73 m³
- 4) MOC : RCC (with suitable internal painting)

4.3.3. Parshall Flume

- 1) Quantity : 1no. for each clarifier

4.3.4. Flash mixer:

- 1) Quantity : 2X60%
- 2) Retention time : 1 minute
- 3) Capacity : 37m³ each stream
- 4) Tank MOC : RCC (with suitable internal painting)
- 5) Agitator MOC : MS-FRP
- 6) Agitator : With gearbox & Motor (suitable size)
- 7) Motor : Refer motor specification ROS 4261

4.3.5. Flocculator:

- 1) Quantity : 2X60%
- 2) Retention time : 20 minutes
- 3) Capacity : 727m³ each stream
- 4) Tank MOC : RCC (with suitable internal painting)
- 5) Agitator MOC : MS-FRP
- 6) Mechanism : With gearbox & Motor (suitable size)

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7) Motor : Refer motor specification ROS 4261

4.3.6. Lamella Clarifier/ Tube settler:

- 1) Quantity : 2X60%
- 2) Type : Lamella type clarifier/ tube settlers
- 3) Design : As per CPHEEO manual on water supply and treatment.
- 4) Tank MOC : RCC (with suitable internal painting)
- 5) Capacity : 1762 m³/hr (at 50%) each
/ 2115 m³/hr (at 60%) each
- 6) MOC of Internals : All steel parts shall be FRP lined
- 7) Inclined plates & tube packs : Shall be FRP/ GRP / PVC / SS
- 8) Shape of inclined plates/tubes : Circular / Square / Rectangular
- 9) Submergence of plate/tube : 500mm -750mm from Top
- 10) Angle of inclination of plates/tubes: 60° (to the horizontal plane)
- 11) Surface loading in Clarifier : 80 – 206 m³/m²/day of horizontal projected area
- 12) Sludge removal mechanism : By gravity
- 13) Water losses in de-sludging : 3% (maximum)

Note:

1. The tube settler/ Lamella Clarifiers shall be circular/ rectangular with distinct tube / plate separation zones, sludge thickener zone, clear water zone and oil skimming zone.
2. The tube settler/ Lamella Clarifiers shall be counter flow or cross flow type.
3. The water shall flow up from the bottom of the tube/ plate pack through all the plates for 100% flow exposure to the entire plate surface area.
4. The Bidder shall justify the design basis of entire plate/tube type separator unit and individual components of the entire unit with backup calculations.
5. The material of construction of tube settler/ Lamella Clarifiers shall be as specified in Data Sheets with an upper tank containing the inclined lamella plates/ tube packs and a lower tank-underflow chamber.
6. The inclined tubes/plates shall be spaced so that stable flow conditions are available. The flow through the tube/plates shall be viscous /laminar.
7. The tubes/plates shall be arranged such that the complete water travels through all the tubes across the cross section of separator.
8. To ensure full utilization of all plate areas, velocities through the unit shall be kept sufficiently low to prevent the shearing of floc particles. Flow velocity calculation shall be submitted for feed ducts, feed bay and plate/tube packs separators during detailed engineering.
9. Water shall flow up through the plate pack and uniformly crest over the adjustable water weir and into the overflow chamber. A fixed water weir shall control the clarification chamber water level. The water over weir shall provide an even water distribution across the width and length of the chamber. This clarifier shall be provided with an effluent outlet at one side of the clarifier. The clarifier tanks shall be in RCC construction as specified. (RCC tanks civil works in BHEL

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scope. Design, Analysis, & detail design drawings shall be furnished by Successful bidder.

10. Overflow from the clarifier shall be led by gravity to Clarified water storage tank.
11. The length of the tubes/plates through which the water flows, shall not be less than 1.5 M.
12. The plates shall be supported by dividers constructed of stainless steel, Teflon or moulded plastic inserts and shall be individually removable. The plates shall be a minimum of 2.28 mm thick FRP. The plates shall have a resin rich surface. The plates shall be produced by contact moulding or machine extrusion, "hand or spray lay-up fabrication" are not acceptable. Gasket materials utilized in the plate construction shall be Viton or Teflon. All assembly clips shall be constructed of Teflon.
13. The entire pack shall be rigid and shall not deflect by self-weight, water load or operator movement over the pack. Tube packs / plates shall be supported adequately to withstand a load of 100% filled with sludge of specific gravity 1.4 or above, with all water drained from the clarifier, without any collapse of the assembly.
14. The clarifier shall have an RCC underflow chamber with sludge collecting hopper located below the plate zone. Design of the sludge removal system shall be such as to minimize loss of water during sludge blow off within 3% of rated flow. Angle of inclination of sludge hopper shall be minimum 55° to horizontal plane for effective collection of sludge. To remove settled particles from the plates/tubes suitable water jet arrangement shall be provided. Pumping and piping arrangement shall be separately provided for this purpose (Pump Capacity to be defined). The tube/ plates shall be easily accessible for cleaning purpose. The tube pack / plates shall be placed inside the separator such that these may be individually removed for maintenance even when separator is operating.
15. The tube settler/ Lamella Clarifiers shall employ positive removal system of consistent density, central sludge concentrating sump, water flushing nozzles etc. as per the standard design of manufacturer. Sludge removal system shall be designed to thicken the sludge to minimum 2% consistency before disposing from separator bottom. All the pipelines carrying the sludge shall be provided with flushing connection. The pumps and piping for flushing purpose shall also be separately provided (Capacity of the pump). Sludge blow-off shall be effected by the static head of water in the Tube settler/Lamella Clarifiers. Sludge outlet pipe from the concentrated sludge hopper shall be branched into main disposal line. Main sludge disposal line should consist of blow-off valve which shall be operated manually and drain sludge to the sludge disposal sump. This would be an intermittent operation. Continuous sludge disposal line shall consist of a telescopic stand pipe, the top of which would be maintained at a desired elevation to ensure trickle flow of water of sludge water mixture to the sludge sump.
16. The units shall be provided with walkway (bridge) and platform to approach all the internals. Clear width of the bridge shall not be less than 1200 mm.
17. The tube settler/ Lamella Clarifiers periphery shall have sufficient width to have an easy walkway along-with hand-railing for general inspection. Access staircase (Minimum two sides) with platforms and hand railing shall be provided in the

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separator for good approach. However, the manual sludge valves shall be operable from the top of the sludge chamber through head stock and extended spindle arrangement

18. Suitable sampling connections from various levels/ zones of clarifier and at the outlet shall be provided for performance monitoring.
19. Drain connection shall be provided in the desludging line at the clarifier tank bottom for complete dewatering of the Lamella clarifier/Tube Settler.

4.3.7. Sludge pit:

- 1) Quantity : 1
- 2) Type : Rectangular and Underground, Outdoor Location.
- 3) Effective Capacity : Not less than 436m³
- 4) Min. free board : 500mm
- 5) Material of construction : RCC (with suitable internal painting)
- 6) Sludge flushing arrangement: Required through high pressure water and nozzles to ensure no deposition/ settling of sludge as per the P&ID. Water shall be taken from service water pump discharge header. Additional pump system with Pipes & Nozzles to be supplied with necessary lines connected from Service Water Pump Discharge Header
- 7) Accessories : Shall be provided as per system requirements in line with attached P&ID.

4.3.8. Sludge pit air blowers:

- 1) Quantity : 2 Nos. (1W+1S)
- 2) Location : Outdoor
- 3) Service : To scour the sludge bed
- 4) Duty : Intermittent
- 5) Type of blower : Rotary Twin lobe oil free
- 6) Type of impeller : Involute
- 7) Design standard : Standard to be indicated
- 8) Service temperature : 60 °C max.
- 9) Rated capacity m³/hr: 100% of the sludge sump reqmnt. (min. 480Nm³/hr)
- 10) Permissible tolerance in rated capacity, in %: As per BS-1571-Part II.
- 11) Head to be developed : 7psi min. at rated capacity
- 12) Material of construction : Casing- CI, Lobe: CI
- 13) Common base plate : Fabricated carbon steel
- 14) Coupling pulley : CI/ Carbon steel
- 15) Coupling guard : Carbon steel
- 16) Safety relief valve : SS316
- 17) Fasteners : SS316L
- 18) Type of drive : Electric motor
- 19) Criteria for selection of drive motor: Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no case be less than the maximum power required by the Blower. Refer Motor spec. ROS4261
- 20) Type of coupling between Blower & Motor: V belt

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21) Noise level (for complete set of Blower & Motor): Not more than 85 dbA (At a distance of 1.0 m from the outer surface of Motor).

22) Accessories: Common base frame, Pulley, V-Belt Guard, Acoustic Hood, Suction Filter, Suction Silencer, Discharge Silencer, Anti Vibration Pad, Safety Relief Valve, Non Return Valve etc.

4.3.9. Sludge transfer pumps with motor & acc:

- 1) Quantity : 2 Nos. (1W+1S)
- 2) Location : Outdoor
- 3) Type : Vertical Non clog type
- 4) Type of impeller : Open
- 5) Fluid to be handled : Sludge-water, slurry
- 6) Duty : Intermittent
- 7) Design standard : As per supplier standard practice
- 8) Service temperature : 60 °C max.
- 9) Rated capacity m³/hr : 160m³/hr
- 10) Head : 3kg/cm²(g)
- 11) Shut off head : To be suitable for stable operation at rated duty point.
- 12) Range of operation : 20% - 120%
- 13) Material of construction :
 - a. Casing : ASTM A995, CE3MN(5A) or Equivalent
 - b. Impeller : ASTM A995, CE3MN(5A) or Equivalent
 - c. Shaft : ASTM A182, F53 S32750 or Equivalent
 - d. Shaft sleeve : ASTM A182, F53 S32750 or Equivalent
 - e. Wear Rings : ASTM A182, F53 S32750 or Equivalent
 - f. Bearing Housing : Cast Iron 30B or equivalent
 - g. Bolts : ASTM A193, Grade B8M or Equivalent
 - h. Nuts : ASTM A194, Grade B8M or Equivalent

All stainless steel material in contact with sea water shall have a minimum Pitting Resistance Equivalent Number (PREN) of more than 38, derived by
 $PREN = Cr (\%) + 3.3 \times Mo (\%) + 16 \times N (\%)$
- 14) Pump speed (rpm) : 1500 (max.)
- 15) Type of drive : Electrical motor
- 16) Criteria for selection of drive motor: Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no case be less than the maximum power required by the Blower. Refer Motor spec. ROS4261
- 17) Type of coupling between pump & motor: Flexible spacer
- 18) Noise level : Not more than 85 dbA (At a distance of 1.0 m from the outer surface of Motor).

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4.3.10. Aeration for Sludge pit

- 1) Aeration with Sludge pit air blowers
- 2) Air agitation : Required with air grid arrangement

4.3.11. Ferric chloride dosing tanks

- 1) Quantity : 2 Nos.
- 2) Type : Vertical rectangular with flat bottom
- 3) Type of fluid handled: 10% w/w FeCl₃ solution
- 4) Effective capacity: Each tank to be sized for 120% of the quantity required for 12hr operation of the Clarifier system. (Min. 10m³)
- 5) Free board : 300mm
- 6) Design pressure : Atmospheric
- 7) Design Temperature in degree Celsius: 60
- 8) Material of construction: RCC (with acid proof tile lining)
- 9) Agitator : Along with drive motor & all other accessories
- 10) No. of agitators : 1 no. per tank
- 11) Agitator MOC : MS FRP with vinyl ester lining
- 12) Dissolving basket: 1No. per tank
- 13) Dissolving basket MOC: SS316 construction with 10mm dia. holes with 50mm triangular pitch

4.3.12. Ferric chloride dosing pumps with motor & acc.

- 1) Quantity : 4 Nos.(2W+2S)
- 2) Type of pump : Diaphragm type with remote/ local stroke adjustment metering pumps
- 3) Location : Indoor
- 4) Fluid to be handled: 10% w/w FeCl₃ solution
- 5) Dosage rate : min. 15ppm as 100% (Bidder to decide)
- 6) Service : To dose FeCl₃ solution to the clarifiers
- 7) Duty : Continuous and suitable for parallel operation
- 8) Suction condition: Flooded
- 9) Suction dampening pot: Required
- 10) Operation : Automatic (i.e. proportional dosing based on change in feed flow)
- 11) Rated capacity : min. 500lph each. (to be sized to produce clarified water at the rate of 1762m³/hr (3524m³/hr for 2 clarifiers) (with due consideration of water loss through clarifiers for disposal of sludge)
- 12) Head (mwc) : As required to meet system requirement
- 13) Rated speed : 100 strokes per minute (max.)
- 14) MOC : PP with PTFE diaphragm
- 15) Accessories : Pulsation dampeners, Pressure relief valve
- 16) Erection : The dosing pumps shall be mounted on a common skid frame along with suction and discharge piping, instrument tapping and with

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common discharge header and supplied for erection at site.

4.3.13. Polyelectrolyte dosing tanks

- 1) Quantity : 2 Nos.
- 2) Type : Vertical rectangular with flat bottom
- 3) Type of fluid handled: 0.5% w/w Polyelectrolyte (PE) solution
- 4) Effective capacity: Each tank to be sized for 120% of the quantity required for 12hr operation of the Clarifier system. (Min. 10m³)
- 5) Free board : 300mm
- 6) Design pressure : Atmospheric
- 7) Design Temperature in degree Celsius: 60
- 8) Material of construction: RCC (with acid proof tile lining)
- 9) Agitator : Along with drive motor & all other accessories
- 10) No. of agitators : 1 no. per tank
- 11) Agitator MOC : MS FRP with vinyl ester lining
- 12) Dissolving basket: 1No. per tank
- 13) Dissolving basket MOC: SS316 construction with 10mm dia. holes with 50mm triangular pitch

4.3.14. Polyelectrolyte dosing pumps with motor & acc.

- 1) Quantity : 4 Nos.(2W+2S)
- 2) Type of pump : Diaphragm type with remote/ local stroke adjustment metering pumps
- 3) Location : Indoor
- 4) Fluid to be handled: 0.5% w/w PE solution
- 5) Dosage rate : min. 1ppm as 100% (Bidder to decide)
- 6) Service : To dose PE solution to the clarifiers
- 7) Duty : Continuous and suitable for parallel operation
- 8) Suction condition: Flooded
- 9) Suction dampening pot: Required
- 10) Operation : Automatic (i.e. proportional dosing based on change in feed flow)
- 11) Rated capacity : min. 500lph each. (to be sized to produce clarified water at the rate of 1762m³/hr (3524m³/hr for 2 clarifiers) (with due consideration of water loss through clarifiers for disposal of sludge)
- 12) Head (mwc) : As required to meet system requirement
- 13) Rated speed : 100 strokes per minute (max.)
- 14) MOC : PP with PTFE diaphragm
- 15) Accessories : Pulsation dampeners, Pressure relief valve
- 16) Erection : The dosing pumps shall be mounted on a common skid frame along with suction and discharge piping, instrument tapping and with common discharge header and supplied for erection at site.

Note: MOC of all components coming in direct contact with chemical shall be compatible to the respective chemical.

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4.3.15. Gate valves

a. For Clarifier system area

- 1) Quantity : As required, also refer PID for minimum qty
- 2) Type : Rising spindle conventional closure type or equiv.
- 3) Operating torque: Bidder to specify
- 4) Seating head : Bidder to specify
- 5) Unseating head : Bidder to specify
- 6) Working liquid head: Bidder to specify
- 7) Material of construction:
 - a) Frame : Duplex SS 2205
 - b) Slide (door) : Duplex SS 2205
 - c) Guide (LH & RH): Duplex SS 2205
 - d) Frame & door seating: IS318, LTB-2 or equivalent
 - e) Stem & Stem extension: Duplex SS 2205
 - f) Stem coupling: SS316
 - g) Fasteners: SS316L
 - h) Stem Nut: SS316L

b. For Clarified water tank

- 1) Quantity : 6 nos.
- 2) Type : Rising spindle conventional closure type or equiv.
- 3) Operating torque: Bidder to specify
- 4) Seating head : Bidder to specify
- 5) Unseating head : Bidder to specify
- 6) Working liquid head: Bidder to specify
- 7) Material of construction:
 - a) Frame : Duplex SS 2205
 - b) Slide (door) : Duplex SS 2205
 - c) Guide (LH & RH): Duplex SS 2205
 - d) Frame & door seating: IS318, LTB-2 or equivalent
 - e) Stem & Stem extension: Duplex SS 2205
 - f) Stem coupling: SS316
 - g) Fasteners: SS316L
 - h) Stem Nut: SS316L

4.3.16. PIPING & VALVES:

LP valves and piping materials shall be selected in the low-pressure area suitable to handle seawater and chemicals to avoid corrosion. Each pump is provided with Check valve, Butterfly valve and rubber expansion bellow. For the seawater applications including SWRO reject, the fasteners shall be SS316 MOC. The piping considered as low-pressure piping are upto HP Pump suction and RO permeate line.

The following materials are selected for LP piping & fittings

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Sl. No.	Service	Sizes	Pipes	Fittings
1	Clarifier/PSF/UF Feed / Permeate/Backwash / chemical backwash / chemical cleaning / effluent water piping	All sizes	GRP, PN 10	GRP, PN 10
2	All chemical dosing line piping	All sizes	c-PVC sch.80 (Industrial Grade)	c-PVC sch.80 (Industrial Grade)
3	All Instrument/ Plant air piping PSF blower & Sludge blowers Process air	All sizes	Galvanized iron, Heavy grade HDPE for PSF blower & Sludge blowers Galvanized iron, Heavy grade	Screwed fittings Galvanized iron, Heavy grade
4	Velocity Pump suction Pump discharge & recirculation Header	≤150mm ≥200mm ≤50mm ≤150mm ≥200mm ≤150mm ≥200mm	1.2-1.5 m/s 1.2-1.5 m/s 1.2-1.8 m/s 1.8-2.4 m/s 2.1-2.5 m/s 1.5-2.4 m/s 2.1-2.4 m/s	

****GRP pipes shall be with the following requirements:**

1. Inner corrosion resistance layer of 1.5 mm thickness Vinyl Ester resin (Resin/mat-90:10 by weight)
2. Outer layer cross filament wound at 54.7° to horizontal and Resin isophthalic (Resin / mat-30:70 by weight)
3. Minimum Stiffness -2500 N/m²
4. Pressure Rating- PN10
5. Top most layer -resin rich, UV stabilizer, with pigment of 0.2 to 0.3 mm & Bright Finish.
6. Tolerance on thickness, resin-filament ratio, etc., will be 5% (+/-).

Notes:

1. Pipes & Fittings shall be tested for its material composition and certificate shall be enclosed for the same.

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- All piping & valves supports shall be of dismantling type for easy maintenance using suitable bolted connections

The following materials are selected for LP valves. (Valves are of #150 rating)

Sl. No.	Service	Size	Body	Disc	Seat
1	Sea water applications (butterfly valves)				
	Type –wafer		Ductile Iron & Al Bronze	Duplex SS 2205	EPDM/ Nitrile Rubber
	Type-flanged		Ductile Iron & Al Bronze with rubber lining	Duplex SS 2205	EPDM/ Nitrile Rubber
2	Brackish water applications (butterfly valves)	All	Cast Iron/ Cast steel	SS316	EPDM/ Nitrile Rubber
3	Compressed air application	< DN50 > DN65	Gun metal Cast/ Forged		

Remarks: For higher sized flanged butterfly valves, the valve body shall be completely rubber lined including the flanged portion and the disc shall be Duplex SS .

- All high points in piping system shall be provided with air vents along with valves. All low points shall be provided with drains along with valves.
- Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic location in piping system.
- Necessary thrust blocks shall be provided to minimize water hammer & vibration in piping & headers.
- ANSI B16.5, 150 class shall be followed for all Flanges
- Supporting arrangement of piping system shall be rigid and properly designed for systems where hydraulic shocks and pressure surges may arise in the system during operation.
- Sufficient upstream and downstream lengths shall be provided for flow measuring device, control valves and other specialties.
- Test certificate / compliance certificate to be furnished by the bidder for all the components instruments & piping etc.

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8. Velocity guidelines:

Pump suction	$\leq 150\text{mm}$ $\geq 200\text{mm}$	1.2-1.5 m/s 1.2-1.5 m/s
Pump discharge & recirculation	$< 50\text{mm}$ $\leq 150\text{mm}$ $\geq 200\text{mm}$	1.2-1.8 m/s 1.8-2.4 m/s 2.1-2.5 m/s
Header	$\leq 150\text{mm}$ $\geq 200\text{mm}$	1.5-2.4 m/s 2.1-2.4 m/s
Channels		$\leq 1 \text{ m/s}$ (minimum 300 mm freeboard)

4.3.17. GENERAL DESIGN REQUIREMENTS

The common requirements for the system are stated in general design requirements. However, requirements indicated in the technical specification for mechanical equipment section shall be strictly complied with.

A. COMMON REQUIREMENTS:

1. Only latest revision of standards shall be considered for Design & manufacturing.
2. MOC of all components coming in direct contact with chemical shall be compatible to the respective chemical.
3. All rotating equipment's noise level shall be $< 85\text{dBA}$ measured at 1 mtr distance from the equipment.
4. Sampling connections and air vent at the top most point of piping and vessels shall be provided at all stages of the Unit.
5. The size of the overflow pipes of all storage tanks shall be one size higher than inlet pipe sizes of these tanks.
6. All the piping & valves are shall be located to facilitate easy accessibility and operation from ground level.
7. All flange fasteners shall be SS316 MOC.
8. Fasteners shall be stud type with spring washers & nuts.

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9. Direction of Flow shall be indicated by an arrow at regular intervals on all pipelines with good visibility.

B. CENTRIFUGAL PUMPS:

1. The critical speed of the pumps shall be well away from the operating speed and not less than 130% of the rated Speed.
2. The pumps shall have stable head Vs capacity characteristic continuous rising towards shut-off with an approximate shut-off head of 15% more than the design head for radial flow type pumps.
3. The characteristic curves of given set of pumps shall match for load sharing in case of parallel operation.
4. Pumps shall be provided with non-return valve & shut off valve on discharge side and shut-off valve on suction side.
5. Unfiltered vibration velocity for horizontal pumps up to 3000 rpm with antifriction bearing or sleeve bearings when measured at the bearing housing in horizontal or vertical direction shall not exceed 4 mm/sec RMS.
6. Tolerance in pump guaranteed efficiency and rated head for the rated flow shall be minus 2% to plus 3%.
7. Pressure gauges shall be provided on discharge side of all pumps.
8. Each pump suction and discharge shall be installed with an expansion bellow.
9. The pumps shall be designed for continuous operation at its best efficiency to satisfy the performance requirements.
10. The pumps shall be controlled from remote panel and locally.

5.0 PAINTING

The painting specification enclosed as **Annexure-B**.

6.0 VENDOR LIST FOR MECHANICAL ITEMS

The vendor list enclosed with this specification as **Annexure-A**.

7.0 TECHNICAL SPECIFICATION FOR ELECTRICAL, CONTROLS & INSTRUMENTATION

The pre-treatment system shall be designed suitable for Auto Operation through a DCS system to be arranged by BHEL. This DCS system will cover the requirements of the PT Plant. Bidder shall provide necessary Electrical, Control Valve etc. in this plant to facilitate auto operation. All the control valves shall be MOV type.

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Bidder shall furnish a “Control philosophy with control logic” explaining the controls, interlocks etc., for the system which will be arranged in the DCS system by BHEL. Necessary Valve Sequence Charts, Logic Diagram control philosophy, list of Interlocks, I/o list etc., shall be furnished by Bidder during detailed engineering to facilitate implementation of the system controls & interlocks in the DCS system. In addition to the above documents bidder shall also furnish the Parshall flow transmitter calculation sheets, Level to flow conversion graph, mounting arrangement required for this flow transmitter.

Based on the inputs furnished by system Bidder, BHEL-EDN will prepare the Logic software. The Bidder shall assist BHEL-RANIPET/EDN during Logic programming and DCS Panel manufacturing. Bidder shall assist for proper functioning of the entire PT system in Auto & Manual mode.

7.1 ELECTRICAL AND C&I SCOPE OF WORK BETWEEN BHEL & BIDDER

S.No	ELECTRICAL SYSTEM	ACTIVITY	AGENCY
1.	415V MCC PANEL	SUPPLY ERECTION	BHEL BHEL
2.	LT MOTORS FOR PUMPS SUPPLIED BY BIDDER (AS PER ENCLOSED P&ID)	SUPPLY ERECTION	BIDDER BIDDER
3.	LT MOTOR SIDE CABLE GLANDS AND LUGS	SUPPLY ERECTION	BIDDER BHEL
4.	CABLE SCHEDULE & CABLE INTERCONNECTION DRAWING OF BIDDER SUPPLIED EQUIPMENT	PREPARATION VETTING	BIDDER BHEL
5.	LT POWER, CONTROL AND INSTRUMENTATION CABLES. (INCLUDING GLANDS, LUGS , LAYING AND TERMINATION)	SUPPLY ERECTION TECHNICAL ASSISTANCE	BHEL BHEL BIDDER
6.	CABLING MATERIAL (CABLE TRAYS, SUPPORT MATERIAL ACCESSORIES, AND CONDUITS ETC.)	SUPPLY ERECTION	BHEL BHEL
7.	DCS SYSTEM – SYSTEM BIDDER TO EXTEND TECH. ASSISTANCE FOR ESTABLISHING THE SYSTEM IN AUTO & MANUAL MODE	SUPPLY ERECTION COMMNG. TECHNICAL ASSISTANCE	BHEL BHEL BHEL BIDDER
8.	JUNCTION BOXES	SUPPLY ERECTION	BHEL BHEL
9.	START STOP PUSH BUTTON STATION FOR MOTORS	SUPPLY ERECTION	BHEL BHEL
10.	EQUIPMENT EARTHING, LIGHTING, A/C AND VENTILATION	SUPPLY ERECTION	BHEL BHEL
11.	INSTRUMENTS WITH FITTINGS	SUPPLY	BHEL

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		ERECTION COMMNG.	BHEL BHEL
12.	INSTRUMENT FLANGED TAPPING POINT WITH CPVC VALVE (Size will be specified during detailed engg.)	SUPPLY ERECTION	BIDDER BIDDER

NOTES:

1. Necessary layout inputs shall be furnished by bidder for bidder supplied equipment.
2. Instrument Tapping points (flange, counter flange and CPVC Pipe) with isolation valves (CPVC MOC) has to be provided for all the instruments mentioned in P&ID and for any other instrument additionally mentioned in Bidder instrument schedule.
3. Cable gland & Lugs shall be provided by Bidder for equipment supplied by Bidder.
Cable glands shall match to cable sizes where cables are supplied by purchaser.
(Cable sizes shall be furnished to the Bidder during detailed Engineering)

7.2 Dosing system

AUTO STROKE CONTROL (As specified for auto dosing pumps in Mechanical section)

The stroke control mechanism shall be able to adjust the stroke of dosing pump/ vary the dosing rate as per the input signal from DCS. In addition, the operating dosing rate has to be transmitted back to DCS.

Input signal: 4-20mA (isolated 2 wire) for receiving auto stroke command.

Output signal: 4-20mA (isolated 2 wire) for actual dosing rate FB to DCS.

Electronic Positioner for capacity adjustment with respect to incoming 4-20mA control signal shall be provided for auto dosing pumps. The output 4-20mA signal corresponding to actual dosing rate feedback shall also be provided. The electronic positioner shall have display unit with span/ zero adjustment and suitable for field mounting in IP 55 junction boxes. Signals shall be terminated in field junction box with suitable identification and segregation.

SKID MOUNTED JUNCTION BOXES (As specified for auto dosing pumps in Mechanical section for 4-20mA signal terminals and positioner power supply) In general junction boxes with plastic casings resistant to impact, sand, light and water, or hot dip galvanized junction boxes are to be provided with mounted on skid frame. Protection class must be at least IP 55. The necessary earthing terminals must be provided for earthing purposes.

The cabinets must be equipped with the necessary terminal blocks for power, signals with sufficient separation.

The control and communication signal cables must be laid sufficiently apart from the power cables so that no interference will occur in transmission of signals.

The junction boxes are to be firmly fitted with supports within the skid. Cable entry shall be from bottom through removable gland plate.

7.3 Electrical actuators

As per specification ROS 4263 REV00

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8.0 TECHNICAL DETAILS FOR CIVIL WORKS:

Construction of civil tanks, foundation and flooring etc for the Pre-treatment system is not in bidder scope. However, the foundation materials like grouting mix, foundation bolts & packing shims etc, shall be provided by Bidder. The bidder shall provide equipment layout drawing along with bid. Bidder shall provide complete civil design, construction drawing with foundation requirement like load details, foundation pockets etc, for all the equipment, tanks, agitators, flooring requirements, trenches for pipe routing, cable routing & drains etc. are in the scope of Bidder and shall be furnished to customer for further construction immediately after order.

Any special requirement like handling arrangement, floor / trench protection etc. shall also be indicated in the drawings. All plant drains & trenches shall be connected in a common trench and terminated to Sludge pit. The approximate area & location are indicated in the enclosed layout drawing. Bidder shall accommodate Pre-treatment system within the stipulated area only as indicated in the typical layout drawing **(1-WT-220-01806, Rev 00)** attached along with this specification.

9.0 PERFORMANCE GUARANTEE

The system performance guarantees applicable are detailed in this section.

9.1 PERFORMANCE GUARANTEE

The bidder shall guarantee all equipment for workmanship, materials and satisfactory performance. The guarantee for performance will cover individual items and systems including electrical for their ratings / outputs as well as for the integrated operation of equipment and its auxiliaries as a whole. On completion of satisfactory commissioning, the supplier shall conduct performance / acceptance tests on the equipment and system as a whole for demonstrating the guaranteed performance parameters specified.

- a. Waste water treatment outlet water quality as indicated in section 3.2
- b. Power consumption for continuous operating equipment as per Annexure-2
- c. Vibration and noise level of rotating equipment

Minimum 72 hrs performance test run shall be conducted for the guaranteed values of treated water quality, quantity and other performance parameters.

9.2 General

In addition to the guarantees mentioned above, the requirements of specifications on all guarantees as elaborated under relevant clauses of Technical Specifications should be met.

The guarantee for the equipment shall start after 18 months from the date of supply (or) 12 months from the date of commissioning, whichever is earlier.

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Any part which proves to be defective either in design, materials / and / or manufacture within the above guarantee period shall be replaced free of cost to the owner at site and the provision of this clause shall apply to the portions of the plant so replaced or renewed until the expiration of the guarantee period or from the date of replacement which ever is later. (Replacement work / activity of failed part shall be in the scope of Bidder at No cost to Customer)

10.0 SPARES:

10.1 Commissioning Spares:

The bidder shall take care of requirement for trouble free commissioning (of the system since commissioning is under bidder's scope). The commissioning spares List and the individual price shall be indicated and included in the main supply. The bid price shall include these spares also. Any unutilized commissioning spares shall be handed over to the purchaser. The commissioning spares shall be delivered well in time before the start-up & commissioning of the plant.

10.2 Mandatory Spares:

The mandatory spares shall be delivered along with the main supply. The Cost of mandatory spares shall be indicated separately and the same will be considered for Bid Evaluation.

The list of mandatory spares are given below:

10.2.1 Spares

SL. NO.	Name of Items	Qty	Remarks
1.	Complete valve	1 Set	Each of different size of valves in the system
2.	Sampling & needle valve	4 Nos.	Each type & size
3.	Control valve assembly complete	2 Nos.	
4.	Flocc. Drive head complete with bevel & pinion set	1 No.	
5.	Bearing, Impeller with shaft & gear unit for each type and size of air blowers	2 sets	
6.	Current collectors	1 set	

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7.	Weir with stuffing box	1 Set	
8.	Floats for each size and type with links & levers	2 sets	
9.	Bearings, shaft sleeve, impeller and mechanical seal for each type & duty parameters of pump sets	1 Set	For each pump(applicable for both horizontal & vertical)
7.	Metering pumps for dosing system in Pre-treatment plant	1 No.	For each type & size

11.0 ERECTION, COMMISSIONING, PG TEST & HANDING OVER:

Erection, commissioning, PG test & Handing over for the Pre-treatment system shall be as per the requirement mentioned elsewhere in the specification(ROS-9064).

12.0 TERMINAL POINTS

- Sea water from Desalination plant supply pumps will be terminated near Pre-treatment plant boundary (refer Layout drawing 1-WT-220-01806 for Coordinates) in 800NB GRP pipe with Flange (as per ANSI B16.5). Further mating flange & piping shall be in Bidder's scope.
- The clear water from lamella clarifiers/ tube settlers shall be terminated at the inlet chamber of Clarified water storage tank located at the elevation of 3.5 m above Finished Ground Level (FGL) (refer Layout drawing 1-WT-220-01806 for coordinates) by the bidder through channel.
- The waste from the clarifier system and drains from clarifier system (Stilling chamber, Flash mixers, Flocculators, clarifiers) shall be terminated by the bidder into the Sludge sump. Necessary isolation valve for drains shall be provided for each of the Clarifier system.
- Isolation valves shall be provided for each of the sludge collection hoppers of the clarifier.
- Sludge pumps including common discharge header piping within plant boundary shall be in the scope of Bidder (refer Layout drawing 1-WT-220-01806 for Coordinates).
- All the civil works are in the scope of Customer (BHEL scope). However, Civil design shall be provided by Bidder (including Architectural drawing, STAAD Design, Foundation Design & Drawings, Superstructure drawings & grade slab design & drawings – if applicable). Bidder shall provide all necessary civil drawings for construction of the Clarifier system.
- Service water shall be provided upto dosing/ preparation tanks. Bidder shall consider tapping for the service water line for any other requirements.

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- h. All the Dosing pumps for FeCl₃ dosing system shall be mounted on a skid frame along with suction piping & discharge piping. Further piping from Common discharge lines (refer PID drg.1-WT-220-01570) upto Stilling chamber of Clarifier system shall be in Customer's scope. Diffusers if applicable shall be provided by Bidder.
- i. All the Dosing pumps for Polyelectrolyte dosing system shall be mounted on a skid frame along with suction piping, discharge piping & instruments. Further piping from Common discharge lines (refer PID drg.1-WT-220-01570) upto Stilling chamber of Clarifier system shall be in Customer's scope (BHEL). Diffusers if applicable shall be provided by Bidder.
- j. The service water piping shall be terminated at one point near the Clarifier by Customer. Further piping shall be by Bidder.
- k. All the flanges dimensions shall conform to ANSI B 16.5, 150 #.
- l. All the sumps depths shall be considered as maximum 2 m SWD.

