



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 1 of 15

ANNEXURE VIII

SITE STORAGE AND PRESERVATION



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 2 of 15

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

**TITLE****4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT****SPECIFICATION NO.**

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 3 of 15

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, lose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION**a) GENERAL STORAGE REQUIREMENTS**

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks.

**TITLE****4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT****SPECIFICATION NO.**

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 4 of 15

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

**TITLE****4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT****SPECIFICATION NO.**

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 5 of 15

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.

11. Following preservatives/preservation methods can be used depending upon type of equipment

- a. Rust preventive fluid (RPF)
- b. Rust protective paints
- c. Tarpaulin covers, in case of outdoor storage
- d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

- Ingress of moisture and corrosion damages.
- Damage to protective coating.
- Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.

- In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
- Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 6 of 15

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i Closed storage with dry and dust free atmosphere. (C)

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii Semi-closed storage. (S)

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 7 of 15



iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as "scrap yard" slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.





TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 8 of 15

The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage .	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 9 of 15

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 10 of 15

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 11 of 15

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 12 of 15

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 13 of 15

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 14 of 15

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 15 of 15

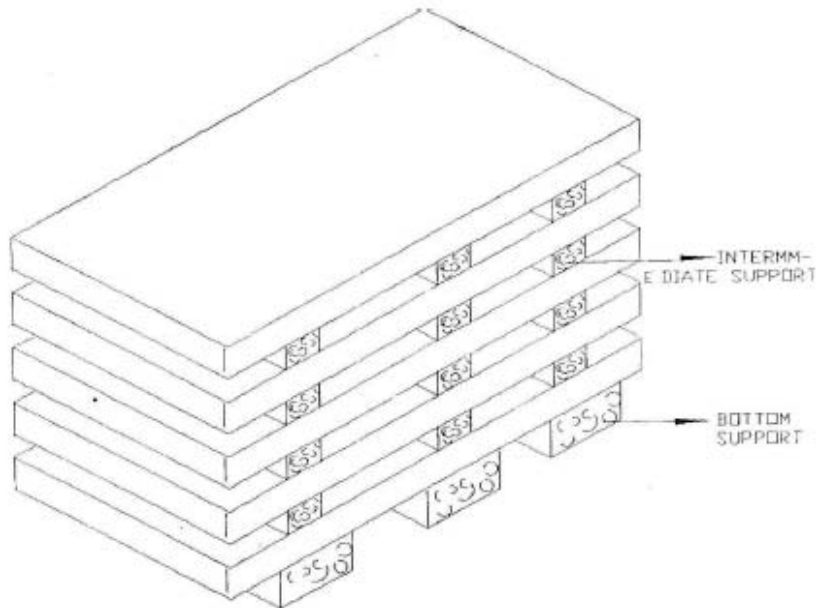


Figure – 1 – PLATE STACKING ARRANGEMENT

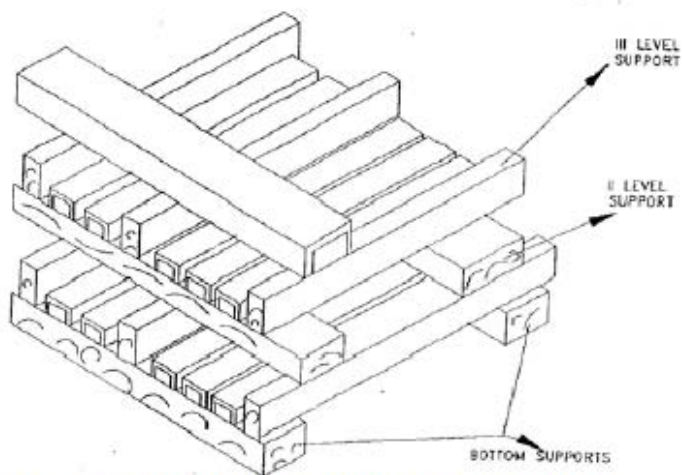


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 1 of 2

ANNEXURE IX

INPUT DRAWINGS



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 2 of 2

SL. NO.	DRAWING TITLE	DRAWING NO.
1.	P & ID OF STP	PE-DG-411-673A-A001
2.	PLOT PLAN	PE-DG-411-100-M001

MANUAL VALVE LEGEND-

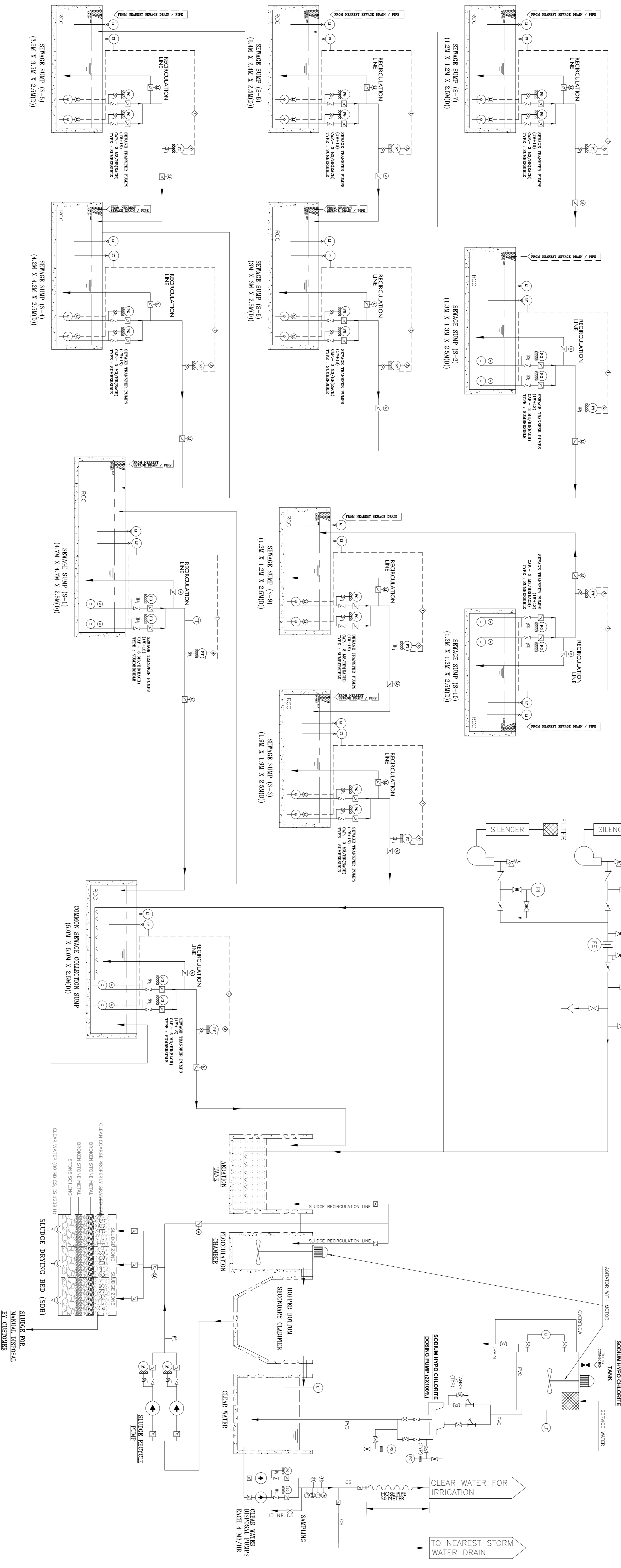
- ↔ - NON RETURN VALVE
- ⊞ - BUTTERFLY VALVE
- ⊞ - 3 WAY GAUGE COCK
- ⊞ - BALL VALVE
- ⊞ - DIAPHRAGM SEAL

INSTRUMENT LEGEND-

- ⊞ - FIELD INSTRUMENT
- ⊞ - PRESSURE GAUGE
- ⊞ - INTERLOCK
- ⊞ - ALARM
- ⊞ - LEVEL INDICATOR
- ⊞ - FLOW TRANSMITTER
- ⊞ - SUBVERSIBLE PUMP
- ⊞ - LEVEL TRANSMITTER
- ⊞ - MOTOR OPERATED

LEGEND

- ⊞ - GATE VALVE
- ⊞ - NON RETURN VALVE
- ⊞ - CENTRIFUGAL PUMP
- ⊞ - METERING PUMP
- ⊞ - STIRRER
- ⊞ - LEVEL SWITCH
- ⊞ - LEVEL GAUGE
- ⊞ - PRESSURE GAUGE
- ⊞ - DIFFUSER
- ⊞ - CARBON STEEL
- ⊞ - POLYVINYL CHLORIDE



- NOTES:**
1. AIR BLOWER SHALL BE IN ACOUSTIC ENCLOSURE.
 2. INSTRUMENTATION, VALVES, PIPING SHOWN IN P & ID ARE BARE MINIMUM REQUIREMENT. BIDDER HAS TO PROPOSE COMPLETE P & ID WITH ALL NECESSARY INSTRUMENTATION, PIPING AND VALVES FOR SAFE AND TROUBLE FREE OPERATION.
 3. ALL THE EQUIPMENTS SHOWN IN THIS DRAWING ARE IN BIDDER'S SCOPE AS WELL AS ANY OTHER EQUIPMENT WHICH IS NOT SHOWN IN P & ID AND APPLICABLE AS PER SYSTEM REQUIREMENT SHALL BE SUPPLIED BY BIDDER WITHOUT ANY PRICE DELIVERY IMPLICATION.
 4. ALL THE PIPING SHOWN IN THIS DRAWING ARE IN BIDDER'S SCOPE.
 5. DIMENSIONS SHOWN FOR SUMPS ARE EFFECTIVE HOWEVER DEPTH OF SUMPS MAY Varies UP TO 3.5M.

JOB NO. 411		CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LIMITED.	
STATUS: CONTRACT		PROJECT: 4X270 MW BHADRADERI TPS	
DISTRIBUTION		BHARATI HEAVY ELECTRICALS LTD	
TO		DEPT	DN
NO. OF		DESIGN	DN
REV		DATE	DN
DATE		APPD	DN
ALT		NO	DN
CHD		DATE	DN
APPD		NO	DN
TITLE: P & ID FOR SEWAGE TREATMENT PLANT			
DEPT	SCALE	DRAWING NO.	
NO		PE-DG-411-673A-A001	
DATE		SHEET 1	OF 1
		REV	0

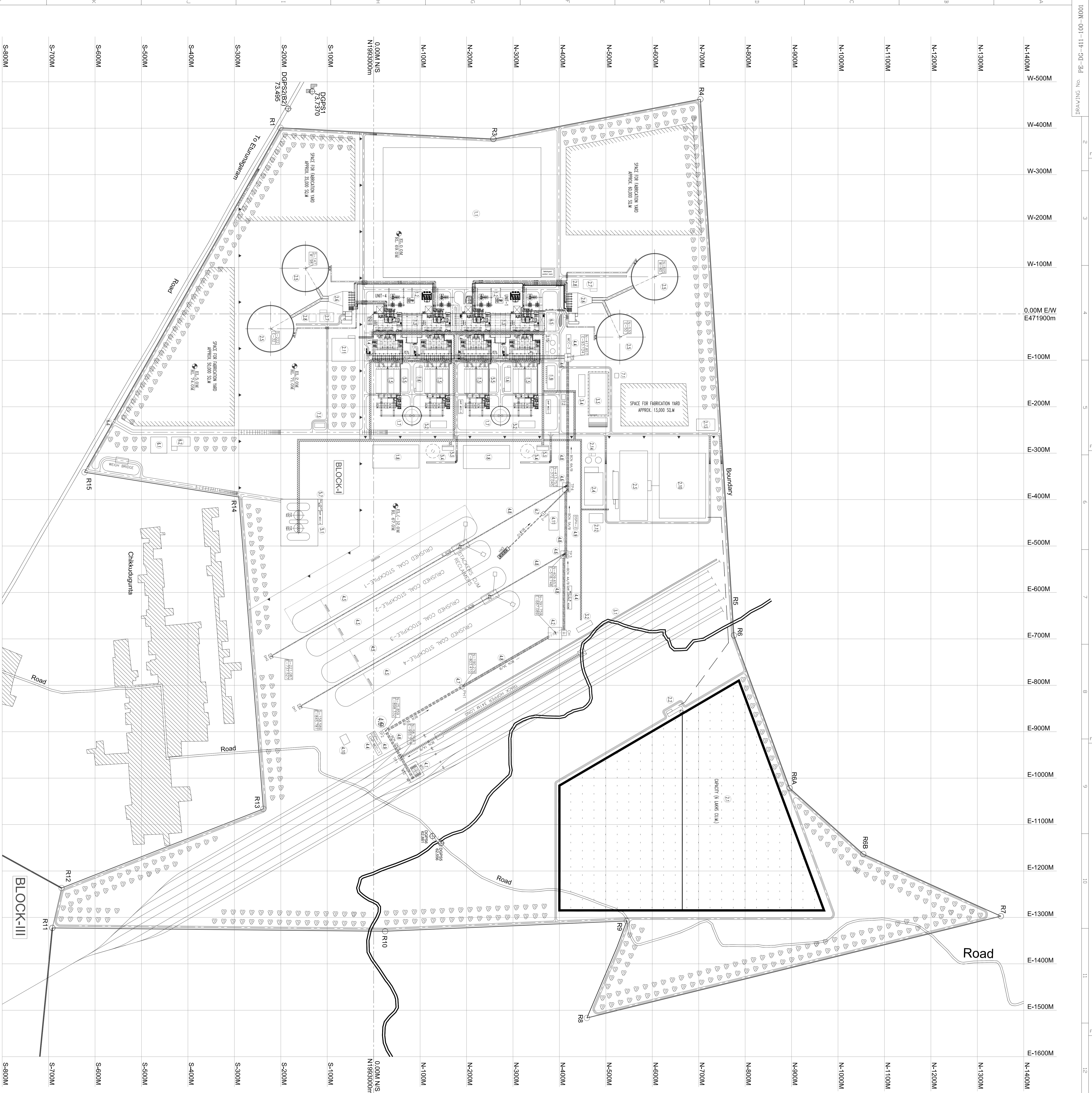
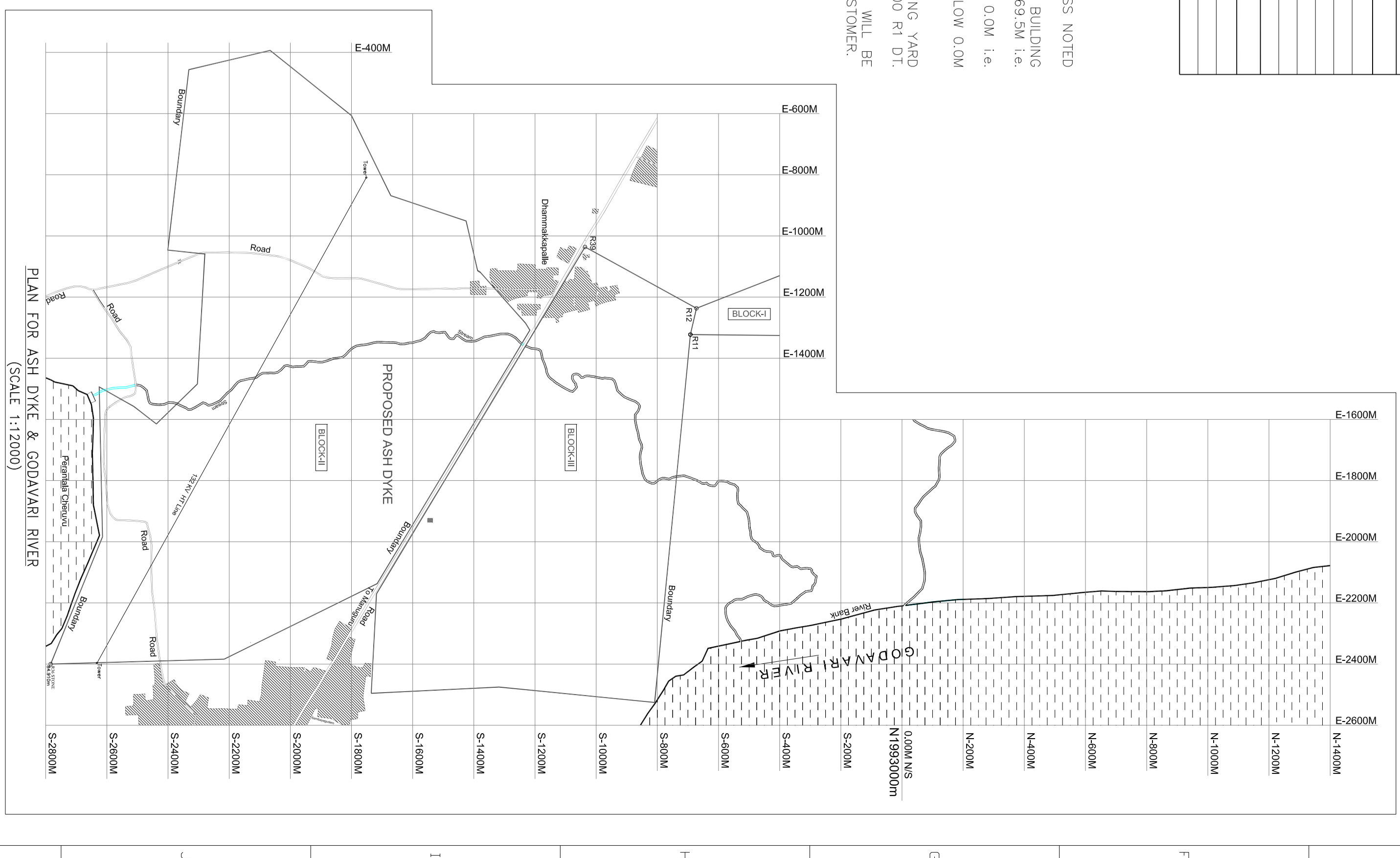