13.0 EXCLUSIONS

- a. Sludge discharge piping from sludge transfer pump common discharge header up to ash pond shall be in the scope of BHEL.
- b. Chemicals (FeCl₃ & PE) supply will be by BHEL. Bidder to provide the requirements to Customer.
- c. FeCl₃ & PE dosing piping from dosing pump common discharge to dosing points.
- d. Civil construction works.

14.0 DOCUMENTATION:

The documentation during bid and post order stage shall meet the following requirements.

1. All documents and drawing shall be submitted in English
2. Soft copies of all final documents in MS word / MS office in the form of CD –1 set
3. Soft copies of all final calculations in MS excel/ MS office in the form of CD–1set
4. Soft copies of all final drawings in Auto Cad, latest version in the form of CD-1set

14.1 DOCUMENTS ALONG WITH BID:

The following drawings / documents shall be enclosed along with the bid for scrutiny.

1. Technical write-up giving details of equipment operation, interlocks / control
2. requirement. (for clarifier system & combo unit)
3. P& I diagram along with instrument list
4. Equipment layout drawing
5. Filled up data sheets as called in the specification – Annexure -1, 2, 3 & 4
6. Valve schedule indicating valve type, location, Quantity, operating parameters, measuring range, Makes in BHEL Format
7. Data Sheet for LT Motors.

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8. Datasheet for MOV, installation manual
9. Instrument schedule indicating instrument type, location, quantity, operating parameters, measuring range, Makes in BHEL format
10. Trouble shooting manual and maintenance manuals
11. Operation sequence chart, control logic chart and control philosophy for system operation.
12. Chemical consumption for Lamella Clarifier/tube settler
13. Parshall flow transmitter calculation sheets, Level to flow conversion graph, mounting arrangement required for this flow transmitter.
14. Utility requirements like instrument air, service air and service water
15. Pump performance curves with marked duty point.
16. Sub vendor list for mechanical, electrical and C&I items.
17. Preliminary civil requirements.
18. I/O list
19. Tentative quantity of Power, Control and Screened cables to be supplied for the waste water treatment system by the Purchaser.
20. Deviation schedule duly filled, if any –Annexure – 5. Any deviation should have cost of withdrawal for our evaluation in the commercial bid.
21. Unpriced commercial offer including commissioning spares on the scope of supply
22. Reference list of the plants with minimum one year in operation.

Note:

In case of any deviation, the Bidder shall indicate the deviation, clause by clause in the deviation format attached in **Annexure – 5**. If there is no deviation “NIL” statement shall be furnished. In the absence of the non-attachment of this **Annexure-5**, it will be construed that the bid confirms strictly to the specification.

14.2 DOCUMENTS AFTER ORDER

The following documents/Drawings and data to be furnished for BHEL / customer approval.

Phase-I (for approval within 10 days from the date of ordering):

1. Technical Write-up and design basis (Clarifier system & sludge handling system)
2. P&ID diagram including pipe sizes & terminal points.
3. Equipment layout showing clarifier, all equipment etc.,
4. Sizing, process calculations for various equipment
5. Filled up datasheets for approval as per Annexure – **1,2, 3 & 4**
6. Electrical load list indicating kW rating and no. of drives to be submitted for all items under scope of supply as applicable.
7. Mechanical & Civil GAs of all structures
8. Hydraulic flow diagram
9. Equipment datasheets of clarifier, pumps & other equipment as per specification

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10. Quality Plan and field quality checks, stage inspection etc. for the above equipment & system
11. Performance curves for pumps & motors
 - a. Flow Vs Head
 - b. Flow Vs efficiency
 - c. Flow Vs Power
 - d. Flow Vs NPSH
12. Instrument schedule.
13. I/O list.
14. Parshall flow transmitter calculation sheets, Level to flow conversion graph, mounting arrangement required for this flow transmitter.
15. Foundation Details indicating foundation design, load data, anchor bolt location, pocket details, floor & trenches etc.
16. Civil assignment & design drawings for all the structures / tanks, sumps except for chemical house.
17. Performance Test procedure

Phase-II (for information within 2 weeks from the date of LOI):

1. General arrangement drawings for all the equipment showing dimensions and details of materials
2. Piping and Valves schedule
3. Erection Manual indicating
 - a. Erection/installation instructions of equipments.
 - b. Log sheet containing stage check parameters & clearance
 - c. Log sheets for alignment check of pump & motor
 - d. Field quality checks
4. All the documents called in Electrical specification.

Phase-III (for information-before dispatch):

1. Performance Test procedure
2. Shipping list for BHEL's approval in BHEL format

Phase-III (for review):

1. Pump performance test reports
2. Pump performance guarantee certificates
3. Operation and maintenance manual.
4. Maintenance instruction & assembly
5. Lubrication chart.

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6. Electrical equipment layout, Cable trench layout, cable routing, cable schedules and cable termination details.
7. Cable interconnection diagram for cables up to junction box & cable schedule.
8. Test Certificates for all the supplied instruments.
9. List of alarm, interlock & trip set points
10. Installation drawings for instruments
11. Wiring drawings & GA drawings for Local Panels, junction boxes.
12. All other details called in Electrical specification.

Note: Bidder shall confirm in their offer that details called in 14.2 shall be provided.

15.0 ATTACHMENTS

The following drawings enclosed are a part of the specification:

1. PID for Clarifier system : 1-WT-220-01805 Rev: 00
2. Layout : 1-WT-220-01806 Rev:00
3. Erection, commissioning, PG test & handing over specification no. ROS 9064, Rev 00
4. Electric Actuator specification no. ROS 4263, Rev 00
5. Electrical motor specification no. ROS 4261, Rev 00
6. Vendor list(**Annexure-A**)
7. Painting specification (**Annexure-B**)

16.0 IMPORTANT POINTS TO BIDDERS

1. If the bidder has suggestions/requirements of any additional instruments/equipment over & above as shown in the P & ID drawing for the efficient functioning of the system, the same shall be clearly indicated and suitably covered in the commercial bid also separately.
2. The specification for the instruments/ equipment available in the main specification shall be taken for such additional requirements (or) Customer should be contacted.

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ANNEXURE-1

DATA SHEET

I CLARIFIED WATER QUALITY

Sl.No	Description	Unit	Values
1	pH		
2	Total Suspended Solids	ppm	
3	Turbidity	NTU	

II CHEMICAL REQUIREMENT

Sl.No.	Description	Unit	Total per day
1	FeCl ₃ (for clarifier)	kg	
2	Polymer(for clarifier)	kg	

III CHEMICAL DOSING DURATION

Sl.No.	Description	Unit	Duration & cycles per day
1	FeCl ₃ (for clarifier)	Min.	
2	Polymer(for clarifier)	Min.	

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Annexure-2

ELECTRICAL POWER CONSUMPTION

Sl. No.	Equipment Description	Qty		Efficien cy	Drive rating KW	Conn load. Load KW	Power consumption KW	Voltage, Phase
		W	SB					
A	FOR CONTINUOUS OPERATING EQPT.							
1								
2								
3								
4								
5								
6								
	Sub total of A							
B	FOR INTERMITTENT OPERATING EQPTS.							
1								
2								
3								
4								
5								
6								
	Grand Total							

Note: W – Working SB – Standby

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Annexure - 3

VALVE SCHEDULE – DATA SHEET TO BE FILLED BY THE BIDDER

Sl. No.	Service	Valve Type	Size	BODY	Disc / Ball / Diaphragm	Stem / Shaft	Valve seat / Seat ring	Hinge Pin	Valve Ends
1	Manual valves								
2	Pneumatic/ motorized valves (if any)								
3	Check Valves								

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Annexure-4

INSTRUMENT SCHEDULE FOR PT PLANT

INSTRUMENT SCHEDULE FOR PT PLANT																					
Project :				MEDIUM	OPER	DESIGN	OPER	DESIGN	OPER	DESIGN	Min Inst Range	Max Inst Range	Max Inst Range Unit	SETPOINT	TYPE	PROCESS CONNECTION-INST	PROCESS CONNECTION-PIPING	ELECTRICAL CONNECTION	MAKE	MODEL	REMARKS
BHEL Drg. No:					PRESS	PRESS	TEMP	TEMP	Flow	Flow											
S.No	Description	Qty	Scope		Kg/cm2	Kg/cm2	DEGC	DEGC	m3/hr	m3/hr				ALARM							

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ANNEXURE -5

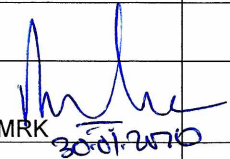
TECHNICAL DEVIATIONS

Sl. No	Section no.	Clause No.	Page / No.	Specification	Statement of Deviations/variatio	Reason for Deviation	cost of withdrawal

	GENERAL SPECIFICATION FOR ERECTION, COMMISSIONING, PG TEST & HANDING OVER FOR PRE-TREATMENT SYSTEM	SPEC. No: ROS:9064
		REV: 00

**BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET- 632 406.**

**GENERAL SPECIFICATION
FOR
ERECTION, COMMISSIONING, PG TEST & HANDING OVER
OF
PRE-TREATMENT SYSTEM**

00	30.01.20	 SS	 IMRL	 MRK 30.01.2020	Fresh issue
Rev.No	Date	Prepared	Checked	Approved	Remarks

	GENERAL SPECIFICATION FOR ERECTION, COMMISSIONING, PG TEST & HANDING OVER FOR PRE-TREATMENT SYSTEM	SPEC. No: ROS:9064
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1.0 **SCOPE OF WORK ON SERVICES**

The scope of Erection and Commissioning services covers erection, commissioning of Pre-treatment system which comprises of receipt of materials & equipment at site, unloading, storage, transportation to erection spot, erection of complete system including site fabrication, stage clearance, testing, commissioning, Performance Guarantee Test, handing over of the system.

NOTE

- I. Successful commissioning means, erection of entire system, trial run / trial operation till achieving the performance both in terms of Quality (including electrical power consumption) and Quantity to prove the agreed performance of the system and the system is ready for PG Test. Once this stage is reached, Vendor will inform to BHEL that they are ready for PG Test. If BHEL's & Customer's Engineer is satisfied in commissioning, PG test can be conducted within 30 days from the date of such notification by Vendor to BHEL and till such time the running of the system to be taken care of by the vendor. Conduct of PG Test shall be the responsibility of the Vendor. Necessary consumables and chemicals required for the trial run / trial operation till PG Test will be provided by BHEL at free of cost to Vendor. However, the requirement of consumables and chemicals details is to be provided well in advance (min. 4 months) before commissioning by the Vendor to BHEL. Further any testing chemicals for testing / calibration of instruments, consumables required for PG test shall also to be informed with minimum 4 months advance notice before commissioning, failing which the vendor has to take the responsibility of providing the same without any commercial implication.
- II. The equipment after inspection at manufacturer's works shall be transported to BHEL site and shall be received, unloaded and stored by Vendor as detailed in the supply specification and commercial terms of the tender. Bidder shall store all high value items & critical items (such as instruments, UPS, battery, etc.,) under lock & key, using containers only. The applicable materials shall be drawn from Vendor stores as per the relevant procedure. The equipment shall be erected sequentially and shall be interconnected with the applicable piping and valve system. Necessary hydraulic testing of piping, valves etc. shall also be carried out as per supply specification. Necessary pump, blind-flanges, fasteners etc. required for the hydraulic testing are in vendor's scope.

The scope of major equipment covered for the erection & commissioning of the Pre-treatment system at site is covered in Technical Specification.

Apart from the scope mentioned in Technical specification, the foundation

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grouting materials including foundation fasteners, packing shims and final grouting shall be in the scope of bidder.

The quantity and the details given are only indicative. However, the bidder shall supply required quantity to fully cater to the system requirement and carry out the erection of all the items to meet the system requirement as complete without any commercial implication to BHEL.

- 2.0 The Intent of this specification is to provide erection, commissioning & trial operation services for execution of projects according to most modern and proven techniques and codes. It is not the intent to specify completely herein, all aspects of the entire system. Nevertheless, the entire system shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation. The contract services towards installation of the Plant shall not relieve the contractor of the responsibility of providing such services, facilities to complete the project of portion of project awarded to him. The quoted rate shall deem to be inclusive of all such contingencies.
- 3.0 The Contractor shall carry out the work in accordance with instructions/ drawings/ specification/ standard practices supplied / approved by BHEL from time to time.
- 4.0 Modification / Rectification / repair / replacement of defective components if any shall be under bidder's scope within specified time.
- 5.0 Bidder to submit the erection schedule along with stage check data sheets. Each and every stage the bidder to get clearance from the BHEL Engineer / Consultant Engineer / Customer Engineer.
- 6.0 Establish the site co-ordination for identification of materials, storing and issue of materials, stage clearance for erection & commissioning.
- 7.0 Identification of consignment at Vendors stores, verification of the same in the presence BHEL official, taking delivery, co-ordination for the movement from store to erection work, safe custody, erection, commissioning and trial operation.
- 8.0 All the equipment and materials shall be stored at Vendor's stores and it shall be the responsibility of the contractor to take delivery from their stores, transport the same to site. Bidder to ensure proper storage methodology and shall bear the total responsibility of the materials till erection and handing over to end Customer.

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- 9.0 Necessary clearance for stage check, hydraulic test, leak check obtained from the customer engineer & pre – commissioning tests shall be carried out by the bidder.
- 10.0 Commissioning and putting into satisfactory operation of all the equipment at site including successful completion of trial operation and handing over of the system to the end user.
- 11.0 Finish coat (final coat) for all the equipment before hand over of the system to BHEL/Customer as per **Annexure-B** of the specification.

12.0 EXCLUSIONS

The following are excluded from the scope of supplier and will be arranged by BHEL

- 12.1 All civil works pertaining to Pre-treatment System
- 12.2 Service water/ construction water at one point near Pre-treatment system
- 12.3 Construction power supply at one point near Pre-treatment System
- 12.4 Supply of service / instrument air at one point
- 12.5 Chemicals for commissioning and trial operation is involved.
- 12.6 Bidder shall provide the shipping list with details of dispatchable units. The requirement shall be specified by the bidder in their technical offer and the supply shall be limited to the specified quantities.

13.0 Specification, Standards & Codes:

All equipment shall be designed, tested and supplied as per the specification, relevant national / international standards & statutory codes.

14.0 Name plates, labels and directional marks:

Each equipment shall be provided with nameplate details designating the tag no., service of the item etc. Necessary directional arrow marks shall be provided.

15.0 Tools and Tackles:

All the Tools & tackles required for the complete erection of components shall be arranged by the contractor at his cost. The bidder shall have & own a complete set of special tools and tackles required erection, assembly, disassembly and maintenance. The bidder shall also supply any special tools and tackles that may be required additionally during commissioning. All tools & tackles shall be reputed make acceptable to the Purchaser and shall be handed over BHEL after the completion of erection & commissioning.

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16.0 Commissioning Consumables / Spares:

The bidder shall supply all consumables like lubricating oil, Teflon tape, m-seal, cotton waste, tissue paper roll, sampling bottles, mugs, buckets etc required for commissioning the equipment shall be in bidder's scope.

The bidder shall consider sufficient quantity of the commissioning spares so that the commissioning of the system will not be delayed. The bidder shall also supply any spare components that may be required additionally during commissioning. These commissioning spares shall be included in the basic scope of supply.

17.0 Inspection & Testing:

All the stage checks & materials shall be offered to BHEL / Customer/ BHEL'S authorized representative for inspection. No material shall be dispatched without obtaining written clearance from BHEL. During inspection, the internal inspection reports shall be submitted to BHEL / customer for information.

18.0 Packing & Dispatch:

18.1 All equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site, till the time of erection. Each packing shall have necessary handling marks

18.2 Each packing shall contain a packing slip indicating the details of item like item description, quantity, weight etc.

18.3 Details of handling & Storage instruction shall also be provided in each packing.

18.4 All items shall be properly packed with adequate cushioning material to prevent damages due to rough handling and inland transport. The packing shall be in such a way so as to avoid seepage of water into the packing.

18.5 Special care shall be given to prevent damage to the fragile components.

19.0 Additional requirements

19.1 After completion of all erection and commissioning works, the left out items shall be handed over to BHEL site stores.

19.2 During commissioning at site some smaller equipment may get added or Logics may have to be changed. The bidder shall carryout these changes at site without any commercial implications to BHEL.

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20.0 GENERAL INSTRUCTIONS TO THE BIDDER

- 20.1 Bidder shall quote for complete work specified in the document. Incomplete quotations for the part of the work will not be considered even if the quoted rates/price is lower.
- 20.2 Bidder shall contact BHEL and obtain additional details/data if any required to submit proper quotation.
- 20.3 The BHEL reserves the right to omit any one or more items of work at any time of the contract without assigning any reason what so ever.
- 20.4 The Bidder shall include all necessary commissioning spares in his basic scope of supply and the left out spares shall be handed over to BHEL after the completion of E & C.
- 20.5 Adequate lighting facilities such as low volt hand lamps shall be arranged by the contractor at the site of construction etc. at his cost.
- 20.6 All the lifting tackles including wire ropes, slings, shackles and electrically operated equipment shall be got approved by BHEL Engineer before they are actually put on use. Test certificates should be submitted before their usage. Test certificate obtained from the statutory authority should be submitted before their usage.
- 20.7 All equipment so used by contractor shall be of proven quality and safe in operation as approved by BHEL Site Engineers from time to time.
- 20.8 At periodic / intervals of work, complete and detailed account of the equipment so erected shall be submitted to the BHEL Engineer. The required format shall be submitted to BHEL Officials for approval.
- 20.9 All equipment shall be handled very carefully to prevent any damage and loss. No bare wire ropes, slings etc., shall be used for unloading and / or handling for equipment without the specific written permission of the BHEL engineer. The equipment from Vendor's storage yard shall be moved to the actual site of erection / location at the appropriate time as per the direction of BHEL Engineer so as to avoid damage for such equipment at site.
- 20.10 The work covered under this scope of work is of highly sophisticated nature requiring best quality / precision workmanship engineering and construction management. Contractor should also ensure successful and timely commercial operation of equipment installed. The contractor must have adequate quantity of precision tools, construction aids in possession. Contractor must also have

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adequate trained qualified and experienced supervisory staff and skilled personnel.

- 20.11 All the necessary certificates, licenses statutory clearances required to carry out his scope of work are to be arranged by the contractor then and there at no extra cost.
- 20.12 When the work is temporarily suspended contractor shall protect all construction materials equipment and facilities from causing damage to existing property interfering with the operations of the station when it goes into services. The contractor shall comply with all applicable provisions of the safety regulations clean – up programme and other precautionary measures which the BHEL has in effect at the site.
- 20.13 It will be the responsibility of the contractor to ensure the safe lifting of the equipment taking due precautions to avoid any accidents and damage to other equipments and personnel.
All piping shall be adequately supported and protected to prevent damage during handling and erection.
- 20.14 Sometimes it may become necessary for the contractor to handle certain un-required components in order to take out the required materials. The contractor has to take this contingency also into account. No extra payment is payable for such contingencies.
- 20.15 It shall be contractor`s responsibility to arrange for required labour, brush, paint and other consumable like thinner, cotton waste, cloth etc., for carrying out preservative painting. The quoted rates shall be inclusive of above work.
- 20.16 Due to atmospheric conditions erected materials are likely to get rusted more frequently. It is the responsibility of the contractor to preserve the erection materials drawn from their stores for erection till these are commissioned and handed over to customer. The required paint, thinner all other consumables like painting brush, emery paper, cotton waste, cloth etc., have to be arranged by the contractor at his cost. The contractor should ensure that the materials are not rusted on any account till they are handed over to customer. The decision of the BHEL Engineer is final with regard to adequacy of application of paint.
- 21.0 SITE CLEANLINESS AND SAFETY REQUIRMENTS:
- 21.1 Contractor shall strictly follow all safety regulations / conditions as per general conditions of contract booklet enclosed with this tender & **Annexure-6**

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- 21.2 Non – conformity of safety rules and safety appliances will be viewed seriously and the BHEL has right to impose fines on the contractor as under.
- 21.3 Contractors shall ensure that the quality is maintained in all the works connected with this contract at all stages of the requirement of BHEL.
- 21.4 Contractor shall ensure that all Inspection, Measuring and Testing equipment that are used, whether owned by the contractor or used on loan, are calibrated by the authorized agencies and the valid calibration certificate will be available with them for verification by BHEL. A list of such instruments possessed by contractor at site with its calibration status is to be submitted to BHEL Engineer for control.
- 21.5 Contractors shall arrange for the inspection of the works at various stages as required by BHEL. Immediate corrective action shall be taken by the contractor for the non-conformances if any, observed and pointed out by BHEL.

22.0 PAYMENT TO CONTRACTORS

- 22.1 All payment due to the contractors shall be paid by “E-payment” only.
- 22.2 All recoveries due from the contractor shall be effected in full from his bills unless specific approval from the competent authorities is obtained otherwise.
- 22.3 The bill shall be prepared in the proforma prescribed for the purpose based on the certificate issued by BHEL Engineer that entire work as stipulated in the tender specification has been completed in all respects to the entire satisfaction of BHEL. Contactor shall give unqualified “No Due” and “No Demand” certificates. Quantities / Weight erected shall be prepared and paid as per agreed payment terms. The quantities and financial value shall be entered in Measurement Book and signed by both the parties to the contract.

23.0 OTHER STATUTORY REQUIREMENTS:

- 23.1 Contractor shall follow & adhere to all the statutory & safety laws, rules & regulations for labour deployed in executing erection works as amended time to time.
- 23.2 Principle employer's security rules & regulations are to be followed by the contractor scrupulously in executing the contract works.
- 23.3 Contractor shall also adhere to the requirements of the principle employer in respect of minimum wages, provident fund, insurance, etc. as applicable to the contract labour.

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23.4 Contractor should get the clearance from the principle employer (TANGEDCO) & BHEL for wages etc. paid to the labour submitting the necessary proof for the same. Suitable records to be maintained by the contractor for a minimum of 3 years.

23.5 The contractor shall submit a copy of labour license obtained from the licensing Officer.

23.6 The contractor shall submit monthly running bills along with the copies of monthly wages (of the preceding month) as per contract labour rules, copies of monthly return of PF contribution with remittance challans and copy of renewed WC insurance policy or copies of monthly return of ESI contribution with challans (if applicable) in respect of the workmen engaged by them.

23.7 It is advisable that Contractor shall visit the site to have adequate knowledge of all the above rules & regulations before bidding for the tender. No claim shall be entertained for any ignorance of the above rules & regulations during execution of work.

23.8 BHEL shall have the right to with-hold suitable amounts from contractor bills for not making payments to labour engaged by them and not adhering to the statutory, safety rules & regulations till the contractor complies with them.

24.0 TIME OF COMPLETION

24.1 The time schedule as prescribed in the contract is the essence of the contract. The time for completion shall always be reckoned from the date of commencement of work as certified by the BHEL Engineers.

24.2 The entire work shall be completed by the contractor with in the time schedule or within the such extended time as may be allowed under relevant clause.

25.0 ENGAGEMENT OF LABOUR

25.1 The contractor will be directly responsible for provision of health and sanitary arrangements more particularly described in contract labour (regulations & Abolition) Act, safety precautions etc., as may be required for safe and satisfactory execution of the contract.

25.2 The contractor shall be responsible for proper accommodation including adequate medical facilities & transportation to the work spot and back for the personnel employed by him.



2 X 660 MW, UDANGUDI STPP (STAGE-1)

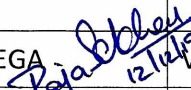
BAP-RANIPET

SPECIFICATION FOR LT MOTOR

No: ROS:4261, REV: 00

BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET- 632 406.

TECHNICAL SPECIFICATION
FOR
LT MOTOR

00	12.12.2019	AJV 	MEGA 	VNS 	Fresh issue
Rev.No	Date	Prepared	Checked	Approved	Remarks

**1. INTENT OF SPECIFICATION**

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station. All motors shall be chosen for non-hazardous SAFE area application.

2. SUPPLY OF LT MOTORS

All equipments, system and service covered under this specification shall comply with the requirements of the latest statutes regulations and safety codes as applicable in the locality where the equipments/systems will be installed. The Bidder shall fully acquaint himself with these requirements and shall ensure compliance with them. The equipments, systems and services furnished as per this specification shall conform to the codes and standards elsewhere in the specification. However, in the event of any conflict between the requirements of two standards or between the requirements of any standard and this specification, the more stringent requirements shall apply unless confirmed otherwise by the Owner in writing. The decision of the Owner shall be final and binding in all such cases.

2.1. CODES AND STANDARDS

All motors shall confirm to the latest editions including all applicable amendment of relevant IS, IEC standards/Publications and all other applicable ANSI, ASME, IEEE, NEC, NEMA, ISA, DIN, VDE, NFPA, IEC, EIA, TIA standards. In case any other standard is followed that ensures equal or better quality, may be accepted. However, the English version of the Standard adopted shall be submitted. Bidder to note that in no case, OEM/manufacturers own standards shall be accepted.

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards. Any other applicable Indian standards for any component part even if not covered in the list shall also be followed.

- | | | |
|----|--------------|--|
| a) | IS: 325 | Three phase induction motors |
| b) | IS: 12615 | Energy efficient induction motors |
| c) | IS: 900 | Code of practice for installation and maintenance of induction motors |
| d) | IS: 996 | Single-phase AC induction motor for general purpose |
| e) | IS: 1231 | Dimensions of three-phase foot-mounted induction motors |
| f) | IS: 2223 | Dimensions of flange mounted AC induction motors |
| g) | IS: 4029 | Guide for testing three-phase induction motors |
| h) | IS: 8789 | Values of performance characteristics for three-phase induction motors |
| i) | IS: 13555 | Guide for selection and application of 3-phase AC induction motors for different types of driven equipment |
| j) | IS: 5571 | Guide for selection of electrical equipment for hazardous areas |
| k) | IS: 12065 | Permissible limits of noise level for rotating electrical machines |
| l) | IS: 12075 | Mechanical vibration of rotating electrical machines |
| m) | IS 60034-5 | Degree of protection provided by Integral design of rotating electrical machines |
| n) | IS 60034-8 | Terminal marking and direction of rotation |
| o) | IS 60079-1 | Equipment protection by flame proof enclosure |
| p) | IS 60034-1 | Rotating electrical machines. |
| q) | IS 60079 | Explosive atmospheres |
| r) | IS/IEC 60529 | Degrees of protection provided by enclosures (IP code) |
| s) | IEC 60034 | Rotating electrical machines. |
| t) | IS 3177 | Code of practice for Design, Manufacture, Erection and testing of Cranes and Hoists |

**2 X 660 MW, UDANGUDI STPP (STAGE-1)****BAP-RANIPET****SPECIFICATION FOR LT MOTOR****No: ROS:4261, REV: 00****2.2. SYSTEM PARAMETERS**

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors. Maximum rating of the LV motor shall be 160 KW. Motors rated 0.20 KW and below shall be 240v, 1Ph, 50Hz motors and all other motors will be 415V, 3 Ph, 50 Hz motors unless otherwise specified. Space heater supply 230V+/-10%, 1Ph, 50Hz+/-5%, 10% (Absolute sum)

Sl.No.	Description	LT System
1	Voltage level	240 V : up to 0.2 kW 415 V: >0.2 kW and up to 200 kW.
2	System earthing	415 V system solidly grounded.
3	Fault withstand rating of motor terminal box (Breaker operated)	415 V system : 50/65 kA for 0.2 second

2.3. DESIGN REQUIREMENTS**2.3.1 Duty**

1. For the purpose of design of equipments /systems, an ambient temperature of 50 °C and relative humidity of 95% shall be considered. The equipment shall operate in hot, humid and a highly polluted (coal and fly ash) environment.
2. All AC motors shall be squirrel cage three phase/single phase induction motors. All the motor shall be designed for bi-directional rotation.
3. All motors shall be continuously rated (S1 duty). However, crane and hoist motors shall be intermittent (S4 duty), 40% cyclic duration factor.
4. All the motors shall be suitable for direct on-line starting with any type of breaker on full load. Where variable voltage and variable frequency (VVFD) operation is envisaged through VVFD drives, motors shall be specially designed for such application.
5. All LV motors with S1 duty shall be compulsorily of Energy efficient level IE 3 as per IS 12615. For VFD controlled motors it shall be level IE 2 as per IS 12615

2.3.2 Design Margin

1. The motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher, considering highest system frequency.
2. Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations. The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating; pull up, breakdown and full load torques are available for the intended service.
3. Service shall be considered as 1.0 only.
4. Motors that are operated through VFD as per process requirement shall meet IEC 60034-17 and the motor insulation shall be able to withstand the peak voltage, dV/dt and rise time as specified in IEC 60034-17 (for standard motors when controlled by VFD drives). In addition, these motors shall be provided with insulated bearings from motor frame size 160 and onwards on the non-driving end side of the motor. Vacuum Pressure Impregnation (VPI) shall be provided to windings for motors identified with VFD operation. This shall also have no additional cost implication to BHEL.

**2.4. STARTING REQUIREMENTS**

1. Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.
2. Starting Voltage requirement motors :80 % of rated voltage for all motors. Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.
3. Motors shall be capable of restarting under full load after a momentary loss of voltage with the possibility of 150 % nominal voltage during fast bus transfer.
4. The motor shall be designed for direct on line starting at full voltage. Starting current shall not exceed 6 times full load current for all auxiliaries, subject to IS tolerance.
5. The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.
6. Transient voltage dip on starting of the largest motor with DOL shall be limited to 20% of the nominal system voltage at the voltage terminals.

2.5. TORQUE REQUIREMENTS

1. Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
2. Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.
3. Motors subjected to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% of rated speed in reverse direction.

2.6. The following frequency of starts shall apply

Continuous duty motors shall be suitable for the following starting requirements under the specified conditions of load, torque and inertia.

1. No. of consecutive hot starts shall be 2 (with initial temperature of the motor at full load operating level).
2. No. of consecutive cold starts shall be 3 (with initial temperature of the motor at ambient temperature).

2.7. RUNNING REQUIREMENTS

1. Minimum voltage required for starting the motors shall be 85% of rated voltage
2. Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.
3. Motor shall not stall due to voltage dip in the system causing momentary drop in voltage up to 70% of the rated voltage for duration of 2 secs.

2.8. STRESS DURING BUS TRANSFER

1. All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
2. The motors shall be suitable for bus transfer schemes provided on the 11 kV, 3.3 kV/415V systems without any injurious effect on its life.
3. Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.



4. Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.
5. The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

2.9. LOCKED ROTOR WITHSTAND TIME

1. Locked rotor current of the LV motor shall not exceed 600% of full load current inclusive of IS tolerance.
2. The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time at minimum permissible voltage of 80% rated voltage by at least 3 seconds or 15% of the accelerating time whichever is greater. Provision of speed switch shall be avoided to the extent possible.
3. For the LT motors having starting time up to 20 seconds at minimum permissible voltage, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 seconds more than the starting time.
4. For the motors having starting time more than 20 seconds and up to 45 seconds at minimum permissible voltage, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 seconds more than the starting time.
5. For motors having starting time more than 45 seconds at minimum permissible voltage, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
6. Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
7. When a speed switch is mounted on the motor shaft, the same shall remain closed for speeds lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% over speed in either direction of rotation.
8. Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

2.10. CONSTRUCTIONAL FEATURES

1. Canopy shall be provided for outdoor motors.
2. Bidder shall provide fully compatible electrical system, equipments, accessories and services.
3. All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.
4. **Bearings**
 - a. Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
 - b. Sleeve bearings shall be split type, ring oiled with permanently aligned, close running shaft sleeves. Grease lubricated bearings shall be pre-lubricated and shall have provisions for inservice positive lubrication with grease nipple and relief holes. For sleeve bearings, the bearing housing shall be preferably in end shield itself.
 - c. Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred. However, if anti-friction bearings can take vertical thrust, thrust and guide bearings are not required.
 - d. All motors below 15 kW shall be provided with sealed ZZ bearings.
 - e. For motors rated above 1000 KW having shaft length more than 1.5 M shall have insulated bearings to prevent flow of shaft currents.
 - f. For all VFD operated motors shall have insulated bearings to prevent flow of shaft currents.

**2 X 660 MW, UDANGUDI STPP (STAGE-1)****BAP-RANIPET****SPECIFICATION FOR LT MOTOR****No: ROS:4261, REV: 00**

5. Motors shall be designed to easy access for drilling holes through motor feed of mounting flange for installation of dowel pins after assembly of the motor and driven equipment.
6. For bearing temperature measurement, duplex RTDs shall be provided for each bearing and shall be wired up to the terminal box.
7. Degree of Protection: Motors and Cable Box: IP 55
8. Non-hygroscopic, oil resistant, flame resistant
9. Suitable single phase space heaters shall be provided on motors rated 30 kW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.
10. Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362. Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled
11. Motors shall be designed with cooling fans suitable for both directions of rotation.
12. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.
13. Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.
14. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10 deg C.
15. Winding and insulation
 - a. Winding shall be class F insulation with temperature limited to class B. Insulation shall be Non-hygroscopic, oil resistant, and flame resistant. Winding, fittings and hardware shall be corrosion resistant. Winding shall be tropicalized and suitably varnished, baked and treated for operating satisfactorily in humid and corrosive atmosphere.
 - b. For the VFD operated drives, insulation shall be designed to take care of stresses due to high DV/DT. Motors shall be wound with dual coated winding wires and impregnated with VPI process. Further for such application, insulated bearings shall be provided to avoid circulating current caused by shaft induced voltages.
 - c. All insulated winding shall be of copper.
 - d. Two hot starts in succession, with motor initially at normal running temperature
16. Noise and vibration
 - a. The peak amplitude of the vibration shall be within IS specified limits.
 - b. Noise level and vibration shall be limited within the limits prescribed in IS: 12065 & IS: 12075 respectively. Motors shall withstand vibrations produced by driven equipment.
17. Grounding

Motor body shall be grounded at two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.