TABLE	
Sl. No.	DESCRIPTION OF FACILITIES
1.0 MAIN PLANT AREA	
1.1	SMITH HOUSE
1.2	TRANSFERER YARD
1.3	TURBINE BUILDING
1.4	EQUR
1.5	ESP CONTROL ROOM
1.6	ESP CONTROL ROOM
1.7	COMPACT
1.8	SPACE FOR FGD
1.9	8.5% COMPRESSOR HOUSE
1.10	8.5% COMPRESSOR HOUSE
2.0 WATER SYSTEM	
2.1	RAW WATER PUMP HOUSE
2.2	RAW WATER PUMP HOUSE
2.3	PFI PLANT
2.4	CM PLANT
2.5	CM PLANT
2.6	CM PLANT
2.7	CM PLANT
2.8	CM PLANT
2.9	CM PLANT
2.10	CM PLANT
2.11	CM PLANT
2.12	CM PLANT
2.13	CM PLANT
2.14	CM PLANT
2.15	CM PLANT
2.16	CM PLANT
2.17	CM PLANT
2.18	CM PLANT
2.19	CM PLANT
2.20	CM PLANT
2.21	CM PLANT
2.22	CM PLANT
2.23	CM PLANT
2.24	CM PLANT
2.25	CM PLANT
2.26	CM PLANT
2.27	CM PLANT
2.28	CM PLANT
2.29	CM PLANT
2.30	CM PLANT
2.31	CM PLANT
2.32	CM PLANT
2.33	CM PLANT
2.34	CM PLANT
2.35	CM PLANT
2.36	CM PLANT
2.37	CM PLANT
2.38	CM PLANT
2.39	CM PLANT
2.40	CM PLANT
2.41	CM PLANT
2.42	CM PLANT
2.43	CM PLANT
2.44	CM PLANT
2.45	CM PLANT
2.46	CM PLANT
2.47	CM PLANT
2.48	CM PLANT
2.49	CM PLANT
2.50	CM PLANT
2.51	CM PLANT
2.52	CM PLANT
2.53	CM PLANT
2.54	CM PLANT
2.55	CM PLANT
2.56	CM PLANT
2.57	CM PLANT
2.58	CM PLANT
2.59	CM PLANT
2.60	CM PLANT
2.61	CM PLANT
2.62	CM PLANT
2.63	CM PLANT
2.64	CM PLANT
2.65	CM PLANT
2.66	CM PLANT
2.67	CM PLANT
2.68	CM PLANT
2.69	CM PLANT
2.70	CM PLANT
2.71	CM PLANT
2.72	CM PLANT
2.73	CM PLANT
2.74	CM PLANT
2.75	CM PLANT
2.76	CM PLANT
2.77	CM PLANT
2.78	CM PLANT
2.79	CM PLANT
2.80	CM PLANT
2.81	CM PLANT
2.82	CM PLANT
2.83	CM PLANT
2.84	CM PLANT
2.85	CM PLANT
2.86	CM PLANT
2.87	CM PLANT
2.88	CM PLANT
2.89	CM PLANT
2.90	CM PLANT
2.91	CM PLANT
2.92	CM PLANT
2.93	CM PLANT
2.94	CM PLANT
2.95	CM PLANT
2.96	CM PLANT
2.97	CM PLANT
2.98	CM PLANT
2.99	CM PLANT
2.100	CM PLANT

- NOTES:-**
1. ALL DIMENSIONS AND CO-ORDINATES ARE IN METERS UNLESS NOTED OTHERWISE.
 2. OTHER FINISHED FLOOR LEVEL (FFL) OF POWER HOUSE BUILDING GROUND FLOOR IS EL. 0.00M WHICH CORRESPONDS TO RL 69.5M i.e. 0.5M ABOVE FFL.
 3. 200MM FINISHED GRADED LEVEL IS 200MM BELOW 0.0M I.e. RL. 69.3M.
 4. TRANSFORMER YARD FINISHED GRADED LEVEL IS 100MM BELOW 0.0M.
 5. THE PIPE BACK SHOW IS INDICATING ONLY IN TRANSFORMER YARD ASH DYE LICATION FOR BLOCKS I & II.
 6. ASH DYE LICATION FOR BLOCKS I & II IS INDICATED IN THE PLAN FOR 31.12.14 ROAD. VIDE MAIL DTD. 09.01.15.
 7. THE PLAN IS SUBJECT TO ANY CHANGES AS PER THE SUBSEQUENT MAIL DRESS FROM CUSTOMER.

- LEGENDS:-**
- AREA BOUNDARY
 - ROAD
 - RIVER STREAM
 - DGPS POINT WITH UML LEVEL
 - VILLAGE
 - PIPE/CABLE BACK
 - GREEN BELT



PROGRESSIVE COPY
 18.04.2015

TELANGANA STATE POWER GENERATION CO. LTD.

4X270 MW BHADRADRI TPS

PLOT PLAN

Customer: BHARAT HEAVY ELECTRICALS LTD
Product: POWER SECTOR MANAGEMENT
Project: NEW BELHI

Job No.: 411
Status: CONTRACT

Scale: SCALE: 1:2000

Sheet: 1 OF 1

Author: [Name]
Checked: [Name]
Approved: [Name]



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 1 of 1

SECTION – D

STANDARD TECHNICAL REQUIREMENTS

SECTION – D1: STANDARD TECHNICAL REQUIREMENTS FOR MECHANICAL

SECTION – D2: STANDARD TECHNICAL REQUIREMENTS FOR ELECTRICAL

SECTION – D3: STANDARD TECHNICAL REQUIREMENTS FOR CONTROL AND

INSTRUMENTATION



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO. PE-TS-411-164A-A001

VOLUME: II B

REV 00

SHEET 1 of 3

SECTION – D1

STANDARD TECHNICAL SPECIFICATIONS (MECHANICAL)

**TITLE****4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO. PE-TS-411-164A-A001

VOLUME: II B

REV 00

SHEET 2 of 3

1. GENERAL DESCRIPTION

The function of the Sewage Treatment Plant is to collect all sanitary sewage originating in the plant, perform treatment and transfer the treated water horticulture / irrigation. Sewage treatment in general carried out to reduce the solid contents of the sewage, and change the character of the sewage so that it can be reused.

Sanitary wastes are collected from the buildings that contain sanitary facilities by gravity. Sanitary lift stations shall be used to forward the waste to an onsite sewage treatment plant. Solid wastes shall be hauled offsite.

2. SEWAGE GENERATION AND CHARACTERISTICS

The Sewage Treatment Plant is designed for the following sewage flow rate and characteristics are as follows:

Persons Envisaged	:	1200
Flow Rate	:	60 M ³ /day (Max).
BOD ₅	:	300 mg/l.
COD	:	600 mg/l.
TSS	:	450 mg/l.
pH	:	7 – 8.
Temperature	:	Ambient.

The treated sewage water shall be used for gardening purpose. The treated sewage will conform to the following quality standards:

BOD ₅	:	20 mg/l
COD	:	100 mg/l
TSS	:	30 mg/l
pH	:	7 – 8
Temperature	:	Ambient

Notes:

The treated sewage quality standards shall be achieved at average sewage flow rates as well as peak sewage flow rates.

3. TECHNICAL SPECIFICATION**3.1 PROCESS DESCRIPTION**

The treatment scheme shall be aerobic biological extended aeration treatment. Aerobic biological sludge generated shall be thickened in the Hopper Bottom Clarifier and aerobically digested/dried in a Sludge Drying Bed. The dry sludge shall be disposed manually by Customer. The P & id is enclosed for reference.

The treatment scheme shall have following parts:

- **Pre-Treatment**, which consists of raw sewage collection and pumping.
- **Biological Treatment**, comprising of aeration followed by clarification and chlorination.
- **Sludge Digestion/ Disposal** comprising of aeration of excess biological sludge, and sludge disposal through Sludge Drying Beds.

**TITLE****4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO. PE-TS-411-164A-A001

VOLUME: II B

REV 00

SHEET 3 of 3

Detailed description of each treatment step is given below:

The various raw sewages shall be collected by gravity at local sewage lifting stations at different areas and the same to be pumped by using 2 Nos (1W+1S) Sewage Lifting Pumps to an underground Centralized Sewage Collection Pit located at sewage treatment plant area. Collected raw sewage shall be pumped from the Centralized Sewage Collection Pit using 2 Nos (1W+1S) Sewage Lifting Pumps to the Aeration Tank. The Sewage Lifting Pumps shall be of submersible and heavy duty grinding type which shall cut and grind solids present in raw sewage into small fragments. The Sewage Lifting Pumps shall automatically interchange every 8 hours and shall automatically START at high level in the Sewage Collection Pit and STOP at low level. The Centralized Sewage Collection Pit shall also be provided with a coarse air bubble diffuser and an air line tapping from the Air Blower delivery header so as to allow continuous aeration in order to protect the Package STP site against unpleasant odours. Sludge recirculation line from Thickened Sludge Transfer pumps discharge header to Flocculation Chamber shall be provided to improve clarifier operation.

The Package Sewage Treatment Plant shall consist of an Aeration Tank, a Hopper Bottom Clarifier, Sludge drying bed and a Treated Sewage Sump (Clean Water Tank). Aerobic biological treatment shall be carried out in the various compartments of the sewage treatment.

2 Nos (1W+1S) Air Blowers common for Centralized Sewage Collection Pit and Aeration Tank shall be provided to supply air through an underwater piping grid and fine air bubble membrane diffusers. Timers shall be provided in the Electric Panel such that the Air Blower in operation will automatically interchange every 8 hours.

Sodium hypochlorite solution dosing shall be carried out into the Treated Sewage Sump to control the BOD.

The stabilized sludge shall be free of offensive odours. The aerobically digested sludge shall be wasted as required using an air lift pump arrangement to sludge Drying Bed to dry the sludge.

3.2 GENERAL REQUIREMENTS

- All interconnecting piping/ fittings/ valves/ cabling shall be provided as required.
- All interconnecting piping/ fittings/ valves in direct contact with sewage shall be of Carbon Steel (IS 1239 Heavy Grade).
- NaOCl dosing pipes shall be of PVC (sch 20).
- The pipes carrying air shall be of Carbon Steel (IS 1239 Heavy Grade).
- Internal painting of the package plant shall be suitable for withstanding effect of sewage and mixed liquid suspended solids.

3.3 Control Philosophy

The plant operation shall be carried out from the PLC based local system.

PLC shall be located in the STP area.

All pumps shall be fitted with check valves and shut-off valves on the discharge side. All pump shall be tripped automatically in case of low level in the pits and shall be start automatically when level reaches at desired level.

Timer shall be provided in the Control Panel such that the sewage lifting pumps at Centralized Sewage collection pit & air blowers (located at Sewage treatment plant areas only) are in operation will interchange automatically every 8 hours.

Number of signals/Annunciation shall be provided in PLC.

SECTION-VII**TECHNICAL SPECIFICATION
FOR
PRESSURE AND STORAGE VESSELS****1.00.00 INTENT OF SPECIFICATION**

This specification covers the design, manufacture, shop testing, shop testing, construction, fabrication, erection, testing, inspection & commissioning of pressure and storage vessels at works & site.

2.00.00 CODES AND STANDARDS

The design, manufacture, shop testing, site fabrication and erection, testing and commissioning of the pressure vessels and atmospheric storage tanks vessels shall conform to the latest revisions of the following standards, in addition to other standards addressed elsewhere in the Bid Specification subject to any modification and requirement, as specified elsewhere:

a)	ASME Section VIII	Rules for Construction of Pressure Vessels
b)	ASTM Standards	Standards published by American Society for Testing and Materials
c)	BS EN 12285-2	Workshop fabricated steel tanks. Horizontal cylindrical single skin and double skin tanks for the aboveground storage of flammable and non-flammable water polluting liquids
d)	IS-803	Code of Practice for Design Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks
e)	IS-816	Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel
f)	IS-817	Code of Practice for Training and Testing of Metal Arc Welders
g)	IS-822	Code of Procedure for Inspection of Welds
h)	IS-1363 Part 1 to Part 3	Hexagon Head Bolts, Screws and Nuts of Product Grade C
i)	IS-1367 Part 1 to Part 16	Technical Supply Conditions for Threaded Steel Fasteners
j)	IS-2002	Steel Plates for Pressure Vessels for Intermediate

		and High Temperature Service including Boilers
k)	IS-2062	Hot Rolled Medium and High Tensile Structural Steel
l)	IS-2825	Code for Unfired Pressure Vessels
m)	IS-3133	Manhole and Inspection Openings for Chemical Equipment - General Requirements
n)	IS-4049 Part 1 & Part 2	Formed Ends for Tanks and Pressure Vessels
o)	IS-4682 Part 1 to Part 10	Code of Practice for Lining of Vessels and Equipment for Chemical Processes
p)	IS-4864 to IS-4870	Shell Flanges for Vessels and Equipment

3. 00.00 **GENERAL DESIGN FEATURES**

3. 01.00 Design of all pressure vessels shall conform to IS 2825 or ASME Section VIII Division-I or equivalent code / standard (subject to approval by Purchaser).
3. 02.00 Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and other chemicals shall conform to IS-803.
- Supporting frame where required for design of Demineralized Water Storage Tanks shall be in accordance with IS-800. The tank shall be "Non-pressure" fixed roof type with atmospheric vents.
3. 03.00 Design of all horizontal cylindrical atmospheric storage tank containing decationized water, acid, alkali and other chemicals shall conform to BS EN 12285-2.
3. 04.00 Design temperature of all pressure vessels and atmospheric storage tanks shall be 10 deg. C higher than the maximum temperature that any part of the vessel / tank is likely to attain during operation.
3. 05.00 Design pressure shall be the maximum expected pressure to which the vessels may be subjected to plus 5% additional margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pumps suction, if any.
3. 06.00 In case, tank is subjected to vacuum under any situation, the same shall be duly considered as one of the criteria for design of the tank.
3. 07.00 Each pressure vessel / atmospheric storage tank without inside rubber lining shall have a corrosion allowance of minimum 2.0 mm.
3. 08.00 Mill tolerance as per applicable code (minimum 0.3 mm) shall be duly considered for each shell as well as dished end.
3. 09.00 Thinning allowance of 2.0 mm (minimum) shall be considered for each dished end.