The grounding connection shall be suitable for accommodation of ground conductors as follows:

LT Motors	
a. Fractional HP	8 SWG GI wire
b. Up to 25 KW	25 x 3 mm flat
c. 25 to 125 KW	25 x 6 mm flat
d. above 125 KW	50 x 6 mm flat
Control Desks, Control/relay panels, LDBs, PDBs, Lighting Panels, Power receptacles, Lighting Masts, Lighting Poles	25 x 3 mm flat
LPB stations, Limit/Pressure switches, Starters, CT/PT terminal Boxes	8 SWG GI wires
Columns, Fence, Gates, Cable trays etc	50 x 6mm flat

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18. The cable terminal box shall have a separate grounding pad, Terminals and Terminal Boxes.
- The motor terminal box shall be suitable for withstanding the maximum system fault current for a duration of at least 0.25 seconds.
 - Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified below.
 - Unless otherwise stated, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current Short time rating for terminal boxes below 110 kW (Contactor controlled) shall be 50 KA protected by fuse for 0.25 sec
 - Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on top or left hand side of the motor when viewed from the non-driving end.
 - Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A, B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or V, W & V respectively.
 - Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.
 - Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable.
 - Degree of protection for terminal boxes shall be IP 55 as per IS 4691.
 - Separate terminal boxes shall be provided for space heaters. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.
 - Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degrees for LV motors.
 - Suitable Double Compression type Cable glands and cable lugs shall be provided. Cable lugs and lugs shall be as specified elsewhere in the specification. The cable sizes will be informed during detail engineering.
 - Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size suitable for solidly grounded system shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.
19. Painting: Motor including fan Painting shall be carried out by an approved process. Pretreatment shall conform to applicable standard. The equipment shall be subject to a coat of red oxide primer paint. All inside and outside surface shall be painted with epoxy based paint. The final thickness of paint film on steel shall not be less than 100 microns. Finish shade shall be 631 of IS: 5 (smoke grey).
- 20 Lifting Provisions: Motor weighing 25 kg or more shall be provided with eye bolt or other adequate provision for shifting.

2.11. GENERAL

- Motors provided for similar drives shall be interchangeable.
- Suitable foundation bolts are to be supplied along with the motors.
- Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956
- All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

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5. Name plate with all particulars as per IS: 325 shall be provided
6. Necessary cable glands & cable lugs for the motors shall be supplied by the bidder
7. Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
8. Name Plate: Motor shall have stainless steel nameplate(s) showing diagram of connections, all particulars as per IS: 325 / IS: 12615 and shall also have 'BEE' marking.

2.12. INSPECTION AND TESTING

1. All materials, components and equipment covered under this specification shall be procured, manufactured, as per the Approved quality plan
2. LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.
3. All motors shall be subjected to routine tests as per IS: 325. Noise level measurement and vibration test as per standards shall be conducted on all motors.
4. Inspection: for Motors Upto 55KW –Inspection by BHEL, for motors with a rating more than 55KW inspection is by BHEL, Customer and Consultant.

2.12.1. LIST OF TESTS TO BE CONDUCTED FOR HV, MV and LV MOTORS**1. TYPE TESTS**

Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished for the motors rated 30 kW and above.

The following type tests shall be conducted on LT motors.

- a. Measurement of resistance of windings of stator and wound rotor.
- b. No load test at rated voltage to determine input current power and speed
- c. Full load test to determine efficiency power factor and slip.
- d. Temperature rise test.
- e. Momentary excess torque test.
- f. High voltage test.
- g. Test for vibration severity of motor.
- h. Test for noise levels of motor
- i. Test for degree of protection

2. ROUTINE TESTS

The following routine tests shall be carried out for the motors as per applicable standards.

- a. IR of Winding before and after HV tests
- b. HV test on main winding space heater, RTD, BTD
- c. Resistance measurement
- d. No load run test Major Electrical
- e. Phase sequence and direction of rotation
- f. Vibration check Major Electrical
- g. Reduced voltage running test
- h. Locked rotor test at reduced voltage
- i. Record of RTD & BTD resistance at the end of no load test
- j. Test on space heater & RTD
- k. Visual Control of terminal box and verification of construction with respect to short tested terminal box.

3. INSPECTION AND TESTING AT SITE

Insulation resistance of 415V motors shall be measured between the winding of the machine and its frame by means of a 500/1000V megger. A minimum value of 1 mega ohm for 415V motors shall be considered a safe value. In case of lower I.R. Value, the insulation value shall be brought up by any of the following methods as desired by the Site Engineer:

- a. Blowing hot air in case of big motors.
- b. Putting the motor in electric oven in case of smaller motors.



- c. Placing heaters or lamps around and inside in case of small motors after making suitable guarding and covering arrangements so as to conserve the heat.

4. Site Test

The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out

- a. Measurement of vibration.
- b. Measurement of insulation resistance and polarization index.
- c. Measurement of full load current.
- d. Test running of the motors, checking the temperature rise and identifying the hot spot.

2.13. DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

- 1) OGA drawing showing the position of terminal boxes, earthing connections etc.
- 2) Arrangement drawing of terminal boxes.
- 3) Characteristic curves:
 - i. Current vs. time at rated voltage.
 - ii. Speed vs. time at rated voltage.
 - iii. Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
 - iv. Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.
 - v. Load performance curves.

2.14. DATA SHEET

LT MOTORS (A.C.)

1. Application :
2. Type : Energy Efficient (IE3)
3. Frame size :
4. Manufacturer :
5. Rated output in KW :
6. Duty cycle : Continuous, S1
7. Rated voltage, no. of phases and frequency : 415 V, 3 Ph, 50 Hz
8. Allowed voltage variation : $\pm 10\%$.
9. Allowed frequency variation : (+) 3% and (-) 5%
10. Combined voltage and Frequency Variation : 10 % (Absolute sum)
11. At rated Voltage and frequency
 - a. Full load current (Amps) :
 - b. Rated speed :
 - c. Full load efficiency :
 - d. Full load power factor :
 - e. Starting torque in % of FLT :
12. Method of starting :
13. Degree of protection :
14. Method of ventilation :
15. Class of insulation : "F" (temp. rise limited to class B)
16. Stator winding connection :
(For continuous run) (Delta / Star)
17. Full load torque :

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18. Breakdown torque in % of FLT :
19. Pull up torque in % of FLT :
20. Locked rotor current in Amps :
(600% with tolerance of 20%)
21. Motor efficiency and P.F.AT :
 - a. 100 % load
 - b. 75% load
 - c. 50% load
 - d. 25% load
22. Locked rotor withstand time under hot/cold condition at 110 % Voltage :
23. Maximum permissible starting time :
24. No load current in Amps. :
25. Starting time in seconds with driven equipment coupled at
 - a. rated voltage :
 - b. Min. Voltage :
 - c. Max. Voltage :
26. Actual temperature rise over an ambient of 50°C when motor is delivering rated output
 - a. By thermometer method :
 - b. By resistance method : (70°C for air cooled motors)
27. Number of successive starts with driven equipment coupled and motor initially at rated load temperature :
28. Minimum voltage required by the motor to bring the driven equipment to rated speed: To be 80% of RV.
29. Resistance per phase in ohms at 20 degrees :
30. Direction of rotation from driving end :
31. Make, type and size of bearing
 - a. At drive end :
 - b. At Non drive end :
32. Type of mounting and shaft Orientation :
33. Location of terminal box viewed from driving end :
34. Type and number of terminals brought out :
35. Type and size of cable gland & lugs for power cables & (if applicable) space heater cable : (size will be given during Detail engg)
36. Cable gland entry side :
37. Tropical & fungicidal treatment :
38. GD² of the motor :
39. Weight of the motor :
40. Space heater Rating & other details (for 30KW and above motors) :

3. SPECIFICATION FOR CABLE GLANDS & LUGS**3.1. Specification for Cable Glands**

- a. Bidder shall provide all cable glands required for glanding the above mentioned cables both at field instrument and local control panel side, junction boxes side and at control room side.
- b. Cable glands
 - i. Cable glands shall conform to BS: 6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation.

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- ii. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene and of tested quality. Necessary cable dimensions shall be furnished to the successful contractor.
- iii. Cable glands shall be single compression for indoor use, double compression type for outdoor use. Glands for classified hazardous areas shall be double compression type flameproof and weather proof duly certified by CMRS and approved by CCE.

3.2. Cable lugs/ferrules

The cables lugs shall be conforming to IS: 8309. Machine ferruling shall be adopted.

Cable lugs for power cables shall be Aluminium solder less crimping type suitable for aluminium compacted conductor cables.

- i) Copper tubular terminal end for solder less crimping to copper conductors.
- ii) Cable lugs for control cable termination shall be insulated type. These lugs shall be flat type/ring type/U type to suit the terminals provided in the pan
- iii) Pin type lugs shall not be used.
- iv) Aluminium tubular terminal ends for solder less crimping of to Aluminium conductor.

Solder less crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.

4. LIST OF MANDATORY SPARES

a	Motors – Bearings	One (1) Set each for drive end and Non drive end for each TYPE.
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NOTES:

- 1. The word 'TYPE' means the Make, Model no., Type, Range, Size/ Length, Rating, Material, accessories as applicable.
- 2. Wherever % age is identified, Bidder shall supply next higher rounded figure.
- 3. The terminology used under 'Part Description' is the commonly used name of the part and may vary from manufacturer to manufacturer.
- 4. Commissioning spares are part of Bidder scope of supply. Mandatory spares as indicated above do not cover commissioning spares.

4.1. INTERCHANGEABILITY & PACKING

All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site. e.g. small items shall be packed in sealed transparent plastic bags with desiccators packs as necessary.

4.2. IDENTIFICATION

Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers, and other packages must be suitably marked and numbered for the purpose of identification.

4.3. CONTRACT-QUANTITIES

The quantities & mandatory spares shall be as specified herein. Any other mandatory spares not listed above however required for any instrumentation item shall also be supplied by bidder. The final quantities may require addition/deletion during the contract stage. The Bidder shall furnish unit price for each mandatory spare under appropriate schedules which shall be used for adjusting the contract price in the event of addition/deletion from contract quantities specified herein.

**2 X 660 MW, UDANGUDI STPP (STAGE-1)****BAP-RANIPET****SPECIFICATION FOR LT MOTOR****No: ROS:4261, REV: 00****4.4. DOCUMENTATION**

Bidder shall furnish detailed catalogue, part number and subassembly/assembly drawings with manufacturer's cross reference for each spare part. The data and information furnished shall be of nature and content as per owner's approval to enable owner procurement of these spare parts directly from the respective manufacturer.

5. PACKING AND DISPATCH

Equipment shall be packed with suitable desiccants sealed in water-proof, vapour-proof wrapping, and packed in lumber or plywood enclosures, suitably braced tied and skidded. Lumber enclosures shall be solid, not slatted.

Review by the Owner of the Bidder's proposed packaging methods shall not relieve the Bidder of responsibility for damage or deterioration to the equipment and materials specified.

All equipment and materials shall be suitably coated, wrapped or covered end boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site.

All itemized list of contents shall be enclosed inside each case, and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc. according to its individual shipping number:

- a) Export case markings.
- b) Case number.
- c) Gross weight and net weight in Kilograms
- d) Dimensions in centimeters.
- e) Complete description of material including order number.

Electrical equipment controls and instrumentation shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection.

6. BIDDER LIST

1	KIRLOSKAR ELECTRIC CO LTD	BENGALURU/CHENNAI
2	NGEF (HUBLI) LTD	BENGALURU
3	SIEMENS INDIA LTD	JOKA
4	BHARAT BIJILEE LTD	MUMBAI
5	CROMPTON GREAVES LIMITED	CHENNAI
6	LAXMI HYDRAULICS PVT LTD	SOLAPUR
7	JYOTI LIMITED	VADODARA
8	BHEL ELECTRICAL MACHINES LTD	KASARAGOD
9	BHARAT BIJILEE LIMITED	CHENNAI
10	ABB LIMITED	CHENNAI
11	MARATHON ELECTRICAL MOTORS INDIA LIMITED	CHENNAI

Note: This Bidder list is subject to customer approval



2 X 660 MW, UDANGUDI STPP (STAGE-1)

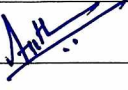
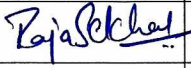
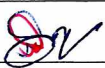
BAP-RANIPET

SPECIFICATION FOR ELECTRICAL ACTUATORS

No: ROS: 4263, REV: 00

**BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET- 632 406.**

**TECHNICAL SPECIFICATION
FOR
ELECTRICAL ACTUATORS
(INCHING DUTY)**

					
00	18.1.2020	AJV	MEGA	VNS	Fresh issue
Rev.No	Date	Prepared	Checked	Approved	Remarks

**1.0.0 INTENT OF SPECIFICATION**

This section covers the requirements of motor operated electrical actuators.

2.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest edition (including amendments) of the applicable Indian Standards (IS), IEC publications and other codes except where modified and /or supplemented by this specification.

3.0.0 TECHNICAL REQUIREMENTS

- 3.1.0 Electric actuators shall be provided as specified in Mechanical and C&I section. It shall be equipped with 3 phase induction motor, rated for S2-15 minutes' duty for ON/OFF valve and intermittent duty for inching duty. **For inching service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.**
- 3.2.0 Motor shall be class F insulated with temperature rise limited to class B. Motor shall be of class H insulation with temperature limited to class B used for high pressure and high temperature valves. Canopy shall be provided for outdoor service.
- 3.3.0 Motor shall be surface cooled designed for enclosure protection class of IP 67. Motor shall be suitable for starting direct on-line, with starting current limited to 6 times full-load current.
- 3.4.0 The actuator is placed in non-hazardous area.
- 3.5.0 Actuators shall be suitable for operation at an ambient temperature of 50 degree C and relative humidity of 95%.
- 3.6.0 Maximum continuous motor rating shall be atleast 10% above the maximum load derived of the driven equipment under entire operating range including voltage & frequency variation.
- 3.7.0 Motors shall be capable of operating under following supply variations without exceeding its guaranteed temperature limits.
- Frequency variation : (+) 3% and (-) 5% of 50 Hz
 - Voltage variation for LT motors : (±) 10% of 415 V
 - Combined variation of voltage and frequency: 10% (absolute sum)
- 3.8.0 All actuators shall be of integral type. Duty cycle of actuators shall suit the system requirement. The actuators shall be capable of giving the required torque at the output shaft. The actuators shall be designed to take the full thrust.
- 3.9.0 Electrical Actuators of Inching type position transmitters of non-contact type shall be interfaced to DCS.
- 3.10.0 Actuators shall be of totally enclosed weather proof and dust proof construction with NEMA-6/IP 65 enclosure and shall be suitable for outdoor application without the necessity

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for a canopy. The actuator shall be suitable for mounting directly on the valve. The actuator shall be capable of giving the required torque, rpm and thrust without the help of any spur gear arrangement. The actuator shall be suitable for mounting in any position. Actuators shall be provided with integral starters.

- 3.11.0 The actuator shall be complete with motor, reduction gears, change gears, terminal compartment, switch compartment with limit switches and torque switches, local position indicator, position transmitter for remote position indicator, thermistor, space heaters, cable glands, mechanical position indicator, hand wheel for manual operation, valve attachment etc.
- 3.12.0 Each actuator shall have a hand wheel fitted on it for emergency operation. The hand wheel shall be designed such that it is declutched automatically when the power supply to the motor is restored. The material of the hand wheel shall be either malleable iron or steel. The hand wheel shall have adequate clearance from housing for each gripping and operation. Actuators offered shall be with self-locking worm. The maximum hand wheel force of 500N must not be exceeded. For limiting hand wheel forces, for control and operation purposes it may be necessary to install appropriate gears.
- 3.13.0 Two number adjustable torque switches (one for open and one for close) each with 2 NO and 2 NC potential free contacts shall be provided. It is required to have calibration for the torque switches so that the switches can be easily set to any value desired.
- 3.14.0 Two numbers of position limit switches (one for open and one for close) each with 2 NO and 2 NC potential free contacts shall be provided. Two auxiliary limit switches (one for open and one for close) with 2 NO and 2 NC potential free contacts shall also be provided. The limit switches shall be of independently adjustable type. Limit switches and actuating mechanism shall be rust proof suitable for damp atmospheres. Limit switch compartment shall be weather proof and spacious enough for easy setting. The limit switches shall be suitable for the following ratings, both 240 Volts AC, 10 A and 220 V DC, 0.5 Amps.
- 3.15.0 Each actuator shall have a space heater in the limit switch compartment suitable for 240 V AC 50 Hz single phase supply. Earthing terminals shall be provided on either side of the motor. All terminals must be suitable for 2.5 sq.mm wires.
- 3.16.0 The wiring from the limit switches, torque switches etc. shall be brought out in a separate terminal box of adequate size, so as to easily terminate the control cables.
- 3.17.0 Actuators shall be supplied with integral starter which shall have sophisticated electronic controls with field programming feature. It shall be designed for remote control from DCS/Respective control system. Required interposing relays for receiving open/close/stop command from DCS/Respective control system shall be provided. Potential free contacts and transducers shall be provided to provide status indication at remote DCS/Respective control system. The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

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The actuator shall have:

- One (1) built-in local position indicator for 0-100% travel.
- One (1) position transmitter, 4-20 mA current signals as position feedback to DCS.

In addition, all actuators for valves are to be fitted with socket and plug of well-established make to IEC 60309 or equivalent for the power cable connection. For the control cable connection separate socket and plug shall be provided.

3.18.0 A three position selector switch (marked as LOCAL-OFF-REMOTE) and push buttons OPEN-STOP-CLOSE (for local operation) with indication lamps for running OPEN and running CLOSE shall be provided.

3.19.0 The Remote command signal (OPEN-STOP-CLOSE) from DCS/Respective control system/Control panel shall be isolated from control electronics through opto-isolator.

The following controls to be provided as a part of the Electric actuated valves- Inching duty.

1. Commands for Open, Close, Stop
2. Limit switch Feedbacks for Open, Close at any position within 0-100%, OTS, CTS
3. 4-20 mA current signals as position feedback

3.20.0 The following individual Status annunciation LED's and fault annunciation LED's shall be provided locally (Integral to actuator) to annunciate the following for easy local monitoring.

- Actuator in local mode
- Actuator in remote mode
- Actuator running in OPEN direction
- Actuator running in CLOSE direction
- Actuator in inching mode.
- Actuator in self-retaining mode
- Limit switch OPEN trip
- Limit switch CLOSE trip
- Control voltage availability

3.21.0 The following individual fault annunciation LED's (Colour-Red) shall be provided locally. (Integral to Actuator)

- Torque switch OPEN
- Torque switch CLOSE
- Thermo switch trip
- Electronic overload relay trip
- Motor single phasing
- Common fault (Inclusive of any one or combination of above fault)

3.22.0 View port shall be provided on integral starter unit to monitor the above status annunciation and fault annunciation.

3.23.0 Electronic Overload relay shall be provided to trip actuator in case of overload. Plug in connections/design shall be provided between: -

- Integral starter unit and basic actuator
- Between external customer connections and actuator.

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3.24.0 OPEN-CLOSE indication /LED shall be provided for indication of full open/close position.

3.25.0 Automatic phase correction facility and potential free contact for annunciation of power failure shall be provided.

3.26.0 The following individual potential free relay contacts shall be provided in the actuator for remote annunciation to facilitate continuous monitoring of the actuator.

- Actuator (valve) running in OPEN direction.
- Actuator (valve) running in CLOSE direction.
- Actuator in remote mode.
- Actuator in local mode.
- Actuator power switched off /single phasing.
- Torque switch trip, thermo switch trip and overload relay trip

4.0.0 TESTING AND INSPECTION

Equipment offered shall be of type tested and proven type. Routine tests shall be carried out for all the equipment as per applicable standards. Copies of certified reports of all tests carried out at the works shall be furnished.

The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out.

- Measurement of insulation resistance.
- Measurement of full load current.
- Test running of the motors.

5.0.0 DRAWINGS & DOCUMENTS

The following drawings and documents shall be submitted for approval during detail engineering stage.

- Integral starter details
- Technical particulars of actuator
- Wiring diagram
- General arrangement drawings
- Test reports

BHEL - BAP, Ranipet
Water systems
Sub-Vendor list for Pre-treatment system

Annexure-A
30-01-2020

S.No	Product Description	Supplier Name	Place
1	LP PUMPS	FLOWSERVE INDIA CONTROLS (P) .LTD	COIMBATORE
		KIRLOSKAR BROTHERS LIMITED	CHENNAI
		MATHER AND PLATT PUMPS LTD.,	CHENNAI
		SULZER PUMPS INDIA LIMITED	CHENNAI
		KSB PUMPS LTD.,	CHENNAI
		BEST & CROMTON ENGG LIMITED	CHENNAI
		GRUNDFOS PUMPS INDIA PVT LTD	CHENNAI
		FLOWMORE LIMITED	GURGAON
		RUHRPUMPEN INDIA PRIVATE LIMITED	CHENNAI
2	DOSING PUMPS	PSI ENGINEERING SYSTEMS P. LTD	CHENNAI
		GRUNDFOS PUMPS INDIA PVT LTD	CHENNAI
		ACCUDYNE INDUSTRIES INDIA PRIVATE LTD (MILTON ROY)	CHENGALPATTU
		POLY-PUMP INDUSTRIES,	BERHAMPUR.(ORISSA)
		ANTICORROSIVE EQUIPEMENT	MUMBAI
		S.J.INDUSTRIES	CHENNAI
3	GRP PIPES & PIPE FITTINGS	MODERN ENGINEERING PLASTICS PV	SALEM
		SHRIRAM SEPL COMPOSITES P LTD	MARSHALL
		EPP COMPOSITES PRIVATE LIMITED	RAJKOT
		REINHOLD POLY GLASS	HOSUR
		CHEMICAL PROCESS PIPING PVT LIMITED	MUMBAI
		SUNRISE INDUSTRIES (INDIA) LIMITED	VADODARA
		EXTRACO COMPOSITES INDIA PVT LTD	CHENNAI
4	LP BUTTERFLY VALVES (MANUAL)	L & T VALVES LIMITED	CHENNAI
		INTERVALVE POONAWALLA LTD	PUNE,
		INTERVALVE POONAWALLA LTD	CHENNAI
		WEIR BDK VALVES	HUBLI
		WEIR BDK VALVES	VELACHERY,CHENNAI
		KIRLOSKAR BROTHERS LIMITED	CHENNAI

		CRANE PROCESS FLOW TECHNOLOGY (I) LTD.,	PUNE
		MICROFINISH VALVES PVT LTD	DHARWAD
		DELVAL FLOW CONTROLS PVT LTD,	CHENNAI
		SIGMA INDUSTRIES	NAVI MUMBAI
		GM ENGINEERING PRIVATE LIMITED	RAJKOT
		MASCOT VALVES PVT LTD	AHEMEDABAD
		BRAY CONTROLS INDIA PRIVATE LIMITED	DIST-VADODARA
		KAMALA VALVES & ENGINEERING WORKS	HOWRAH
		SAP INDUSTRIES LTD	AHMEDABAD
		STAFFORD CONTROLS LIMITED	CHENNAI
		CANLE VALVES PRIVATE LIMITED	COMBATORE
		ORBINOX INDIA PRIVATE LIMITED	COIMBATORE
5	PP/CPVC/UPVC BALL	MODERN FABRICATORS AND	KASTURIBAI NAGAR,ADYAR,C
		SEWVAC INDIA	CHENNAI
		ALIAxis UTILITIES & INDUSTRY PVT LTD	AHMEDABAD
		ALIAxis UTILITIES & INDUSTRY PVT LTD	GOA
		ASTRAL INDIA PVT LTD.	CHENNAI
		GEORG FISCHER PIPING SYSTEMS (SWITZERLAND) LTD	SWITZERLAND.
		GEORG FISCHER PIPING SYSTEMS PVT LTD	MUMBAI
		GEORG FISCHER PIPING SYSTEMS PVT LTD	CHENNAI
6	LP PIPING - UPVC & CPVC	MODERN FABRICATORS AND	KASTURIBAI NAGAR,ADYAR,C
		SEWVAC INDIA	CHENNAI
		SPAN CORPORATION	CHENNAI
		ASTRAL POLY TECHNIK LIMITED	AHMEDABAD
		SANGIR PLASTICS PVT LTD	MUMBAI
		FIP SPA FORMATURA INIEZIONE POLIMERI	ITALY
7	LP PIPING - HDPE	MODERN FABRICATORS AND	KASTURIBAI NAGAR,ADYAR,C
		SPAN CORPORATION	CHENNAI
		JAIN IRRIGATION SYSTEMS LTD	CHENNAI
		GODAVARI POLYMERS PVT LTD	CHENNAI
		HASTI PIPES LTD,	AKOLA
		AEROCHEM PIPING P. LTD	AHMEDABAD
		SANGIR PLASTICS PVT LTD	MUMBAI
8	ELE. MOTOR OPERATED BUTTERFLY VALVES	L & T VALVES LIMITED	CHENNAI
		INTERVALVE POONAWALLA LTD	PUNE,

	INTERVALVE POONAWALLA LTD	CHENNAI
	WEIR BDK VALVES	HUBLI
	WEIR BDK VALVES	VELACHERY,CHENNAI
	CRANE PROCESS FLOW TECHNOLOGY (I) LTD.,	PUNE
	MICROFINISH VALVES PVT LTD	DHARWAD
	SEVERN GLOCON INDIA PVT LTD	CHENNAI
	SIGMA INDUSTRIES	NAVI MUMBAI
	MASCOT VALVES PVT LTD	AHEMEDABAD
	ORBINOX INDIA PRIVATE LIMITED	COIMBATORE

Note:

- 1) Above is the typical Vendor list which is to be followed by Bidder.
- 2) Bidder to submit the Vendor list for all the items to BHEL for approval during contract stage

**VOLUME II****SUB-SECTION 2.25****CLEANING, PROTECTIVE COATING AND PAINTING****1.0.0 GENERAL**

This specification covers the general requirements related to the cleaning protective coating and painting of equipment, components and systems that are covered under main equipment / system specifications for 2x660 MW Supercritical Thermal Power Plant. The components and/or equipment shall be mechanically and /or chemically cleaned during the following stages of the Contract.

- Cleaning in workshop
- Cleaning before painting and/or corrosion protection (application of prime coat)
- Cleaning before erection and during installation.

Cleaning of fabricated component items shall be carried out after fabrication and final heat treatment or welding at manufacturer's works or at site, as appropriate. No paint shall be applied surfaces within 75 mm of field welded connections. These surfaces shall be coated with a consumable preservative and marked.

For cleaning in workshop and before painting, mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out, hand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the Owner / Engineer.

Machined surfaces shall be protected during the cleaning operations.

In the event of the surfaces not being cleaned to the Owner's satisfaction, such parts of the cleaning procedures or agreed alternatives as are deemed necessary to overcome the deficiencies shall be carried out at the supplier's sole expense.

For reclining small areas, hand cleaning by wire brushing may be permitted.

2.0.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the Codes indicated below and shall conform to the relevant IS Code for the material and workmanship.

The following codes and standards shall be followed for the surface preparation, surface protection and painting works.

IS: 5	Colors for ready mixed paints and enamels.
IS: 101	Methods of test for ready mixed paints and enamels.
IS: 104	Ready mixed paint, brushing, Zinc Chrome, priming.
IS: 158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS: 161	Heat resistant paints
IS: 1303	Glossary of terms relating to paints.
IS: 1477	Code of practice for painting of ferrous metals in buildings (Parts I & II).
IS: 2074	Specifications for ready mixed paint, Air drying, red oxide zinc chrome priming.
IS: 2338	Code of practice for finishing of wood and wood based materials: Parts 2 schedules.



IS: 2339	Aluminum paint for general purposes, in dual container.
IS: 2395	Code of practice for painting of concrete, masonry and plaster surfaces: Part 2 schedules.
IS: 2524	Code of practice for painting of non-ferrous metals in buildings (Parts I & II).
IS: 2932	Specification for enamel, synthetic, exterior (a) undercoating, (b) Finishing
IS: 3140	Code of practice for painting asbestos cement building products.
IS: 6158	Recommended practice for design safeguarding against Embrittlement of hot dip Galvanized Iron & steel products.
IS: 6159	Recommended practice for design & fabrication of Iron & steel products prior to Galvanizing & metal spraying.
IS: 6278	Code of practice for white washing and Color - Washing.
IS: 10221	Code of practice for coating & wrapping of underground mild steel pipelines.
IS: 33	Inorganic pigments and extenders for paints –Methods of sampling & test.
IS: 13183	Aluminum paint, Heat resistant - specifications.
IS: 144	Specification for ready mixed paint brushing, petrol resisting, Air drying for Interior paints of tanks and containers, Red oxide.
IS: 9954	Pictorial surface preparation standards for painting of steel surfaces.
IS: 11883	Specification for Ready Mixed Paint, Air Drying, Red Oxide Priming for metals.
IS: 9404	Color code for identification of pipelines used in the Thermal Power Plants.
IS: 12744	Specification for Ready Mixed Paint, Air Drying, Red Oxide-Zinc Phosphate Priming.
BS: 2015	Glossary of paint selected terms.
BS: 5252	Final coat color.
BS: 7079A1/S1	Specification for rust grades and preparation grades of uncoated substrates after overall removal of previous coating.
BS: 7079A2	Preparations grades of previously coated steel substrates.
BS: 7079GrC	Surface roughness characteristics of blast cleaned steel substrates.
BS: 7079GrD	Methods for surface preparation.
BS-4232	Surface Finish of Blast cleaned steel for painting.
ASTM	American Standard for Testing Material.
ASTM A 780	Standard practice for repair of damaged galvanized coatings.
AWWA	American Water Works Association.
ASA-A-13.1-1981	Scheme for identification of piping system (American National Standard Institution).
DIN	Deutshes Institute for Normung
SIS-055900-1967	Surface preparation standards for painting steel surfaces. (Swedish standard Institution)
SSPC-SP	Preparation Specifications (Steel structures painting council, U.S.A.).
	National Association of Corrosion Engineers, U.S.A. (NACE).



3.0.0 SCOPE OF WORK AND GENERAL REQUIREMENTS

This specification covers the surface preparation, method of application and material to be used for all coating of equipment, steel structures and piping. Steel material subjected to surface preparation on shop/site shall have minimum requirements in accordance with Rust Grade B (SSPC/SSPM Volume-2).

Coating materials according to SSPC, EN ISO, ASTM, BIS or DIN standards, shall be used. The paint shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work. The materials shall be matched with each other so that they are compatible. Coatings deviating this specification shall be subject to approval.

Standards of surface preparation and painting shall give a time to first maintenance of minimum 10 years.

The paint to be applied shall be approved by Owner.

All paints & paint material used shall be procured from approved manufacturers. Paint shall be supplied in manufacturers original containers with the description of content, specification No., colour, ref no, date of manufacture, shelf life expiry date & pot life.

The paint manufacturers shall provide coating system data sheet for each coating system to be used containing the following information

- a. Surface preparations
- b. Film thickness (min and max)
- c. Min and max recoating intervals at relevant temperatures
- d. Mixing ratio, thinner details and coating repair systems

The sample for testing the paint being used may be taken by the Owner at any time.

In general Shop fabricated equipment will be delivered to the site coated with a shop applied system or the manufacturer's standard finish in accordance with the requirements of this specification.

For equipment that has received shop prime coat, all touch-up prime coat and additional coats shall be applied in accordance with the coating schedule. It is responsibility of the vendor to ensure compatibility between shop and field applied paint systems.

Necessary precautions shall be provided to all equipment, structures to protect other surfaces from abrasive blasting, coating over spray and spatter. Damage to other surfaces or equipment shall be repaired by the vendor.

The Contractor shall submit the following for review and approval by the Owner:

- a. Manufacturer's recommended paint scheme for the project
- b. Latest published product & instructions for application data,
- c. Procedures for surface preparation and application.
- d. Pre qualification for equipments and blasting materials, product, procedure and personnel qualifications for the paint and painting systems.
- e. Painting repair procedures

Painting records shall contain:

- Equipment/components/location painted
- Date of painting
- Paint details such as specification No, colour, date of manufacture, shelf life, expiry date
- Application equipments



- Ambient conditions at the time of painting
- Surface temperature
- Drying time between coating, DFT and number of coatings
- Appropriate work plan for painting.

The supply of all necessary equipments, weather protection, and scaffolding for painting to ensure work is carried out in accordance with the specification and agreed programme.

Maintenance of the paint work until completion of the contract, this shall include repair of any damaged areas caused by third party.

Disposal of painting waste resulting from painting, shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work and coating materials.

It is a mandatory requirement that all operatives working to this procedure take full cognizance and implement necessary safety precautions.

4.0.0 CLEANING AT MANUFACTURER'S WORKS

Mechanical cleaning shall preferably be carried out by abrasive blasting. The Owner is prepared to consider alternative methods such as chemical cleaning provided they achieve the necessary surface condition.

In case of chemical cleaning, the detailed procedure for chemical cleaning as well as the system for which chemical cleaning is required shall be submitted by the contractor for Owner's approval. The procedure shall comprise of pre-treatment and acid treatment to achieve cleanliness equivalent to that specified for mechanical cleaning.

Surface condition:

The Metal surfaces shall be clean and free of mil scale, rust, dirt, grease and any other deleterious matter.

Where metal surfaces are to be painted the surface profiles shall conform to the painting specification requirements.

Where this does not apply, surfaces shall have a surface texture not coarser than Grade 80 abrasive paper.

Abrasives:

Abrasives containing silica, silicates or slag residues shall not be used for water/steam side surfaces of plant except for cleaning sand castings, where hydro blasting may be employed.

For austenitic materials only, abrasives containing 98% or more of alumina, Al_2O_3 , shall be used.

Removal of abrasive and debris:

After cleaning, abrasive and debris shall be thoroughly removed for components.

5.0.0 PROTECTION AT MANUFACTURER'S WORKS

As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.



All water, air and steam side surfaces shall be protected by the application of approved water soluble corrosion inhibitors, or vapor phase inhibitors that can be subsequently removed by site water washing or steam blowing.

The gas side of steam generating plant items shall be protected by the application of temporary protective that do not require to be removed before commissioning, but which are removed during initial firing.

The rate of application of volatile corrosion inhibitors shall be at least 10 grams per square meter or 35 grams per cubic metre, whichever is the greater, except for pipes up to 300 mm diameter for which the minimum application rates shall be 5 grams per square metre.

Immediately after the protective treatment has been applied all vessels and pipes shall be suitably sealed off by discs or caps or approved alternatives to prevent ingress from the surroundings. Cylindrical plugs shall not be driven into the ends of pipes. These protective covers shall not be removed until immediately before final connection is made to the associated equipment.