3. 10.00 Effective liquid volume for an atmospheric storage tanks tank shall be considered as the liquid volume in between the design highest operating level / design highest level switch set point and design lowest operating level / design lowest level switch set point.
3. 11.00 A liquid volume (corresponding to a minimum of 100 mm shell / liquid height in between design lowest operating level / design lowest level switch set point and top of side mounted outlet nozzle / bottom of tank) below the required effective liquid volume shall be considered & provided for satisfactory functioning of concerned level switch.
3. 12.00 Each atmospheric tank shall have sufficient free board (minimum 300 mm unless specified otherwise) above the design highest level / design highest level switch set point.
3. 13.00 The invert of overflow nozzle shall be kept at least 50 mm or 5 % of total height whichever is higher above the design highest level / design highest level switch set point for each of the atmospheric tanks, except for the Demineralized Water Storage Tanks.
3. 14.00 For Demineralized Water Storage Tanks, the invert of overflow nozzle shall be kept at least 500 mm or 5 % of total shell height whichever is higher above the design highest level / design highest level switch set point.
3. 15.00 A minimum 100 mm shell height shall be provided above the top of overflow nozzle of each atmospheric storage tank.
3. 16.00 Wall thickness of each of atmospheric tanks shall not be less than 6 mm. If higher thickness for any atmospheric storage tank is specified elsewhere in this Specification, the same shall be provided.
3. 17.00 Vessels coming under preview of IBR shall be designed accordingly.
4. 00.00 **MATERIAL OF CONSTRUCTION**
4. 01.00 The pressure vessels shall be designed as Class 3 vessels (as per IS-2825) and fabricated of steel as per IS-2062 / IS-2002 Grade 3 or SA-515 / 516 Grade 60 / 70 In case, the vessels are designed as Class 1 or Class 2 vessels (as per IS-2825), the material of construction shall conform to IS-2002 Grade 3.
4. 02.00 Atmospheric storage tanks shall be fabricated of mild steel as per IS-2062.
4. 03.00 The material of construction for various connections, for all the lined or unlined vessels/tanks shall be same as that of interconnecting piping material suitably lined wherever required. The pipe flanges, manhole/manhole covers, reinforcement pads etc. shall be fabricated out of the same material as that one used for the vessel / tank. However, screwed fittings for instrumentation, sample connection, drain connection of size 25 mm NB and less shall be of stainless steel construction (SS-316).

5. 00.00 **FABRICATION**
5. 01.00 All pressure vessels and storage tanks except the large tanks like Demineralised Water Storage Tanks should preferably be fabricated and tested completely at manufacturer's works to ensure better workmanship.
5. 02.00 The plates to be used for fabrication shall preferably have a minimum width of 1500 mm.
5. 03.00 Ends of pressure vessels shall be of dished design and constructed of forging, pressing or spinning as per IS-4049.
5. 04.00 Interior surfaces of all atmospheric storage tanks shall be clear of stiffeners and other structural supports. Tanks shall be reinforced and stiffened externally as required.
5. 05.00 Plates to be used for fabrication of atmospheric vertical storage tanks shall be accurately formed in bending rolls to the diameters called for and cold rolled through plate bending machine by several number of passes to true curvature and joined by welding.
5. 06.00 The atmospheric vertical storage tanks shall have flat bottom.
5. 07.00 Ends of atmospheric horizontal storage tanks shall be of dished design and constructed of forging, pressing or spinning as per IS-4049. Conical or Flat Ends shall not be accepted.
5. 08.00 All welding shall be as per IS-816 or equivalent code (subject to approval by Purchaser). The qualification of the welders should be as specified in IS-817 and welding electrodes shall be as per relevant Codes / Standards.
5. 09.00 Bidder shall state clearly in his proposal the make and type of welding rods necessary for fabrication / construction work.
5. 10.00 Welding sequence shall be adopted in such a way so as to minimize the distortion due to welding shrinkage. The Bidder shall indicate in drawing, the sequence of welding proposed which should meet prior approval of the Purchaser. Welding shall not be carried out when the surface of the parts to be welded are wet from any cause and during periods of rain and high winds unless the welder and work are properly shielded.
5. 11.00 All seams shall be so positioned that they do not pass through connections of vessel / tank. The connections shall be flushed with inner surface of vessel / tank and welded continuous on both sides of the vessel / tank. Sharp inside edges shall be rounded to a minimum 3 mm radius. Inside seam weld shall be ground smooth, suitable for applicable of corrosion resistant coating / lining.
5. 12.00 All the joints (circumferential / longitudinal) shall be double butt welded with full penetration or single butt welded without backing strip. For joints involving small thickness 6 mm or less, back chipping to metal followed by DP test and re-welding shall be done to have full penetration.
5. 13.00 All internal baffles, wear plates, pipes etc. shall be continuously welded on both sides at all contact points with full fillet welds which shall be free of voids, gaps,

- craters, high spots, sharp edges, and undercutting. Sharp edges shall be ground to a 3 mm minimum radius.
5. 14.00 All welds on inner surface of vessel / tank shall be free of voids, gaps, craters, pits, high spots, sharp edges, abrupt ridges and valleys or undercut edges. High spots, irregularities and sharp edges shall be removed by grinding.
5. 15.00 Weld splatter shall be removed.
5. 16.00 Inspection of all welds shall be carried out in accordance with IS-822 'Code of Practice for Inspection of Welds.'
6. 00.00 **APPURTENANCES**
6. 01.00 Internals for pressure vessels and atmospheric storage tanks shall be provided as detailed out elsewhere in the specification and as further required.
6. 02.00 All the pressure vessels and atmospheric storage tanks shall be provided with drain connections along with drain valves of suitable size.
6. 03.00 All the pressure vessels and atmospheric storage tanks shall be provided with the vent connections. The design shall be as to offer adequate area for venting. Venting area shall be such that over pressure/vacuum is not created during maximum filling / withdrawal rate. The maximum withdrawal rate for the Demineralized Water Storage Tanks shall be intimated later at detail engineering stage to the Bidder.
6. 04.00 Various instrumentation and the fittings required for the pressure vessels and atmospheric storage tanks shall be provided as elaborated elsewhere in the specification.
6. 05.00 **Manholes / Hand Holes**
- 6.05.01 Manholes shall be provided for all pressure vessels and atmospheric storage tanks to provide easy access into the same. The diameter shall be minimum 500 mm and each manhole will be provided with cover plate, nuts, bolts and gaskets to ensure leak tightness at the test pressure. Manholes shall be davit type for rubber lined vessels.
- 6.05.02 Each of the pressure vessels and horizontal type storage tanks shall be provided with at least one manhole at the top.
- 6.05.03 Each of the vertical type atmospheric storage tanks with diameter 1200 mm or more shall be provided with a manhole on the top. For the Demineralized Water Storage Tanks, manholes shall be provided as per IS-803.
- 6.05.04 Each of the pressure vessels filled with ion exchange resins shall be provided with a handhold of diameter at least 150 mm at a level in the vicinity of bottom of resin bed.
- 6.05.05 The required lining / coating for the inside surface of the manhole / handhold, nozzle and cover plate of the manhole/ handhold shall be same as that of the respective vessel/tank.
6. 06.00 **Nozzle Connections**

- 6.06.01 Bidder shall furnish all materials required for nozzle connections with reference to system requirements. In addition to these, additional nozzle connections, if required by the Purchaser for the inter-connection with other systems / piping / instruments etc. shall also be provided. Such additional requirements may be intimated to the Bidder later at detail engineering stage and Bidder shall provide the same complete with necessary supports and other accessories without any sort of price implication whatsoever.
- 6.06.02 Nozzle wall thickness shall be as per relevant code for design to be followed for the vessel/tank in questions.
- 6.06.03 All flanged connections should be supplied complete with matching counter flanges, bolts, nuts and gasket materials. The flange design (thickness and drilling etc.) shall match with the interconnected piping flanges.
- 6.06.04 Bolts and nuts to be used externally to the vessels shall be of hexagonal head conforming to IS-1367. However fasteners if any within tanks shall be of SS-316 / SS-304 or Hastalloy-B as per the duty conditions / requirements.
- 6.06.05 Gaskets shall be of full face type.
6. 07.00 Sight glasses shall be provided for the tanks/vessels as specified elsewhere in the specification. The material for sight glass shall be high quality transparent PLEXIGLASS of sufficient thickness to withstand the test pressure. The sight glass shall be provided with suitable gaskets and bolts to ensure leak tightness at the test pressure.
6. 08.00 **Vessels Supports / Lifting Lugs**
- 6.08.01 Adequate supporting arrangements like legs, straps, saddles, skirt boards, pillars etc. for the pressure vessels and atmospheric storage tanks shall be provided to transfer all loads to civil foundation. All foundation bolts, inserts etc. shall also be provided.
- 6.08.02 All vessels shall be provided with lifting lugs, eye bolts etc. for effective handling during erection.
- 6.08.03 All vessels of internal, diameter of 1200 mm or greater shall be provided with minimum four (4) lifting lugs for safe and effective handling during erection. Smaller vessels shall be provided with atleast two (2) lifting lugs.
- 6.08.04 Material of construction for these vessel supports, saddles, lugs shall conform to IS-2062.
6. 09.00 **Special Accessories for Tanks**
- 6.09.01 Each of all the tanks shall be provided with over flow connection designed for the filling rate of the respective tank.
- 6.09.02 Water Seal shall be provided for the overflow line of Demineralized Water Storage Tanks. Vent line of Demineralized Water Storage Tanks shall be provided with Carbon-Di-Oxide Absorber / Breather of proven design to prevent contamination from atmospheric air. Carbon-Di-Oxide Absorber / Breather shall preferably be located at finished floor / pavement level.

- 6.09.03 The vent and overflow lines of Acid Bulk Storage / Day / Measuring Tanks shall be provided with fume absorber using suitable packing material, such as pall rings / raschig rings.
- 6.09.04 The vent and overflow lines of Alkali Bulk Storage / Preparation / Day / Measuring Tanks shall be provided with Carbon-Di-Oxide Absorber / Breather as addressed under clause no. 6.05.02 above.
- 6.09.05 Conservation Vent Valve shall provided on each of Demineralized Water Storage Tanks to ensure minimum contact with air. The valve should normally be closed. With vacuum or pressure to the extent of 65mm water gauge into the tank, the valve shall open to relieve the vacuum or pressure.

Material of construction should be as follows:

Body & valve disc	-	Die cast aluminium.
Spindle	-	Steel
Spring	-	Phosphor Bronze
Seal	-	Rubber

7.00.00 **ERECTION**

- 7.01.00 Each of all pressure vessels and atmospheric storage tanks should be directly placed on the civil foundation when supplied in fully fabricated form.
- 7.02.00 All fabricated part, before assembly, shall be transported by the Bidder to installation at site. All preliminary work and fabrication in part or full shall be done at the Bidder's fabrication yard or shop.
- 7.03.00 All material before final installation over the foundation at the respective locality shall be inspected and faired as necessary to ensure that any damage received during transportation is corrected before erection to the satisfaction of the Purchaser. Particular attention shall be given towards removal of buckles and other form of distortion in shell and bottom plates of vertical atmospheric storage tanks. Irregularities and dirt which would prevent metal to metal contact at the jointing faces shall be removed.
- 7.04.00 The method of holding the plates in position during welding and all devices used for this purpose should be approved by the Purchaser. All lap joints shall be held in close contact during welding and the surface in contact shall be thoroughly cleaned before assembly.
- 7.05.00 Holes in plate work to assist in erection should be avoided as far as possible. The location of the holes shall be indicated in the fabrication drawing. The method of filling holes shall be approved by the Purchaser. Lugs attached by welding to the tank and required only for the purpose of erection shall be removed and any projections of weld metal shall be chipped and grounded flush with the plate surface.
- 7.06.00 In the construction of the shell, every care shall be taken to minimize distortion or lack of circularity due to welding or for any other reason.

- 7.07.00 Tanks shall be safeguarded against damage due to wind or any other external causes by providing suitable steel cable guys until completion.
- 7.08.00 All materials used by the Bidder such as electrodes, gaskets, bolts and nuts, paints and any other appurtenance shall be conforming to relevant Indian Standard Code of Practice or equivalent (subject to approval by the Purchaser). Manufacturer's test certificate for guaranteed performance shall have to be provided when called for.
- 7.09.00 The finished bottom plate of vertical atmospheric tanks shall be crowned from the outer periphery to the centre with a slope of 1:36. Sufficient number of plugged holes shall be provided in bottom plate of the tanks for bottom testing.
8. 00.00 **PROTECTIVE LINING AND PAINTING**
8. 01.00 Inside surfaces of all pressure vessels and atmospheric storage tanks shall be protected by anticorrosive paints or rubber lining as required / specified. External surfaces of all pressure vessels and atmospheric storage tanks shall be protected by anti corrosive painting.
8. 02.00 The supply and application of Protective Lining and Painting with reference to pressure vessels and atmospheric storage tanks need to be as per **Sub Section: M7 – Technical Specification for Protective Lining and Painting**, attached herewith.
9. 00.00 **TESTS AND INSPECTION**
9. 01.00 All pressure vessels shall be hydraulically tested at 1.5 times design pressure or 2 times the maximum working pressure whichever is higher, for a period not less than one (1) hour.
9. 02.00 All atmospheric storage tanks shall be tested for leak tightness by filling up with water up to the highest level for a period not less than 8 hours.
9. 03.00 Full rubber lining is to be tested as per IS-4682 Part I for the following tests:
- (a) Adhesion tests
 - (b) Tests to check resistance to bleeding
 - (c) Measurement of lining thickness
 - (d) Shore hardness test
 - (e) Spark test at high voltages 5 KV / mm of thickness with a gap of 8 mm between the probe and lining.
9. 04.00 Thickness of painting shall be checked with dry type thickness gauge.
9. 05.00 Vessels as per IBR shall be tested accordingly.
9. 06.00 DP test after back gauging and on complete welds on atmospheric tanks and pressure vessels need to be carried out.
9. 07.00 All non-destructive tests shall be carried out as per the applicable design code / standard for all pressure vessels and atmospheric tanks.

- 9. 08.00 Butt welds if any on the dished ends shall be radio graphed after dishing and shall be stress relieved.
- 9. 09.00 All dished ends for pressure vessels shall be stress relieved after dishing.
- 9. 10.00 All weld procedure and welder qualification certificates shall be verified.
- 9. 11.00 All painting on vessels and tanks shall be checked for the thickness as per the specification mentioned elsewhere.
- 9. 12.00 All materials to be used for the pressure vessels and atmospheric tanks and accessories should be of tested quality and test certificates shall be made available to the Purchaser.

SECTION : IX
TECHNICAL SPECIFICATION
FOR
HORIZONTAL CENTRIFUGAL PUMPS

1.00.00 INTENT OF SPECIFICATION

The specification covers the design, performance, manufacturing, shop testing, erection, testing and commissioning at site, of the horizontal centrifugal pumps.

2.00.00 CODES AND STANDARDS

2.01.00 The design, manufacture and performance of the horizontal centrifugal pumps shall conform to the latest revisions of the following codes and Indian standards, in addition to other stipulations and standards mentioned elsewhere in the specification :

- a) IS-1520 : Horizontal centrifugal pumps for clear cold fresh water.
- b) IS-5120 : Technical requirement rotodynamic special purpose pumps.
- c) IS-5639 : Pumps handling chemicals and corrosive liquids.
- d) IS-5659 : Pumps for process water.
- e) Standards of Hydraulic Institute, U.S.A.

2.02.00 The material of construction for the various components of the pumps shall conform to the applicable standards like "American Society of Testing & Materials (ASTM)" and Indian Standards.

3.00.00 DESIGN AND CONSTRUCTION

3.01.00 Pumps shall be of horizontal/vertical split casing with speed preferably be limited to 1500 RPM. Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets in Appendix-I of SECTION-III may be referred to.

3.01.01 **Casing**

The casing shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimize radial loads at part load operations.

3.01.02 **Impeller**

The impeller shall be as per the proven design of the manufacturer. It shall be keyed to the shaft and locked in position. The rotor assembly shall be statically and dynamically balanced and designed with critical speed substantially above the operating speed.

3.01.03 Impeller/Casing Wearing Rings

Replaceable type wearing rings shall be provided at suitable locations for each pump. The rings shall be so fitted as to prevent turning while the pump is in operation.

3.01.04 Shaft

The shaft shall be adequately sized to withstand all stress from rotor weight and hydraulic loads etc. The shaft shall be ground and polished to final dimensions.

3.01.05 Shaft Sleeves

Pump shafts shall be protected by renewable type shaft sleeves which shall extend well beyond the pump glands. The sleeves shall be highly polished and shall be securely fastened to the shaft to prevent any loosening.

3.01.06 Bearings

Heavy duty bearings, adequately designed for the type of service specified and for long and trouble-free operations, shall be furnished. The design shall be such that the bearing lubricating oil does not contaminate the liquid being pumped.

3.01.07 Thrust Bearings

Adequately designed thrust bearings to absorb pump thrust or other unbalanced force, if any, shall be provided.

3.01.08 Lubrication system shall be designed in such a way that in case of total power failure, there will not be any damage while coasting down to stop.

3.01.09 Stuffing Boxes

Stuffing boxes of packed ring construction or of mechanical seal type as desired in the Data Sheet - Appendix-II attached with this specification shall be provided. The necessary piping, valves, fitting etc. for the gland sealing connection shall be provided. For mechanical seals, the mating surfaces shall be suitably hard faced to ensure long life.

3.01.10 Pump Shaft-Motor Shaft Coupling

The pump shaft and motor shaft shall be connected with a suitably designed flexible coupling of approved design preferably with a spacer to facilitate dismantling of the

pump without disturbing the motor. Necessary coupling guards for the coupling shall also be furnished.

3.01.11 **Base Plate**

A common base plate for mounting the pump and the corresponding driver motor shall be furnished. The base plate shall be of fabricated steel and of rigid construction, properly ribbed as required. Driplip with drain tap suitable for type of service specified shall be furnished.

3.01.12 **Drain, Vent and Priming Connections**

Each pump shall be provided with a casing drain, vent and priming connection at suitable locations.

3.01.13 **Drive Motor and Its Control**

Please refer Electrical Specification enclosed herewith this specification.

3.01.14 **Anchor Bolts, Sleeves, Inserts, Lifting Lugs, Eye Bolt, etc.**

All anchor bolts, foundation plates, sleeves, nuts, inserts etc. to be embedded in concrete for the equipment are to be supplied. The length of the foundation bolts shall be liberally sized to reach below the reinforcement level.

Each equipment shall be provided with suitable lifting lugs, eye bolts etc. to facilitate maintenance.

3.02.00 Consistent with good operating characteristics and high efficiency, each pump shall have a continuously rising head capacity characteristics curve without any zone of instability. Power flow characteristic shall preferably be non-overloading type beyond rated duty point. The characteristic curves of each set of pumps shall match each other for equal sharing in case of parallel operation. The pump motor set shall be designed in such a way that there is no damage due to reverse flow through the pump which may occur due to any mal-operation of the system.

3.03.00 The pumps shall be suitably designed also for smooth and trouble free continuous solo operation in the event of trip out of the remaining pumps running in parallel.

3.04.00 The pumps shall be designed to have best efficiency at the rated duty point. The pumps shall be suitable for continuous operation within a wide range above and below the rated duty point. Such range of operation within which category of pumps can satisfactorily operate on continuous basis, shall be clearly indicated.

3.05.00 Drive motors for each category of pumps shall be suitable for use on 415V $\pm 10\%$, 3 ϕ , 50 Hz $\pm 5\%$ and neutral grounded system. Drive motors shall have 15% spare margin over the maximum power requirement of the pump within the range of operation.

- 4.00.00 TESTING
- 4.01.00 **Testing and Inspection at Manufacturer's Works**
- 4.01.01 All tests required shall be conducted to ensure that the equipment furnished shall conform to the requirements of this specification and in compliance with requirements of the applicable codes.
- The particulars of the proposed tests and the procedures for the tests shall be submitted for approval before conducting the tests.
- 4.01.02 The representatives of Purchaser shall be given full access to all tests. Prior to pump performance tests, the manufacturer shall inform the Purchaser allowing adequate time so that if the Purchaser desires, his representatives can witness the test.
- 4.01.03 All materials and casting used for the equipment shall be of tested quality. The test certificates shall be made available to Purchaser.
- 4.01.04 The pump casing shall be hydraulically tested at 200% of pump rated head or at 150% of shut-off head, whichever is higher. The test pressure shall be maintained for at least half an hour.
- 4.01.05 The pump rotating parts shall be subjected to static and dynamic balancing tests.
- 4.01.06 All pumps shall be tested at the shop for capacity, head efficiency and brake horse power and cavitation. The tests are to be done according to the requirement of the "Hydraulic Institute" of USA, ASME Power Test Code PTC-8.2 (latest edition) and Indian Standards as applicable.
- 4.01.07 The pump accessories e.g. the thrust bearing, the motor pump shaft coupling etc. will be subjected to tests as per Manufacturer's standard.
- 4.01.08 The combined vibration of pump and motor should be restricted to the limits specified by Hydraulic Institute Standards, USA, when the pump is in operation at any load singly or in parallel.
- 4.01.09 Tests on motors shall be conducted as per electrical specification enclosed herewith this specification.
- 4.01.10 The reports and certificates of all the above mentioned tests to ensure satisfactory operation of the system shall be submitted to the Purchaser before despatch.
- 4.01.11 Cast heat marks are to be provided on castings for casing and impeller.
- 4.02.00 Tests at Site
- After erection at site, pumps under different services shall be operated to prove satisfactory performance as individual equipment as well as a system.

**Telangana State Power Generation Corporation Ltd.
1x800 MW Kothagudem TPS**

**EPC Bid Document
e-PCT/TS/K/02/2014-15**

**TECHNICAL SPECIFICATION
FOR
VERTICAL CENTRIFUGAL PUMPS**

SECTION: X

TECHNICAL SPECIFICATION
FOR
VERTICAL CENTRIFUGAL PUMPS

1.00.00 INTENT OF SPECIFICATION

The specification covers the design, performance, manufacturing, shop testing, erection, testing and commissioning at site, of the vertical centrifugal pumps.

2.00.00 CODES AND STANDARDS

2.01.00 The design, manufacture and performance of the vertical centrifugal pumps shall conform to the latest revisions of the following codes and Indian Standards in addition to other stipulations and standards mentioned elsewhere in the specification :

- a) IS-1710 : Vertical turbine pumps for clear, cold, fresh water.
- b) IS-5120 : Technical requirement for rotodynamic special purpose pumps.
- c) IS-5639 : Pumps handling chemicals and corrosive liquids.
- d) IS-5659 : Pumps for process water.
- e) Standards of Hydraulic Institute, USA.

2.02.00 The material of construction for the various components of the pumps shall conform to the applicable standards like "American Society of Testing & Materials (ASTM)" and Indian Standards.

3.00.00 DESIGN AND CONSTRUCTION

3.01.00 Pump Type

The pumps shall be vertical wet pit type with open shaft or enclosed shaft construction depending on the type of liquid to be pumped. Material of construction shall be as per the data sheets in Appendix-II. The pump shed shall preferably be limited to 1500 RPM.

3.02.00 Discharge Head Assembly

The pump shall have fabricated discharge head disposed above the ground. The head shall be capable of supporting the pump and motor on the foundation; expansion joint shall be provided immediately at the pump discharge; but no thrust block shall be provided for the unbalanced hydraulic thrust thus developed. The anchor bolts and pump fixing arrangement shall be suitably designed to take up the back thrust due to the expansion joint.

The head shall contain a packed type stuffing box to prevent any leakage.

A water stinger may be fitted to the top shaft to protect the motor from water spray.

3.03.00 Bowl

In addition to housing the impellers properly, the bowls shall provide a smooth path to water passage and shall be hydraulically designed to minimise radial thrust.

3.04.00 Impeller

The impeller shall be closed or open as per standard design of the manufacturer. All rotating parts including the impeller shall be statically and dynamically balanced. The critical speed of all the rotating parts shall be substantially above the design speed.

3.05.00 Pump Shaft and Motor Shaft Coupling

The pump shaft shall be connected to motor shaft by a heavy duty flexible coupling.

3.06.00 Column Pipe and Shaft

The line shaft and the shaft enclosing tube shall be made in convenient sections and shall be joined securely by union couplings. The column pipe shall also be made in sections and shall be joined by flanged coupling. In case of flanged joint gaskets shall be provided at each connection.

For sludge handling, vertical cantilever pump with no submerged bearing shall be provided.

3.07.00 Shaft Sleeves

Replaceable shaft sleeves shall be furnished. The shaft sleeve shall be securely locked to shaft to prevent loosening while in operation.

3.08.00 The necessary supporting frame, base-plates, sole-plates, mounting-plates, etc. as required shall be supplied under this specification, alongwith anchor bolts, foundation bolts, pipe sleeves etc.

3.09.00 Thrust Bearings

Thrust bearing of adequate design shall be furnished for taking the pump weight as well as maximum hydraulic thrust. The bearing may be lubricated by grease or oil. The design should be such that the bearing lubricating oil does not contaminate the liquid being pumped. Cooling of thrust bearing, if necessary, shall be done by liquid tapped from the discharge of the pump itself. The thrust bearing shall be designed on the basis of 20,000 working hours minimum for the load corresponding to the duty point.

3.10.00 Line Shaft and Bowl Bearing

Adequate number of properly designed bearings shall be furnished to prevent undue vibration.

3.11.00 Lubrication system shall be designed in such a way that in case of total power failure, there will not be any damage while coasting down to stop.

3.12.00 Shaft Enclosing Tube

For sludge/turbid/dirty water/chemical services, the pump shaft shall be of enclosed tube construction. For the lubrication of shaft necessary clarified/filtered water required shall be arranged. Necessary piping, valves, fittings, booster pumps etc. as required shall be included in scope.

- 3.13.00 **Suction Bell**
- The pump shall be complete with adequately dimensioned suction bell to guide and streamline intake fluid.
- 3.14.00 **Adjustment of Impeller**
- The pump shaft shall have suitable arrangement for vertical adjustment of impeller position from an accessible point.
- 3.15.00 **Pump Characteristics**
- Head capacity curve should be rising upto the shut-off head condition. Power versus capacity curve shall be non-overloading type beyond rated duty point.
- The characteristic curves of each set of pumps shall match each other for equal load sharing in case of parallel operation. The pump shall however, be also designed for smooth and trouble-free continuous solo operation in the event of trip-out of the remaining pumps running in parallel.
- 3.16.00 The pumps shall be designed for reverse flow through them. The drive motor shall be capable of bringing the pump to its rated speed in the normal direction from the point of maximum possible reverse speed when power to the drive is restored.
- 3.17.00 The pumps shall be designed to have best efficiency at the rated duty point.
- The pumps shall be suitable for continuous operation within a wide range above and below the rated duty point. Such range of operation within which the pumps can satisfactorily operate on continuous basis, shall be clearly indicated.
- 3.18.00 Drive motors for the pumps shall be suitable for use on 415V \pm 10%, 3 ϕ , 50 Hz, \pm 5% and neutral grounded system. Drive motors shall have 15% spare margin over the maximum power requirement of the pump within its range of operation.
- 4.00.00 **TESTING**
- 4.01.00 **Testing and Inspection at Manufacturer's works**

- 4.01.01 All tests required shall be conducted to ensure that the equipment furnished conforms to the requirements of this specification and is in compliance with requirements of the applicable codes. The particulars of the proposed tests and the procedures for the tests shall be submitted to Purchaser for approval before conducting the tests.
- 4.01.02 The representatives of Purchaser shall be given full access to all tests. Prior to pump performance tests, the manufacturer shall inform the Purchaser allowing adequate time so that if the Purchaser so desires, his representative can witness the test.
- 4.01.03 All materials and casting used for the equipment shall be of tested quality. The test certificates shall be made available to the Purchaser.
- 4.01.04 The pump casing shall be hydraulically tested at 200% of pump rated head or at 150% of shut-off head, whichever is higher. The test pressure shall be maintained for at least half an hour.
- 4.01.05 The pump rotating parts shall be subjected to static and dynamic balancing.
- 4.01.06 All pumps shall be tested at the shop for capacity, head, efficiency, brake horse power and cavitation. The tests are to be done according to the requirements of the Hydraulic Institute of USA, ASME Power Test Code, Indian Standards, as applicable.
- 4.01.07 The pump accessories e.g. the thrust bearing, the motor pump shaft coupling etc. will be subjected to tests as per manufacturer's standards.
- 4.01.08 The combined vibration of pump and motor should be restricted within limits specified by Hydraulic Institute Standards, USA when the pump is in operation at any load singly or in parallel.
- 4.01.09 Tests on motors shall be conducted as per electrical specification enclosed with this specification.
- 4.01.10 Test reports and certificates of the above mentioned tests to ensure satisfactory operation of the system shall be submitted to the Purchaser before despatch.
- 4.01.11 Cast heat marks shall be provided on castings for casing and impeller.
- 4.02.00 Test at Site

Telangana State Power Generation Corporation Ltd.
1x800 MW Kothagudem TPS

EPC Bid Document
e-PCT/TS/K/02/2014-15

After erection at site, pumps under different services shall be operated to prove satisfactory performance as individual equipment as well as a system.

**TECHNICAL SPECIFICATION
FOR
POSITIVE DISPLACEMENT PUMPS**

SECTION: XI

**TECHNICAL SPECIFICATION
FOR
POSITIVE DISPLACEMENT PUMPS**

1.00.00 INTENT OF SPECIFICATION

This specification covers the design, performance, manufacturing, shop testing, erection, testing & commissioning at site, of the positive displacement pumps.