6.0.0 WEATHER CONDITIONS

Painting shall be done only when the surface temperature is above 5°C. Surface temperature must be at least 3°C above dew point to ensure that condensation does not occur on the surface.

Reasonable protection against precipitation and seawater spray shall be exercised for the painting of outdoor parts.

Precautions shall also be taken against solar radiation to ensure that the specified dry film thickness of priming or finish coats is obtained.

Any prime coat exposed to excess humidity, rain, dust etc., before drying, shall be permitted to dry and the damaged area of primer shall be removed and the surface prepared and primed again.

Sheltered or unventilated horizontal surfaces on which dew may collect require more protection, and to achieve this additional top coat of paint shall be applied.

The temperature quoted as “normal” in the “Paint System Tables” refers to the average local climatic conditions.

7.0.0 SURFACE PREPARATION

In preparing any surface to be coated, all loose paint, dirt, grease, rust, scale, weld slag or spatter or any other extraneous material shall be removed and defects repaired, so as to obtain a clean, dry, even surface to receive the priming or finishing coat (s) as called for in the painting schedules. Sharp edges should be rounded, especially when tank linings have to be applied.

All machined surfaces, including flange faces, shall be suitably covered to prevent damage during surface preparation.

All surfaces should be blast cleaned whenever possible.

**Surface preparation methods:**

Bare steel surfaces should be prepared by one of the methods described below in order of preference and in accordance with Swedish Standard SIS 05 59 00 or Steel Structures Painting Council, SSPC, Vis 1, or DIN 55928, section 4.

The relative humidity level should not be more than 60% & the steel surface temperature at least 3° C above the dew point during dry blast cleaning operations.

a. White metal blast cleaning Sa 3 or SSPC - SP 5

Sa 3 Blast cleaning to bare metal. Mill scale, rust and foreign matter must be removed completely. Subsequently, the surface is cleaned with vacuum cleaner, clean dry compressed air or a clean brush. It must then have a uniform metallic color and correspond in appearance to the prints designated Sa 3.

b. Near white metal blast cleaning Sa 2 1/2 or SSPC - SP 10

Sa 2 1/2. very thorough blast cleaning. Mill scale, rust and foreign matter shall be removed to the extent that the only traces remaining are slight imperfections in the form of spots or stripes. Subsequently, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It must then correspond in appearance to the prints designated Sa 2 1/2.

Mechanical cleaning should only be used when procedures (a) and (b) are not practicable.

c. Near white metal blast cleaning P Sa 2 1/2 DIN 55928

Very thorough blast cleaning. Very adhesive coatings remain. From all other surface mill scale and rust are to be removed to such an extent that the only traces remaining are slight imperfections in the form of spots or stripes. Further treatments see Sub b).

The adhesivity of residual coatings in the transition zone has to be tested even after the application of the primer.

d. Very thorough mechanical scraping and wire brushing St 3

St 3 very thorough scraping and wire-brushing - machine brushing - grinding - etc. are to be preferred. Surface preparation as for St 2. But much more thoroughly. After the removal of dust, the surface must have a pronounced metallic sheen and correspond to the prints designated St. 3.

e. Thorough scraping and wire brushing St 2

St 2 Thorough scraping and wire-brushing - machine brushing - grinding - etc. The treatment shall remove loose mill scale, rust and foreign matter. Subsequently, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It should then have a faint metallic sheen. The appearance must correspond to the prints designated St 2.

f. Air Blasting with Non-Metallic Abrasives Powder

Whenever the "Duplex"-process is to be applied (hot dip galvanising followed by painting), prepare the hot dip galvanised surface by water washing to remove flux residues and careful air blasting with non-metallic abrasive powder. Use an abrasive with grain size from 0.1 to 0.5 mm, at a greatly reduced air pressure, max. 2 bar (g) (28 psig).

This procedure also applies to stainless steel and aluminium surfaces to be coated.



Surface preparation methods	SIS 055900	DIN 55928 Part-4	BS 4232 only for blasting	SSPC-Vis
Blasting acc to item (a),(b),(c),	Sa 3		First quality	White metal SP 5
Blasting acc to item (b)	Sa 2 1/2		Second quality	near White SP 10
Blasting acc to item (c)	Sa 2		Third quality	Commercial blast SP 6
Hand/or power tool derusting acc to item (e)	St 2		--	Hand tool cleaning SP 2
acc to items (d) and (e)	St 3		--	Power tool cleaning SP 3
Flame jet cleaning		F1	--	Flame cleaning SP 4
Pickling		Be	--	Pickling

Steel structures to be blast cleaned have to be free of pitting and other severely corroded places in accordance with B.S. 4232 and SIS 055900.

The abrasives used for blast-cleaning shall be graded flint, grit, shot or silica sand and shall be such that they will produce an average keying profile on the blast-cleaned surface of not more than 40 microns.

An air pressure of 7 bar g at the nozzle shall be used.

After blast-cleaning, all accumulated grit, dust, etc., must be removed leaving the surface clean, dry and free of mill scale, rust grease and other foreign matter.

In the event of rusting after completion of the surface preparation, the surface must be cleaned again in the manner specified.

Oil, grease, soil, cement, salts, acids or other corrosive chemicals shall be cleaned from steel surfaces, by the use of solvents, emulsions or cleaning compounds. The final wiping shall be with clean solvent and clean rags or brushes. There shall be no detrimental residue left on the surface.

Primed areas which suffer damage must be spot blasted on site to a degree of cleanliness Sa 2 1/2 before, touching up.

Protective coating must be applied as quickly as possible after the completion of surface preparation no matter what cleaning method has been used.

No blast-cleaned surface shall be allowed to remain uncoated overnight.

Steel work protected by shop primer after arrival on site must be cleaned of salt, sand, oil etc. Before the first coat of paint is applied on site. Shop primer damaged during transport must be rectified by blast-cleaning and coating before application of the site coats.

Wood surfaces shall be sanded clean. All nail holes shall be puttied and sanded before priming.

Concrete: If a protective coating is required, concrete shall be allowed to cure before painting.



8.0.0 PREPARATION OF COATING MATERIALS

All containers shall remain un-opened until required for use.

Primers and paints which have livered, gelled or otherwise deteriorated shall not be used.

The oldest primer or paint of each kind shall be used first.

All ingredients in any container shall be thoroughly mixed before use, and shall be agitated frequently during application to keep the primer in suspension.

Primer or paint mixed in the original container shall not be transferred until all settled pigment is incorporated into the body of liquid.

Mixing in open containers shall be done in a well ventilated area.

Primer or paint shall be mixed in a manner ensuring the breakdown of all lumps, complete dispersion of pigment and uniform composition.

Two-component primers shall be mixed in accordance with the manufacturer's instructions. Thinners shall not be added to primers or paints unless necessary for proper application according to the manufacturer's instructions. When use of thinners is permitted, it must be added to the primer or paint during mixing.

8.1.0 Primer Paint

After the surface is prepared, one coat of suitable primer shall be applied. After this first coat is dried up completely, second coat of primer shall be applied.

Primer shall be applied by brushing to ensure a continuous film without 'holidays'. The dry film thickness of each coat shall be as specified in the Annex- ANNEX 25.1.2 -Paint System of this specification.

The primer should be worked by brush application to cover the crevices, corners, sharp edges etc. in the presence of inspector.

The shades of successive coats should be slightly different in color in order to ensure application of individual coats, the thickness of each coat and complete coverage should be checked as per specification approved by Engineer before application of successive coats.

The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Elko meter for measuring the Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting. Holiday detectors and pinhole detectors for checking the painted surface discontinuities should be provided by the contractor.

The contractor shall make arrangements for paint manufacturer to provide expert technical service at site as and when required free of cost and without any obligation to the Owner, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations.

Final inspection shall include measurement of paint dry film thickness, check of finish and workmanship.

8.2.0 Rub down and Touch Up of Primer

The shop coated surfaces shall be rubbed down thoroughly with emery paper to remove all dust, rust and other foreign matters, washed, degreased, then cleaned with warm fresh water and air dried.



The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry before applying a coat of primer.

The compatibility between shop coat and field primer shall be ascertained from the paint manufacturer. In case degreasing with white spirit is not effective, the surface shall be finally wiped clean with aromatic solvent like xylol or light naphtha.

8.3.0 Non Compatible Shop Coat Primer

- a) The compatibility of finishing coat shall be confirmed from the paint manufacturer. In the event of use of primer such as zinc rich epoxy, inorganic zinc silicate etc., the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer. Shop coated (coated with primer & finishing coat) equipment shall not be repainted unless paint is damaged.
- b) Shop primed equipment and surfaces shall only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer shall be completely removed before application of selected paint system for particular environment. For package units/equipment, shop primer shall be as per the paint system given for particular environment.
- c) In case of existing paint, compatibility between finishing coat and new selected finish coat shall be ascertained before application of finish coat. In case, the coat is selected for upgrading existing alkyd coating to high performance coating then, surface preparation shall be by manual/mechanical means to remove loose rust, peeled off/damaged paint, but sound old coating need not be removed. It shall be touched with suitable primer wherever it has peeled off before application of tie coat. The tie coat shall be applied after 7 days of curing of the primer. If, new paint system is not suitable to upgrade existing coating then complete paint shall be removed by mechanical or blast cleaning before application of new coating system.

8.4.0 Finish Paint

Suitable Finish paints as per the schedule shall be applied for the jobs. The color/shade shall be as approved by the Owner. After cleaning the dust on the dried up primer, first coat of finished paint shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After applying second coat, allowing the water to get evaporated completely, third finish coat of finish paint may be applied(if applicable).

9.0.0 STEEL STRUCTURES PAINTING

Generally, all steel structures shall receive two primer coats and two finish coats of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied (if required) after erection and final alignment of the erected structures. Two finish coats shall also be applied after erection.

Steel surface which is to painted shall be cleaned off dust and grease and the heavier layers of rust shall be removed by chipping to grade ST-2 as per SIS05-5900 or as per IS: 1477 (part -I) prior to actual surface preparation. Suitable primer of required DFT shall be applied as specified in the Paint system of this document- Annex-25.1.1.

Suitable finish paint of required DFT shall be applied as specified in the Paint system of this document- Annex-25.1.1. The undercoat and finish coat shall be of different tint to distinguish



the same from finish paint. All paints shall be of approved brand and shade as per the Owner's requirement.

Joints to be site welded shall have no paint applied within 100 mm of welding zone. Similarly where Friction grip fasteners are to be used no painting shall be provided. On completion of the joint the surfaces shall receive the paint as specified.

Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams supporting gratings or chequered plate shall receive one additional coat of finish paint over and above number of coats specified before erection. Portion of steel member embedded / to be encased in concrete shall not be painted.

10.0.0 PAINT MATERIALS

The paints shall conform to the specifications given in this Annex and class - 1 quality in the products range of any of the following manufacturers:

- a. Asian Paints (India) Ltd.
- b. Bombay Paints
- c. Berger Paints India Ltd.,
- d. Good lass Nerolac Paints Ltd.,
- e. Garware Paints
- f. Jenson & Nicholson
- g. Shalimar Paints
- h. Equivalent other country manufacturer after prior approval of Owner.

11.0.0 STORAGE

All paints and painting material shall be stored only in rooms to Engineer's approval. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separated from adjacent buildings. A signboard bearing the words "PAINT STORAGE - NO NAKED LIGHT - HIGHLY INFLAMMABLE - DANGER - NO SMOKING" shall be clearly displayed outside. All paints shall be stored in the safest manner so that no container rolls down and causes accidents. The shelf life of the paints shall be ensured so that the paint materials are not in storage and use after the date of expiry.

12.0.0 APPLICATION

Health and safety of work

The supplier has to check all painting work to be carried out according to the specification of the paint supplier further to all relevant prescriptions and regulations concerning the health and safety of work.

The paint supplier has to present a written specification including at least the flash point of the paints, ventilation requirements, handling precautions such as inhalation, eye and skin protection, and first aid procedure, storage requirements, spill or leak procedure, fire precaution, waste disposal.

Methods

Quality of the surface to be painted or coated has to be tested acc. to DIN 55928 and DIN 8202.

Temporary corrosion protections are to be completely removed prior to applying the definite one, in acc. with DIN 55928.



All prime coatings shall be applied by brush or airless spray or a combination of these methods, as approved by the coating manufacturer.

All doors, windows, stairways, handrails (if painted), bolts, flanges and equipment supports shall be finish painted by brush.

Spray guns should not be used outside in windy weather or near surfaces of a contrasting colour unless the latter is properly protected.

All cold-spray painting shall be done using standard equipment in accordance with accepted standards and methods.

Care has to be taken not to connect spraying devices for nitro and backelite paints simultaneously to oil based paints.

Paint applied to items that are not being painted shall be removed at the supplier's expense, leaving the surface clean, unstained and undamaged.

Dry film thickness (DFT)

To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats shall not be of the same colour.

For a composite paint or coating system consisting of several coats, the total DFT must be at least equal to the sum of the minimal DFT's for the individual coats. If, the paint system does not have the required minimum DFT those areas should be marked & repainted. If the occurrence of those areas is high, the complete surface must be repainted. It is also critically important to check the DFT of primers and intermediate coats and to correct them where necessary.

For paintings based on Zinc silicate the DFT is limited as well on minimum DFT as on maximum (150µm) because of the risk of mud cracking.

Consumption of paints

Has to be evaluated according to DIN 53220. The paints shall be tested as per IS - 101.

Each coat of paint shall be allowed to harden before the next is applied. For epoxy paint the hardening time normally is 12-14 hours. Suppliers' recommendations regarding hardening time of epoxy paints must be followed.

Particular attention must be paid to full film thickness at edges.

The minimum total dry film thickness of the paint systems shall be as recommended in the **Annex 25.1.2**. The DFT is given in microns (millionths of a metre).

13.0.0 PROTECTIVE COATINGS AND PAINT SYSTEMS

The colour coding for identification of pipelines should comply with IS-2379 & IS -9404.

The type and number of protective coats for any item requiring painting are to be in accordance with DIN 55928 and are to be at least of a quality as shown in the attached Annex-25.1.1- Paint System.

Alternative to the Annex-25.1.1- Paint System specified, are to be presented on the schedule Departure from Specification, as indicated elsewhere.



Generally, all parts shall receive the specified prime coat (s) at the supplier's works to ensure that no corrosion occurs during transport to the site and storage at the site.

Parts which cannot be damaged during transport shall receive the full number of coats.

Types of Substrate, Base metal:

- Ferrous (Surface Temperature during operation < 120° C, EN ISO 12944:1998)

To this group belongs carbon steel, low alloyed steel & high alloyed steel. All paint systems are inevitable for corrosion protection.

- Hot dip galvanized surfaces.

Hot dip galvanized surfaces do require painting in a wet, industrial, chemicals and/or marine environment

- SS (EN ISO 12944:1998 conditionally applicable)

In general, SS surfaces do not require painting unless in a chemical and/or marine environment. In case of chemical and/or marine environments determination of whether or not the surface requires painting depends on the chemical content of the base metal.

The following formula applies:

$$W = Cr + 3.3 \times Mo + 22.45 N_2$$

If $W < 23$, then the surface has to be painted.

If $W < 28$ & $W > 23$, then the surface to be painted if splash contact with the media (i.e. sea) is possible. This may also occur if there is a strong wind carrying drops to the surface.

If $W > 28$, then the surface need not be painted.

- Aluminium

By default such surfaces/components will not be painted. Exceptions are architectural/aesthetic reasons and high corrosive conditions, which shall be evaluated separately depending on aluminum alloys.

14.0.0 GALVANIZING

Galvanizing works shall conform in all respect to B.S. 729, B.S. 3083 and B.S.C.P. 2008 and to DIN 50976 whatever requires the higher quality and shall be performed by the hot dip process, unless otherwise specified.

It is essential that details of steel members and assemblies which are to be hot-dip galvanized should be designed in accordance with B.S 4479.

Vent-holes and drain-holes should be provided to avoid high internal pressures and air-locks during immersion, which may cause explosions, and to ensure that molten zinc is not retained in pockets during withdrawal.

Careful cleaning of welds is necessary before welded assemblies are dipped. The welds and the surrounding metal should be cleaned separately, preferably be blast-cleaning, because the usual preliminary pickling cannot be relied on to remove the welding slag.

All defects of the steel surface including cracks, surface laminations, laps and folds shall be removed in accordance with B.S. 4360. All drilling, cutting, welding, forming and final



fabrication of unit members and assemblies shall be completed, where feasible, before the structures are galvanized. The surface of the steelwork to be galvanized shall be free from paint, oil, grease and similar contaminants in accordance with DIN 55928, part 4 and DIN 50976. The weight of zinc coating per unit area has to be noted in the manufacturing documents in accordance with DIN 50976.

The minimum average coating weight shall be as specified in Table 1 of B.S. 729 or Table 2, DIN 50976, whatever requires higher quality.

Structural steel items shall be initially grit-blasted to B.S. 4232, second quality, (Sa 21/2) or by pickling in a bath and the minimum average coating weight on steel sections 5 mm thick and over shall be 610 g/m^2 (DFT = 85μ).

On removal from the galvanizing bath, the resultant coating shall be smooth, continuous, free from gross surface imperfections such as bare spots, lumps, blisters and inclusions of flux, ash or dross.

Galvanized contact surfaces to be joined by high-tensile friction-grip bolts shall be roughened before assembly so that the required slip factor (defined in B.S. 3294, part 1 and B.S. 4604, part 1) is achieved. Care shall be taken to ensure that the roughening is confined to the area of the mating faces.

Bolts, nuts and washers, including general grade high-tensile friction grip bolts (referred to in B.S. 3139, and B.S.4395 part 1) shall be hot dip galvanized and subsequently centrifuged (according to B.S. 729). Nuts shall be tapped up to 0.4 mm oversize after galvanizing and the threads oiled to permit the nuts to be finger-turned on the bolt for the full depth of the nut. No lubricant, applied to the projecting threads of galvanized high-tensile friction-grip bolt after the bolt has been inserted through the steelwork, must be allowed to come into contact with the mating faces of the steelwork,. A local remelting of the galvanized parts to achieve the nuts to be finger turned on the bolt is possible in accordance with DIN 50976.

Protected slings must be used for offloading and erection. Galvanized work which is to be stored at the works or on site shall be stacked so as to provide adequate ventilation to all surfaces to avoid wet storage staining (white rust).

Small areas of the galvanized coating damaged in any way shall be restored in accordance with DIN 55928, part A and DIN 50976 by:

- Cleaning the area of any weld slag rust and other impurities and by thorough wire brushing to give a metallic clean surface.
- Application of suitable number of coats of zinc-rich paint containing more than 90 % w/w of zinc in dried film. The dry film thickness shall exceed at least 50 % the thickness of the desired galvanization. In case of application of a low melting point zinc alloy repair rod, the rods shall be in accordance with DIN1707, the thickness of the alloy shall be at least as of the desired galvanization.

The restored area is not to exceed 1 % of the galvanized surface.

Surface restoration of parts in contact with drinking water is not allowed and the quality of the galvanization is to be in accordance with DIN 2444.

After fixing, bolt heads, washers and nuts shall receive two coats of zinc-rich paint. Connections between galvanized surfaces and copper, copper alloy or aluminum surfaces shall be protected by suitable preferably hydrophobe tape wrappings to the owner's approval.



15.0.0 SPRAYED METAL COATINGS

Corrosion protection may be also achieved by spraying of suitable metals as zinc and/or aluminum on the surfaces of structures. For special cases tin, copper, lead can be used as well. Methods of surface preparation have to conform to B.S. 2569 or to DIN 8567. A proper treatment of the surface followed by an immediate spraying is to apply to ensure adhesion of the sprayed metal. The surface has to be clean, free of impurities, rust, mill scale and rough enough to have binding properties to ensure good enticulation with the sprayed layer. Suitable roughness can be achieved by blast cleaning acc. to BS 4232 or DIN 8567. Welds are to be cleaned and prepared with special care. All surfaces to be treated have to be dry and accessible.

Application of coatings, requirements for thickness, adhesion, composition of coating metals, and subsequent treatment have to conform to BS 2569, DIN 8565 and 8567.

Testing of the spray coated layers are to be carried out in accordance with DIN 8565.

The contractor has to specify the type, composition and thickness of the sprayed metal and of the sealing coating according to DIN 8565 including the corresponding warranties and tests if, sprayed metal coating will be applied.

Safety of work:

All precautions connected with this type of application of corrosion protection have to be in accordance with German regulation DVS 2307, page 1. 2.

Sprayed, unfused coating of metals and metallic compounds applied by combustion gas flame, plasma arc, detonation and similar processes, and the preparation of components, spraying techniques, sealing, finishing and inspection shall be according to B.S. 4761.

The hot galvanized surface has to be cleaned before the application of the coats to remove corrosion products, dirt, dust, grease.

The cleaning can be achieved by

- brush off
- washing with 1 - 1.5 % ammonia water with up to 0.1 % detergent added and followed by wet grinding to turn the foam to grey color,
- steam blasting.

16.0.0 WARNING NOTES / SIGNALS

This Instruction serves the identification of the coated surfaces that are received from shop in assembled condition / module wise.

The warning note shall prevent any possible damage to the coated surfaces during transportation / assembly at site.

Eg.: Welding work OR Heat treatment work on the outside of coated or lined surfaces is prohibited.

17.0.0 COLOUR CODE FOR PIPING

- a. The colour code scheme is intended for identification of the individual group of the pipeline. The system of colour coding consists of a ground colour and colour bands superimposed on it. The colour coding for the identification of pipelines shall comply with **Annex – 25.1.1** of this specification.



Ground Colour shall be applied throughout the entire length for un insulated pipes. For insulated pipes, on the metal cladding or on the pipes of material such as non-ferrous metals, austenitic stainless steel etc., ground colour coating of minimum 2m length or of adequate length not to be mistaken as colour band shall be applied at places requiring colour bands. Colour band(s) shall be applied at the following location.

- i. At battery limit points
 - ii. Intersection points & change of direction points in piping ways.
 - iii. Other points, such as midway of each piping way, near valves, junction joints of service appliances, walls, on either side of pipe culverts.
 - iv. For long stretch/yard piping at 50 M interval.
 - v. At start and terminating points.
- b. Flow direction shall be indicated by an arrow in the location stated above and as directed by Engineer. Colors of arrows shall be black or white and in contrast to the color on which they are superimposed. The size of the arrows shall confirm to IS:2379. Product names shall be marked at pump inlet, outlet and battery limit in a suitable size as approved by Engineer. As a rule minimum width of color band shall conform to 75 mm up to 300 NB and to 100 mm over 350 NB. Whenever it is required by the Engineer to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal stripes of red and golden yellow as per IS:2379 shall be painted on the ground color.
- c. All uninsulated piping systems, hangers and supports shall have two coats of suitable primer coats and with suitable finish paints as per Annex 25.1.2 Painting system. Shades shall be as per IS 5 or as indicated by Owner /Engineer. Service of the pipe/line designations shall be painted on all pipes at visible locations.

18.0.0 IDENTIFICATION OF VESSELS, PIPING ETC.

Equipment number shall be stenciled in black or white on each vessel, column, equipment and machinery after painting.

Line number in black or white shall be stenciled on all the pipelines of more than one location as directed by Engineer; size of letters printed shall be 150 mm (high) for column & vessels. 50 mm (high) for pump compressor and other machinery and shall be as per IS: 9404 for piping. The storage tanks shall be marked as detailed in the respective drawing.

19.0.0 INSPECTION AND TESTING

- a) All painting materials including primers and thinners brought to site for application shall be procured directly from manufacturer as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable. Engineer at his discretion, may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batch wise test of wet paints for physical & chemical analysis. All costs thereof shall be borne by the contractor. The paints shall be tested as per IS: 101 / equivalent international standard and approved by the Owner.
- b) The painting work shall be subject to inspection by Engineer at all times. In particular, following stage wise inspection shall be performed and contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection shall be surface preparation, primer application and each coat of paint. In addition to above, record shall include type of shop primer already applied on equipment e.g. red oxide zinc chromate or zinc phosphate or Silicate primer etc.



- c) Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of Engineer before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work, contractor shall be responsible for making good of any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint shall be applied to make-up the DFT specified without any extra coat to the Owner.

20.0.0 GUARANTEE

The contractor shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein/to be provided during execution of work. The contractor shall produce test reports from the manufacturer regarding the quality of the particular batch of paint supplied. The Engineer shall have the right to test wet samples of paint at random for quality of the same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.



ANNEX-25.1.1

STANDARD FINAL COLOUR OF EQUIPMENT AND PIPING

1.0.0 STANDARD COLOUR CODE FOR MECHANICAL EQUIPMENT

Sl. No.	Description	Ground Colour
A	CLOSED COOLING WATER SYSTEM	
1	Closed cooling water pumps	Sea Green
2	Plate heat exchanger	Sea Green
3	Closed Cycle cooling Water (CCCW) pumps	Sea Green
4	CCCW Expansion tank	Sea Green
5	CCCW chemical dosing tank	Sea Green
B	WATER TREATMENT PLANT	
1	Raw water	
a	Raw water pump	Sea Green
b	Clarifier	Sea Green
c	- Raw / Fire water storage tank	Sea Green
d	DM plant supply pump	Sea Green
e	Filter air blower	Sea Green
f	Filter back wash pump	Sea Green
g	Lime slaking tank & agitator	Sea Green
h	Lime slurry transfer pump	Sea Green
i	Lime solution tank	Sea Green
j	Lime solution dosing pump	Sea Green
k	Alum solution tank	Sea Green
l	Alum solution metering pump	Sea Green
m	Polyelectrolyte solution tank	Sea Green
n	Polyelectrolyte solution metering pump	Sea Green
o	Sludge feed pump	Sea Green
p	Filter press	Sea Green
q	Service water tank for DM building	Sea Green
r	Service water tank for control annex	Sea Green
2	Demineralization system	
a	Activated carbon filter	Sea Green
b	Cation exchanger	Sea Green
c	Anion exchanger	Sea Green
d	Degasser tower	Sea Green
e	Air blower for degasser tower	Sea Green
f	Strong base anion exchanger	Sea Green
g	Degassed water transfer pump	Sea Green
h	Strong base anion exchanger	Sea Green
i	Mixed bed polisher	Sea Green
j	Air blower for mixed bed polisher	Sea Green
k	DM Water Storage tank	Sea Green
l	DM water transfer pump	Sea Green
m	Acid unloading cum transfer pump	Dark Admiralty Grey
n	Bulk acid storage tank	Dark Admiralty Grey
o	Acid measuring tank for SAC	Dark Admiralty Grey
p	Acid measuring tank for MB	Dark Admiralty Grey
q	Regeneration water pump	Dark Admiralty Grey
r	Caustic Lye unloading cum transfer pump	Dark Violet
s	Bulk caustic storage tank	Dark Violet
t	Caustic regeneration tank & agitator	Dark Violet



Sl. No.	Description	Ground Colour
u	Caustic solution filter	Dark Violet
v	Caustic dilution tank for SBA/WBA	Dark Violet
w	Caustic dilution tank for MB	Dark Violet
x	Caustic pump for regeneration for WBA/SBA	Dark Violet
y	Waste water recirculation cum disposal pump	Sea Green
C	CRANE & HOIST	
1	Power house EOT crane	Canary Yellow
2	CW pump house EOT crane	Canary Yellow
D	COMPRESSED AIR PLANT	
1	Air compressor	Sky Blue
2	Compressed air dryer	Sky Blue
3	Air receiver	Sky Blue
E	Chemical Dosing	
1	Hydrazine preparation tank	Dark Admiralty Grey
2	Ammonia preparation tank	Dark Admiralty Grey
3	Hydrazine & ammonia dosing tank	Dark Admiralty Grey
4	Hydrazine & ammonia dosing pump	Dark Admiralty Grey
5	Phosphate preparation tank	Dark Admiralty Grey
6	Phosphate dosing tank	Dark Admiralty Grey
7	Phosphate dosing pump	Dark Admiralty Grey
8	Sampling system	Dark Admiralty Grey
F	FIRE PROTECTION SYSTEM	
1	Diesel engine driven pump	Fire Red
2	Fuel tank for diesel engine driven pump	Fire Red
3	Main hydrant pump (Electrical)	Fire Red
4	Jockey pump	Fire Red
5	Fire Water Storage tank	Fire Red
6	CO2 cylinder	Fire Red
G	FUEL OIL SYSTEM	
1	Fuel oil pumps skid	Light Brown
2	Fuel oil Storage tank	Light Brown
3	Fuel oil strainer	Light Brown
H	ASH DISPOSAL SYSTEM	
1	Ash transmitting vessel	Aluminium
I	AIR CONDITIONING AND VENTILATION SYSTEM	
1	Refrigerant compressor	Sky Blue
2	Chilled / condenser pumps	Sea Green
3	Condenser water pipe	Sea Green
4	Fans	Grey

Notes:

1. This color code basically refers to IS:2379 for piping with necessary modifications
2. For any item left out, color coding will be decided after Owner's approval.

**2.0.0 STANDARD COLOUR CODE FOR ELECTRICAL EQUIPMENT**

	Description	Colour	Colour No.
1	Generator	Two undercoats of high quality epoxy based primer followed by two coats of epoxy painting	
2	Generator circuit breaker	-	RAL 7032
	a) Outdoor		
	b) Indoor	Glossy white	-
3	Transformers	Pebble grey	RAL 7032
4	Bus ducts	Pebble grey	RAL 7032
5	Junction boxes.	Pebble grey	RAL 7032
6	HT/LT Switchboards, Distribution boards, Control & Relay panels		
	a) Indoor	Pebble grey	RAL 7032
	b) Outdoor	Pebble grey	RAL 7032
7	UPS Panel, charger panels	Pebble grey	RAL 7032
8	DG Alternator	Onan Green	-
9	NGR	Pebble grey	RAL 7032
10	Motor	Pebble grey	RAL 7032
11	Lighting fittings	As per manufacturer's standard	As per manufacturer's standard
12	Cable trays	Galvanized	
13	Elevator	Red oxide primer paint	

1. For interior coating, manufacturer's standard can be adopted subject to Owner's approval.
2. All panels that are to be erected at CCR floor shall be painted using RAL 7032 (exterior colour). All Electrical, C&I, Fire alarm or any other panel shall have this colour.



3.0.0 COLOUR CODING FOR IDENTIFICATION OF PIPELINES USED IN THERMAL POWER PLANTS

Sl.No	Medium	Ground Shade		Band Shade		Remarks
		Color	Color No. as per IS:5	Color	Color No. as per IS:5	
1	Water system					
a)	Untreated or raw / service	Sea green	217	White	-	White is not included in IS - 5-2007
b)	Treated/dematerialized	Sea green	217	Light orange	557	
c)	Condensate	Sea green	217	Light brown	410	
d)	Potable water	Sea green	217	French blue	166	
e)	RO water	Sea green	217	Light orange	557	
f)	Service & clarified water	Sea green	217	French blue	166	
2	Steam system					
a)	Auxiliary steam	Aluminum	-	Signal red	537	with aluminum
3	Air system					
a)	Instrument	Sky Blue	101	White	-	White not included in IS- 5 - 2007
b)	Service/Plant	Sky Blue	101	White	-	
c)	Vacuum pipes	Sky Blue	101	Black	-	
4	Gas system					
a)	Hydrogen	Canary yellow	309	Signal red	537	White is not included in
b)	Chlorine	Canary yellow	309	Dark violet	796	
c)	Carbon dioxide	Canary yellow	309	Light grey	631	
d)	Oxygen	Canary yellow	309	White	218	
5	Oils					



Sl.No	Medium	Ground Shade		Band Shade		Remarks
		Color	Color No. as per IS:5	Color	Color No. as per IS:5	
a)	LDO/HFO	Light brown	410	Brilliant green	221	
b)	Transformer oil	Light brown	410	Light orange	557	
6	Chemical feed					
a)	Acid piping (in water treatment plant)	Dark admiralty grey	632	Signal red	537	Hazard mark is given
b)	Alkali Piping (in water treatment plant)	Dark violet	796	Golden yellow	356	Hazard mark is given
7	Fire services	Fire red	536	-	-	-
8	Effluent pipes	Black	-	-	-	-

4.0.0 COLOUR CODE FOR STRUCTURAL STEEL

SL. NO	ITEM/SERVICE	COLOR	COLOR No. as per IS:5
1	Gantry girder & monorail	Brilliant green	221
2	Gantry girder & monorail stopper	Signal red	537
3	Building structural steel columns brackets, beams bracings, roof truss, purloin, side grit, louvers, stringers	Dark admiralty grey	632
4	Pipe rack structure & trestle	Dark admiralty grey	632
5	Chequered plate (Plain Face)	Black	-
6	Grating	Black	-
7	Ladder	Dark admiralty grey	632
8	Hand railing Hand rail	Signal red	537
9	Middle rail	Signal red	537
10	Toe Plate	Signal red	537
11	Vertical post	Black	-
12	Structural steel for Silo	Smoke grey	692



Notes

1. Covering capacity and DFT depends on method of application. Covering capacity specified above is theoretical. Allowing the losses during application, min specified DFT shall be maintained.
2. All primers and finish coats shall be cold cured and air dried unless otherwise specified.
3. All paints shall conform to relevant Indian Standard and shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship shall be ensured.
4. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
5. In case of use of epoxy tie coat, manufacturer shall demonstrate satisfactory test for inter coat adhesion. In case of limited availability of epoxy tie coat, alternate system may be used taking into consideration the service requirement of the system.
6. Contractor will submit the final colour shade for all equipments & piping under his scope for final approval by client / consultant.



ANNEX 25.1.2 PAINTING SYSTEMS						
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.						
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat
Structural Steel work, piping (Oil + Water), tanks outside surface, transmission towers cranes, steel floors, galleries, stairways, Outdoor.	< 130 Deg	SA 2 1/2	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1	75
			Touch up	1	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	(75)
			Mid coat	1	2 pack High build High Solid Lamellar MIO based Epoxy Mid coat.	200
			Finish	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of at least 90% on QUVB exposure of minimum 1000 hrs.	75
					Total	350
Structural Steelwork, piping, indoor and outdoor	130 to 200 Deg	SA 2 1/2	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75
			Touch up	1	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	(75)
			Sealer	1	Single pack Heat Resistant Silicon Acrylic Finish paint.	25
			Finish	2	Single pack Heat Resistant Silicon Acrylic Finish paint.	25
					Total	150
Alternative -2		SA 2 1/2	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75
				1	Single pack Moisture Cured, Inorganic Silicate based heat resisting finish up to 400 Deg - Grey shade./ white/ Aluminium.	50
			Finish	1		50
					Total	175
Alternative-3			Finish	1	Single pack Heat Resistant Silicon Acrylic Finish paint. - either Aviation White/ Aviation Orange.	80
					Total	155
Structural Steel work Piping, Un-insulated	200 to 400	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs	75



ANNEX 25.1.2 PAINTING SYSTEMS						
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.						
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat
Carbon Steel Indoor and Outdoor	Deg C.				/ 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	
			Touch up	1	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level 2.	(75)
			Finish	2	Heat Resisting Silicon Aluminium Paint. VS to be min 28%.	20
					Total	115
Carbon steel surfaces subjected to temperature up to 400 °C. But Under Thermal Insulation.	< 400 °C	Power tool cleaning to St 2 /3		2	Red-oxide Zinc phosphate primer to IS 12744	30
						60
Components coming in the gas path (other than Coils), including water walls, SH panels, SH Headers, Hot air ducts etc.		Power tool cleaning		2	Red-oxide Zinc phosphate primer to IS 12744	30
						60
Structural Steel work, Piping (Oil + water) , Tanks Indoor.	<130 Deg.C	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75
			Touch up	1	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	(75)
			Mid coat	2	2 pack High build High Solid Lamellar MIO based Epoxy Mid coat.	100
			Finish	2	Two component Polyamide Cured Epoxy Coating.	25
					Total	325
Structural Steel work in the battery rooms, chlorination plant and	Ambient	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance	75



ANNEX 25.1.2 PAINTING SYSTEMS						
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.						
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat
water treatment plant, (extremely aggressive atmosphere)					specifications for SSPC Paint 20 , Level 1	
			Touch up		Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	(75)
			Mid coat	1	Two component, high build rust encapsulating, aluminium pigmented modified epoxy coating.	125
			Finish	1	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%	150
					Total	350
Steel Tanks inside Surface (Total) for Oil Storage	Normal	SA 2.5	Primer	1	Two component high build amine cured epoxy Primer with zinc phosphate pigment.	75
			Finish	2	Two component Self priming High Build Polyamine adduct cured epoxy coating.	125
					Total	325
Alternative-1			Finish	3	Two component Self priming High Build Polyamine adduct cured epoxy coating. (No primer required. Self priming coating post blasting)	125
					Total	375
Alternative-2			Finish	2	Two component High build high solid Solvent free epoxy coating - certified by CFTRI for Potable water usage. (Primer same as above)	150
					Total	300
Steel Tanks inside Surface (Total) for Water Storage (Potable and Distilled Water)	Ambient	SA 3	Primer	1	Two component high build polyamide cured zinc phosphate Primer	75
			Finish	2	Two component Self priming High Build Polyamine adduct cured epoxy coating - certified by CFTRI for Potable water usage.	125
					Total	325
Alternative 1			Finish	2	Two component High build high solid Solvent free epoxy coating - certified by CFTRI for Potable water usage. (No primer required. Self priming coating post blasting)	200
					Total	400
Steelwork immersed in	< 60	SA 3	Primer	1	Two component High Build High Solid Rapid Curing Epoxy	75



ANNEX 25.1.2 PAINTING SYSTEMS						
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.						
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat
seawater such as inlet/ outlet structures, dolphins, sheet piling	Deg C				Zinc Phosphate Primer.	
			Finish	1	Two component High build High Solid Modified Epoxy coating.	500
					Total	575
			Wherever TAR based product is not to be recommended.			
			Finish	1	Two component High build High Solid Modified Epoxy coating	500
					Total	500
			Finish	1	Two component High build High Solid Modified Epoxy coating with Glass Flake.	500
					Total	500
Alternative 1						
Cast Iron Water pipelines - Outside surface, buried in Soil	< 60 Deg C	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1	75
			Finish	2	Polyamide Cured Coal Tar Epoxy, Vs min 65% black.	200
					Total	475
Alternate-1			Finish	1	Two component High build High Solid Modified Epoxy coating	500
Alternate -2			Finish	1	Two component High build High Solid Modified Epoxy coating with Glass Flake	500
Steel Pipes - Inside surfaces such as cooling water lines.	< 60 Deg C	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75
			Finish	2	Coal Tar Epoxy, Vs min 65% black.	225
					Total	525
Water Pipelines - Outside Surface, Indoor	< 60 Deg C	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75
			Touch	1	Two component Zinc rich Primer meeting performance and	(75)



ANNEX 25.1.2 PAINTING SYSTEMS						
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.						
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat
			up		compositional specifications of SSPC Paint 20 Level2	
			Finish	2	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%	100
					Total	275
Oil pipelines - Outside surface, above ground	< 100 Deg C	SA 3	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75
			Touch up		Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	(75)
			Mid coat	2	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%	100
			Finish	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of at least 90% on QUVB exposure of minimum 1000 hrs.	75
					Total	350
Pumps, Motors, Turbine, Claddings, Steam Turbine Condenser, Indoor	Up to 90 Deg	SA 2.5	Primer	1	Catalysed Zn rich Primer with a VS of 60% min, complying to SSPC Paint 20 level 2.	75
			Finish	2	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%.	100
					Total	275
Alternative 1		SA 2.5	Primer	1	Catalysed Zn rich Primer with a VS of 60% min, complying to SSPC Paint 20 level 2.	75
			Mid coat	1	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%.	100
			Finish	2	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of at least 90% on QUVB exposure of minimum 1000 hrs.	75
					Total	250
Heat Exchangers - Inside Surface.	Up to 60 Deg	SA 2.5	Primer	1	Solvent based IZS - VS of 60%. Zn Dust - 1.77 kg/ltr minimum. Zn dust by weight - minimum 85%. Pot life 12 hrs / 21 Deg.- Paint to meet compositional & performance specifications for SSPC Paint 20 , Level 1.	75
			Finish	2	Coal Tar Epoxy, Vs min 65% black.	200



ANNEX 25.1.2 PAINTING SYSTEMS						
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.						
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat
					Total	475
Heat exchanger Coils coming in the gas path . (Eco, SH, RH coils & Loose tubes etc.)		Power tool cleaning			One coat of dip-coat paint -Red-oxide Zinc phosphate primer	35
Instrument panels, Electrical cubicles and similar steel sheet – indoor (Can be used on Aluminium, steel, stainless steel and galvanized substrates.)	Ambient	Oil grease and contaminants must be removed	Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	75
			Mid coat	1	Two component High Build Surface Tolerant Epoxy coating pigmented with Aluminium and Lamellar Micaceous iron oxide	100
			Top coat	1	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%	100
					Total	275
Instrument panels, Electrical cubicles and similar steel sheet – outdoor (Can be used on Aluminium, steel, stainless steel and galvanized substrates.)	Ambient	Oil grease and contaminants must be removed	Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	100
			Mid coat	1	Two component High Build Surface Tolerant Epoxy coating pigmented with Aluminium and Lamellar Micaceous iron oxide.	150
			Top coat	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of atleast 90% on QUVB exposure of minimum 1000 hrs.	75
					Total	325
Substrate, base metal: Carbon steel, HDG acc ISO 1461 Or. Equiv. Non Insulated. - Outdoor	<120 Deg	Air blasting with Nonmetallic abrasive Powder	Touch up	1	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	(75)
			Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	50
			Mid coat	1	Two component High Build Surface Tolerant Epoxy coating pigmented with Aluminium and Lamellar Micaceous iron oxide	150



ANNEX 25.1.2 PAINTING SYSTEMS						
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.						
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat
			Finish	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of atleast 90% on QUVB exposure of minimum 1000 hrs.	75
					Total	275
Substrate, base metal: Carbon steel, HDG acc ISO 1461 Or. Equiv. Non Insulated.- Indoor	<120 Deg	Air blasting with Nonmetall ic abrasive Powder	Touch up	1	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level 2.	75
			Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	125
			Finish	1	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%.	100
					Total	225
			For Outdoor Application			
			Touch up	1	Two component Zinc rich Primer meeting performance and compositional specifications of SSPC Paint 20 Level2	(75)
			Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	125
			Finish	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of at least 90% on QUVB exposure of minimum 1000 hrs.	75
					Total	200
			For Indoor Application			
Substrate, Stainless Steel - Non insulated.	< 120 Deg	Air blasting with Nonmetall ic abrasive Powder	Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	125
			Finish	1	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%	100
					Total	225
			For Outdoor Application			
			Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	125
			Finish	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of atleast 90% on QUVB exposure of minimum 1000 hrs.	75
					Total	200
Applicable for Water -				For Indoor Application		



ANNEX 25.1.2 PAINTING SYSTEMS						
Cleaning, Protective Coating and Painting - Systems designed as per ISO 12944 with service life of 10 yrs.						
Surface/ Location	Temp	Surface prep	Coat	No. of coats	Generic Type	Dft/Coat
Water Cooled heat Exchangers like Condensers, Flash box, Water - Water coolers etc. For Outdoor installations in corrosive atmosphere - like Chemical/ Marine.	< 120 Deg	Air blasting with Nonmetallic abrasive Powder	Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	75
			Top coat	2	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%.	100
					Total	275
			For Outdoor Application			
			Primer	1	Two pack , high build siloxane modified epoxy primer with zinc phosphate pigment.	125
			Mid coat	1	Two component High Build high Solid Aliphatic Amine Cured Epoxy coating. - Min VS 85%.	100
			Top coat	1	2 pack Acrylic Aliphatic Polyurethane top coat - with Gloss retention of at least 90% on QUVB exposure of minimum 1000 hrs.	75
					Total	300

**PAINTING SPECIFICATION FOR CIVIL BUILDINGS – COASTAL**

S.No.	Location	Description
1	Metal and Timber Joinery	Two component high build, self priming, rust encapsulating, modified epoxy coating. Min VS 80%.
2	All Ceiling	Oil bound distemper (Office rooms) White Washing - all areas.
3	Internal wall surfaces	Oil Bound distemper
4	Control room/office	Acrylic Emulsion.
5	External faces of walls	Cement based Water proof paint
6	Walls of battery room and other acid/alkali spillage areas	1. Primer -1 coat of 50 microns - Two pack Polyamide Epoxy Primer with Zinc phosphate Pigment for concrete application. Min VS 48%. 2. Top coat - 1 coat of 125 microns - Two component self priming, high build polyamine adduct cured epoxy coating having excellent chemical resistance. Min VS 60%.
7	Cooling Tower External	
	a. Steel sections	i) Blasting to SA 2.5 ii) 1 x 75 microns - Inorganic Zinc Silicate as per SSPC Paint 20 Level 2. iii) 1 x 150 microns –Two components high build epoxy intermediate pigmented with lamellar micaceous iron oxide. Min VS 65%. iv) 1 x 75 microns - Two component high solids, Glossy, Acrylic Aliphatic Polyurethane paint, Min VS of 57%, Gloss retention of 90% after exposure to 2000 hrs under QUV B 313 lamp
	b. Concrete sections	1. 1 x 50 microns - Epoxy Polyamide Primer 2. 1x 500 microns-Two components high build high solid, engineered epoxy coating. Min VS 87%. - Typical dft - 500 microns per coat. Condensation as per IS 101 - 9000 hrs, Salt spray as per ASTM G 85 - 8000 hrs.
8	Chimney external	i) 1 x 50 microns Concrete Epoxy Polyamide primer followed by ii) 2 Coats of 50 microns of Acrylic Aliphatic Polyurethane paint

	BHEL: BAP: RANIPET Water Systems Pre-Qualification Requirement (QR) for Pre-treatment system & acc.	Ref:	PT system: UDG
		Dt:	18.01.2020
		Rev :	00

The Qualification requirements for Pre-treatment system and accessories are listed below and bidders should meet the same.

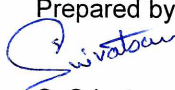
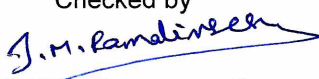
Pre-treatment system: Bidder should have supplied the Pre-treatment system comprising Lamella/ Tube settler clarifier, associated dosing system, sludge handling for raw water source as Sea Water. The total capacity of the reference Pre-treatment plant should not be less than 1000m³/hr with each stream capacity not less than 500m³/hr. Such Pre-treatment system including Lamella clarifier/ tube settler should have been in successful operation for at least one (1) year as on date of technical bid opening. Pre-treatment system mentioned above shall mean the Clarifier, stilling chamber, flow control station, flash mixers, flocculators, lamella plates/ tubes, sludge sump, sludge disposal pumps and dosing systems as minimum.

Documentary evidence to be submitted by the bidder (in support of meeting Qualification requirement) along with the bid.

1. Performance certificate from the end user for the successful operation of the reference plant for minimum one year as on date of technical bid opening.
2. Purchase Order copy for the reference plant
3. Supporting documents clearly indicating capacity of Pre-treatment plant, type of Clarifier, treated water quality (Turbidity, Total suspended solids (TSS), etc.,).

General:

1. Bidders who defaulted, in any of the previous tenders floated by BHEL are not permitted to respond. Such offers, if found later, will not be considered for evaluation.
2. After receipt of offers, during scrutiny, if any vendor found to have been banned by BHEL, then their offer will be summarily rejected at any stage.
3. In case BHEL decides, bidder to arrange necessary permission to visit the reference plant furnished by the bidder for meeting the PQR requirements.

Prepared by  S. Srivatsan	Checked by  I. M. Ramalingeswara Rao	Approved by  M. Salai Manalan
--	--	--

	BHEL: BAP: RANIPET Water Systems Pre-Qualification Requirement (QR) for Pre-treatment system & acc.	Ref:	PT system: UDG
		Dt:	18.01.2020
		Rev :	00

Annexure-I

Qualification Requirement Datasheet

A. Customer details: -

- a) Name :
- b) Designation :
- c) Mobile :
- d) Land line :
- e) Fax :
- f) Email id :
- g) Postal address :

B. Plant Details: -

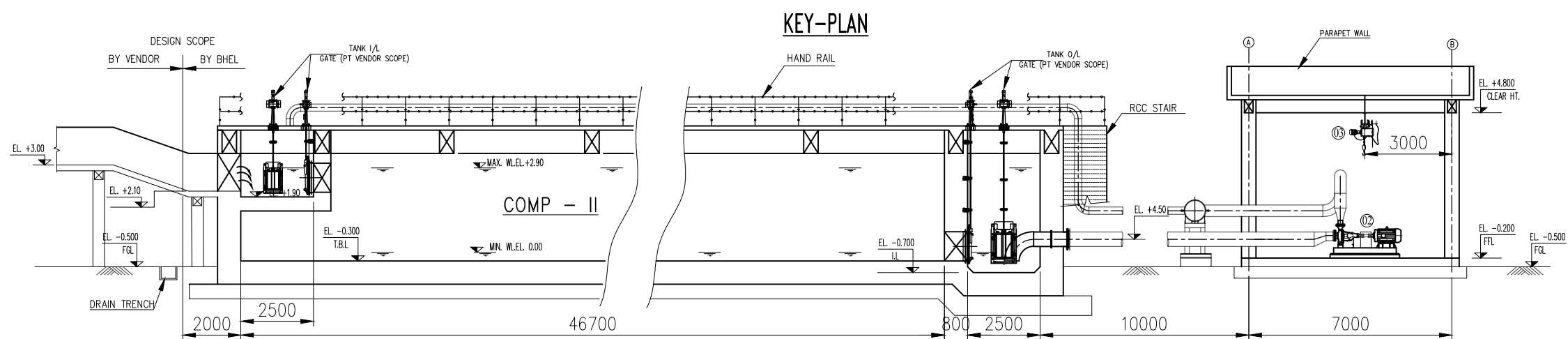
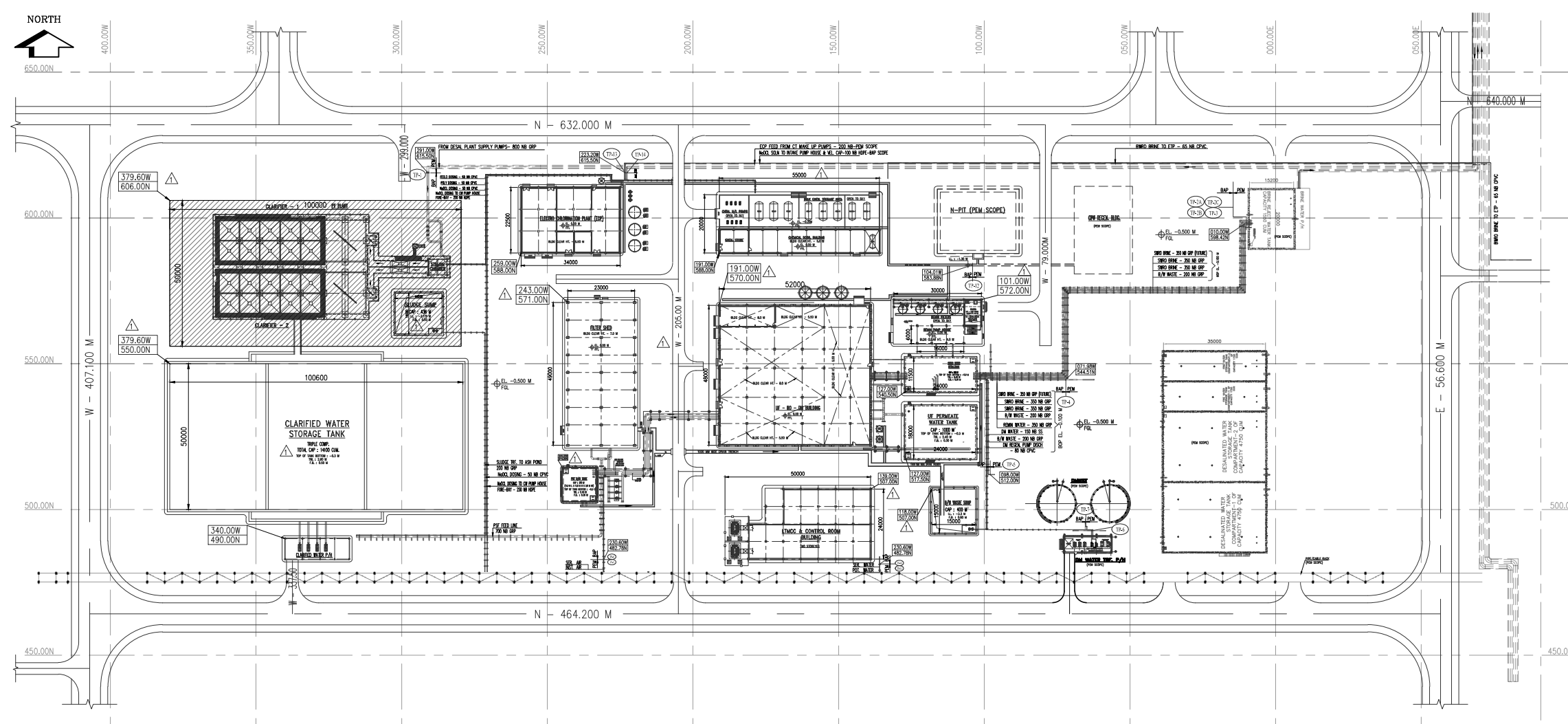
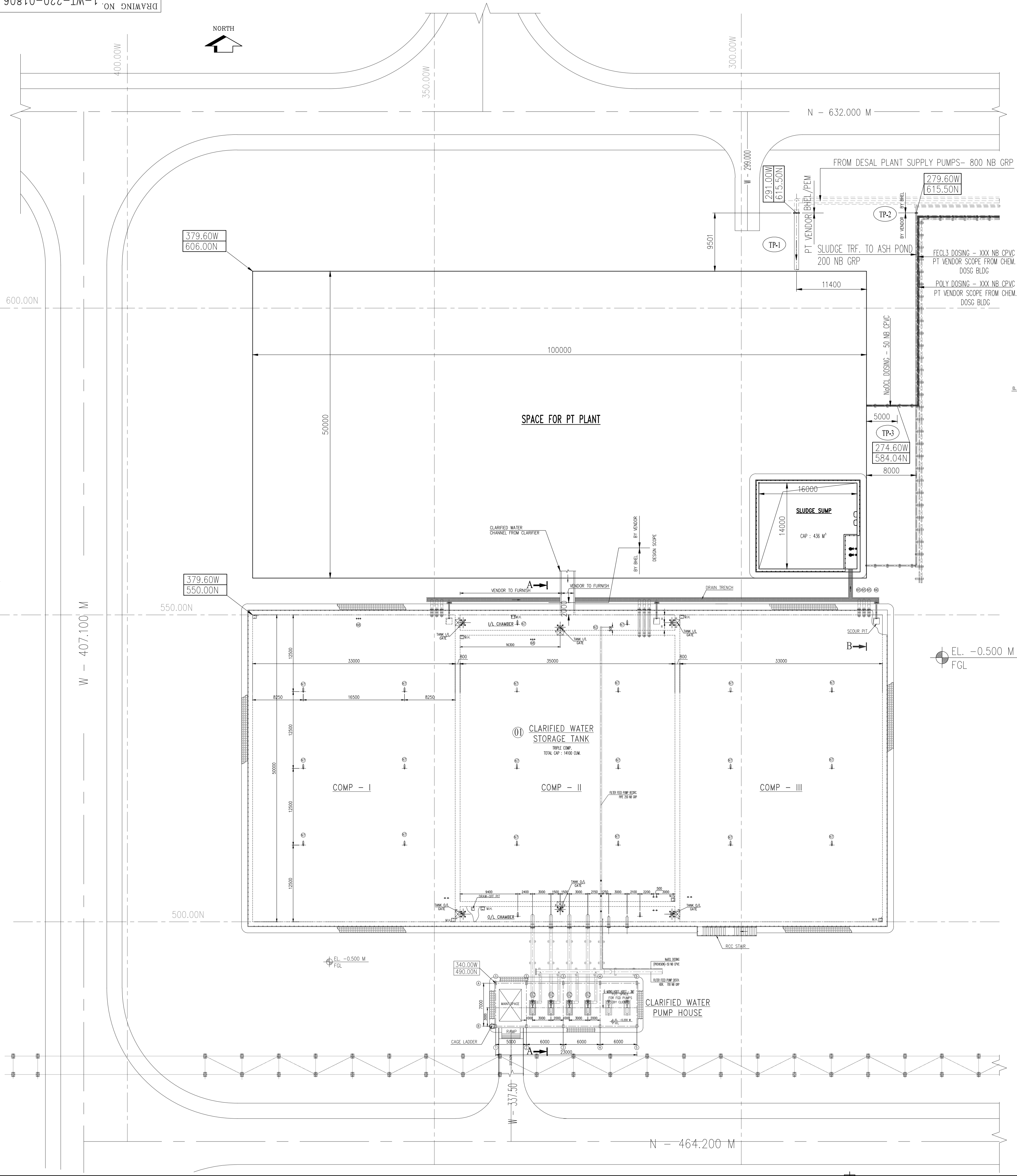
Date of Supply :

Date of commissioning:

Sl. No.	Parameters	Unit	Value
1.	Number of streams	Nos	
2.	Capacity of PT plant	m ³ /hr	
3.	No. of streams	Nos.	
4.	Treated water quality (Total Suspended solids (TSS))	ppm	
5.	Treated water quality (Turbidity)	NTU	

Signature of the Vendor

90810-220-01806
DRAWING NO. 1-WT-220-01806



SECTION A-A

TERMINAL POINTS (TP)

TP NO.	ZONE	DESCRIPTION	FLANGE SIZE	APPROX. LOCATION		PIPE ELEVATION IN MTRS (APPROX.)
				NORTH/SOUTH	EAST/WEST	
TP-1		PT PLANT INLET	800 NB	615.50N	291.00W	-0.100 M (BOP)
TP-2		PT PLANT SLUDGE	200 NB	558.04N	274.60W	-0.100 M (BOP)
TP-3		NaOCL DOSG LINE	50 NB	584.05N	274.60W	-0.100 M (BOP)
TP-4		FECL3 DOSING	XXX NB	CHEMICAL DOSG BLDG		
TP-5		POLY DOSING	XXX NB	CHEMICAL DOSG BLDG		

NOTES :

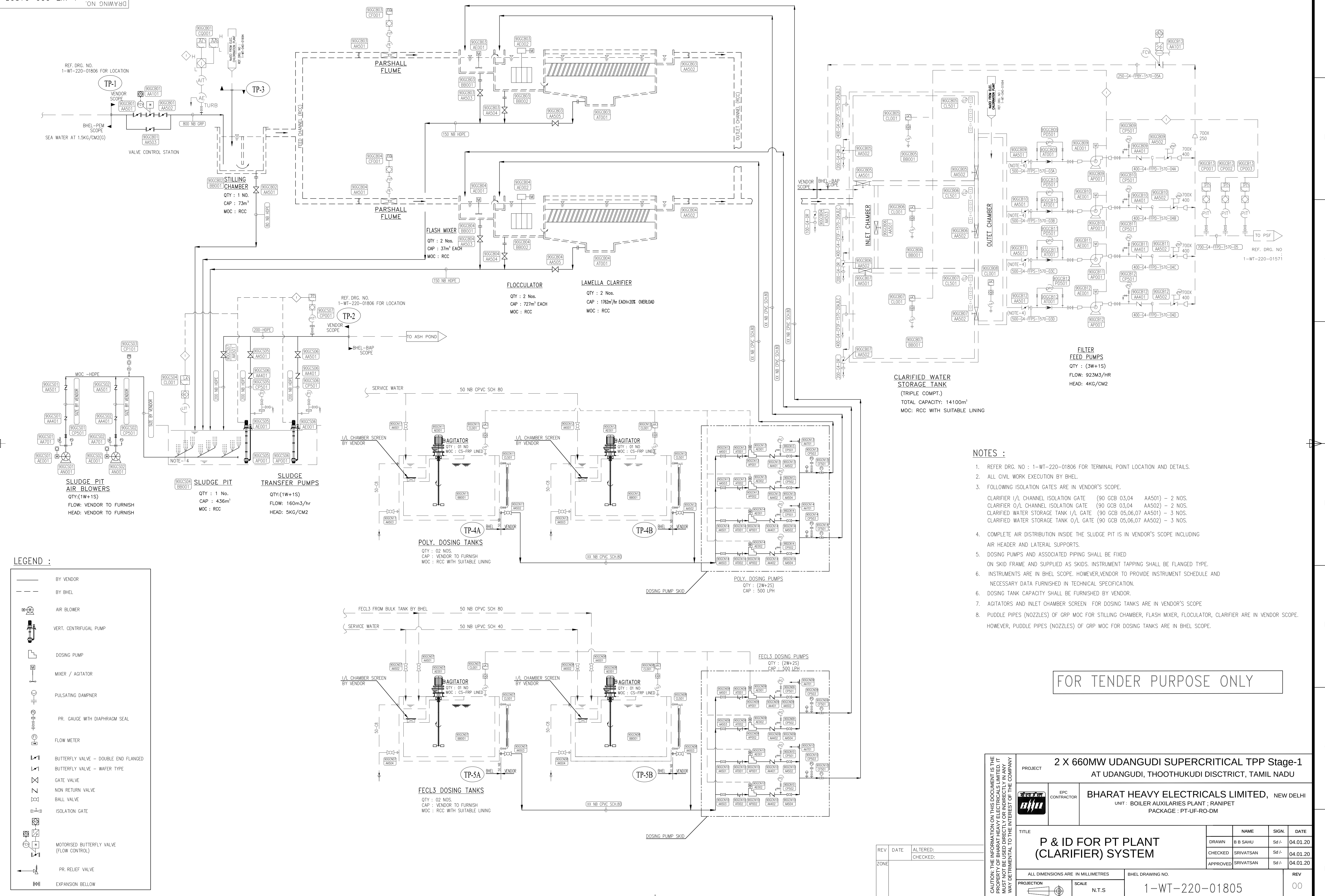
1. FINISHED GRADED LEVEL (FGL) ELEVATION IS -0.500 M.
2. VENDOR HAS TO ACCOMMODATE THE PT PLANT INCLUDING THE SLUDGE SUMP AND ASSOCIATED EQPT TO PT PLANT IN THE AREA MENTIONED FOR PT PLANT.
3. VENDOR HAS TO FIX THE PLAN VIEW OF PT PLANT EQPT IN THE LAYOUT. AS WELL ELEVATION VIEW OF THE CLARIFIER AND ASSOCIATED EQPT.
4. VENDOR HAS TO DESIGN THE UPSTREAM EQPT. (CLARIFIER) ELEVATION CONSIDERING THE INVERT LEVEL OF INLET CHANNEL TO CLARIFIED WATER STORAGE TANK.
5. CLARIFIER BOTTOM HOPPER ELEVATION HAS TO BE DESIGNED SUITABLY TO DRAIN THE SLUDGE TO SLUDGE SUMP BY GRAVITY.
6. ALL TERMINAL POINTS SHALL BE FOLLOWED BY VENDOR FOR THEIR BOQ CONSIDERATION.
7. FECL3 AND POLY DOSING SYSTEM ARE KEPT IN CHEMICAL DOSING BUILDING. FOR DETAILED SCOPE SPLIT OF THESE SYSTEM VENDOR HAS TO FOLLOW TENDER PID AND SPECIFICATION. PIPING OF DOSING SYSTEM FROM CHEMICAL DOSING BUILDING TO CLARIFIER ARE IN VENDOR SCOPE. FOR BOQ PURPOSE VENDOR HAS TO FOLLOW THE KEY-PLAN. DETAILED LAYOUT WILL SHARED DURING CONTRACT STAGE.
8. CIVIL DESIGN OF STILLING CHAMBER, FLASH MIXER, FLOCCULATOR, CLARIFIER, INTER CONNECTING CHANNELS, OUTLET CHANNEL UPTO CLARIFIED WATER TANK, SLUDGE SUMP, EXTERNAL EQPT. FDN. IF ANY , DRAIN CHANNEL IF ANY ARE IN THE SCOPE OF VENDOR. HOWEVER CIVIL EXECUTION IS BY BHEL.
9. VENDOR HAS TO CONSIDER APPROACH PLATFORM, LADDER AND EQPT. HANDLING ARG. IF ANY IN HIS DESIGN AND THE SAME HAS TO BE SHOWN IN THE LAYOUT.

FOR TENDER PURPOSE ONLY

PROJECT		2 X 660MW UDANGUDI SUPERCRITICAL TPP Stage-1 AT UDANGUDI, THOOTHUKUDI DISCTRICK, TAMIL NADU				
CAUTION: THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY		EPC CONTRACTOR		BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI UNIT : BOILER AUXILIARIES PLANT; RANIPET PACKAGE : PT-UF-RO-DM		
		TITLE		PT PLANT LAYOUT		
		DRAWN		NAME	SIGN.	
		CHECKED		G RAJENDIRAN	Sd/-	
ALL DIMENSIONS ARE IN MILLIMETRES		BHEL DRAWING NO.		REV		
PROJECTION		SCALE		1-WT-220-01806		
N.T.S.				00		

50810-0ZZ-1W-1
DRAWING NO.

ALL DIMENSIONS ARE IN MILLIMETRES



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REV	DATE	ALTERED:
ZONE		CHECKED:



**HEALTH, SAFETY AND ENVIRONMENT
PLAN FOR
SITE OPERATION by SUBCONTRACTORS**

POWER SECTOR

Doc no.: HSEP: 14

REV: 00

Date: 12.08.2014

DOCUMENT ISSUE SHEET

	Prepared	Reviewed	Approved
Name	Sanghamitra B. Jayant	A.K. Sinha	Anuj Bhatnagar
Designation	Dy. Manager PSHQ(FQA & Safety)	GM PSHQ(FQA & Safety)	ED PSHQ(FQA & Safety)
Signature			
Date	12/8/14	12/8/14	12/8/14

HSE PLAN FOR SITE OPERATIONS BY BHEL'S SUBCONTRACTORS

AT A GLANCE

BEFORE START	SIGNING OF MOU	
	Agree to comply to HSE requirement- Statutory and BHEL's	
PLAN	HSE ORGANISATION	
	Manpower 1 (one) safety officer for every 500 workers or part thereof 1(one) safety-steward/ supervisor for every 100 workers Qualification As per Cl. 7.1	HSE Roles and responsibilities - Site In-charge- As per clause 7.2.1 - Safety officer- As per clause 7.2.2
PROVIDE	HSE Planning	
	for Man , Machinery/Equipment/Tools & Tackles	
	HSE INFRASTRUCTURE	
	- PPEs - Drinking Water - Washing Facilities - Latrines and Urinals - Provision of shelter for rest - Medical facilities	- Canteen facilities - Labour Colony - Emergency Vehicle - Pest Control - Scrapyard - Illumination
TRAIN	HSE TRAINING , AWARENESS & PROMOTION	
	Training - Induction training - Height work and other critical areas - Tool Box talk & Pep Talk	Awareness & Promotion - Signage - Poster - Banner - Competition - Awards
COMMUNICATE	HSE COMMUNICATION	
	Incident Reporting - Accident- Fatal & Major - Property damage - Near Miss	Event Reporting - Celebrations - Training - Medical camp

EXECUTE SAFELY

OPERATIONAL CONTROL PROCEDURES

PERMIT TO WORK

Height work (above 2 metres), Hot Work, Heavy Lifting, Confined Space, Radiography, excavation(More than 4 metres)

SAFETY DURING WORK EXECUTION

- | | |
|--|---|
| <ul style="list-style-type: none"> • Welding • Rigging • Cylinder- storage & Movement • Demolition work • T&Ps • Chemical Handling • Electrical works | <ul style="list-style-type: none"> • Fire • Scaffolding • Height work • Working Platform • Excavation • Ladder • Lifting • Hoisting appliance |
|--|---|

HOUSE KEEPING

WASTE MANGEMENT

TRAFFIC MANAGEMENT

ENVIRONMENTAL CONTROL

EMERGENCY PREPAREDNESS AND RESPONSE PLAN

CHECKS

HSE AUDITS & INSPECTION

- | | |
|---|---|
| <ul style="list-style-type: none"> • Daily Checks • Inspection of PPEs • Inspection of T& Ps • Inspection of Cranes & Winches | <ul style="list-style-type: none"> • Inspection of Height work • Inspection of Welding and Gas cutting • Inspection of elevators etc |
|---|---|

HSE PERFORMANCE EVALUATION PARAMETERS

NON CONFORMANCE

PENALTY for NON CONFORMANCE

Refer Clause 16

Incremental penalty

For repeated violation by the same person, the penalty would be double of the previous penalty

For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.