2.00.00 GENERAL DESIGN FEATURES

This specification provides guideline for design, manufacturing and testing of positive displacement pumps with variable capacity to inject chemicals, generally used in the treatment of water in metered amounts.

2.01.00 Pumps shall be simplex/duplex type, positive displacement hydraulically operated diaphragm design, driven by squirrel cage induction motor through suitable speed reduction unit.

2.02.00 The stroke shall be continuously adjustable to give a capacity variation 0-100% range, while the pump is running or stopped. Adjustment of capacity shall be done automatically, wherever required, by pneumatic stroke positioner in proportion to a 0.2 - 1.0 Kg/Sq.Cm air signal or manually. For automatic pumps, in addition to the automatic control, manual control facility shall also be provided. Manual control facility shall be of micrometric adjusting type.

2.03.00 Capacity variation may be effected by changing eccentricity of the driving crank or by suitable hydraulic circuit. Pump accuracy shall be industry standard, $\pm 1\%$ of capacity setting.

2.04.00 Pumps shall be provided with an integral relief valve, spring operated, to release pressure when delivery line blockage occurs.

2.05.00 Crank case shall be constructed of high quality cast iron, which will also house the gear box and guides for cross head.

2.06.00 Material of construction should be as follows :

- | | |
|---------------------------|--------------------|
| ◆ Crank case | Cast iron. |
| ◆ Pump head | Polypropylene. |
| ◆ Valve and valve housing | Polypropylene. |
| ◆ Wheel | Cast iron to a 48. |

**Telangana State Power Generation Corporation Ltd.
1x800 MW Kothagudem TPS**

**EPC Bid Document
e-PCT/TS/K/02/2014-15**

◆ Worm	AISI 4142.
◆ Shafts (worm)	En 19.
◆ Diaphragm	Chemically inert teflon.
◆ Base plate	MS.
◆ Foundation bolts	MS.

- 2.07.00 Suitable gland seal should be provided to prevent leakage.
- 2.08.00 Electric drive motor particulars should follow Electrical Specification, enclosed herewith.
- 3.00.00 TESTING
- 3.01.00 Testing and Inspection at Manufacturer's Works
- 3.01.01 The Manufacturer shall conduct all tests required to ensure that the equipment furnished conforms to the requirements of this specification and is in compliance with requirements of the applicable codes.
- The particulars of the proposed tests and the procedures for the tests shall be submitted to Purchaser for approval before conducting the tests.
- 3.01.02 The representatives of Purchaser shall be given full access to all tests prior to pump performance tests. The Manufacturer shall inform the Purchaser allowing adequate time so that if the Purchaser so desires, his representatives can witness the test.
- 3.01.03 All materials and castings used for the equipment shall be of tested quality. The test certificates shall be made available to Purchaser.
- 3.01.04 The pump casing shall be hydraulically tested at 200% of pump operating pressure or 15 Kg/Sq.Cm(g) whichever is higher. The test pressure shall be maintained for at least half an hour.
- 3.01.05 The rotating parts of pump drive shall be subjected to static balancing.
- 3.01.06 All pumps shall be tested at the shop for capacity volumetric accuracy, repeatability accuracy, power and volumetric efficiency. The tests are to be done according to the requirements of the "Hydraulic Institute" of U.S.A. ASME Power Test Code and Indian Standards or as per API.- 675.
- 3.01.07 The pump accessories e.g. gear box, speed reduction unit etc. will be subjected to tests as per Manufacturer's standards.
- 3.01.08 The combined vibration of pump and motor should be restricted within limits specified by Hydraulic Institute Standards, USA, when the pump is in operation singly or in parallel.

3.01.09 Test reports and certificates of all the above mentioned tests to ensure satisfactory operation of the system shall be submitted to the Purchaser before despatch.

3.01.10 Performance test shall be carried out for the setting of pressure relief valve.

3.02.00 Test at Site

After erection at site, pumps under different services shall be operated to prove satisfactory performance as individual equipment as well as a system.

SECTION-XII

TECHNICAL SPECIFICATIONS
FOR
SCREW PUMPS

01.00.00 GENERAL

This section covers general requirement of design, construction features, manufacture, inspection and performance testing of screw / gear pump for water, oily water, fuel oil and sludge applications.

2.00.00 CODES AND STANDARDS

The equipment supplied shall comply with the latest applicable Indian Standards listed below. Other national standards are acceptable provided they are established to be equal or superior to the Indian Standards mentioned herewith.

IS : 5120. 1977	Technical requirements of rotodynamic purpose pumps
BS : 599. 1966	Method of testing for pumps
HIS	Hydraulic Institute Standards, USA
API: 676. 1980	Positive Displacement Pumps - Rotary
VDMA 24284. 1970	Positive Displacement Pumps - Code for Acceptance Test
IS: 210.1993	Grey Iron Castings
IS : 2062, 1992	Steel for general structural purposes
ANSI B16.5	Pipe flanges and flanged fittings
ASME Sec II	Engineering Materials

03.00.00 TECHNICAL REQUIREMENTS

03.01.00 Design & Performance Requirements

- 03.01.01 The pump shall be horizontal, rotary, positive displacement type with gear or screw as rotary element.
- 03.01.02 The pump shall be capable of developing the required total head at rated flow under continuous operation. The maximum efficiency of the pump shall be within $\pm 10\%$ of rated flow.
- 03.01.03 Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load sharing. Components of identical pumps shall be interchangeable.
- 03.01.04 Pumps shall run smoothly without undue noise and vibration. The noise level at a distance of 1 m from the equipment shall not exceed 85 dBA.
- 03.01.05 The pumps shall be suitable to handle fluid of characteristics as indicated in technical data sheet.
- 03.01.06 The pumps shall be suitable to handle the specified fluid for the complete range of operating conditions. The pump capacity shall be selected based on lowest possible viscosity and driving motor power shall be selected based on highest possible viscosity.
- 03.01.07 Each pump shall be connected to its drive motor directly and shall be mounted on a common base plate. The pump set along with drives shall be designed to permit rapid and economical maintenance.
- 03.01.08 All pumps shall be provided with suitable mechanical seals of proven design and material.
- 03.01.09 The supplier shall assume full responsibility in the operation of pump and motor as a unit.
- 03.02.00 Construction Requirements
- 03.02.01 Pump Casing
Casing and supports shall be designed to have sufficient strength and rigidity to prevent any adverse effect on internal clearances and to limit change of alignment to 50 micrometers at the coupling

flange caused by the worst combination of pressure, torque or allowable piping stress.

Pump casing shall be provided with a vent connection along with piping, fittings & valves unless pump is self-venting by the arrangement of nozzles. Casing drain, as required, shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature.

Jacket for cooling or heating shall be provided, if specified in technical particulars. Passages shall not open into casing joints.

Inlet and outlet connections shall be flanged. Flanges shall be raised face and shall conform to ANSI B 16.5. Counter flanges with necessary bolts. nuts. gasket etc. shall be supplied along with the pump.

03.02.02 Rotating Elements

Rotating parts shall be properly aligned. Rotor and shaft shall be stiff enough to prevent contact between the rotor bodies and the casing. It shall be of material that have wear, corrosion and erosion resistance compatible with the application.

03.02.03 Mechanical Seals

The Pumps shall generally be employed with mechanical seals, which shall be arranged that replacement of seal should be possible with minimum downtime. T sealing faces should be highly lapped surfaces of materials known for their frictional coefficient and resistance to corrosion against the liquid being pumped

The seal end plate or rotating cover and bolting shall be designed to retain the SI with sufficient rigidity to prevent distortion that might impair seal operation. T stationary seal member shall be positively retained to prevent its rotation. For 1 seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating.

If seal flushing and cooling is provided by the pumped fluid, the pump supplier shall ensure that sufficient flow reaches the primary seal faces to provide for cooling and maintenance of a stable film at

the seal faces.

03.02.04 Stuffing Box

Stuffing box, if provided, should permit replacement of packing without removing any part other than the gland. Asbestos shall not be used as a packing material.

Stuffing Boxes of packed ring construction type preferably to accommodate five rings of packing (minimum four rings of packing) plus a lantern ring shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. or the gland sealing connection.

03.02.05 Bearing

Heavy duty antifriction bearings, adequately designed for the type of service specified in the technical data sheet and for long, trouble free operation shall be furnished.

The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. Antifriction bearings shall be designed for a rated life of either 25000 hours with continuous operation at rated conditions or 16000 hours at maximum axial and radial loads and rated speed.

Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearing assembly.

Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearing housing.

03.02.06 Pump & Motor shaft Coupling

The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

03.02.07 Base plate

A common base plate for the pump and motor shall be provided. The base plate shall be of fabricated steel (minimum 6 mm thickness) and of rigid construction suitably ribbed and reinforced. Base plate and pump supports shall be constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. The base plate shall be suitably drilled for the anchor bolts. The base plate shall have drip pan and suitable draining arrangement.

03.02.08 Relief Valve

To protect against damage due to accidental closure of discharge valve, each pump shall be provided with a relief valve of adequate capacity,

Relief valve shall be able to handle the pump rated capacity when fully open, at a pressure not more than 10 percent above the set pressure.

03.02.09 Material of Construction

The material of construction of various components shall be as indicated in technical particulars. These are to be considered as minimum requirement and it is the responsibility of supplier to select and offer proper material of construction for the required service,

03.02.10 Assembly and Dismantling

Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouted base plate or alignment.

03.02.11 Drive Motor

The motor shall be sized to meet the maximum specified operating conditions. including external gear and/or coupling losses. Continuous Motor rating (at 50 ° C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range including the run out condition to take care of the system frequency & voltage variation.

The enclosure of motor shall comply various requirements of flame proof construction as per IS-2148 and degree of protection shall be as per IP-55.

Other design and construction features of the drive motor shall be as specified, elsewhere, under Standard Electrical Specifications.

4.00.00 TESTS

Material test certificates from recognized laboratories shall be furnished for review\for various components.

Following are the minimum shop and site tests to be conducted by the supplier:

4.01.00 Shop Tests

4.01.01 Hydrostatic Test

Pressure containing parts, including cooling and heating jackets, shall be test hydrostatically with liquid at a minimum of 1.5 times the maximum allowable working pressure but at not less than 1.38 bar gauge.

Tests shall be maintained for a sufficient period of time to permit complete examination of parts under pressure. The hydrostatic test shall be considered satisfactorily when no leaks are observed for a minimum of 30 minutes.

4.01.02 Mechanical Balancing

All rotating components of the pumps shall be subjected to static and dynamic balancing at shop as per ISO 1940. The dynamic balancing shall be done at or near the operating speed and the supplier shall furnish its acceptance norms for approval before conducting the test.

4.01.03 Non-destructive Testing

Non-destructive testing of the pump components shall be conducted in accordance with relevant standards. Prior to testing, the test procedure and repair procedure shall be submitted for approval. All components subjected to testing shall be identified and only those which are tested successfully shall be used for the manufacture of final product. All test results shall be submitted by the supplier for approval

All cast iron parts shall be tested in accordance with IS - 210. Test bars shall be cast or physical tests from the same ladle of metal as the casting they represent.

Steel forgings used in pump shall be tested for both physical properties and chemical composition. steel forgings shall be ultrasonically tested.

4.01.04 Performance Testing

All pumps shall be performance tested at the Manufacturer's Works as per testing code. The test shall be conducted to determine the following characteristics:

- a) Speed
- b) Discharge Pressure
- c) Suction Pressure
- d) Capacity
- e) Power

The test shall be conducted preferably with the tested job motor.

04.02.02 Noise and vibration shall be measured during the performance testing. For pumps operating in parallel, the load sharing should not vary by more than 5%.
testing, for reference purposes.

The pumps showing any abnormal behaviour during the performance testing or the pumps as required shall be stripped down for a thorough examination after the performance test. The performance test report shall be prepared by the supplier and submitted for approval, before despatch of the pumps.

04.02.00 Site Tests

04.02.01 After installation, the pumps supplied shall be operated to prove satisfactory performance as individual equipment as well as a system. The noise and vibration level of the pumps shall be measured and it should be within the design values. For pumps operating in parallel, the load sharing should not vary by more than 5%. If performance at site is found to be unsatisfactory, then the supplier shall rectify or replace the equipment.

04.02.03 Test Procedure Instruments

The test procedures to be followed and instruments to be used for testing shall be subject to the approval. All instruments to be used for stage and performance testing shall be calibrated at reputed third party laboratories.

SECTION: VIII**TECHNICAL SPECIFICATION
FOR
PIPING, FITTINGS & VALVES****1.00.00 INTENT OF SPECIFICATION**

This specification covers the design, manufacturing, inspection, shop testing, erection, testing and commissioning at site of all the piping, fittings, valves and all other accessories as specified and as further required.

2. 00.00 SCOPE

The items & materials to be supplied shall include but not be limited to the following:

- 2. 01.00 Pipes, bends, elbows, tees, branches laterals, crosses, reducing unions, couplings, cap, expansion joints, flanges, blank flanges, saddles, shoes, sampling connections etc. necessary for making a reliable piping system.
- 2. 02.00 Gaskets, ring joint, backing rings, jointing material etc. as required.
- 2. 03.00 Instrument tapping connection, stub and thermowells.
- 2. 04.00 Supply and machining work of flanges, pipe spools and matching pipes to connect flow measuring orifice nozzles etc., pressure accumulators as necessary.
- 2. 05.00 Valves and Isolation Gates, to start/stop and control / regulate flow.
- 2. 06.00 Strainers.
- 2. 07.00 Anchor blocks (for buried / over ground piping), support brackets, clamps, support trestles, hangers, vibration dampener etc. for the piping under the scope of contract.
- 2. 08.00 Bolts, nuts, fasteners as required for interconnecting piping, valves and fitting as well as for terminal points.
- 2. 09.00 Steel for pipe supports and embedded steel. Also pipe supports and necessary embedment required to be embedded in concrete for underground / above ground pipes.
- 2. 10.00 Painting, anti-corrosive coatings, etc. inside and outside of pipes as necessary and as specified.
- 2. 11.00 All embedded parts required for all tanks/water retaining structures made of RCC including puddle pipes shall be supplied by the Bidder.

3. 00.00 **CODE & STANDARDS**

The design, manufacture, fabrication shop testing & inspection, erection, testing and commissioning of piping fittings and valves shall conform to the latest revisions of the following Indian / International codes / standards and other applicable statutory codes / ordinances, rules, regulations as well as safety codes, in addition to other codes / standards if any as addressed elsewhere in the Tender Specification.

Other National / International Standards may also be considered acceptable (subject to specific approval by Purchaser) with reference to any specific situation / requirement provided they are recognized to be equivalent or superior to the Standards as stipulated in the Tender Specification.