**HEALTH, SAFETY AND ENVIRONMENT
PLAN FOR
SITE OPERATION by SUBCONTRACTORS**

POWER SECTOR

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**HEALTH, SAFETY AND ENVIRONMENT
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1.0 PURPOSE

- 1.1 The purpose of this HSE Plan is to provide for the systematic identification, evaluation, prevention and control of general workplace hazards, specific job hazards, potential hazards and environmental impacts that may arise from foreseeable conditions during installation and servicing of industrial projects and power plants.
- 1.2 This document shall be followed by BHEL's subcontractors at all installation and servicing sites. In case customer specific documents are to be implemented, this document will be followed in conjunction with customer specific documents.
- 1.3 Although every effort has been made to make the procedures and guidelines in line with statutory requirements, in case of any discrepancy relevant statutory guidelines must be followed.
- 1.4 In case the customer has any specific requirement, the same is to be fulfilled.

2.0 SCOPE

The document is applicable for BHEL's Subcontractors at all installation / servicing activities of BHEL Power Sector as per the relevant contractual obligations.

3.0 OBJECTIVES AND TARGETS

The HSE Plan reflects that BHEL places high priority upon the Occupational Health, Safety and Environment at workplaces.

- Ensure the Health and Safety of all persons at work site is not adversely affected by the work.
- Ensure protection of environment of the work site.
- Comply at all times with the relevant statutory and contractual HSE requirements.
- Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.
- Provide all personnel with adequate information, instruction, training and supervision on the safety aspect of their work.
- Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including subcontractors in respects of HSE.
- Establish effective communication on HSE matters with all relevant parties involved in the Project works.
- Ensure that all work planning takes into account all persons that may be affected by the work.
- Ensure fitness testing of all T&Ps/Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent person.
- Ensure timely provision of resources to facilitate effective implementation of HSE requirements.
- Ensure continual improvements in HSE performance
- Ensure conservation of resources and reduction of wastage.
- Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause.
- Ensure timely implementation of correction, corrective action and preventive action.



**HEALTH, SAFETY AND ENVIRONMENT
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HSE TARGETS

EXPLOSION	ZERO
FATALITY	ZERO
LOST TIME INJURY	ZERO
FIRE	ZERO
VEHICLE INCIDENTS	ZERO
ENVIRONMENTAL INCIDENTS	ZERO

4.0 BHEL POWER SECTOR HEALTH, SAFETY & ENVIRONMENT POLICY

Power Sector HSE Policy

We, at BHEL Power Sector, reaffirm our belief that the Health and Safety of our stakeholders and conservation of Environment is of utmost importance and takes precedence in all our business decisions. In pursuit of this belief and commitment, we strive to:

- ✓ Ensure total compliance with applicable legislation, regulations and other requirements concerning Occupational Health, Safety and Environment.
- ✓ Ensure continual improvement in the Occupational Health, Safety and Environment Management System performance.
- ✓ Enhance Occupational Health, Safety and Environment awareness amongst employees, customers and suppliers by proactive communication and training.
- ✓ Review periodically and improve Occupational Health, Safety and Environment Management System to ensure its continuing suitability, adequacy and effectiveness in a continuously changing business environment.
- ✓ Develop a culture of safety through active leadership and provide appropriate training at all levels to enable employees to fulfill their Health, Safety and Environmental obligations.
- ✓ Incorporate appropriate Occupational Health, Safety and Environmental criteria into business decisions for selection of plant, technology and services as well as appointment of key personnel.
- ✓ Ensure availability at all times of appropriate resources to fully implement the Occupational Health, Safety and Environmental policy of the company.

This policy will be communicated to all employees and made available to interested parties.

Sd/-

Date: 01.05.2013

Director (Power)

	HEALTH, SAFETY AND ENVIRONMENT PLAN FOR SITE OPERATION by SUBCONTRACTORS	Doc no.: HSEP: 14
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5.0 MEMORANDUM OF UNDERSTANDING:

After award of work, subcontractors are required to enter into a memorandum of understanding as given below:

Memorandum of Understanding

BHEL, Power Sector _____ Region is committed to Health, Safety and Environment Policy (HSE Policy).

M/s _____ do hereby also commit to comply with the same HSE Policy while executing the Contract Number _____

M/s _____ shall ensure that safe work practices as per the HSE plan. Spirit and content therein shall be reached to all workers and supervisors for compliance.

In addition to this, M/S _____ shall comply to all applicable statutory and regulatory requirements which are in force in the place of project and any special requirement specified in the contract document of the principal customer.

M/s _____ shall co-operate in HSE audits/inspections conducted by BHEL /customer/ third party and ensure to close any non-conformity observed/reported within prescribed time limit.

Signed by authorized representative of M/s -----

Name :

Place & Date:



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6.0 TERMS AND DEFINITIONS

6.1 DEFINITIONS

6.1.1 INCIDENT

Work- related or natural event(s) in which an injury , or ill health (regardless of severity), damage to property or fatality occurred, or could have occurred.

6.1.2 NEAR MISS

An incident where no ill health, injury, damage or other loss occurs, but it had a potential to cause, is referred to as "Near-Miss".

6.1.3 MAN-HOUR WORKED

The total number of man hours worked by all employees including subcontractors working in the premises. It includes managerial, supervisory, professional, technical, clerical and other workers including contract labours. Man-hours worked shall be calculated from the payroll or time clock recorded including overtime. When this is not feasible, the same shall be estimated by multiplying the total man-days worked for the period covered by the number of hours worked per day. The total number of workdays for a period is the sum of the number of men at work on each day of period. If the daily hours vary from department to department separate estimate shall be made for each department and the result added together.

6.1.4 FIRST AID CASES

First aids are not essentially all reportable cases, where the injured person is given medical treatment and discharged immediately for reporting on duty, without counting any lost time.

6.1.5 LOST TIME INJURY

Any work injury which renders the injured person unable to perform his regular job or an alternative restricted work assignment on the next scheduled work day after the day on which the injury occurred.

6.1.6 MEDICAL CASES

Medical cases come under non-reportable cases, where owing to illness or other reason the employee was absent from work and seeks Medical treatment.

6.1.7 TYPE OF INCIDENTS & THEIR REPORTING:

The three categories of Incident are as follows:

Non-Reportable Cases:

An incident, where the injured person is given medical help and discharged for work without counting any lost time.



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Reportable Cases:

In this case the injured person is disable for 48 hours or more and is not able to perform his duty.

Injury Cases:

These are covered under the heading of non-reportable cases. In these cases the incident caused injury to the person, but he still continues his duty.

6.1.8 TOTAL REPORTABLE FREQUENCY RATE

Frequency rate is the number of Reportable Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula read as:

$$\frac{\text{Number of Reportable LTI} \times 1,000,000}{\text{Total Man Hours Worked}}$$

6.1.9 SEVERITY RATE

Severity rate is the Number of days lost due to Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula reads as:

$$\frac{\text{Days lost due to LTI} \times 1,000,000}{\text{Total Man Hours Worked}}$$

6.1.10 INCIDENCE RATE

Incidence Rate is the Number of LTI per one thousand manpower deployed. Mathematically, the formula reads as:

$$\frac{\text{Number of LTI} \times 1000}{\text{Average number of manpower deployed}}$$

7.0 HSE ORGANISATION

Number of safety officers:

The subcontractor must deploy one safety officer for every 500 workers or part thereof in each package. In addition, there must be one safety-steward/safety-supervisor for every 100 workers.

Deployment: The subcontractor should deploy sufficient safety officers and safety-steward/Safety-supervisor, as per requirement given above, since initial stage and add more in proportion to the added strength in work force. Any delay in deployment will attract a penalty of Rs.30,000/- per man month for the delayed period.

7.1 QUALIFICATION FOR HSE PERSONNEL

Sl.no	Designation	Qualification	Experience
1	Safety officer (Construction Agency)	Degree or Diploma in Engineering with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years for degree holder and five years for diploma holder in the field of Construction of power plant/ major industries



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2	Safety-Steward/ Supervisor	Safety- Supervisor	Degree or diploma in any discipline with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years
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7.2 RESPONSIBILITIES

7.2.1 SITE IN -CHARGE OF SUBCONTRACTOR

- Shall sign Memorandum of Understanding (MoU) for compliance to BHEL's HSE Plan for Site Operations as per clause 5.0
- Shall engage qualified safety officer(s) and steward (s) as per clause 7.0
- Shall adhere to the rules and regulations mentioned in this code, practice very strictly in his area of work in consultation with his concerned engineer and the safety coordinator.
- Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
- Shall not engage any employee below 18 years.
- Shall arrange for all necessary PPEs like safety helmets, belts, full body harness, shoes, face shield, hand gloves etc. before starting the job. Shall ensure that no working men/women carry excessive weight more than stipulated in Factory Rule Regulation R57.
- Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent person.
- Shall ensure that provisions stipulated in contract Labour Regulation Act 1970, Chapter V C.9, canteen, rest rooms/washing facilities to contracted employees at site.
- Shall adhere to the instructions laid down in Operation Control Procedures (OCPs) available with the site management.
- Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
- Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
- Shall report all incidents(Fatal/Major/Minor/Near Miss)to the Site engineer /HSE officer of BHEL.
- Shall ensure that Horseplay is strictly forbidden.
- Shall ensure that adequate illumination is arranged during night work.
- Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
- Shall ensure display of adequate signage/posters on HSE.
- Shall ensure that mobile phone is not used by workers while working.
- Shall ensure conductance of HSE audit, mockdrill, medical camps, induction training and training on HSE at site.
- Shall ensure full co-operation during HQ/External /Customer HSE audits.



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- Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
- Shall ensure good housekeeping.
- Shall ensure adequate valid fire extinguishers are provided at the work site.
- Shall ensure availability of sufficient number of toilets /restrooms and adequate drinking water at work site and labour colony.
- Shall ensure adequate emergency preparedness.
- Shall be member of site HSE committee and attend all meetings of the committee
- Power source for hand lamps shall be maximum of 24 v.
- Temporary fencing should be done for open edges if Hand – railings and Toe-guards are not available.

7.2.2 HEALTH, SAFETY AND ENVIRONMENT OFFICER OF SUBCONTRACTOR

- Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, P&M and other tools and tackles.
- Facilitate inclusion of safety elements into Work Method Statement.
- Highlight the requirements of safety through Tool-box / other meetings.
- Help concerned HOS to prepare Job Specific instructions for critical jobs.
- Conduct investigation of all incident/dangerous occurrences & recommend appropriate safety measures.
- Advice & co-ordinate for implementation of HSE permit systems, OCPs & MPs.
- Convene HSE meeting & minute the proceeding for circulation & follow-up action.
- Plan procurement of PPE & Safety devices and inspect their healthiness.
- Report to PS Region/HQ on all matters pertaining to status of safety and promotional program at site level.
- Facilitate administration of First Aid
- Facilitate screening of workmen and safety induction.
- Conduct fire Drill and facilitate emergency preparedness
- Design campaigns, competitions & other special emphasis programs to promote safety in the workplace.
- Apprise PS– Region on safety related problems.
- Notify site personnel non-conformance to safety norms observed during site visits / site inspections.
- Recommend to Site In charge, immediate discontinuance of work until rectification, of such situations warranting immediate action in view of imminent danger to life or property or environment.
- To decline acceptance of such PPE / safety equipment that do not conform to specified requirements.
- Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.
- Shall work as interface between various agencies such customer, package-in-charges, subcontractors on HSE matters

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8.0 PLANNING BY SUBCONTRACTOR

8.1 MOBILISATION OF MACHINERY/EQUIPMENT/TOOLS BY SUBCONTRACTOR

- As a measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and complies with legislative and owner requirement, inspection shall be arranged by in-house competent authority for acceptance as applicable.
- The machinery and equipment to be embraced for this purpose shall include but not limited to the following:
 - Mobile cranes.
 - Side Booms.
 - Forklifts.
 - Grinding machine.
 - Drilling machine.
 - Air compressors.
 - Welding machine.
 - Generator sets.
 - Dump Trucks.
 - Excavators.
 - Dozers
 - Grit Blasting Equipment.
 - Hand tools.
- Subcontractor shall notify the engineer, of his intention to bring on to site any equipment or any container, with liquid or gaseous fuel or other substance which may create a hazard. The Engineer shall have the right to prescribe the condition under which such equipment or container may be handled and used during the performance of the works and the subcontractor shall strictly adhere to such instructions. The Engineer shall have the right to inspect any construction tool and to forbid its use, if in his opinion it is unsafe. No claim due to such prohibition will be entertained.

8.2 MOBILISATION OF MANPOWER BY SUBCONTRACTOR

- The subcontractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.
- The subcontractor shall take special care of the employees affected with occupational diseases under rule 230 and schedule II of BOCW Rules. The employees not meeting the fitness requirement should not be engaged for such job.
- Ensure that the regulatory requirements of excessive weight limit (to carry/lift/ move weights beyond prescribed limits) for male and female workers are complied with.
- Appropriate accommodation to be arranged for all workmen in hygienic condition.



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8.3 PROVISION OF PPEs

- Personnel Protective Equipment (PPEs), in adequate numbers, will be made available at site & their regular use by all concerned will be ensured
- The following matrix recommends usage of minimum PPEs against the respective job.

Sl. No	Type of work	PPEs
1	Concrete and asphalt mixing	Nose mask, hand glove, apron and gum boot
2	Welders/Grinders/ Gas cutters	Welding/face screen, apron, hand gloves, nose mask and ear muffs if noise level exceeds 90dB. Helmet fitted with welding shield is preferred for welders
3	Stone/ concrete breakers	Ear muffs, safety goggles, hand gloves
4	Electrical Work	Rubber hand glove, Electrical Resistance shoes
5	Insulation Work	Respiratory mask, Hand gloves, safety goggles
6	Work at height	Double lanyard full body harness, Fall arrestor (specific cases)
7	Grit/Sand blasting	Blast suit, blast helmet, respirator, leather gloves
8	Painting	Plastic gloves, Respirators (particularly for spray painting)
9	Radiography	As per BARC guidelines

- The PPEs shall conform to the relevant standards as below and bear ISI mark.

Relevant is-codes for personal protection

IS: 2925 – 1984	Industrial Safety Helmets.
IS: 4770 – 1968	Rubber gloves for electrical purposes.
IS: 6994 – 1973 (Part-I)	Industrial Safety Gloves (Leather & Cotton Gloves).
IS: 1989 – 1986 (Part-I-II)	Leather safety boots and shoes.
IS: 5557 – 1969	Industrial and Safety rubber knee boots.
IS: 6519 – 1971	Code of practice for selections care and repair of Safety footwear.
IS: 11226 – 1985	Leather Safety footwear having direct molding sole.
IS: 5983 – 1978	Eye protectors.
IS: 9167 – 1979	Ear protectors.
IS: 1179-1967	Eye & Face protection during welding
IS: 3521 – 1983	Industrial Safety Belts and Harness
IS: 8519 -1977	Guide for selection of industrial Safety equipment for body protection
IS: 9473-2002, 14166-1994, 14746-1999	Respiratory Protective Devices

The list is not exhaustive. The safety officer may demand additional PPEs based on specific requirement.



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- Where workers are employed in sewers and manholes, which are in use, the subcontractor shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manhole, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent incident to the public
- Besides the PPEs mentioned above, the persons shall use helmet and safety shoe. The visitors shall use Helmet and any other PPEs as deemed appropriate for the area of work.

Colour scheme for Helmets:

1. Workmen: Yellow
 2. Safety staff: Green or white with green band
 3. Electrician: Red
 4. Others including visitors: White
- All the PPEs shall be checked for its quality before issue and the same shall be periodically checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be repaired/ replaced.
 - The issuing agency shall maintain register for issue and receipt of PPEs.
 - The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.
 - The body harnesses shall be serial numbered.

8.4 ARRANGEMENT OF INFRASTRUCTURE

8.4.1 DRINKING WATER

- Drinking water shall be provided and maintained at suitable places at different elevations.
- Container should be labeled as " Drinking Water"
- Cleaning of the storage tank shall be ensured atleast once in 3 months indicating date of cleaning and next due date.
- Potability of water should be tested as per IS10500 at least once in a year.

8.4.2 WASHING FACILITIES

- In every workplace, adequate and suitable facilities for washing shall be provided and maintained.
- Separate and adequate cleaning facilities shall be provided for the use of male and female workers. Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition and dully illuminated for night use.
- Overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the painters and other workers to wash during the cessation of work.

8.4.3 LATRINES AND URINALS

- Latrines and urinals shall be provided in every work place.
- Urinals shall also be provided at different elevations.
- They shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times, by appointing designated person.
- Separate facilities shall be provided for the use of male and female worker if any.

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8.4.4 PROVISION OF SHELTER DURING REST

Proper Shed & Shelter shall be provided for rest during break

8.4.5 MEDICAL FACILITIES

8.4.5.1 MEDICAL CENTRE (As per Schedule V, X and XI of BOCW central Rules, 1998)

- A medical centre shall be ensured/identified at site with basic facilities for handling medical emergencies. The medical center can be jointly developed on proportionate sharing basis with permission from BHEL
- A qualified medical professional, not less than MBBS, shall be deployed at the medical centre
- The medical centre shall be equipped with one ambulance, with trained driver and oxygen cylinder.
- Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste –Management and Handling Rules, 1998)

8.4.5.2 FIRST AIDER

- Ensure availability of Qualified First-aider throughout the working hours.
- Every injury shall be treated, recorded and reported.
- Refresher course on first aid shall be conducted as necessary.
- List of Qualified first aiders and their contact numbers should be displayed at conspicuous places.

8.4.5.3 FIRST AID BOX (as per schedule III of BOCW)

- The subcontractor shall provide necessary first aid facilities as per schedule III of BOCW. At every work place first aid facilities shall be provided and maintained.
- The first aid box shall be kept by first aider who shall always be readily available during the working hours of the work place. His name and contact no to be displayed on the box.
- The first aid boxes should be placed at various elevations so as to make them available within the reach and at the quickest possible time.
- The first aid box shall be distinctly marked with a Green Cross on white background.
- Details of contents of first aid box is given in Annexure No. 01
- Monthly inspection of First Aid Box shall be carried out by the owner as per format no. HSEP:13-F01
- The subcontractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

8.4.5.4 HEALTH CHECK UP (As per schedule VII and Form XI)

The persons engaged at the site shall undergo health checkup as per the format no. HSEP:13-F02 before induction. The persons engaged in the following works shall undergo health checkup at least once in a year:

- a. Height workers
- b. Drivers/crane operators/riggers



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- c. Confined space workers
- d. Shot/sand blaster
- e. Welding and NDE personnel

8.4.6 PROVISION OF CANTEEN FACILITY

- Canteen facilities shall be provided for the workmen of the project inside the project site.
- Proper cleaning and hygienic condition shall be maintained.
- Proper care should be taken to prevent biological contamination.
- Adequate drinking water should be available at canteen.
- Fire extinguisher shall be provided inside canteen.
- Regular health check-up and medication to the canteen workers shall be ensured.

8.4.7 PROVISION OF ACCOMODATION/LABOUR COLONY

- The subcontractor shall arrange for the accommodation of workmen at nearby localities or by making a labour colony.
- Regular housekeeping of the labour colony shall be ensured.
- Proper sanitation and hygienic conditions to be maintained.
- Drinking water and electricity to be provided at the labour colony.
- Bathing/ washing bay
- Room ventilation and electrification.

8.4.8 PROVISION OF EMERGENCY VEHICLE

- Dedicated emergency vehicle shall be made available at workplace by each subcontractor to handle any emergency

8.4.9 PEST CONTROL

Regular pest control should be carried out at all offices, mainly laboratories, canteen, labour colony and stores.

8.4.10 SCRAPYARD

- In consultation with customer, scrapyard shall be developed to store metal scrap, wooden scrap, waste, hazardous waste.
- Scrap/Waste shall be segregated as Bio-degradable and non-bio-degradable and stored separately.

8.4.11 ILLUMINATION

- The subcontractor shall arrange at his cost adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. at various levels for safe and proper working operations at dark places and during night hours at the work spot as well as at the pre-assembly area.
- Adequate and suitable light shall be provided at all work places & their approaches including passage ways as per IS: 3646 (Part-II). Some recommended values are given below:



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S. No.	Location	Illumination (Lux)
A. Construction Area		
1.	Outdoor areas like store yards, entrance and exit roads	20
2.	Platforms	50
3.	Entrances, corridors and stairs	100
4.	General illumination of work area	150
5.	Rough work like fabrication, assembly of major items	150
6.	Medium work like assembly of small machined parts	300
	rough measurements etc.	
7.	Fine work like precision assembly, precision measurements etc.	700
8.	Sheet metal works	200
9.	Electrical and instrument labs	450
B. Office		
1.	Outdoor area like entrance and exit roads	20
2.	Entrance halls	150
3.	Corridors and lift cars	70
4.	Lift landing	150
5.	Stairs	100
6.	Office rooms, conference rooms, library reading tables	300
7.	Drawing table	450
8.	Manual telephone exchange	200

- Lamp (hand held) shall not be powered by mains supply but either by 24V or dry cells.
- Lamps shall be protected by suitable guards where necessary to prevent danger, in case of breakage of lamp.
- Emergency lighting provision for night work shall be made to minimise danger in case of main supply failure.

If the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instructions issued by the authorized BHEL official, BHEL shall have the right to take corrective steps at the risk and cost of the subcontractor

9.0 HSE TRAINING& AWARENESS

9.1 HSE INDUCTION TRAINING

All persons entering into project site shall be given HSE induction training by the HSE officer of BHEL /subcontractor before being assigned to work.

In-house induction training subjects shall include but not limited to:

- Briefing of the Project details.
- Safety objectives and targets.
- Site HSE rules.
- Site HSE hazards and aspects.
- First aid facility.
- Emergency Contact No.
- Incident reporting.
- Fire prevention and emergency response.
- Rules to be followed in the labour colony (if applicable)



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- Proper safety wear & gear must be issued to all the workers being registered for the induction (i.e., Shoes/Helmets/Goggles/Leg guard/Apron etc.)
- They must arrive fully dressed in safety wear & gear to attend the induction.
- Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.
- On completing attending subcontractor's in-house HSE induction, each employee shall sign an induction training form (format no. HSEP:13-F03) to declare that he had understood the content and shall abide to follow and comply with safe work practices. They may only then be qualified to be issued with a personal I.D. card, for access to the work site.

9.2 HSE TOOLBOX TALK

- HSE tool Box talk shall be conducted by frontline foreman/supervisor of subcontractor to specific work groups prior to the start of work. The agenda shall consist of the followings:
 - Details of the job being intended for immediate execution.
 - The relevant hazards and risks involved in executing the job and their control and mitigating measures.
 - Specific site condition to be considered while executing the job like high temperature, humidity, unfavorable weather etc.
 - Recent non-compliances observed.
 - Appreciation of good work done by any person.
 - Any doubt clearing session at the end.
- Record of Tool box talk shall be maintained as per format no. HSEP:13-F04
- Tool box talk to be conducted at least once a week for the specific work.

9.3 TRAINING ON HEIGHT WORK

Training on height work shall be imparted to all workers working at height by in-house/external faculty at least twice in a year. The training shall include following topics:

- Use of PPEs
- Use of fall arrester, retractable fall arrester, life line, safety nets etc.
- Safe climbing through monkey ladders.
- Inspection of PPEs.
- Medical fitness requirements.
- Mock drill on rescue at height.
- Dos & Don'ts during height work.

9.4 HSE TRAINING DURING PROJECT EXECUTION

- Other HSE training shall be arranged by BHEL/ subcontractor as per the need of the project execution and recommendation of HSE committee of site.
- The topics of the HSE training shall be as follows but not limited to:
 - Hazards identification and risk analysis (HIRA)
 - Work Permit System
 - Incident investigation and reporting
 - Fire fighting
 - First aid
 - Fire-warden training
 - EMS and OHSMS
 - T & Ps fitness and operation



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- Electrical safety
- Welding, NDE & Radiological safety
- Storage, preservation & material handling.
- A matrix shall be maintained to keep an up-to-date record of attendance of training sessions carried out.

9.5 HSE PROMOTION-SIGNAGE, POSTERS, COMPETITION, AWARDS ETC

9.5.1 Display of HSE posters and banners

- Site shall arrange appropriate posters, banners, slogans in local/Hindi/English languages at work place

9.5.2 Display of HSE signage

- Appropriate HSE signage shall be displayed at the work area to aware workmen and passersby about the work going on and do's and don'ts to be followed

9.5.3 Competition on HSE and award

- Site will arrange different competition (slogan, poster, essay etc.) on HSE time to time (Safety day, BHEL day, World Environment Day etc.) and winners will be suitably awarded.

9.5.4 HSE awareness programme

- Subcontractor shall arrange HSE awareness programme periodically on different topics including medical awareness for all personnel working at site

10.0 HSE COMMUNICATION

10.1 INCIDENT REPORTING

- The subcontractor shall submit report of all incidents, fires and property damage etc to the Engineer immediately after such occurrence, but in any case not later than 24 hours of the occurrence. Such reports shall be furnished in the manner prescribed by BHEL. (Refer HSE procedure for incident investigation, analysis and reporting for details)
- In addition, periodic reports on safety shall also be submitted by the subcontractor to BHEL from time to time as prescribed by the Engineer. Compiled monthly reports of all kinds of incidents, fire and property damage to be submitted to BHEL safety officer as per prescribed formats.
- HSE incidents of site shall be reported to BHEL site Management as per Procedure for Incident Investigation and Reporting in format no. HSEP:14-F15. Corrective action shall be immediately implemented at the work place and compliance shall be verified by BHEL HSE officer and until then, work shall be put on hold by Construction Manager.

10.2 HSE EVENT REPORTING

- Important HSE events like HSE training, Medical camp etc. organized at site shall be reported to BHEL site management in detail with photographs for publication in different in-house magazines
- Celebration of important days like National Safety Day, World Environment Day etc. shall also be reported as mentioned above.



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11.0 OPERATIONAL CONTROL

All applicable OCPs (Operational control procedures) will be followed by subcontractor as per BHEL instructions. This will be done as part of normal scope of work. List of such OCPs is given below. In case any other OCP is found to be applicable during the execution of work at site, then subcontractor will follow this as well, within quoted rate. These OCPs (applicable ones) will be made available to subcontractor during work execution at site. However for reference purpose, these are kept with Safety Officer of BHEL at the Power Sector Regional HQ, or available in downloadable format in the website, which may be referred by subcontractor, if they so desire.

LIST OF OCPs

Safe handling of chemicals	Safety in use of cranes	Hydraulic test
Electrical safety	Storage and handling of gas cylinders	Spray insulation
Energy conservation	Manual arc welding	Trial run of rotary equipment
Safe welding and gas cutting operation	Safe use of helmets	Stress relieving
Fire safety	Good house keeping	Material preservation
Safety in use of hand tools	Working at height	Cable laying/tray work
First aid	Safe excavation	Transformer charging
Food safety at canteen	Safe filling of hydrogen in cylinder	Electrical maintenance
Illumination	Vehicle maintenance	Safe handling of battery system
Handling and erection of heavy metals	Safe radiography	Computer operation
Safe acid cleaning	Waste disposal	Storage in open yard
Safe alkali boil out	Working at night	For sanitary maintenance
Safe oil flushing	Blasting	Batching
Steam blowing	DG set	Piling rig operation
Safe working in confined area	Handling & storage of mineral wool	Gas distribution test
Safe operation of passenger lift, material hoists & cages	Drilling, reaming and grinding(machining)	Cleaning of hotwell / deaerator
Electro-resistance heating	Compressor operation	O&M of control of AC plant & system
Air compressor	Passivation	Safe Loading of Unit
Safe EDTA Cleaning	Safe Chemical cleaning of Pre boiler system	Safe Boiler Light up
Safe Rolling and Synchronisation		

11.1 HSE ACTIVITIES

HSE activities shall be conducted at site based on the HSEMSM developed by Power Sector and issued to site by Regions.

While planning for any activity the following documents shall be referred for infrastructural requirements to establish control measures:

- 1) HSE Procedure for Register of OHS Hazards and Risks
- 2) HSE Procedure for Register of Environmental Aspects and Impacts
- 3) HSE Procedure for Register of Regulations



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- 4) Operational Control Procedures
- 5) HSE Procedure for Emergency Preparedness and Response Plan
- 6) Contract documents

11.2 WORK PERMIT SYSTEM

- The following activities shall come under Work Permit System
 - a. Height working above 2 metres
 - b. Hot working at height
 - c. Confined space
 - d. Radiography
 - e. Excavation more than 4 meter depth
 - f. Heavy lifting above 50 tonRefer Annexure 05 for Work permit formats.
- "HSE Procedure for Work Permit System" shall be followed while implementing permit system. Where customer is having separate Work Permit System the same shall be followed.
- Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work with Job Hazard Analysis.
- Permit signatory shall check that all the control measures necessary for the activity are in place and issue the permit to the permit holder.
- Permit holder shall implement and maintain all control measures during the period of permit .He will close the permit after completion of the work. The closed permit shall be archived in HSE Department of site.

11.3 SAFETY DURING WORK EXECUTION

Respective OCPS are to be followed and adherence to the same would be contractually binding

11.3.1 WELDING SAFETY

All safety precautions shall be taken for welding and cutting operations as per IS-818. All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

11.3.2 RIGGING

Rigging equipment shall not be loaded in excess of its recommended safe working load. Rigging equipment, when not in use, shall be removed from the original work area so as not to present a hazard to employees.

11.3.3 CYLINDERS STORAGE AND MOVEMENT

All gas cylinders shall be stored in upright position. Suitable trolley shall be used. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced. No of cylinders shall not exceed the specified quantity as per OCP

Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dragged, struck or permitted to strike each other violently.

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When cylinders are transported by powered vehicle they shall be secured in a vertical position.

11.3.4 DEMOLITION WORK

Before any demolition work is commenced and also during the process of the work the following shall be ensured:

- All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- No electric cable or apparatus which is liable to be a source of danger nor a cable or an apparatus used by the operator shall remain electrically charged.
- All practical steps shall be taken to prevent danger to persons employed from the risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render them unsafe.

11.3.5 T&Ps

All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test/calibration certificates bearing endorsement from competent authority of BHEL..Subcontractor to also submit monthly reports of T&Ps deployed and validity test certificates to BHEL safety Officer as per the format/procedure of BHEL.

11.3.6 CHEMICAL HANDLING

Displaying safe handling procedures for all chemicals such as lube oil, acid, alkali, sealing compounds etc , at work place.Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the subcontractor shall be responsible for carrying out such provision / storage in accordance with the rules & regulations laid down in the relevant petroleum act, explosive act and petroleum and carbide of calcium manual, published by the chief inspector of explosives of India. All such storage shall have prior approval if necessary from the chief inspector of explosives or any other statutory authority. The subcontractor shall be responsible for obtaining the same.

11.3.7 ELECTRICAL SAFETY

- Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts.
- Fulfilling safety requirements at all power tapping points.
- High/ Low pressure welders to be identified with separate colour clothings. No welders will be deployed without passing appropriate tests and holding valid welding certificates. Approved welding procedure should be displayed at work place.
- The subcontractor shall not use any hand lamp energized by Electric power with supply voltage of more than 24 volts in confined spaces like inside water boxes, turbine casings, condensers etc.
- All portable electric tools used by the subcontractor shall have safe plugging system to source of power and be appropriately earthed. Only electricians licensed by appropriate statutory authority shall be employed by the subcontractor to carry out all types of electrical works. Details of earth resource and their test date to be given to BHEL safety officer as per the prescribed formats of BHEL
- The subcontractor shall use only properly insulated and armored cables which conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site.



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- BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the cost of the subcontractor.
- All electrical appliances used in the work shall be in good working condition and shall be properly earthed.
- No maintenance work shall be carried out on live equipment.
- The subcontractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
- Area wise Electrical safety inspection is to be carried out on monthly basis as per "Electrical Safety Inspection checklist" and the report is to be submitted to BHEL safety officer
- Adequate precautions shall be taken to prevent danger for electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public
- The subcontractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.

11.3.8 FIRE SAFETY

- Providing appropriate fire fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
- Subcontractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labor colony etc. Such fire protection equipment shall be easy and kept open at all times.
- The fire extinguishers shall be properly refilled and kept ready which should be certified at periodic intervals. The date of changing should be marked on the Cylinders.
- All other fire safety measures as laid down in the "codes for fire safety at construction site" issued by safety coordinator of BHEL shall be followed.
- Non-compliance of the above requirement under fire protection shall in no way relieve the subcontractor of any of his responsibility and liabilities to fire incident occurring either to his materials or equipment or those of others.
- Emergency contacts nos must be displayed at prominent locations
- Tarpaulin being inflammable should not be used (instead, only non infusible covering materials shall be used) as protective cover while preheating, welding, stress relieving etc. at site.

11.3.9 SCAFFOLDING

- Suitable scaffolds shall be provided for workman for all works that cannot safely be done from the ground, or from solid construction except in the case of short duration of work which can be done safely from ladders.
- When a ladder is used, it shall be of rigid construction made of steel. The steps shall have a minimum width of 45 cm and a maximum rise of 30 cm. Suitable handholds of good quality wood or steel shall be provided and the ladder shall be given an inclination not steeper than $\frac{1}{4}$ horizontal and 1 vertical.
- Scaffolding or staging more than 3.6 m above the ground floor, swung or suspended from an overhead support or erected with stationery support shall have a guard rail properly bolted, braced or otherwise secured, at least 90 cm above the floor or platform of such scaffolding or staging and extending along the entire length of the out side and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from savor, from swaying, from the building or structure.

11.3.10 WORK AT HEIGHT:

- Guardrails and toe-board/barricades and sound platform conforming to IS:4912-1978 should be provided.



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- Wherever necessary, life-line(pp or metallic) and fall arrestor along with Polyamide rope or Retractable lifeline should be provided.
- Safety Net as per IS:11057:1984 should be used extensively for prevention/ arrest of men and materials falling from height. The safety nets shall be fire resistant, duly tested and shall be of ISI marked and the nets shall be located as per site requirements to arrest or to reduce the consequences of a possible fall of persons working at different heights.
- Reaching beyond barricaded area without lifeline support, moving with support of bracings, walking on beams without support, jumping from one level to another, throwing objects and taking shortcut must be discouraged.
- Use of Rebar steel for making Jhoola and monkey-ladder (Rods welded to vertical or inclined structural members), temporary platform etc. must be avoided.
- Monkey Ladder should be properly made and fitted with cages.
- Jhoola should be made with angles and flats and tested like any lifting tools before use.
- Lanyard must be anchored always and in case of double lanyard, each should be anchored separately.
- In case of pipe-rack, persons should not walk on pipes and walk on platforms only.
- In case of roof work, walking ladder/ platform should be provided along with lifeline and/ or fall arrestor.
- Empty drums must not be used.
- For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure alongwith separate fall arrestor. Rope ladder should be discouraged.

11.3.11 WORKING PLATFORM

Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform gangways provided is more than 3.6 m above ground level or floor level, they shall be closely boarded and shall have adequate width which shall not be less than 750 mm and be suitably fenced as described above. Every opening in the floor or a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 90 cm.

11.3.12 EXCAVATION

Wherever there are open excavation in ground, they shall be fenced off by suitable railing and danger signals installed at night so as to prevent persons slipping into the excavations.

11.3.13 LADDER SAFETY

Safe means of access shall be provided to all working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 m in the length while the width between side rails in rung ladder shall in no case be less than app. 29.2 cm for ladder upto and including 3 m in length. For longer ladders this width shall be increased at least 1/4" for each additional foot of length.

A sketch of the ladders and scaffolds proposed to be used shall be prepared and approval of the Engineer obtained prior to Construction.

11.3.14 LIFTING SAFETY

- It will be the responsibility of the subcontractor to ensure safe lifting of the equipment, taking due precaution to avoid any incident and damage to other equipment and personnel.



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- All requisite tests and inspection of handling equipment, tools & tackle shall be periodically done by the subcontractor by engaging only the Competent Persons as per law.
- Defective equipment or uncertified shall be removed from service.
- Any equipment shall not be loaded in excess of its recommended safe working load.

11.3.15 HOISTING APPLIANCE

- Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safe guards.
- Hoisting appliance should be provided with such means as will reduce to the minimum the risk of any part of a suspended load becoming incidentally displaced.
- When workers employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided.
- The worker should not wear any rings, watches and carry keys or other materials which are good conductor of electricity.

11.4 ENVIRONMENTAL CONTROL

Environment protection has always been given prime importance by BHEL. Environmental damage is a major concern of the principal subcontractor and every effort shall be made, to have effective control measures in place to avoid pollution of Air, Water and Land and associated life. Chlorofluorocarbons such as carbon tetrachloride and trichloroethylene shall not be used. Waste disposal shall be done in accordance with the guidelines laid down in the project specification.

Any chemical including solvents and paints, required for construction shall be stored in designated bonded areas around the site as per Material Safety Data Sheet (MSDS).

In the event of any spillage, the principle is to recover as much material as possible before it enters drainage system and to take all possible action to prevent spilled materials from running off the site. The subcontractor shall use appropriate MSDS for clean-up technique

All subcontractors shall be responsible for the cleanliness of their own areas.

The subcontractors shall ensure that noise levels generated by plant or machinery are as low as reasonably practicable. Where the subcontractor anticipates the generation of excessive noise levels from his operations the subcontractor shall inform to Construction Manager of BHEL accordingly so that reasonable & practicable precautions can be taken to protect other persons who may be affected.

It is imperative on the part of the subcontractor to join and effectively contribute in joint measures such as tree plantation, environment protection, contributing towards social upliftment, conversion of packing woods to school furniture, keeping good relation with local populace etc.

The subcontractor shall carry out periodic air and water quality check and illumination level checking in his area of work place and take suitable control measure.

11.5 HOUSEKEEPING

- Keeping the work area clean/ free from debris, removed scaffoldings, scraps, insulation/sheeting wastage /cut pieces, temporary structures, packing woods etc. will be in the scope of the subcontractor. Such cleanings has to be done by



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subcontractor within quoted rate, on daily basis by an identified group. If such activity is not carried out by subcontractor / BHEL is not satisfied, then BHEL may get it done by other agency and actual cost along with BHEL overheads will be deducted from contractor's bill. Such decisions of BHEL shall be binding on the subcontractor

- Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis.
- All surplus earth and debris are removed/disposed off from the working areas to identified locations.
- Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.
- All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations. Sufficient waste bins shall be provided at
- Different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from high location.
- Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.
- Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
- Labour camp area shall be kept clear and materials like pipes, steel, sand, concrete, chips and bricks, etc. shall not be allowed in the camp to obstruct free movement of men and machineries.
- Fabricated steel structures, pipes & piping materials shall be stacked properly.
- No parking of trucks/trolleys, cranes and trailers etc. shall be allowed in the camp, which may obstruct the traffic movement as well as below LT/HT power line.
- Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas

11.6 WASTE MANAGEMENT

Take suitable measures for waste management and environment related laws/legislation as a part of normal construction activities. Compliance with the legal requirements on storage/ disposal of paint drums (including the empty ones), Lubricant containers, Chemical Containers, and transportation and storage of hazardous chemicals will be strictly maintained.

11.6.1 BINS AT WORK PLACE

- Sufficient rubbish bins shall be provided close to workplaces.
- Bins should be painted yellow and numbered.
- Sufficient nos. of drip trays shall be provided to collect oil and grease.
- Sufficient qty. of broomsticks with handle shall be provided.
- Adequate strength of employees should be deployed to ensure daily monitoring and service for waste management.

11.6.2 STORAGE AND COLLECTION

- Different types of rubbish/waste should be collected and stored separately.
- Paper, oily rags, smoking material, flammable, metal pieces should be collected in separate bins with close fitting lids.
- Rubbish should not be left or allowed to accumulate on construction and other work places.
- Do not burn construction rubbish near working site.

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11.6.3 SEGREGATION

- Earmark the scrap area for different types of waste.
- Store wastes away from building.
- Oil spill absorbed by non-combustible absorbent should be kept in separate bin.
- Clinical and first aid waste stored and incinerated separately.

11.6.4 DISPOSAL

- Sufficient containers and scrap disposal area should be allocated.
- All scrap bin and containers should be conveniently located.
- Provide self-closing containers for flammable/spontaneously combustible material.
- Keep drainage channels free from choking.
- Make schedule for collection and disposal of waste.

11.6.5 WARNING AND SIGNS

- Appropriate sign to be displayed at scrap storage area
- No toxic, corrosive or flammable substance to be discarded into public sewage system.
- Waste disposal shall be in accordance with best practice.
- Comply with all the requirements of Pollution Control Board (PCB) for storage and disposal of hazardous waste.

11.7 TRAFFIC MANAGEMENT SYSTEM

11.7.1 SAFE WORKPLACE TRANSPORT SYSTEM

- Traffic routes in a work place shall be suitable for the persons or vehicles using them. This shall be sufficient in number and of sufficient size. This shall reflect the suitability of traffic routes for vehicles and pedestrians.
- Where vehicles and pedestrians use the same traffic routes there shall be sufficient space between them. Where necessary all traffic routes must be suitably indicated. Pedestrians or vehicles must be able to use traffic routes without endangering those at work. There must be sufficient separation of traffic routes from doors, gates and pedestrian traffic routes.
- For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.
- Temporary obstacles shall be brought to the attention of drivers by warning signs or hazard cones.
- Speed limits shall be clearly displayed. Speed ramps preceded by a warning signs or marker are necessary.
- The traffic route should be wide enough to allow vehicles to pass and re-pass oncoming or parked traffic and it may be advisable to introduce on-way system or parking restrictions.
- Safest route shall be provided between places where vehicles have to call or deliver.
- Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse



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- Safe areas shall be provided for loading and unloading.
- Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
- Ensure road crossings are minimum and clearly signed.
- Entrance and gateways shall be wide enough to accommodate a second vehicle without causing obstruction.
- Set sensible speed limits which are clearly sign posted.
- Where necessary ramps should be used to retard speed. This shall be preceded by a warning sign or mark on the road.
- Forklift trucks shall not pass over road hump unless of a type capable of doing so.
- Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.
- Road traffic signs shall be provided on prominent locations for prevention of incidents and hazards and for quick guidance and warning to employees and public. Safety signs shall be displayed as per the project working requirement and guideline of the state in which project is done. Vehicles hired or used shall not be parked within the 15m radius of any working area. Any vehicle, that is required to be at the immediate/near the vicinity, shall be approved by the person in-charge of the site.

11.7.2 TRAFFIC ROUTE FOR PEDESTRIANS

- Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.
- Separate routes shall be provided for pedestrians to keep them away from vehicles. Provide suitable barriers/guard at entrances/exit and the corners or buildings.
- Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.
- Where crowd is likely to use roadway e.g. at the end of shift, stop vehicles from using them at such times.
- Provide high visibility clothing for people permitted in delivery area.

11.7.3 WORK VEHICLE

Work vehicle shall be as safe stable efficient and roadworthy as private vehicles on public roads. Site management shall ensure that drivers are suitably trained. All vehicle e.g. heavy motor vehicle forklift trucks dump trucks mobile cranes shall ensure that the work equipment conforms to the following:

- A high level of stability.
- A safe means of access/egress.
- Suitable and effective service and parking brakes.
- Windscreens with wipers and external mirrors giving optimum all round visibility.
- Provision of horn, vehicle lights, reflectors, reversing lights, reversing alarms.
- Provision of seat belts.
- Guards on dangerous parts.
- Driver protection - to prevent injury from overturning and from falling objects/materials.
- Driver protection from adverse weather.
- No vehicle shall be parked below HT/LT power lines.
- Valid Pollution Under Control certification for all vehicles



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11.7.4 DAILY CHECK BY DRIVER

- There should also be daily safety checks containing below mentioned points by the driver before the vehicle is used.
 - Brakes.
 - Tires.
 - Steering.
 - Mirrors.
 - Windscreen waters.
 - Wipers.
 - Warning signals.
 - Specific safety system i.e. control interlocks
- Management should ensure that drivers carry out these checks.

11.7.5 TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES

- All drivers shall hold a valid driving License for the class of vehicle to be driven and be registered as an authorized BHEL driver with the Administration Department.
- Securing of the load shall be by established and approved methods, i.e. chains with patented tightening equipment for steel/heavy loads. Sharp corners on loads shall be avoided when employing ropes for securing.
- All overhangs shall be made clearly visible and restricted to acceptable limits
- Load shall be checked before moving off and after traveling a suitable distance.
- On no account is construction site to be blocked by parked vehicles Drivers of vehicles shall only stop or park in the areas designate by the stringing foreman.
- Warning signs shall be displayed during transportation of material.
All vehicles used by BHEL shall be in worthy condition and in conformance to the Land Transport requirement.

11.7.6 MAINTENANCE

All Vehicles used for transportation of man and material shall undergo scheduled inspections on frequent intervals to secure safe operation. Such inspections shall be conducted in particular for steering, brakes, lights, horn, doors etc. Site management shall ensure that work equipment is maintained in an efficient, working order and in good repair. Inspections and services carried out at regular intervals of time and or mileage. No maintenance shall be carried below HT/LT power lines.

11.8 EMERGENCY PREPAREDNESS AND RESPONSE

- Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by Regional HQ
- Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its subcontractors
- All the subcontractor's supervisory personnel and sufficient number of workers shall be trained for fire protection systems. Enough number of such trained personnel must be available during the tenure of contract. Subcontractor should nominate his supervisor to coordinate and implement the safety measures.
- Assembly point shall be earmarked and access to the same from different location shall be shown
- Fire exit shall be identified and pathway shall be clear for emergency escape.



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- Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
- Adequate number of first aid boxes shall be strategically placed at different work places to cater emergency need. Holder of the first aid box shall be identified on the box itself who will have the responsibility to maintain the same.
- First aid center shall be developed at site with trained medical personnel and ambulance
- Emergency contact numbers (format given in EPRP) of the site shall be displayed at prominent locations.
- Tie up with fire brigade shall be done in case customer is not having fire station.
- Tie up with hospital shall be done in case customer is not having hospital.
- Disaster Management group shall be formed at site
- Mock drill shall be arranged at regular intervals. Monthly report of the above to be given to BHEL safety Officer as per prescribed BHEL formats
- Mock drill shall be conducted on different emergencies periodically to find out gaps in emergency preparedness and taking necessary corrective action

12.0 HSE INSPECTION

Inspection on HSE for different activities being carried out at site shall be done to ensure compliance to HSEMS requirements. The subcontractor shall maintain and ensure necessary safety measures as required for inspection and tests HV test, Pneumatic test, Hydraulic test, Spring test, Bend test etc as applicable, to enable inspection agency for performing Inspection. If any test equipment is found not complying with proper safety requirements then the Inspection Agency may withhold inspection, till such time the desired safety requirements are met.

12.1 DAILY HSE CHECKS

Both the Site Supervisors and safety officer of Subcontractor are to conduct daily site Safety inspection around work activities and premises to ensure that work methods and the sites are maintained to an acceptable standard. The following are to form the common subjects of a daily safety inspection:

- Personal Safety wears & gear compliance.
- Complying with site safety rules and permit-to-work (PTW).
- Positions and postures of workers.
- Use of tools and equipment etc. by the workers.

The inspection should be carried out just when work starts in beginning of the day, during peak activities period of the day and just before the day's work ends.

12.2 INSPECTION OF PPE

- PPEs shall be inspected by HSE officer at random once in a week as per format no. HSEP:13-F06 for its compliance to standard and compliance to use and any adverse observation shall be recorded in the PPE register.
- The applicable PPEs for carrying out particular activities are listed below.

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12.3 INSPECTION OF T&Ps

- A master list of T&Ps shall be maintained by each subcontractor.
- All T&Ps being used at site shall be inspected by HSE officer once in a month as per format no. HSEP:13-F07 for its healthiness and maintenance.
- The T&Ps which require third party inspection shall be checked for its validity during inspection. The third party test certificate should be accompanied with a copy of the concerned competent person's valid qualification record.
- The validity of T&P shall be monitored as per "Status of T&Ps" format no. HSEP:13-F08

12.4 INSPECTION OF CRANES AND WINCHES

- Cranes and winches shall be inspected by the operator through a daily checklist for its safe condition (as provided by the equipment manufacturer) before first use of the day.
- Cranes and Winches shall be inspected by HSE officer once in a month as per format no. HSEP:13-F09 for healthiness, maintenance and validity of third party inspection.
- The date of third party inspection and next due date shall be painted on cranes and winches.
- The operators/drivers shall be authorized by sub-contractor based on their competency and experience and shall carry the I-card.
- The operator should be above 18 years of age and should be in possession of driving license of HMV man & goods), vision test certificate and should have minimum qualification so that he can read the instructions and check list.

12.5 INSPECTION ON HEIGHT WORKING

- Inspection on height working shall be conducted daily by supervisors before start of work to ensure safe working condition including provision of
 - Fall arrestor
 - Lifelines
 - Safety nets
 - Fencing and barricading
 - Warning signage
 - Covering of opening
 - Proper scaffolding with access and egress.
 - Illumination
- Inspection on height working shall be conducted once in a week by HSE officer as per format no. HSEP:14-F10.
- Medical fitness of height worker shall be ensured.
- Height working shall not be allowed during adverse weather.

12.6 INSPECTION ON WELDING AND GAS CUTTING OPERATION

- Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
- Gas cylinders shall be kept upright.
- Use of Flash back arrestor shall be ensured at both ends.



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- Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per format no. HSEP:14-F11.
- Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
- Availability of fire extinguisher at vicinity shall be ensured.

12.7 INSPECTION ON ELECTRICAL INSTALLATION / APPLIANCES

- Ensure proper earthing in electrical installation
- Use ELCB at electrical booth
- Electrical installation shall be properly covered at top where required
- Use appropriate PPEs while working
- Use portable electrical light < 24 V in confined space and potentially wet area.
- Monthly inspection shall be carried out as per format no. HSEP:14-F12.

12.8 INSPECTION OF ELEVATOR

- Elevators shall be inspected by concerned supervisors once in a week as per format no. HSEP:14-F13.
- All elevators shall be inspected by competent person and validity shall be ensured.
- The date of third party inspection and next due date shall be painted on elevator.

13.0 HSE PERFORMANCE

HSE performance of the subcontractor shall be monitored as per the following parameters:

Sl. No.	Parameters of measurement
1	Timely deployment of qualified safety officer and cumulative number of days in a month the required no. of qualified safety officer is available
2	Shortfall in number of meetings in the month conducted or attended by the safety officer
3	Level of compliance wrt decisions taken in previous meetings/audit/inspection/as reported.
4	Delay in submission of monthly report on safety in the prescribed format
5	Delay in reporting any incident including near-miss to BHEL /Customer/statutory authority(if required)
6	Degree of PPE non-compliance
7	Non- conducting of health check-up as per BOCW equirements
8	Non availability of proper first-aid facility , ambulance, adequate labour welfare initiatives
9	Non conductance of induction training and tool box meeting
10	Total number of instances in the month, House keeping NOT attended inspite of instructions by BHEL i.e. removal/disposal of surplus earth/ debris/scrap/unused/surplus cable drums/other electrical items/surplus steel items/packing material

- Suitable HSE reward system shall be developed at site level to promote HSE compliance amongst workmen.
- To decide HSE reward performance towards HSE shall be evaluated for workmen and it shall be awarded regularly in public gathering.
- If safety record of the subcontractor in execution of the awarded job is to the satisfaction of safety department of BHEL, issue of an appropriate certificate to recognize the safety performance of the subcontractor may be considered by BHEL after completion of the job.

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14.0 HSE PENALTIES

- As per contractual provision HSE penalties shall be imposed on subcontractors for non- compliance on HSE requirement as per format no. HSEP:14-F14. The list in the format is only indicative. For any other violation, not listed in the format, the minimum penalty amount is to be decided as per BOCW act.
- If principal customer/statutory and regulatory bodies impose some penalty on HSE due to the non-compliance of the subcontractor the same shall be passed on to them.
- The penalty amount shall be recovered by Site Finance department from subcontractors from the RA/Final bill.

15.0 OTHER REQUIREMENTS

- In case of any delay in completion of a job due to mishaps attributable to lapses by the subcontractor, BHEL shall have the right to recover cost of such delay from the payments due to the subcontractor, after notifying the subcontractor suitably.
- If the subcontractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instruction regarding safety issued by BHEL, BHEL shall have the right to take corrective steps at the risk and cost of the subcontractor after giving a notice of not less than 7 days indicating the steps that would be taken by BHEL.
- If the subcontractor succeeds in carrying out its job in time without any fatal or disabling injury incident and without any damage to property BHEL may, at its sole discretion, favorably consider to reward the subcontractor suitably for the performance.
- In case of any damage to property due to lapses by the subcontractor, BHEL shall have the right to recover the cost of such damages from the subcontractor after holding an appropriate enquiry.
- The subcontractor shall take all measures at the sites of the work to protect all persons from incidents and shall be bound to bear the expenses of defense of every suit, action or other proceeding of law that may be brought by any persons for injury sustained or death owing to neglect of the above precautions and to pay any such persons such compensation or which may with the consent of the subcontractor be paid to compromise any claim by any such person, should such claim proceeding be filed against BHEL, the subcontractor hereby agrees to indemnify BHEL against the same.
- The subcontractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.
- The subcontractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard.
- BHEL shall have the right to prescribe the conditions under which such equipment or materials may be handled and the subcontractor shall adhere to such instructions.



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- BHEL may prohibit the use of any construction machinery, which according to the organization is unsafe. No claim for compensation due to such prohibition will be entertained by BHEL.

16. NON COMPLIANCE

NONCONFORMITY OF SAFETY RULES AND SAFETY APPLIANCES WILL BE VIEWED SERIOUSLY AND BHEL HAS RIGHT TO IMPOSE FINES ON THE SUBCONTRACTOR AS UNDER FOR EVERY INSTANCE OF VIOLATION NOTICED:

SN	Violation of Safety Norms	Fine (in Rs)
01	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03	Not wearing safety shoe	200/-*
04	Not keeping gas cylinders vertically	200/-
05	Not using flash back arrestors	100/-
06	Not wearing gloves	50/- *
07.	Grinding Without Goggles	50/- *
08.	Not using 24 V Supply For Internal Work	500/-
09.	Electrical Plugs Not used for hand Machine	100/-
10.	Not Sliding properly	200/-
11.	Using Damaged Sling	200/-
12.	Lifting Cylinders Without Cage	500/-
13.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
14.	Not Removing Small Scrap From Platforms	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
16.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
17.	Improper Earthing Of Electrical T&P	500/-
18	No or improper barricading	500/-
19.	Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case)	1000/-
20.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

- Legend:-

*: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

Any other non-conformity noticed not listed above will also be fined as deemed fit by BHEL. The decision of BHEL engineer is final on the above. The amount will be deducted from running bills of the subcontractor. The amount collected above will be utilized for giving award to the employees who could avoid incident by following safety rules. Also the amount will be spent for purchasing the safety appliances and supporting the safety activity at site.



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17.0 HSE AUDIT/INSPECTION

- Regular HSE Audit/inspection shall be carried out by Subcontractor as per Site HSE audit calendar.
- HSE checklist(**Annexure 02**) shall be used for carrying out audit/inspection and report shall be submitted to BHEL sitemanagement
- All non-conformities and observations on HSE identified during internal or external HSE audit shall be disposed off by site in a time bound manner and reported back the implementation status
- Corrective action and Preventive action on HSE issues raised by certification body issued by Regional HQs shall be implemented by site and reported to Site management.

18.0 MONTHLY HSE REVIEW MEETING

- Site shall hold HSE review meeting every month to discuss and resolve HSE issues of site and improve HSE performance. It will also discuss the incidents occurred since previous meeting, its root cause and Corrective action and Preventive action. The agenda is given below:
 - Implementation of earlier MOM
 - HSE performance
 - HSE inspection
 - HSE audit and CAPA
 - HSE training
 - Health check-up camp
 - HSE planning for the erection and commissioning and installation activities in the coming month
 - HSE reward and promotional activities
- The meeting shall be chaired by Construction Manager, convened by HSE coordinator and attended by all HOS, Site Incharge of Subcontractors and HSE officer of Subcontractors.
- MOM on the discussion will be circulated to the concerned for implementation.

19.0 FORMATS USED (Details available in Annexure-04)

SL. No.	Format Name	Format No.	Rev No.
01	Inspection of First Aid Box	HSEP:13-F01	00
02	Health Check Up	HSEP:13-F02	00
03	HSE Induction Training	HSEP:13-F03	00
04	Tool Box Talk	HSEP:13-F04	00
05	Monthly Site HSE Report	HSEP:13-F05	00
06	Inspection of PPE	HSEP:13-F06	00



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07	Inspection of T&Ps	HSEP:13-F07	00
08	Status of T&Ps	HSEP:13-F08	00
09	Inspection of Cranes and Winches	HSEP:13-F09	00
10	Inspection on Height Working	HSEP:13-F10	00
11	Inspection on Welding & Gas Cutting	HSEP:13-F11	00
12	Inspection on Electrical Installation	HSEP:13-F12	00
13	Inspection on Elevator	HSEP:13-F13	00
14	HSE Penalty	HSEP:13-F14	00
15	Accident /incident / property damage /fire incident report	HSEP:13-F15	00



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20.0 ANNEXURES

ANNEXURE 01

As per Contract Labour (Regulation & Abolition Act), Central Rules, 1971,

- (1) The first-aid box shall be distinctively marked with a Red Cross on a white background and shall contain the following items, namely:

(a) For establishments in which the number of contract labour employed does not exceed fifty, each first aid box shall contain the following equipment:

(i)	6 small sterilized dressings
(ii)	3 medium size sterilized dressings
(iii)	3 large size sterilized dressings
(iv)	6 pieces of sterilized eye pads in separate sealed packets.
(v)	6 roller bandages 10 cm wide.
(vi)	6 roller bandages 5 cm wide.
(vii)	One tourniquet
(viii)	A supply of suitable splints
(ix)	Three packets of safety pins.
(x)	Kidney tray.
(xi)	3 large sterilized burn dressings.
(xii)	1 (30ml) bottle containing a two percent alcoholic solution of iodine
(xiii)	1 (30 ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label
(xiv)	1 snake bite lancet
(xv)	1 (30gms) bottle of potassium permanganate crystals.
(xvi)	1 pair scissors
(xvii)	1 copy of the First-Aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India.
(xviii)	A bottle containing 100 tablets (each of 5 grains) of aspirin
(xix)	Ointment for burns
(xx)	A bottle of suitable surgical anti-septic solution

(b) For establishment in which the number of contract labour exceeds fifty each first-aid box shall contain the following equipment:

(i)	12 small sterilized dressings
(ii)	6 medium size sterilized dressings
(iii)	6 large size sterilized dressings.
(iv)	6 large size sterilized burn dressings
(v)	6 (15 grams) packets sterilized cotton wool
(vi)	12 pieces of sterilized eye pads in separate sealed packets.



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(vii)	12 roller bandages 10 cm wide.
(viii)	12 roller bandages 5 cm wide.
(ix)	One tourniquet.
(x)	A supply of suitable splints.
(xi)	Three packets of safety pins.
(xii)	Kidney tray.
(xiii)	Sufficient number of eye washes bottles filled with distilled water or suitable liquid clearly indicated by a distinctive sign which shall be visible at all times.
(xiv)	4 per cent Xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops.
(xv)	1 (60ml) bottle containing a two percent alcoholic solution of iodine
(xvi)	One (two hundred ml) bottle of mercurochrome (2 per cent) solution in water.
(xvii)	1 (120ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label.
(xviii)	1 roll of adhesive plaster (6 cmX1 meter)
(xix)	2 rolls of adhesive plaster (2 cmX1 meter)
(xx)	A snake bite lancet.
(xxi)	1 (30 grams) bottle of potassium permanganate crystals.
(xxii)	1 pair scissors
(xxiii)	1 copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India.
(xxiv)	a bottle containing 100 tablets (each of 5 grains) of aspirin
(xxv)	Ointment for burns
(xxvi)	A bottle of a suitable surgical anti septic solution.

(2) Adequate arrangement shall be made for immediate recoupment of the equipment when necessary.



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ANNEXURE 02

HSE AUDIT/INSPECTION CHECKLIST CUM COMPLIANCE REPORT

PROJECT: _____

SUBCONTRACTOR: _____

DATE : _____

OWNER : _____

INSPECTION BY: _____

Note : write 'NA' wherever the items is not applicable

Item	Y e s	N o	Remarks	Action
HOUSEKEEPING				
Waste containers provided and used				
Passageways and walkways clear				
General neatness of working area				
Other				
PERSONNEL PROTECTIVE EQUIPMENTS				
Goggles; shields				
Face protection				
Hearing protection				
Respiratory masks etc.				
Safety belts				
Other				
EXCAVATIONS / OPENINGS				
Openings properly covered or barricaded				
Excavations shored				
Excavations barricaded				
Overnight lighting provided				
Other				
WELDING, CUTTING				
Gas cylinders chained upright				
Cable and hoses not obstructing				
Fire extinguisher (s) accessible				
Others				
SCAFFOLDING				
Fully decked platforms				
Guard and intermediate rails in place				
Toe boards in place				
Adequate shoring				
Adequate access				
Others				
LADDER				
Extension side rails 1 m above				
Top of landing				
Properly secured				



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Angle $\pm 70^0$ from horizontal				
Other				
HOISTS, CRANES AND DERRICKS				
Condition of cables and sheaf OK				
Condition of slings, chains, hooks OK				
Inspection & maintenance log maintained				
Outriggers used				
Signals observed and understood				
Qualified operators				
Others				
MACHINERY, TOOLS & EQUIPMENT				
Proper instruction				
Safety devices				
Proper cords				
Inspection and maintenance				
Other				
VEHICLE AND TRAFFIC				
Rules and regulations observed				
Inspection and maintenance				
Licensed drivers				
Other				
TEMPORARY FACILITIES				
Emergency instructions posted				
Fire extinguishers provided				
Fire-aid equipment available				
General neatness				
Others				
FIRE PREVENTION				
Personnel instructed				
Fire extinguishers checked				
No smoking in prohibited areas.				
Hydrants				
Clearance				
Others				
ELECTRICAL				
Proper wiring				
ELCB's provided				
Ground fault circuit interrupters				
Protection against damage				
Prevention of tripping hazards				
Other				
HANDLING & STORAGE OF MATERIALS				
Properly stored or stacked				
Passageways clear				
Other				
FLAMMABLE GASES AND LIQUIDS				
Containers clearly identified				
Proper storage				
Fire extinguisher nearby				



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Other				
WORKING AT HEIGHT				
Safety nets				
Safety belts				
Safety helmets				
Anchoring of safety belt to the life line rope				
ENVIRONMENT				
Lubricant waste/engine oils properly dispose.				
Waste from Canteen, offices, sanitation etc. disposed properly.				
Disposal of surplus earth, stripping materials, expired batteries, oily rags and combustible materials done properly.				
HEALTH CHECKS				
Hygienic conditions at labor camps O.K.				
Availability of first-aid facilities				
Proper sanitation at site, office & labor camps.				
Arrangement of medical facilities.				
Measures for dealing with illness.				
Availability of potable drinking water for workmen & staff.				
Provision of crèches for children.				



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ANNEXURE 03

REFERENCES

- Contract documents
- Relevant legislations
- HSEMSM
- Relevant Indian standards as listed below (illustrative only):

SL NO	CODE NAME	TITLE
(1)	IS : 818-1888 (Reaffirmed 2003)	Code of Practice for safety and health requirements in Electric and Gas Welding and Cutting operations.
(2)	IS: 1179-1967 (Reaffirmed 2003)	Specification for Equipment for Eye & Face protection during welding.
(3)	IS : 1989 (Part 2):1986 (Reaffirmed 1997)	Specification for Leather Safety Boots & Shoes
(4)	IS:2925 – 1984 (Reaffirmed 2010)	Specification for Industrial Safety Helmets
(5)	IS:3521 : 1999 (Reaffirmed 2002)	Industrial Safety Belts & Harnesses-Specification
(6)	IS:3646(Part II) – 1966 (Reaffirmed 2003)	Code of Practice for Interior Illumination
(7)	IS:3696 (Part I) – 1987 (Reaffirmed 2002)	Safety Code for Scaffolds and Ladders
(8)	IS: 3696(Part 2) : 1991 (Reaffirmed 2002)	Scaffolds and Ladders-Code of Safety
(9)	IS:3786 – 1983 (Reaffirmed 2002)	Method for Computation of Frequency and Severity Rates for Industrial Injuries and Classification of Industrial Incidents
(10)	IS:4770 : 1991 (Reaffirmed 2006)	Rubber Gloves – Electricals purposes-Specification
(11)	IS:4912 : 1978 (Reaffirmed 2002)	Safety Requirements for Floor and Wall Openings, Railings and Toe Boards
(12)	IS: 5983 – 1980 (Reaffirmed 2002)	Specification for Eye-Protectors
(13)	IS:6519 – 1971 (Reaffirmed 1997)	Code of Practice for Selection, Care and Repair of Safety Footwear
(14)	IS:9167:1979	Specification for Ear-Protectors
(15)	IS:6994(Part I)-1973 (Re affirmed 1996)	Specification for Industrial Safety Gloves Leather and Cotton Gloves
(16)	IS:8519 – 1977 (Reaffirmed 1983)	Guide for Selection of Industrial Safety Equipment for Body Protection.
(17)	IS 11006 : 2011	Flash Back(Flame Arrestor) Specification



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(18)	IS:8520 – 1977 (Reaffirmed 2002)	Guide for Selection of Industrial Safety Equipment for Eye, Face and Ear Protection.
(19)	IS:9473:2002	Respiratory Protective Devices-Filtering Half Masks to protect against Particles-Specification.
(20)	IS:9944:1992 (Reaffirmed 2003)	Natural and Man-made Fiber Rope Slings-Recommendations on Safe working loads.
(21)	IS:11057 – 1884 (Reaffirmed 2001)	Specification for Industrial Safety Nets
(22)	IS:12254:1993 (Reaffirmed 2002)	Polyvinyl Chloride (PVC) Industrial Boots-Specification
(23)	IS:13367(Part 1):1992 (Reaffirmed 2003)	Safe Use of Cranes-Code of Practice
(24)	IS:14166:1994 (Reaffirmed 2002)	Respiratory Protective Devices-Full Face Masks Specification
(25)	IS:14746 : 1999 (Reaffirmed 2003)	Respiratory Protective Devices-Half Masks and Quarter Masks - Specification
(26)	IS : 15397 :2003 (Reaffirmed 2008)	Portable Extinguisher Mechanical Foam Type(Stored Pressure)-Specification
(27)	IS: 19011:2002	Guidelines for Quality and/or Environmental Management Systems Auditing



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**ANNEXURE 04 : SAFETY FORMATS
&
ANNEXURE 05 : WORK PERMIT FORMATS**

**POWER SECTOR****INSPECTION OF FIRST AID BOX**

FORMAT NO: HSEP:13-F01

REV NO.: 00

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Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Number of employees on the site:- _____

Sl.No.	Item	No. Available	Remarks
1	No. of small sterilized dressings		
2	No of medium sized sterilized dressings		
3	No of large sized sterilized dressings.		
4	No of large sized sterilized burn dressings		
5	No of (15 grams) packets sterilized cotton wool		
6	No of pieces of sterilized eye pads in separate sealed packets.		
7	No of roller bandages 10 cm wide.		
8	No of roller bandages 5 cm wide.		
9	Whether tourniquet available		
10	Whether supply of suitable splints available.		
11	No of packets of safety pins.		
12	Whether kidney tray available		
13	Whether sufficient number of eye wash bottles, filled with distilled water or suitable liquid, clearly indicated by a distinctive sign which shall be visible at all times, available.		
14	Whether 4%-xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops available.		
15	Whether (60ml) bottle containing a two percent alcoholic solution of iodine available		
16	Whether (two hundred ml) bottle of mercurochrome (2 per cent) solution in water available.		