ANSI	-	B 16.5	:	Steel pipe flanges and flanged fittings.
ANSI	-	B 16.9	:	Wrought steel Butt welding fittings
ANSI	-	B 16.11	:	Forged steel socket welding and screwed fittings
ANSI	-	B 16.21	:	Non Metallic Gaskets for Pipe Flanges
ANSI	-	B 16.25	:	Butt welding ends
ANSI	-	B 16.28	:	Wrought Steel Butt Welding short radius elbows and returns
ANSI	-	B 31.1	:	Power Piping code.
ANSI	-	B 36.10	:	Welded & seamless wrought steel pipe
ANSI	-	B 36.19	:	Stainless steel pipe
API	-	5L	:	Specification for Line Pipe
ASME	-	Section II		Ferrous Materials Specification
ASTM	-	A 53	:	Seamless carbon steel.
ASTM	-	A 106	:	Grade C Seamless carbon steel pipe.
ASTM	-	F441 / F441M - 09	:	Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM	-	F439 - 11	:	Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

AWWA	-	C-203	:	Coal tar protective coatings and linings for steel water pipe lines - Enamel and Tape - Hot Applied
AWWA	-	C-208	:	Dimensions for Steel Water pipe fittings
AWWA	-	C-504	:	Standard for butterfly valve.
BS	-	1868	:	Specification for steel check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
BS	-	5158	:	Specification for cast iron plug valves
BS	-	5353	:	Specification for steel plug valves
BS EN	-	593	:	Industrial valves. Metallic butterfly valves
BS EN	-	1796	:	Plastics piping systems for water supply with or without pressure. Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP)
BS EN	-	13397	:	Industrial valves. Diaphragm valves made of metallic materials
BS EN	-	13789	:	Industrial valves. Cast iron globe valves
BS EN	-	14364	:	Plastics piping systems for drainage and sewerage with or without pressure. Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP). Specifications for pipes, fittings and joints
BS EN ISO	-	16138	:	Industrial valves. Diaphragm valves of thermoplastics materials
DIN	-	16966	:	Glass fibre reinforced polyester resin (UP-GRP) pipe fittings and joint assemblies - Requirements for and testing of bushes, flanges, and flanged and laminated joints
IS	-	210	:	Grey Iron Castings
IS	-	318	:	Leaded Tin Bronze Ingots and Castings
IS	-	458	:	Precast Concrete Pipes (with and without reinforcement).
IS	-	554	:	Pipe Threads where Pressure Tight-Joints are made on the Threads – Dimensions, Tolerances and Designation.

IS	-	778	:	Copper Alloy Gate, Globe and Check Valves for Waterworks Purposes.
IS	-	783	:	Code of Practice for Laying of Concrete Pipes.
IS	-	1239 Part 1	:	Steel Tubes, Tubulars and other Wrought Steel Fittings - Specification Part 1 Steel Tubes
IS	-	1239 Part 2	:	Specification Steel Tubes, Tubulars and other Steel Fittings Part 2 Steel Sockets Tubular and other Steel Pipe Fittings
IS	-	1363	:	Hexagon Head Bolts, Screws and Nuts of Product Grade C.
IS	-	1364	:	Hexagon Head Bolts, Screws and Nuts of Product Grades A and B.
IS	-	1367	:	Technical Supply Conditions for Threaded Steel Fasteners.
IS	-	1536	:	Indian Standard for Centrifugally Cast (Spun) Iron Pressure Pipes for Water, Gas and Sewage.
IS	-	1537	:	Vertically Cast Iron Pressure Pipes for Water Gas and Sewage.
IS	-	1538	:	Cast Iron Fittings for Pressure Pipes for Water, Gas and Sewage.
IS	-	1703	:	Water Fittings - Copper Alloy Float Valves (Horizontal Plunger type)
IS	-	1879	:	Malleable Cast Iron Fittings
IS	-	2016	:	Plain washers
IS	-	2062	:	Hot Rolled Low, Medium and High Tensile Structural Steel.
IS	-	2629	:	Recommended practice for Hot dip galvanising of iron and steel
IS	-	2633	:	Method for testing uniformity of coating on zinc coated articles.
IS	-	2379	:	Colour Code for Identification of Pipe Lines.

IS	-	2685	:	Code of Practice for Selection, Installation and Maintenance of Sluice Valves.
IS	-	2712	:	Gaskets and Packings- Compressed Asbestos Fibre Jointing.
IS	-	2825	:	Code for Unfired Pressure Vessels.
IS	-	3006	:	Chemically Resistant Glazed Stoneware Pipes and Fittings.
IS	-	3042	:	Single Faced Sluice Gates (200 to 1200 mm size).
IS	-	3114	:	Code of Practice for Laying of Cast Iron Pipes.
IS	-	3589	:	Steel Pipes for Water and Sewage (168.3 to 2540 mm Outside Diameter).
IS	-	4038	:	Foot Valves for Waterworks Purposes.
IS	-	4682 (Part I)	:	Code of practice for lining of vessels and equipment for chemical - rubber lining.
IS	-	4736	:	Hot-dip Zinc Coatings on Mild Steel Tubes.
IS	-	4984	:	High Density Polyethylene Pipes for Potable Water Supplies.
IS :	-	4985	:	Unplasticized PVC Pipes for Potable Water Supplies.
IS :	-	5312	:	Swing Check Type Reflux (non-return) Valves for Water Works Purpose.
IS :	-	5822	:	Code of practice for laying of electrically welded steel pipes for Water supply.
IS :	-	8062	:	Code of practice for cathodic protection (Part-II) of steel structure
IS :	-	10221	:	Code of practice for coating and wrapping of underground mild steel pipes
IS :	-	14846	:	Sluice Valve for Water Works Purposes (50 to 1200 mm Size).

4. 00.00 **DESIGN, MANUFACTURE, FABRICATION AND ERECTION**

4.01.00 The piping system, fittings and accessories supplied shall conform to high standards of engineering, design, workmanship and be capable of performing in continuous commercial operation in a manner acceptable to Purchaser.

4.02.00 All the piping systems, fittings and accessories supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 25 years and shall withstand the operating parameter fluctuations and cycle variations which can be normally expected during this period.

4.03.00 Material of construction for pipes under different services shall be as below:

Service	Recommended Material of Construction
River Water	Carbon Steel
Clarified Water	Carbon Steel
Filtered Water	Carbon Steel (inside rubber lined)
Degassed Water	Carbon Steel (inside rubber lined)
Demineralised Water	Carbon Steel (inside rubber lined)
Service Air	Galvanized Steel
Instrument Air	Stainless Steel (schedule 40)
Potable Water	Galvanized Steel
Chlorine (liquid under pressure)	Seamless Carbon Steel (schedule 80)
Chlorine (dry gaseous under pressure)	Seamless Carbon Steel (schedule 80)
Chlorine under vacuum	CPVC (schedule 80)
Chlorine in water	CPVC (schedule 80) / Carbon Steel (inside rubber lined)
Sodium Hydroxide Solution	CPVC (schedule 80) / Carbon Steel (inside rubber lined)
Alum Solution	CPVC (schedule 80) / Carbon Steel (inside rubber lined)

Service	Recommended Material of Construction
Lime Solution	Galvanized Steel
Polyelectrolyte Solution	CPVC (schedule 80) / Carbon Steel (inside rubber lined)
Hydrochloric Acid (concentrated)	Carbon Steel (inside rubber lined)
Hydrochloric Acid (dilute)	Carbon Steel (inside rubber lined)
Sodium Hydroxide (concentrated)	Carbon Steel (inside rubber lined)
Sodium Hydroxide (dilute)	Carbon Steel (inside rubber lined)
Sulfuric Acid Solution (concentrated)	Carbon Steel
Sulfuric Acid Solution (dilute)	Carbon Steel (inside rubber lined)
Scale Inhibitor Solution	Stainless Steel (schedule 40) / CPVC (schedule 80)
Corrosion Inhibitor Solution	Stainless Steel (schedule 40) / CPVC (schedule 80)
Biocide Solution	Stainless Steel (schedule 40) / CPVC (schedule 80)
Filter Backwash Wastewater	Carbon Steel
Ammonia Solution	Seamless Stainless Steel (304 grade)
Hydrazine Solution	Seamless Stainless Steel (304 grade)
Oxygen Line	Aluminum
Crude Condensate	Carbon Steel (inside rubber lined)
Treated Condensate	Carbon Steel (inside rubber lined)
Demineralized Water with ion exchange resins	Stainless Steel (304 grade)
Non Oily Sludge	Cast Iron (underground) Carbon Steel (overground)
Neutralized Wastewater	Carbon Steel (inside rubber lined)

Cooling Tower Blowdown	Carbon Steel
Boiler Blowdown	Carbon Steel
Crude Oily Wastewater	Seamless Carbon Steel
Treated Oily Wastewater	Seamless Carbon Steel
Rainfall Runoff	Carbon Steel
Equalized Wastewater	Carbon Steel
Oily Sludge	Seamless Carbon Steel

The portion of pipe lines at the downstream of isolation valves, conveying flushing water shall be of the material & type same as those of the pipelines which are being flushed.

4.04.00 Material & Dimensional Standards for Piping and Fittings

4.04.01 The welded Carbon Steel Pipes shall conform to the following codes / standards:

Pipes	Material Code / Standard	Dimension Code / Standard
50 mm NB and below	Mild Steel, ERW, IS-1239 Part-1 / ASTM-A 53 Grade B (Welded), Type-E, Schedule 80.	IS-1239 Part-1. Plain ends for Socket Welding.
65 mm to 150 mm NB	Mild Steel, ERW, IS-1239 Part-1 / ASTM-A 53 Grade B (Welded), Type-E, Schedule 40.	IS-1239 Part-1. Bevelled ends for Butt Welding.
200 mm to 450 mm NB	Mild Steel, ERW, IS-3589 Grade Fe 410 / ASTM-A 53 Grade B (Welded), Type-E, Schedule 40.	IS-3589. Bevelled ends for Butt Welding.
500 mm NB and above	Rolled and Butt Welded from IS-2062 Grade A plates or SA-285 Grade C or Equivalent (subject to approval by Purchaser). / Spiral Welded pipes.	IS-3589. Bevelled ends for Butt Welding.

Elbows (R=1.5 D)	Material Code / Standard	Dimension Code / Standard
50 mm NB and below	Forged carbon steel from ASME-SA 105 / Carbon Steel to IS-1239 Part-2 (Heavy grade).	SW ends to ANSI-B 16.11 (3000#) / IS-1239 Part-2.
65 mm to 150 mm NB	ASME-SA 234 Grade WPB / Carbon Steel to IS-1239 Part-2 (Heavy grade).	BW ends to ANSI-B 16.9 / IS-1239 Part-2.
200 mm to 350 mm NB	ASME SA-234 Grade WPB	BW ends to ANSI-B 16.9 / IS-1239 Part-2.
Mitre Bends (R=1.5 D)	Material Code / Standard	Dimension Code / Standard
400 mm NB and above	Fabricated from parent pipe.	ANSI-B 31.1 / AWWA-C 208. 90 ⁰ - 3 cut, 4 piece constructions. 45 ⁰ - 2 cut, 3 piece constructions.
Tees	Material Code / Standard	Dimension Code / Standard
50 mm NB & below	Forged Carbon Steel to ASME-SA 105 / ASME-SA 234 Grade WPB / Carbon Steel to IS-1239 Part-2 (Heavy grade).	SW ends to ANSI-B 16.11 (3000#) / IS-1239 Part-2.
65 mm to 150 mm NB	ASME-SA 234 Grade WPB / Carbon Steel IS-1239 Part-2 (Heavy grade).	BW ends to ANSI-B 16.9 / IS-1239 Part-2.
200 mm NB and above	ASME-SA 234 Grade WPB / Fabricated from parent pipe.(set in / set on type).	ANSI-B 16.9
Reducers	Material Code / Standard	Dimension Code / Standard
50 mm NB & below	Forged carbon steel to ASME-SA 105 / ASME-SA 234 Grade WPB / Carbon Steel to IS-1239 Part-2 (Heavy grade).	SW ends to ANSI-B 16.11 (3000#) / IS-1239 Part-2.
65 mm to 150 mm NB	ASME-SA 234 Grade WPB / Carbon Steel to IS-1239 Part-2 (Heavy grade).	BW ends to ANSI-B 16.9 / IS-1239 Part-2.

200 mm NB and above	ASME-SA 234 Grade WPB / Fabricated from parent pipe.(set in / set on type)	ANSI-B 16.9
Slip On Flanges / Blind Flanges	Material Code / Standard	Dimension Code / Standard
All sizes	IS-226 / IS-2062 Grade A / ASME-SA 105 / ASTM-A 216 Grade WCB. Flanges shall be either machined or forged from plate / casting.	Dimensions / Drilling as per ANSI-B 16.5, Pressure rating 150# / 300# or otherwise as applicable, generally Flat face.
Bolts & Nuts	Material Code / Standard	Dimension Code / Standard
All sizes	IS -1367 CI 4.6 for bolts IS-1367 CI 4 for nuts	IS -1367
Gaskets	Material Code / Standard	Dimension Code / Standard
All sizes	3 mm thick wire reinforced rubber. Material shall contain no asbestos.	ANSI-B 16.21.

- 4.04.02 Seamless Carbon Steel Pipe shall conform to ASTM-A 106 Grade C (Schedule 80) / ASTM-A 53 / API 5L. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe.
- 4.04.03 Galvanized Steel Pipes and Fittings shall conform to the clause 4.02.01 above and be galvanized to IS-4736. Ends of all fittings will however be screwed as per IS-554. Mitre Bends shall not be used. Pipe joints shall be screwed for lower size and flanged for higher size. No hot work on G.I. pipes shall be done. Flanges shall be screwed and hot dipped galvanized.
- 4.04.04 Pipes and Fittings which shall be rubber lined, need to conform the clause 4.02.01 above. The inside surfaces of the items shall be completely debeaded and made suitable for lining. The items will be inside rubber lined with 3 mm thick (minimum) natural rubber in two layers as per IS-4682. Flanges shall be flat face as per ANSI-B 16.5 and full face rubber lined. Pipe to Pipe joint will be flanged only. For small size fittings, SS-316 fittings shall be used if rubber lined carbon steel fittings are not available.
- 4.04.05 Stainless Steel Pipe shall conform to ASTM-A 312 of specified grade (Schedule 40) with dimensions as per ANSI-B 16.39. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe. Mitre Bends shall not be used. Elbows / Tees / Reducers shall be of Forged Stainless Steel (ASME-SA 182) with SW ends to ANSI-B 16.11 (3000#).

- 4.04.06 Cast Iron pipes shall conform to IS-1536. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe.
- 4.04.07 PVC Pipes shall conform to IS-4984 Class 4. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe.
- 4.04.08 High density Polyethylene Pipes shall conform to IS-4984 Class 5. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe.
- 4.04.09 CPVC pipe (Schedule 80) shall be produced from compounds which conform to and are specified in ASTM-D 1784. CPVC Pipe shall be manufactured in strict compliance with ASTM-F 441. Pressure-Rated CPVC Pipe shall be manufactured in strict compliance with ASTM-F 442. All CPVC piping shall be manufactured from NSF approved compounds and NSF Listed for potable water use. CPVC Fittings (Schedule 80) shall be as per ASTM-F 437 and F 439.
- 4.04.10 Pipe lines carrying water, chemicals, air etc. shall be sized generally based on the following ranges of velocities. However pipe size if any for any particular service is addressed in the Tender Drawings / Data Sheets, the selected size for the applicable service shall not be less than the specified size.

Pipe Size	Velocity in m/sec		
	Below 50 mm	50 mm - 150 mm	200 mm & above
Pump Suction for Water		1.2 - 1.5	1.2 - 1.8
Pump Discharge for Water	1.2 - 1.8	1.8 - 2.4	2.1 - 2.5
Header		1.5 - 2.4	2.1 - 2.4
Compressed air below 2 Kg/cm ² (g)	15 - 20	20 - 30	25 - 35
Compressed air 2 Kg/cm ² & above	20 - 30	25 - 40	35 - 45
Suction to compressor/ Blowers		7 - 8	
Pump Suction for Chemical Solution	1.0 - 1.2	1.1 - 1.3	
Pump Discharge for Chemical Solution	1.2 - 1.4	1.3 - 1.5	

- 4.05.00 Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.

- 4.06.00 The following " C" Value shall be used in WILLIAM & HAZEN formula for calculating the friction loss in piping and fittings.

i)	Carbon Steel Pipe	:	100
ii)	C.I Pipe	:	100
iii)	Carbon Steel Pipe (inside rubber lined)	:	120
iv)	PVC / HDPE / GRP / CPVC pipes	:	140

For calculating the pump head, atleast 10% margin shall be taken over the pipe friction losses.

- 4.07.00 Piping Layout

4.07.01 Piping shall be grouped together as far as practicable and routed to present a neat appearance and orientation. All piping shall generally be installed perpendicular or parallel to the major equipment, building structure and floor. Pipe routing shall be such as to provide sufficient clearance for removal and maintenance of equipment, easy access to valves, instruments and other accessories. The piping shall not encroach on the withdrawal space of other equipment. Piping shall be routed to avoid interferences with other pipes, hangers, structures, equipment electrical trays, HVAC ducts etc. Convenient supporting points, adequate flexibility for thermal expansion and neat appearance shall be considered in piping layout work.

4.07.02 Provision shall be made while preparing piping layout to accommodate all system accessories such as valves/ expansion bellows/instrument stubs/instruments/ specialties as per P&ID.

4.07.03 All local instruments on the pipeline shall be located such that the reading can be observed without inconvenience.

4.07.04 Overhead indoor piping shall have a vertical clearance of minimum 3.0 m above finished floor level of working areas / walkways. Overhead outdoor piping shall have a vertical clearance of minimum 4.0 m above finished ground level and minimum 7.5 m above finished road level unless addressed otherwise elsewhere in this specification. When several pipe lines are laid parallel, flanged joints must be staggered. Welded and flanged joints should as far as possible located at one third span from supports. If the support is situated right under the welded joints this joint must be reinforced with a strap. Flanged and welded joints must be avoided in the middle of the span. Valves should be located in such a manner so as to ensure their convenient operation from the floor or the nearest platform.

4.07.05 In specific cases (subject to instruction by Purchaser for any site specific reason), pipes may be routed overground on RCC pedestals with bottom of pipes minimum 300 mm above finished ground level.

4.07.06 Pipe, when specifically addressed, shall be laid in trenches or buried. All buried pipes in general shall be laid with the top of the pipe 1.2 m to 1.5 m below the finished ground level unless mentioned otherwise. Full length of buried piping shall be provided with 100 mm thick sand bed.

4.07.07 Openings provided to accommodate pipelines must be closed with bricks and mortar with 10 mm to 12 mm clearance between brick work and pipe. The clear space must

be filled with felt or approved filling compound. The details of wall sealing arrangement shall be approved by Purchaser.

4.07.08 Drains shall be provided at low points and at pockets in piping such that complete drainage of system is possible. Vent connections shall be provided at high points where air or gas pockets may occur. Vent for use during hydrostatic test shall be plugged after the completion of the test. Vents shall not be less than 15 mm size. Plugs / cocks required for vent/drain system shall form part of the piping system and shall be supplied by Bidder as per finalized flow diagram. All vent valves & drain valves shall be arranged with easy reach of operation. All pipelines shall be given proper slope towards the drain points.

4.07.09 To facilitate dismantling of piping at the valves and equipment, break up flange/unions shall be provided. The location shall be decided as per the system requirement during detailed engineering.

4.08.00 Line Joints

Line Joints shall be envisaged as follows:

CS and SS pipes	:	Welded (socket welded for 50 mm NB & below & butt welded for 65 mm NB and above)
Galvanized Pipes	:	Screwed
Rubberlined Pipes	:	Flanged

4.08.01 Welded joints

For making welded joints (socket weld or butt weld) the welding shall be performed by manual shielded metal arc process. Any welder employed for carrying out welding shall be qualified as per ASME-Section IX for the type of joints to be welded. Jointing by butt weld or socket weld shall depend upon the respective piping material specification.

For Stainless Steel piping atleast the root run shall be welded with Tungsten Inert Gas (TIG).

Butt welding edge preparation shall be done as per ANSI-B 16.25.

All welding electrodes and welding rods including special ones, if any shall be furnished by the Bidder.

4.08.02 Screwed joints

Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI-B 2.1 (taper) NPT / IS 554, unless specified otherwise.

Teflon tapes shall be used to seal screwed joints and it shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease (with appropriate

solvent if necessary) and dried before applying the sealant. Pipe ends shall be reamed or filed out to size of bore and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe as well as the flange shall be refaced accurately.

4.08.03 Flanged joints

All flanges and flange drilling shall be to ANSI-B 16.5 of applicable pressure/temperature class. However in case of interface with the pipe of Purchaser, the flange/interconnection details shall be designed to match the applicable interface piping and concerned details.

When weld neck or socket weld flanges are used, their bore must be made the same as that of the pipe being welded to. Socket welded or threaded flanges may be used, with the appropriate piping system for connection of pipe to the flanged equipment.

Drilling of flanges on piping must match with the drilling of flanges on the valves /equipments to which the piping is to be connected.

While fitting the mating flanges, care shall be taken to properly align the pipes and to check the flanges to trueness so that the faces of the flanges can be pulled up together without producing any stress on the adjacent pipes and equipment flanges.

Flanges shall be generally Slip-On / Blind Flat Face type. The packing ring or gasket of the flanged joint shall be of full face type. Flanged joints shall not be buried.

4.08.04 With reference to maintenance for carbon steel pipes, three piece socket welded unions for sizes 50 mm NB and below shall be used. For higher sizes, flanged joints shall be used.

4.09.00 Fabrication of Pipes

4.09.01 General Requirements

The Bidder shall prepare necessary fabrication drawings based on approved piping layouts.

Flanges and their contact surfaces shall be concentric with the pipe axis and shall be accurately machined and drilled true to template.

Where welded pipe and fittings are used, the longitudinal weld seams of adjoining sections shall be staggered by 90 degree.

Prefabrication shall be carried out in the fabrication shop to ensure quality of work and to minimize work on the field.

Where fabricated reducers have been specified, they shall be fabricated from parent pipes by the 'cut and shut' method.

All bends, tees and reducers shall be fabricated as per the latest edition of power piping code, ANSI-B 31.1 or approved equivalent. Reinforcement wherever required, shall be provided.

Only shop fabricated mitre bends or mitre fittings shall be acceptable. Mitre bends will not be accepted for steel pipes of 350 NB and below. For sizes 400 mm NB and above, the mitre bends shall conform to BS-534.

For easy handling & removal of equipment, valves etc. and for maintenance purpose, break up flanges shall be provided for 65 mm NB and above. For flanged joints of 50 mm NB and below, suitable type of compression flexible coupling shall be provided.

4.09.02 Rolled and Welded /Spiral Welded Pipes

Pipes of larger diameter shall be fabricated from steel plates conforming to IS-2062 by rolling and welding or spiral welded pipes shall be used.

Where pipe lengths need to be erected before the circumferential joints is welded, the pipe ends at these joints shall be beveled so that the top half is welded mostly from outside and the bottom half mostly from inside of pipe.

Beveled (single V / double V) ends shall be provided for butt welding as per Welding Procedure Specification.

4.09.03 Fabrication of flanges for large diameter pipes (sizes 600 mm NB and above)

Flanges fabricated from plates shall conform to AWWA-C 207 / BS-4504 / ANSI-B 16.47.

All welds in fabricated flanges shall be subjected to 10% radiographic examination.

Flanges shall be flat faced machined to 10 microns surface finish. Back face of the flanges shall also be machined to 25 microns surface finish.

Inspection holes shall be provided at suitable locations for pipes 800 mm NB and above as required for periodic observations and inspection purposes.

4.09.04 Rubber Lined Pipes

All rubber lined pipes shall be seamless or bead removed ERW pipes. Inside surface of the pipes shall be completely cleaned and made suitable for lining.

All rubber lined pipes shall have flanged joints. Pipes shall be welded with flanges before rubber lining.

For rubber lined pipe, natural rubber lining should be applied in two (2) layers on the inside surface of pipes, giving a total thickness not less than 3 mm. Surface hardness of rubber lining shall be 65 ± 5 Shore A class.

4.09.05 Welding

Welding shall be carried out by manual shielded metal arc and Tungsten Inert Gas

Welding process. Electrodes used shall be of Purchaser approved make. Electrodes shall be kept dry and electrode containers shall be protected against moisture. Electrodes that show sign of deterioration or damage shall not be used. Automatic or semiautomatic welding shall be done with the specific approval of Purchaser.

The Bidder shall submit procedures for welding, stress relieving, dye penetrant testing radiography etc. for prior approval of the Purchaser.

Weld shall not be made in pipe bends.

4.10.00 Supports for Overground Pipe

4.10.01 Complete supporting system for the pipe line shall be designed, fabricated and supplied by the Bidder. Inside the building, the overhead portion of the pipe line may be supported from the building structures. No support shall be taken from the brick wall. Outdoor pipes shall run on steel trestles wherever required. All the steel structure for the pipe rack and the supporting posts/trestles along with all necessary hangers, clamps, connecting steel, fixing bolts, nuts etc. shall be supplied and erected by the Bidder.

4.10.02 Hangers and supports shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipe line movements as necessary. All guides, anchors, braces, dampener, expansion joint and structural steel to be attached to the building/structure, trenches etc. shall be provided. Type of hangers and components for all piping shall be selected and approval obtained from the Purchaser.

4.10.03 The supports shall meet the general guidelines indicated in the following code / standards:

MSS-SP 58	:	Pipe hangers & supports - Materials, design and manufacture.
MSS-SP 69	:	Pipe hangers & supports Selection and application.
ANSI-B 31.1	:	Power Piping Codes

4.10.04 Bidder shall locate, design, fabricate, supply and erect all supports, restraints and anchors required for supporting of over ground portion of piping under this contract

4.10.05 Support drawings for piping shall be got approved from the Purchaser. BOM for each support shall also be submitted.

4.10.06 All material for supports shall be of tested quality.

4.10.07 All structural steel required for supports shall be provided by the Bidder at no extra cost to the Purchaser.

4.10.08 All pipe supporting element, guides, sliding support, beams, channel section, attachment to supports, beam clamps etc. shall be provided by the Bidder.

4.10.09 Support locations will be shown in the layout drawing to be submitted by the Bidder.

4.10.10 Fabrication, supply and installation of brackets, pipe shoes, saddles etc. shall be

- included in the scope of Bidder and the same shall be carried out as per approved drawings.
- 4.10.11 If an outdoor saddle support is assumed to permit sliding movement of piping over the support, consideration shall be given in selection of supporting material at the interface so that no rust formation takes place and the actual sliding movement is feasible in practice.
- 4.10.12 All pipe supports shall be designed to fully sustain the pipe in normal operating position, allow free and ample expansion or contraction except where anchored and prevent excessive stress.
- 4.10.13 Sway braces, cushioned clamps or other vibration control equipment shall be used in order to prevent unwanted movements of the piping due to vibration, shock or other causes. These shall be of such design as to protect piping against these movements regardless of direction.
- 4.10.14 The supports shall be so interspaced as to minimize sagging of the pipes and to keep them within permissible limits where pipes are full with the conveying media.
- 4.10.15 All piping supports shall be designed to avoid interference with other piping hangers, electrical conduits equipment and structures etc.
- 4.10.16 Saddles, supports etc. shall be capable of carrying the sum of all concurrent acting loads and shall be fabricated from plates/pipes sections conforming to SA 53 / IS-2062 or equivalent. They shall be designed to provide the requirement of supporting effects and allow pipe line movements as necessary. The structural work shall be as per IS-800 / BS-4360.
- 4.10.17 The maximum spans of the supports of straight lengths shall not exceed the recommended values indicated in ANSI-B 31.1. The spans shall be suitably reduced considering the following:
- a) Point loads due to valves and specialties, branch lines etc.
 - b) Pipe bends
 - c) Structural Steel beams.
 - d) Facilities for maintenance of flanged joints.
 - e) Minimum loads on equipment.
- 4.10.18 All vertical lines shall be properly supported on the vertical run and additionally provided with adequate number of lateral-restraints where the length of vertical run exceeds 5M.
- 4.10.19 At all sliding surfaces of restraints and supports Bidder shall provide a teflon lining to minimize sliding friction.
- 4.10.20 Pipe clamps shall have a minimum thickness of 5 mm for indoor piping and 6 mm for outdoor piping.
- 4.11.00 Erection

- 4.11.01 The Bidder shall coordinate the erection of the piping system as required with the erection schedule of other concerned systems. The sequence of work shall be carefully planned to minimize interference with other groups working in the same area. The actual sequence to be followed shall be to the approval of Purchaser who may at any time, direct the Bidder to reschedule his work as per the status of work site
- 4.11.02 Prior to making interface connections with equipment / system supplied by others, the Bidder shall obtain the approval of the concerned authority.
- 4.11.03 All workmanship shall be accomplished using accepted methods and procedures of the highest recognized fabrication and erection code / standards. Workmanship not conforming to the intent of this specification shall be liable to rejection by the Purchaser at any time, during the progress of work. The Bidder shall correct the workmanship immediately at no extra cost to the Purchaser.
- 4.11.04 The Bidder shall make all interface joints of the piping system, covered under this specification at the connecting points with equipment/piping supplied by others.
- 4.11.05 It is the responsibility of the Bidder to ensure correct orientation of all valves, instrument stubs etc. in line with final piping drawings.
- 4.11.06 The Bidder shall utilize the existing structures if any, to support the piping as far as practicable. All auxiliary steels required shall be supplied by the Bidder.
- 4.11.07 Before performing any welding, all corrosion products, dust, grease and other foreign material shall be cleaned from the surfaces to be joined.
- 4.11.08 Piping on both sides of the joint shall be adequately supported during all welding. Temporary supports, if used shall be so designed that no stress due to pipe weight comes on the joints during the joining.
- 4.11.09 All pipes shall be located and laid in accordance with the approved layout drawings. No deviation will be allowed unless written consent is issued by Purchaser in specific case(s).
- 4.11.10 Before laying the pipes, the coordinates and levels of the pipes shall be checked by the Bidder. Any discrepancies between the execution and approved drawings shall be brought to the notice of the Purchaser and corrections shall be carried out as per his instructions.
- 4.11.11 During erection of piping, the Bidder shall provide proper number and size of bolts and nuts as per drawings and specification. The Bidder shall provide approved quality of grease mixed with graphite powder thoroughly on all the bolts, nuts and washers immediately after erection and when the flange joints are dismantled for flushing, testing and alignment of equipment etc. to prevent rusting of nuts, bolts and gaskets. The grease and graphite powder shall be supplied by the Bidder
- 4.12.00 **Cleaning and Flushing**
- The exterior and interior surface of all piping shall be thoroughly cleaned of all sand, mill scale, grease, oils, dirt and other foreign materials. After cleaning, the interior surfaces of all piping shall be thoroughly blown dry and protected with a completely

water soluble preventive coating.

Flange faces shall be coated with an easily removable rust preventive coating.

Machined surface shall be coated with rust preventive paint. The paint shall be consumable in the welding process.

4.13.00 Pipes and Fittings if any, coming under purview of IBR, should meet its requirements and getting the approval from IBR in respect of the same shall be under the scope of the Bidder.

4.14.00 Valves & Isolation Gates

Valves will be used to start/stop or control flow.