**POWER SECTOR****INSPECTION OF FIRST AID BOX**

FORMAT NO: HSEP:13-F01

REV NO.: 00

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Sl.No.	Item	No. Available	Remarks
17	Whether 120ml bottle containing Sal volatile having the dose and mode of administration indicated on the label, available.		
18	Whether roll of adhesive plaster (6 cmX1 meter) available		
19	No of rolls of adhesive plaster (2 cmX1 meter)		
20	Whether snake bite lancet available.		
21	Whether (30 grams) bottle of potassium permanganate crystals available.		
22	Whether a pair scissors available		
23	Whether copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India available.		
24	Whether bottle containing 100 tablets (each of 5 grains) of aspirin available		
25	Whether Ointment for burns available		
26	Whether bottle of a suitable surgical anti septic solution available		

Signature of Subcontractor's Site I/C::

**POWER SECTOR****HEALTH CHECK UP**

FORMAT NO: HSEP:13-F02

REV NO.: 00

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Name of Site :	
Name of Sub-Contractor :	
Name of Employee :	

NAME:

History Of Past Illness	H/O Epilepsy
	H/O Drug Allergy
	H/O Diabetics/ Hypertension
	H/O Unconsciousness

Personal History

EXAMINATION	OBSERVATION
<u>General Physical Examination</u>	
Height	:
Weight	:
BMI	:
Built And nourishment	:
Pallor	:
Temperature	:
Chest Expansion	: Inspiration Expansion
Lymph Node Enlargement	:
<u>Ear, Nose, Throat</u>	:
Ear	:
Nose	:
Throat	:

**POWER SECTOR****HEALTH CHECK UP**

FORMAT NO: HSEP:13-F02

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EXAMINATION	OBSERVATION
<u>Cardiovascular System Examination :</u>	
Inspection :	
Palpation :	Pulse BP
Auscultation (Heart Sounds) :	
<u>Respiratory System :</u>	
Inspection :	Respiratory Rate
Palpation:	
Percussion :	
Auscultation (Breath Sounds) :	
<u>Examination of Abdomen :</u>	
Inspection :	
Palpation :	
Auscultation (Bowel Sounds) :	
Any Other :	
Clinical Impression	

Signature of the examining doctor

**POWER SECTOR****HSE INDUCTION TRAINING**

FORMAT NO: HSEP:13-F03

REV NO.: 00

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Name of Site :	
Name of Sub-Contractor :	
Date :	
Name of Training Co-ordinator	

Sl No.	Name	Designation	Organisation	Signature

Signature of Training co-ordinator :

	POWER SECTOR	FORMAT NO: HSEP:13-F04 REV NO.: 00 PAGE NO. 01 OF 01
	TOOL-BOX TALK	

Name of Site :	
Sub-Contractors Name :	
Date :	

Topic	Name of person delivered Tool Box Talk	No. of Participants attended	Remarks

Signature of Site I/C of Subcontractor :

	POWER SECTOR	FORMAT NO: HSEP:13-F06 REV NO.: 00 PAGE NO. 01 OF 01
	PERSONAL PROTECTIVE EQUIPMENTS	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Item	Issued this Month	Nos. Issued up to the Month	Percentage of usage at site
Safety Helmet			
Safety Shoes			
Full Body Harness			
Fall Arrestor			
Safety Nets			
Other PPEs.			

Signature of Site I/C of Subcontractor :

**POWER SECTOR****INSPECTION OF T&Ps**

FORMAT NO: HSEP:13-F07

REV NO.: 00

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Name of Site :	
Name of Sub-Contractor :	
Date of Inspection :	

Sl.No.	Description	Remarks
1.0	Name of equipment	
2.0	Basic Information of equipment	
2.1	Specification	
2.2	Sr. No. of equipment	
2.3	Make	
2.4	Year of manufacture	
3.0	Major repairs / overhauls(Furnish details of work carried out)	Date(s) of major repair/overhaul
3.1		
3.2		
3.3	Repairs carried out at site	
4.0	Any performance test conducted	Yes/No
5.0	Document Submitted	Yes/No
6.0	Manufacturer's test / guarantee certificate	Available/ Not available
7.0	Performance test	Done/ Not Done
8.0	Acceptance Norms	
9.0	Committee Observations	
10.0	Date of next review (if accepted)	

Signature-Site Safety Officer (BHEL)

Signature-Subcontractor/ Subcontractor's
Safety Officer

**POWER SECTOR****STATUS OF T&Ps**

FORMAT NO: HSEP:13-F08

REV NO.: 00

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Name of Site	
Name of Sub-Contractor	
Date of Inspection	

Item	Nos. Deployed	Identification No.	Nos. Tested by competent person	Validity of Test Certificate
Winches				
Chain Blocks				
Wire Rope Slings				
Man Cages				
D-Shackles				
Air Compressors				
Crawler Cranes				
Mobile Cranes				
Hydra Cranes				
Others				

Signature of Site I/C of subcontractor :

**POWER SECTOR****INSPECTION OF CRANES AND WINCHES**

FORMAT NO: HSEP:13-F09

REV NO.: 00

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Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Crane Reg. No (Make/Model)

Name of Driver/Operator

Sl.no.	Description	Observation	Measures
1	Valid Driving license		
2	Hook & Hook Latch		
3	Over Hoist limit switch		
4	Boom limit switch		
5	Boom Angle Indicator		
6	Boom limit cutoff switch		
7	Condition of Boom		
8	Condition of ropes		
9	Number of load lines		
10	Size and condition of the slings		
11	Stability of the cranes		
12	Soil Condition		
13	Swing Break And Lock		
14	Proper Break And Lock		
15	Hoist Break And Lock		
16	Boom Break And Lock		
17	Main Clutch		
18	Leakage in Hydraulic Cylinders		
19	Out riggers fully extendable		
20	Tyre pressure		
21	Condition of Battery And Lamps		

**POWER SECTOR****INSPECTION OF CRANES AND WINCHES**

FORMAT NO: HSEP:13-F09

REV NO.: 00

PAGE NO. 02 OF 03

Sl.no.	Description	Observation	Measures
22	Guards of moving and rotating parts		
23	Load chart provided		
24	Number and position of pedant ropes		
25	Reverse Horn		
26	Load Test Details		
27	Operator's fitness		
28	Pollution under control certificate		
29	Fire extinguisher of appropriate type.		
30	Training of the operator		

WINCH

Sl. No.	Description	YES	NO	NA	Remarks
1	Has the copy of Third Party Inspection certificate been provided in winch machine shed?				
2	Is winch machine operator experienced enough to operate the winch machine?				
3	Is the winch machine operated by someone other than the winch machine operator?				
4	Is there guard provided in all moving parts like wheel and motor's shaft?				
5	Will it protect against unforeseen operational contingencies?				
6	Are brakes, clutch and locking arrangement working properly?				
7	Has it been ensured that the guard does not constitute a hazard by itself?				
8	Are the cranks and the connecting rods protected by guardrails?				
9	Is there provision for fully covered shed with wooden plank roof?				

**POWER SECTOR****INSPECTION OF CRANES AND WINCHES**

FORMAT NO: HSEP:13-F09

REV NO.: 00

PAGE NO. 03 OF 03

Sl. No.	Description	YES	NO	NA	Remarks
10	Is wire rope free from any kind of damage or wear and tear?				
11	Is split pin provided for the protection of clutch and brake locking arrangement?				
12	Is pulley inspected by competent person and certified before use?				
13	Is pulley free from any wear and tear visually?				
14	Is winch rope barricaded with clipsheet for the protection of rope and person?				
15	Is the wire rope lubricated by cardium oil?				
16	Is there any friction in wire rope which may damage the wire rope rather than the rolling parts?				
17	Is there any oil leakage in the hydraulic system of the winch machine?				
18	Has it been ensured that the guard will not cause discomfort or inconvenience to operator?				
	Total Number of NO:				
	Total Number of NA:				
	% Compliance :				

Signature of Site I/C of subcontractor :

	POWER SECTOR	FORMAT NO: HSEP:13-F10 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF HEIGHT WORKING	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Sl. No.	Descriptions	Observation (Yes/No)	Remarks
1	All the workers have been explained safe work method?		
2	An established communication system has been established and explained to the workers.		
3	Adequate illumination has been ensured.		
4	Work area inspected prior to the start of the work.		
5	Area below the work place barricaded, particularly below hot work.		
6	Workers provided with bags /box to carry bolts, nuts and hand tools		
7	Arrangement for fastening hand tools made.		
8	All work platforms ensured to be of adequate strength and ergonomically suitable.		
9	Fabricated makeshift arrangements are checked for quality and type of material welding, anchoring etc.		
10.	Work at more than one elevation at the same segment is restricted.		
	ACCESS/EGRESS		
1	Walkways provided with handrail, mid-rail and toe guard?		
2	All checkered plates, gratings properly welded/ bolted?		
3	Are ladders inspected and they are in good condition?		
4	Are ladders spliced?		
5	Are ladders properly secured to prevent slipping, sliding or falling?		
6	Do side rails extend 36" above top landing?		
7	Are built up ladders constructed of sound materials?		

**POWER SECTOR****INSPECTION OF HEIGHT WORKING**

FORMAT NO: HSEP:13-F10

REV NO.: 00

PAGE NO. 02 OF 02

Sl. No.	Descriptions	Observation (Yes/No)	Remarks
8	Are rugs and cleats not over 12" on center?		
9	Metal ladders not used around electrical hazards.		
10	Proper maintenance and storage.		
11	Ladders placed at right slope.		
12	Ladders / staircases welded/ bolted properly.		
13	Any obstruction in the stairs.		
14	Are landing provided with handrails, knee rails, toe boards etc.?		
15	Whether ramp is provided with proper slope.		
16	Proper hand rails / guards provided in ramps.		
	Housekeeping		
1	Walkways, aisles & all overhead workplaces cleared of loose material.		
2	Flammable materials, if any, are cleared.		
3	All the de shuttering materials are removed after de shuttering is done.		
4	Platforms and walkways free from oil/grease or other slippery material.		
5	Collected scrap are brought down or lowered down and not dropped from height.		
	PPE And Safety Devices		
1	Use of safety helmet, safety belts ensured for all workers		
2	Anchoring points provided at all places of work.		
3	Common lifeline provided wherever linear movement at height is required.		
4	Safety nets are use wherever required.		
5	Proper fall arrest system is deployed at critical workplaces.		
6	Crawler boards/Safety system or works on fragile roof are used.		

Signature of Site I/C of subcontractor :

**POWER SECTOR****INSPECTION OF WELDING AND GAS
CUTTING**

FORMAT NO: HSEP:13-F11

REV NO.: 00

PAGE NO. 01 OF 02

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Welding				
Sl.no.	Description	Y e s	N o	Remarks
1	Is electric connection given through 30 mA ELCB/RCCB to welding m/c?			
2	Is electric cable fitted properly in junction box on m/c?			
3	Is electrical cable free from joints?			
4	Are the joints attached firmly & insulated with tape?			
5	Is double earthing given to body of m/c?			
6	Is the physical condition of the m/c good?			
7	Is ON/OFF switch connected to the m/c is working and in good condition?			
8	Are indication lamps on m/c working?			
9	Is the electrode holder in good condition?			
10	Are the cables of the welding m/c lugged & tight properly?			
11	Are return lead connected properly (Rod, Angle, Channels shall not be used)			
	Total No of NO			
	Total No of YES			

**POWER SECTOR****INSPECTION OF WELDING AND GAS
CUTTING**FORMAT NO: HSEP:13-F11
REV NO.: 00
PAGE NO. 02 OF 02

Gas Cutting				
Sl. no	Description	Yes	No	Remarks
1	Are Cylinders kept on trolleys?			
2	Physical condition of Gas cylinders Good?			
3	Is there Oil/Grease on valve of the cylinder?			
4	Are pressure regulators in good condition?			
5	Condition of hose pipe OK?			
6	Are hose pipe clamped with hose clip?			
7	Is flash back arrestor & NRV fitted on torch both for O2 and LPG cylinder?			
8	Is nozzle of the torch cleaned?			
	Total Number of NO			
	Total No of YES			
	% Compliance			

Signature of Site I/C of subcontractor :

**POWER SECTOR****INSPECTION OF ELECTRICAL INSTALLATION**

FORMAT NO: HSEP:13-F12

REV NO.: 00

PAGE NO. 01 OF 02

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection:	

Sr. No.	Contents	Yes/No	Remarks
A	Cable		
1.	Whether the condition of cable is checked?		
2.	Are cables received from other sites checked for insulation resistance before putting them into use?		
3.	Are all main cables taken either underground / overhead?		
4.	Are welding cables routed properly above the ground?		
5.	Are welding and electrical cables overlapping?		
6.	Is any improper joining of cables/wires prevailing at site?		
B	DBs/SDBs		
1.	Is earth conductor continued upto DB / SDB?		
2.	Whether DBs and extension boards are protected from rain / water?		
3.	Is there any overloading of DBs / SDBs?		
4.	Are correct / proper fuses & CBs provided at main boards and sub-boards?		
5.	Is energized wiring in junction boxes, CB panels & similar places covered all times?		
C	ELCB		
1.	Whether the connections are routed through ELCB?		
2.	Is ELCB sensitivity maintained at 30 mA?		

**POWER SECTOR****INSPECTION OF ELECTRICAL INSTALLATION**

FORMAT NO: HSEP:13-F12

REV NO.: 00

PAGE NO. 02 OF 02

Sr. No.	Contents	Yes/No	Remarks
3.	Are the ELCB numbered and tested periodically & test results recorded in a logbook countersigned by a competent person?		
D	Grounding		
1.	Is natural earthing ensured at the source of power (main DB at Generator or Transformer)?		
2.	Whether the continuity and tightness of the earth conductor are checked?		
3.	Mention the gauge of the earth conductor used at the site.		
4.	Mention the value of Earth Resistance.		
E	Electrically operated Machines or Accessories.		
1.	Whether the plug top is provided everywhere.		
2.	Are all metal parts of electrical equipment and light fittings / accessories grounded?		
3.	Is there any shed or cover for welding machines?		
4.	Are halogen lamps fixed at proper places?		
5.	Are portable power tools maintained as per norms?		
6.	Any other information:		

Signature of Site I/C of subcontractor :

**POWER SECTOR****INSPECTION OF ELEVATOR**

FORMAT NO: HSEP:13-F13

REV NO.: 00

PAGE NO. 01 OF 01

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Sr. No.	Description	Remarks
1.0	Name of equipment	
2.0	Basic Information of equipment	
2.1	Specification	
2.2	Sr. No. of equipment	
2.3	Make	
2.4	Year of manufacture	
3.0	Major repairs/overhauls(Furnish details of work carried out)	Date(s) of major repair/overhaul
3.1		
3.2		
3.3	Repairs carried out at site	
4.0	Any performance test conducted	Yes/No
5.0	Document Submitted	Yes/No
6.0	Manufacturer's test / guarantee certificate	Available/ Not available
7.0	Performance test	Done/ Not Done
8.0	Acceptance Norms	
9.0	Committee Observations	
10.0	Date of next review (if accepted)	

Signature-Subcontractor/ Subcontractor's
Safety Officer

Signature-Site Safety Officer (BHEL)

**POWER SECTOR****HSE PENALTY**

FORMAT NO: HSEP:13-F14

REV NO.: 00

PAGE NO. 01 OF 02

Sub: MEMO for Penalty for non compliances in Safety

Following lapse (tick marked) was observed and penalty is imposed as stated at the bottom of this memo. It is requested that such occurrences be please avoided in future.

Safety Area

SN	Violation of Safety Norms	Fine (in Rs)
01	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03	Not wearing safety shoe	200/-*
04	Not keeping gas cylinders vertically	200/-
05	Not using flash back arrestors	100/-
06	Not wearing gloves	50/- *
07.	Grinding Without Goggles	50/- *
08.	Not using 24 V Supply For Internal Work	500/-
09.	Electrical Plugs Not used for hand Machine	100/-
10.	Not Slings properly	200/-
11.	Using Damaged Sling	200/-
12.	Lifting Cylinders Without Cage	500/-
13.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
14.	Not Removing Small Scrap From Platforms	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
16.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
17.	Improper Earthing Of Electrical T&P	500/-
18.	No or improper barricading	500/-
19.	Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case)	1000/-
20.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

Legend:-

*: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

**POWER SECTOR****HSE PENALTY**

FORMAT NO: HSEP:13-F14

REV NO.: 00

PAGE NO. 02 OF 02

Details (if any) related to non- compliance (Name of persons, Nature of deficiency, etc.)

Penalty imposed:

1, Rate as per above chart _____

2. No. of Persons/ machine/ event/ labour _____

3. Total Penalty= 1. X 2. = _____

Signature :

Witnessed by: (Sub- Contractor representative) (BHEL Personnel)

Name _____

Name _____

Distribution: 1 Copy: to Sub- contractor,

1 Copy to Site Construction Manager(BHEL)

	POWER SECTOR- HQ	FORMAT NO: HSEP:13-F15 REV NO.: 00 PAGE NO. 01 OF 01
	Incident Report (To be submitted within 24 hours of time of incident)	

Type of incident: Fatal/Major/ Minor/Fire/Property Damage/Near-miss

1	NAME OF SITE		3	ACTIVITY AREA	
2	SCOPE OF WORK		4	NAME OF CONTRACTOR	
			5	NAME & DESIGNATION OF BHEL ACTIVITY I/C	
6	DATE & TIME OF ACCIDENT		7	DATE RESUMED	
8	NO. OF WORK-DAYS LOST BY VICTIM (If duty not resumed, give estimated figure)				
9	NO. OF MANHOURS LOST BY OTHERS				
10	PERSONAL DETAILS OF INJURED AND / OR DETAILS OF MATERIALS / EQUIPMENT / PROPERTY DAMAGED				
NAME			NAME OF MATERIAL / EQUIPMENT / PROPERTY		
PERIOD OF EMPLOYMENT					
AGE	YRS	SEX	MALE/ FEMALE	ESTIMATED COST	ACTUAL COST
MARITAL STATUS		SINGLE / MARRIED			
OCCUPATION		NATURE OF DAMAGE			
PART OF BODY INJURED					
NATURE OF INJURY					
AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) MOST RESPONSIBLE FOR CAUSING ACCIDENT / INJURY / DAMAGE					
12	PERSON (NAME & DESIGNATION) WITH MOST CONTROL OVER AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) CAUSING ACCIDENT INJURY / DAMAGE				
13	DESCRIBE CLEARLY HOW THE ACCIDENT OCCURRED (USE ADDITIONAL SHEET, IF REQUIRED)				
ANALYSIS					
14	WHAT ACTS AND / OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS ACCIDENT				
15	WHAT ARE THE BASIC REASON FOR THE EXISTENCE OF THESE ACTS AND / OR CONDITION ?				
16	WHAT CORRECTIVE ACTIONS HAVE BEEN TAKEN TO PREVENT ACCIDENT RECURRENCE ?				
	DATE :		SIGNATURE OF SITE HSE COORDINATOR		
17	COMMENTS OF HEAD / SOX				
	DATE:		SIGNATURE OF HEAD/SOX		



SAFETY WORK CLEARANCE

Permit no. _____

Project: _____

Emergency Contact Nos: _____

Subcontractor: _____

BURNING/WELDING /HOT WORK PERMIT

Area : _____ Date: _____ Time: _____

Name of Site Engineer (Permit Requesting Authority): _____ Sign: _____

Name of Work Performing Contractor: _____

Name of Package In charge: _____ Sign: _____ Date: _____

Description of Work: _____

Work Execution Date: _____ Time Valid from: _____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Proper Access/Exit available		
2.	Proper ventilation and /or lighting provided.		
3.	Proper and safe scaffolding, platform, ladder provided.		
4.	Welding machine located in a clean and dry area.		
5.	Welding machine grounded at the equipment and proper leakage current protection device (ELCB) provided for welding machine.		
6.	Emergency STOP buttons are in working condition. Welder /Helper knows how to operate it.		
7.	Welding machine input/output cables, welding holder and weld return clamp (Holder) are insulated and in good condition.		
8.	Welder & Fitter trained to connect ground/work return clamps (Holder) to work place prior to energization of welding machine.		
9.	Gas cylinders are stacked vertically and not below the welding / cutting area. Regulator key is available with cylinder.		
10.	Pressure gauges/Flash back arrestor provided and in working condition.		
11.	Personal Protective equipment Minimum applicable: safety helmet, safety goggles, welding helmet, safety shoes, leather gloves, long sleeve and nose mask -provided		
12.	In case of pits, water removed from the pit and wood/rubber insulation provided.		
13.	Safety signboards are in place.		
14.	Adequate and Suitable nos. of fire fighting extinguisher provided.		
15.	Nearby combustible material removed. Housekeeping done.		
16.	Other		

Name of Contractor Safety Officer: _____ Sign: _____ Date: _____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name: _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Safety Representative: _____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority: _____ **Sign:** _____ **Date:** _____ **Time:** _____**Permit Cancellation:**

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority: _____ Sign: _____ Date: _____ Time: _____

Name of Site Engr. (Permit Requesting Authority): _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Site Engr. (Permit Issuing Authority): _____ Sign: _____ Date: _____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site

Second Copy – BHEL SAFETY

Third Copy : Contractor



SAFETY WORK CLEARANCE

Permit no. _____

Project: _____

Emergency Contact Nos: _____

Subcontractor: _____

LIFTING ACTIVITY PERMIT

Area : _____ Date: _____ Time: _____

Name of Site Engineer (Permit Requesting Authority): _____ Sign: _____

Name of Work Performing Contractor: _____

Name of Package In charge: _____ Sign: _____ Date: _____

Description of Work: _____

Work Execution Date: _____ Time Valid from: _____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Crane used for lifting activity tested, certified and approved for rated lifting		
2.	All lifting tackles, gears/appliances are tested and certified for lifting works.		
3.	Crane operator is trained and competent for lifting operation.		
4.	Lifting sling/ belt is protected against sharp edge of the jobs to be lifted.		
5.	Access and exit marked and without obstruction.		
6.	Lifting arrangement adequate.		
7.	Unwanted rubbish material removed from work platform.		
8.	Minimum 2 guidelines have been provided for balancing and guiding jobs to be lifted.		
9.	Periphery area of crane booms as well as lifting job is barricaded and unauthorised/no-entry sign board posted.		
10.	Rigger and signal man is trained and competent for lifting work.		
11.	No lifting activity to be carried out during lightening, heavy wind/rain.		
12.	If scaffolding to be used during lift, scaffolding with valid tag available for use.		
13.	Double lanyards safety harness/belt checked and in working condition.		
14.	Safety shoes (non-slip), helmet with chin strap available with employees.		
15.	Others.		

Name of Contractor Safety Officer: _____ Sign: _____ Date: _____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name: _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Safety Representative: _____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority: _____ **Sign:** _____ **Date:** _____ **Time:** _____**Permit Cancellation:**

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority: _____ Sign: _____ Date: _____ Time: _____

Name of Site Engr. (Permit Requesting Authority): _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Site Engr. (Permit Issuing Authority): _____ Sign: _____ Date: _____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site**Second Copy – BHEL SAFETY****Third Copy : Contractor**



SAFETY WORK CLEARANCE

Permit no. _____

Project: _____

Emergency Contact Nos: _____

Subcontractor: _____

WORKING AT HEIGHT PERMIT

Area : _____ Date: _____ Time: _____

Name of Site Engineer (Permit Requesting Authority): _____ Sign: _____

Name of Work Performing Contractor: _____

Name of Package In charge: _____ Sign: _____ Date: _____

Description of Work: _____

Work Execution Date: _____ Time Valid from: _____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	All workers on job are medically fit for working at height (Person should not have vertigo)		
2.	Scaffolding with valid tag available for use		
3.	Safety harness with life line support/ fall arrester are checked and in working condition		
4.	Safety shoes (non-slip), Helmet with chin strip available with employees		
5.	Safety nets are provided as per design and provided 25 ft. below working area & extending 8 ft beyond.		
6.	Horizontal life lines are provided to cater to design specification of 2300kg per person.		
7.	Ladders have been inspected and provided as per BHEL standard/contract.		
8.	All lifting / tightening tools, hand tools/equipment checked and in good condition		
9.	Access and exit marked and without obstruction.		
10.	Lighting arrangement adequate.		
11.	Unwanted and rubbish material removed from working platform.		
12.	Electrical cable, welding Hose/Compressed air hose properly secured and lay down without obstruction.		
13.	Signboards provided on working platforms		
14.	Hazards in the vicinity are identified and communicated to the worker.		
15.	Other		

Name of Contractor Safety Officer: _____ Sign: _____ Date: _____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name: _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Safety Representative: _____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority: _____ **Sign:** _____ **Date:** _____ **Time:** _____**Permit Cancellation:**

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority: _____ Sign: _____ Date: _____ Time: _____

Name of Site Engr. (Permit Requesting Authority): _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Site Engr. (Permit Issuing Authority): _____ Sign: _____ Date: _____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site**Second Copy – BHEL SAFETY****Third Copy : Contractor**

		Manufacturer Name & Address:	MANUFACTURING QUALITY PLAN											
			ITEM:			QP NO: REV. NO: DATE: Page 1 of 2		PROJECT: PACKAGE: MAIN SUPPLIER: BHEL, BAP RANIPET						
S.NO	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS		AGENCY			REMARKS
					M	C/B				D	M	C	B	
1	2	3	4	5	6		7	8	9	D*	** 10			11

I.0	RAW MATERIAL													
1.1			MAJOR						TC	√	P	V	-	
2.0	BOUGHT OUT ITEMS													
	MOTOR	TYPE & ROUTINE TEST	MAJOR	PERFORMANCE PARAMETER	100%	100%	PRQA:550/LATEST (AS PER BHEL STANDARD PROCEDURE)		REPORT	√	P	V	-	
3.0	INPROCESS INSPECTION													
				MT/PT	100%	100%	ASME SEC V	ASME SEC V	REPORT	√	P	W	-	
				MEASURE MENT	100%	100%	DRAWING	DRAWING	DR	√	P	W	V	
5.0	FINAL INSPECTION													
5.1	IDENTIFICATION, PAINTING & PRESERVATION	COMPLIANCE TO COMPANY STANDARD	MINOR	VISUAL	100%	100%	AS PER APPD PAINTING SCHEDULE	AS PER APPD PAINTING SCHEDULE		√	P			

		LEGEND: * RECORDS, INDENTIFIED WITH “TICK” (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER, B: BIFPCL P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: BIFPCL SHALL IDENTIFY IN COLUM “B” AS ‘ W’		DOC.NO.:	REV.....	CAT.....	
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER		FOR BIFPCL USE				
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL	

		Manufacturer Name & Address:		MANUFACTURING QUALITY PLAN										
				ITEM:			QP NO: REV. NO: DATE: Page 2 of 2		PROJECT: PACKAGE: MAIN SUPPLIER: BHEL, BAP RANIPET					
S.NO	COMPONENTS & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS		AGENCY			REMARKS
					M	C/B			D				M	
1	2	3	4	5	6		7	8	9	D*	**	10	11	

RECORD OF REVISION		
REV NO	DATE	DESCRIPTION
NOTES: 1. Latest revision of standards & specifications shall apply. Only International Standards are applicable. Indian & Chinese Standards are not applicable. 2. Materials shall be procured in compliance to Functional Technical Specification. 3. Inspection shall be in compliance with approved Quality Control Procedure for the product. 4. NDT shall be carried out by Qualified Personnel with compliance to approved NDT Procedures and Acceptance Norms, as per ASME Section V. 5. Gauges and measuring Instruments, with valid calibration only shall be used 6. Cleaning and Painting of products shall be carried out as per Approved Painting Schedule. 7. Finished Products shall be packed to comply with approved Packing Schedule.		

		LEGEND: * RECORDS, IDENTIFIED WITH “TICK” (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER, B: BIFPCL P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: BIFPCL SHALL IDENTIFY IN COLUM “B” AS ‘W’		DOC.NO.: REV..... CAT.....		
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER		FOR BIFPCL USE			
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL

Sl.No	BHEL / Customer Requirement	##Specific confirmations by the manufacture
1	Quality Plan Requirement:	
	(i) MQP (Manufacturing Quality Plan) shall be submitted in attached format for BHEL/Customer review & approval. Typical MQP is attached for indicative purposes for guidance & use.	
	(ii) MQP shall invariably cover w.r.t Inward inspection including on Raw material Procurement, In process and Final inspection in elaborated way/details.	
	(iii) Bidder shall also to give specific confirmation that on need basis, their competent officials shall visit to BHEL/customer for finalization of Quality plan including test procedure/methodology during preaward / post award approval / detailed engineering in the event of an order.	
	(iv) No deviation on BHEL/Customer approved MQP is acceptable.	
	(v) Bidder shall agree to submit all cross referred documents other than codes/standards to BHEL/Customer/Consultant.	
	Important Notes shall be included in MQP : (a) Latest revision of Standards & Specification shall apply. Only International Standards are applicable. Indian & Chinese Standards are not applicable (b) Materials shall be procured in compliance to Functional Technical Specification. (c) Inspection shall be in compliance with Approved Quality Control Procedure for the Product. (d) NDT shall be carried out by Qualified Personnel with compliance to Approved NDT Procedures and Acceptance Norms, as per ASME Section V. (e) Gauges and measuring Instruments, with valid calibration only shall be used. (f) Cleaning and Painting of products shall be carried out as per Approved Painting Schedule. (g) Finished Products shall be packed to comply with Approved Packing Schedule. (h) Welding shall be carried out by Qualified Personnel with compliance to Approved NDT Procedures and Acceptance Norms, as per ASME Section V.	
2	Domestic / Inland Inspection will be carried out by BHEL/BHEL appointed Third Party Inspection Agency (TPIA) / Customer/Customer Appointed Inspection Agency/Consultant. This is applicable for all Stage inspection and Final Inspection identified as "W" - Witness or "CHP" - Customer Hold Point as per customer approved Quality Plan/ Technical specification / Approved Drawing/ Approved Data sheet / Scheme / PID / PFD / SLD (Process Instrumentation Diagram / Process Flow Diagram / Single Line Diagram) etc (As applicable).	
3	Inspection Agency for Foreign Bidders and also for Indian Bidder but importing from Foreign Sources: (1) Any one of the following Third Party Inspection Agency (TPIA) shall be appointed by the bidder and same shall be furnished by the bidder in techno commercial bid itself. (2) The details of TPIA with contact details like Name of the official, Phone no, Email id shall also to be submitted during pre/post award. However cost for such inspection agency shall be borne by the bidder only. Inspection charges for such inspection agency shall be indicated separately so that if BHEL/Customer is undertaking the inspection by on their own, then these charges non claimable by the bidder. List of TPIA 1.M/s Bureau Veritas 2.M/s TUV-Nord 3.M/s TUV-SUD 4.M/s TUV Rheinland 5.M/s Lloyds Register 6.M/s SGS 7.M/s Germanischer Lloyd 8.M/s QUEST 9.M/s Certification Engineers International 10.M/s Intertek 11.M/s IR Class Systems and Solutions 12.M/s DNV 13. M/s Fichtner 14. M/s ABS Inspection Services	

Sl.No	BHEL / Customer Requirement	##Specific confirmations by the manufacture
4	Stage Inspection during manufacturing Process : Stage Inspection during manufacturing shall be carried out as per approved quality plan and all necessary documents shall be provided for review, verification and clearance for further processing. This inspection call shall be given well in advance (atleast 2 weeks before) to TPI/Bidder's own inspection agency to avoid delay in the manufacturing processes.	
5	Inspection before despatch for domestic supplier : Inspection before despatch at supplier's works shall be carried out by BHEL/BHEL appointed Inspection agency. Inspection shall be done as per approved Quality plan/ Technical specification/ Approved Drawing/ Approved Data sheet .	
6	Inspection at Foreign Source/Supplier: (a) As in sl no: 3. shall be ensured without fail (b) No materail / items shall be despatched without getting the written communication from BHEL / Customer inspection carried out by BHEL/BHEL apointed Third Party Inspection Agency (TPIA) / Customer/Customer Apointed Inspection Agency/Consulatnat. This is applicable for all Stage inspection and Final Inspection identified as "W" - Witness or "CHP" - Customer Hold Point as per customer approved Quality Plan/ Technical specification / Approved Drawing/ Approved Data sheet / Scheme / PID / PFD / SLD (Process Instrumentaion Diagram / Process Flow Diagram / Single Line Diagram) etc (As applicable). Inspection before despatch for Foreign supplier : Inspection before despatch at supplier's works shall be carried out by bidder appointed inspection agencies having international presence at vendors and or vendor's sub vendor works. Inspection shall be done as per approved Quality plan/ Technical specification/ Approved Drawing/ Approved Data sheet by TPIA mentioned in Sl no: 03 at supplier's cost.	
7	Painting shall be done strictly as per BHEL/Customer approved painting schedule / scheme only. Paint Thickness / Paint shade shall be ensured as per BHEL / Customer approved painting schedule / specification / data sheet etc. No deviation is acceptable unless otherwise accepted by BHEL/Customer in writing. Any conflict if any among BHEL / Customer approved painting schedule / Spec / data sheet etc shall be brought to the notice to BHEL well in adavnce before proceding including the BOI being procured for assy / skid like motors etc	
8	Specific conformation for document package in the event of an order (2 Hard copies & soft copy in PDF file) is to be given containing the following with proper linkages (i) Index Sheet (ii) MQP/RQP/Endorsement Sheet (As applicable) (iii) TCs identified by BHEL/ Customer for record for "CHP" / "W" and Verification portion ("V") as given in approved QP. (iv) Final inspection report + TC including Chemical + Mechnaical + HT + NDT etc (v) Third party Inspection report + TC (vi) Customer CHP/ MDCC (vii) Type test / Performance Test reports conducted (viii) Type test / Performance Test approval/ clearance obtained from BHEL/Customer (ix) BOM with As Build Drgs with actual make / rating used with BHEL/customer approved drawings.	
9	Packing / Seaworthy Packing shall be as per BHEL Packing schedule / approved drg / sketch. This shall be ensured to take care tarnsit / handling / transhipment in Road / Sea / Air. Photographs are to be submitted for BHEL review before despatching the material as per contract conditions.	
10	Outsourcing of test facilities: Bidder shall ensure all the testing facilities in house. However If any of the test facilities are not available with successful bidder, then bidder shall ensure the same at NABL accreadted third party lab / Govt / Govt Lab for major testing such as NDT, Electrical & Mechanical testing.	
11	Important Note: No deviation on the above requirement 01 to 10 is acceptable w.r.t Quality Requirement and those offers not meeting these specific customer requirement is liable for rejection and hence the bidder shall submit all the required documentary evidances in the offer itself.	
12	## Necessorily to be filled up by the bidder at the time of offer itself otherwise the offer may not be considered w.r.t Quality Requirement being customer specific requirement.	