All valves, shall be suitable for service conditions i.e. flow, temperature and pressure under which they are required. The valves shall be of standard pressure rating as per the applicable code/ standard. The pressure rating of diaphragm valves shall be selected considering the maximum expected operating differential pressure. Sample valves will be used in sample collection lines.

Gates will be primarily used for isolation of flow in open channels although these should be capable of throttling the flow too.

For location and type of Valves / Isolation Gates, Bidder need to refer to the P&I drawings enclosed with this specification.

4.14.01 Sluice / Gate Valves (for river water / clarified water / filtered water / similar application)

Sluice / Gate valve shall conform to IS-14846 PN1.6 minimum. Stem, seat ring and wedge facing ring shall be of stainless steel construction. Other parts shall be as per IS-14846. Valves shall be of outside screw and rising stem type. Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges.

Sluice / Gate valves for sizes 50 mm NB and below shall conform to IS-778 Class-2 / ANSI-B 16.34 straight, rising stem; with outside screw.

Sluice / Gate valves shall be provided with the following accessories in addition to the standard items.

- a) Hand wheel
- b) Gear Reduction Unit Operator for valves 250 mm NB and above.
- c) Bypass valve for valve of sizes 300 mm NB and above.
- d) Draining / Flushing arrangement wherever required.
- e) Arrow indicating flow direction.
- f) Position indicator.

Sluice / Gate Valves shall be provided with back seating bush to facilitate gland renewal during full open condition.

For lower sizes, the gate valves will be screwed bonnet with outside screw rising stem as per IS-778. The material of construction will be gun metal body, with brass stem and trim. Ends will be screwed to ANSI-B 2.1.

Gate valve on galvanized iron pipe shall be gun metal construction as per IS-778 Class 2. Ends will be screwed to ANSI-B 2.1.

4.14.02 Butterfly Valves (for river water / clarified water / filtered water / similar application)

Butterfly valves shall be of double flanged or lugged wafer type of low leakage rate conforming to AWWA-C 504 class 150 (min.) or BS-5155 PN 10 / class 150 (minimum)

The various components of butterfly valves shall be of the following:

i)	Body	:	Cast Iron – ASTM-A 48 Cl.40; BS-1452 Grade220 SG Iron – BS-2789. Cast Iron IS-210 Grade FG 260 Cast Steel – ASTM-A 216 Grade WCB; BS- 1504 or Equivalent grade (subject to approval by Purchaser).
ii)	Disc	:	Cast Iron – ASTM-A 48 Cl.40; BS-1452 Grade220 SG Iron – BS-2789. Cast Iron IS-210 Grade FG 260 Cast Steel – ASTM-A 216 Grade WCB; BS-1504 or Equivalent grade (subject to approval by Purchaser).
iii)	Shaft	:	ASTM-A 296 Grade CF 8M / AISI 316; AISI-420; BS-970 Grade 316; BS-970 Grade 420 S45.
iv)	Seat rings	:	Nitrile rubber, EPDM (Ethylene propylene rubber), Hypalon.

Butterfly valves shall be fitted with sleeve type bearing such as PTFE. Valves of size 350 mm NB and above shall be provided with one or two thrust bearings to hold the disc securely in the centre of valve seat without hydraulic or external axial shaft loads. Sleeve and other bearings fitted into the valves body shall be of self lubricated materials that do not have any effect on the fluid handled and other components of the valves.

All the butterfly valves shall be provided with Hand wheel or lever/wrench operated as per the requirements.

The use of lever operators shall be limited to valves requiring a maximum of 90 degree stem rotation from full open to full closed position. For lever/wrench operated valves, means shall be provided for positively holding the disc in not less than three intermediate positions

For larger sizes i.e. 150 mm NB and above, hand wheel shall be provided.

Manually operated valves shall be provided with reduction gear unit for valves of size 250 mm NB and above. Valve provided with motorised or pneumatic actuator shall be provided with a hand wheel for manual operation.

All the valves shall be equipped with adjustable mechanical stop-limiting devices to prevent over travel of the valve disc in the open and closed positions. The valve operators (Handwheel or Gear reduction unit or Motor actuator etc.) shall be designed as per applicable International Standard.

All the butterfly valves shall be provided with an indicator to show the position of the disc.

Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges.

4.14.03 Butterfly Valves (for decationized water / deanionized water / demineralized water / desalinated water / similar application)

The butterfly valves shall conform to the requirements addressed under Cl. No. 4.14.02 above along with the requirements delineated below:

- a) Body shall be lined (minimum 3 mm) with natural rubber, ebonite, polypropylene or PVDF.
- b) Disc shall be either lined with PVDF, polypropylene, or natural rubber or shall conform to ASME-SA 479 Grade 316.

4.14.04 Ball Valves (for river water / clarified water / filtered water / similar application)

Ball valves may be used for sizes 40 mm NB and below. Ball valves shall conform to the following technical specifications:

a)	Design Standard	BS:5351
b)	Type	Screwed / Welded / Flanged ends; Full Bore: Split Body & Seat supported construction
c)	Material of Construction	
	Body	Carbon Steel to ASME-216 WCB / Cast Iron to IS-210 Grade 220 or better.
	Ball	Stainless steel ASME-SA 479 Grade 316 or 410.
	Seat ring	PTFE
	Stem	Stainless steel ASME-SA 479 Grade 304 or 316 or 410.
	Seats	Nitrile rubber; PTFE

- d) Valves shall be designed to be directly operable by a wrench / hand lever.

- e) Suitable stops shall be provided for both the fully open & close condition.
- f) All the valves shall be provided with an indicator for showing the position of the ball port.
- g) Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges

4.14.05 Globe Valves (for river water / clarified water / filtered water / similar application)

Globe valves shall conform to the following technical specifications:

For sizes 50 mm NB and below

- i) Design Standard : IS-778 Class-2 / BS-1873
- ii) Type : Straight, rising stem, with outside screw.
- iii) Material of Construction

i)	Body, Bonnet, Stuffing Box & seat rings	Leaded Tin Bronze con forming IS-318 Grade 2
ii)	Stem	Stainless Steel, AISI-316
iii)	Disc	IS-318 Grade 2/AISI-316

Note: However, valves in the flushing water lines shall be of type and material specified for the chemicals which are being flushed by the line.

For sizes above 50 mm NB

- i) Design Standard : BS-13789 PN 10 (minimum).
- ii) Type : Double Flanged or wafer body, outside screw and rising stem type.
- iii) Material of construction

a)	Body	: Cast iron: IS-210 Grade FG260 / BS-1452 Grade14.
b)	Stem	: Stainless steel AISI-410 / 13% chrome steel.
c)	Disc	: Cast iron IS-210 Grade 260 / BS-1452 Grade 14.

d)	Packing	:	PTFE
e)	Seat & seat rings	:	13% chromium steel
f)	Gland & gland nut	:	AISI-420
g)	Hand wheel	:	Cast Iron or Malleable Iron

- iv) Back seat shall be provided on the stem or on the disc.
- v) Renewable disc assembly shall consist of disc holder, disc, disc guide, check nut and disc retaining nut with washer.
- vi) Disc of globe valve may be provided with renewable rubber seating ring.
- vii) Handwheels shall be marked with the word. OPEN or SHUT with arrow to indicate direction of opening or closing.

Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges

Globe valve on galvanized iron pipe shall be gun metal construction as per IS-778 class 2. Ends will be screwed to ANSI-B 2.1.

Note: However, valves in the flushing water lines shall be of type and material specified for the chemicals which is being flushed by the line.

4.14.06 Diaphragm Valves (for river water / clarified water / filtered water / similar application)

Metallic Unlined Diaphragm valves (manual / auto as specified elsewhere in this specification) may be used for isolation purposes.

The Metallic Unlined Diaphragm valves shall conform to the requirements addressed under Cl. No. 4.14.07 below except the requirements with reference to lining for body and integral flanges.

4.14.07 Diaphragm Valves (for decationized water / deanionized water / demineralized water / desalinated water / dilute and concentrated acidic solution / dilute and concentrated alkaline solution / similar application)

Metallic Diaphragm valves (manual / auto as specified elsewhere in this specification) may be used for isolation purposes.

The metallic diaphragm valves shall conform to the following requirements.

- a) Design Standard : BS EN-13397 or Equivalent (subject to approval by Purchaser) of required

- rating/class. (minimum rating of valves should be PN 10).
- b) Type : Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type.
- c) **Material of Construction**
- Body/Bonnet : Cast Iron IS-210 Grade FG.260 or Equivalent (subject to approval by Purchaser).
Cast steel ASTM-A 216 Grade WCB.
- Body lining : Soft Natural rubber - 3 mm thick as per IS-4682 (hardness 85-90 on shore A), Ebonite polypropylene, PVDF.
- Diaphragm : Reinforced rubber, Hypalon
- Handwheel : Cast Iron
- Compressor : Stainless Steel
- Stem & Bush : Stainless Steel
- d) Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (min.) piping flanges, full face rubber lined and shall be cast / integral with the body.
- e) Handwheels shall be marked with the direction of closure.
- f) Valves shall be provided with a position indicator to show the open and closed condition.
- h) Valves provided with pneumatic actuators shall be provided with a handwheel for manual operation. The valves operators shall be designed as per applicable International Standard.
- i) The testing of valves will be as per BS EN-13397 and rubber lining will be tested as per IS-4682.

Note: For valves which may come in contact with concentrated acid/ alkali, the material of construction of diaphragm shall be as follows:

Diaphragm shall be of reinforced Teflon, EPDM for acid services and reinforced Neoprene / Hypalon for alkali services.

Use of Nonmetallic Diaphragm Valves for any specific / critical application shall be subject to approval by Purchaser and shall conform to the requirements of BS EN ISO 16138 - Industrial valves. Diaphragm valves of thermoplastics materials.

4.14.08 Plug Valves (for lime solution / sludge / similar application)

The plug valves shall conform to the following requirements.

a)	Design Standard	BS-5158 or Equivalent (subject to approval by Purchaser)
b)	Type	Flanged and non lubricated, regular pattern, plug valves.
c)	Material of Construction	
	Body	Cast Iron IS-210 Grade FG 260 or Equivalent (subject to approval by Purchaser)
	Plug	Stainless Steel AISI-316
	Body Sleeve or Seat	PTFE
	Seat	PTFE
	Gland	AISI-304 / AISI-316
	Cover	Cast Steel ASTM-A 216 Grade WCB
	Gland Nut	AISI-304 / AISI-316

- d) Valves shall be operated by permanently fitted wrench or Hand lever. Wrench shall be mounted so that they are parallel to the valve bore axis when the valve is in fully open condition.
- e) All valves shall be provided with an indicator for the position of the plug part.
- f) Suitable stops shall be provided for the fully open and fully closed positions of the valve.
- g) Valves of size of 250 mm NB and above shall be provided with a suitable reduction gear unit.
- h) Ends will be flanged and compatible with AISI-16.5 Cl. 150 (minimum) piping flanges.

4.14.09 Non Return or Check Valve (for river water / clarified water / filtered water / similar application)

Non return valves shall be of swing check (reflux) type or dual plate type.

The valves shall conform to the following specifications.

- i) Design Standard : IS-5312, BS-1868, BS-5153, API-594 / API-60 or equivalent (subject to approval by Purchaser)
- ii) Type : Swing check Type and Flanged ends.
- iii) Material of Construction:

a)	Body & Cover Hinge Disk/Door	Cast iron IS-210 Grade FG 260 / Cast Iron BS-1452 Grade 220 or equivalent (subject to approval by Purchaser)
b)	Hinge Pin and Door / Disc Pin	Cast steel ASTM-A 216 Grade WCB High tensile Brass IS-320 HT 2 or BS-2872 equivalent (subject to approval by Purchaser)
c)	Disc facing ring	Stainless steel
d)	Body Seat ring	Stainless steel
e)	Bearing bushes	Leaded Tin Bronze IS-318 Grade 2
f)	Bolts	Carbon Steel

Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges. .

Body shall be permanently marked with an "arrow" inscription indicating the direction of motion of the fluid for all the check valves.

For sizes 50 mm NB and below, check valves shall be gun metal body swing type as per IS-778. Ends will be screwed type to ANSI-B 2.1.

4.14.10

Non Return Valve (for decationized water / deanionized water / demineralized water / desalinated water / dilute and concentrated acidic solution / dilute and concentrated alkaline solution / similar application)

The valves shall conform to Cl. No. 4.09.00 above along with the following requirements:

- a) The body, cover & Disc shall be lined with natural Rubber, PTFE or Viton. The Hinge, Hinge Pin & Disc Pin shall be coated with PVDF, or suitable elastomer. The bearing bushes shall be PTFE or Equivalent (subject to approval by Purchaser) material (subject to approval by Purchaser). Bolting shall be of stainless steel. In the absence of lining/coating, the complete valve shall be of stainless steel construction (AISI-316).
- b) For only acid services Non- Return valves shall be of lined construction & Flap type.
- c) For alkali services, the complete valve shall be stainless steel construction (AISI-316) or of lined construction as specified above.

4.14.11

Valves for Sampling / Instrument Isolation Service

Each sampling valve / instrument isolation valve shall be full bore ball type.

Ball valves shall conform to the requirements stipulated under Cl.4.04.00 above. However, Body material shall be Stainless Steel (AISI-316).

4.14.12 Valves for Air Service

For Air services globe valves or Ball valves may be used for sizes 50 mm NB and below.

For sizes higher than 50 mm NB, either Butterfly valve or Ball valves shall be used.

Globe valves shall generally conform to Cl. 4.05. 00 above.

Ball valves shall conform to the requirements stipulated in Cl.4.04.00 above. However, Body material shall be leaded Tin Bronze (IS-318 Grade2) or stainless steel (AISI-304 / 316).

Butterfly valves shall conform to the Cl.4.03.05 to 4.03.09 of this section. However, the body & Disc shall be either cast iron lined with elastomer such as PVDF or PTFE or stainless steel construction (AISI-304 / 316).

4.14.13 Safety / Relief Valves

The safety valves / relief valves at the downstream of positive displacement type metering pumps shall be of the standard type manufactured by the pump manufacturer and the material of construction shall suit to the fluid handled.

4.14.14 Valves for Resin Transfer Line

In resin transfer line two way eccentric plug valve shall be used. The valves, shall have type 316 stainless steel body and bearings, resilient faced plug and flanged ends.

4.14.15 Isolation Gates

Design standard for gates shall be IS-3042 or Equivalent (subject to approval by Purchaser).

The gates shall be rectangular or square sluice, rising spindle type conforming to class-1 of IS-3042.

Material of Construction

i.	Frame and Door	Cast Iron IS-210 Grade 20
ii.	Spindles, bolts & nuts	M.S. to IS-2062
iii.	Face & seat rings	Gun metal (as per IS-3042).

All the parts of gates shall be applied with the coats of heavy duty bitumastic paint.

Each of the gates shall be provided with handwheel, and a position indicator.

The gates for DM plant drains shall be rubber lined to a minimum thickness of 4.5 mm.

4.15.00 Strainers4.15.01 Basket Strainers

- a) Basket strainers of simplex design shall have the following materials of construction for raw/clarified/filtered water application.

i.	Body	Fabricated mild steel : IS-2062 (Tested quality)
ii.	Strainers	Wire shall be stainless steel (AISI:316 18 BWG 30 mesh suitably reinforced. Reinforcement material shall also be of stainless steel construction.
iii.	Drain Plug / Nuts	Gun metal

- b) Inside and outside of basket body shall be protected with one coat of high build zinc phosphate primer and three coats of Chlorinated rubber paint to a total thickness of 200 microns.
- c) Suitable Vent and drain valves shall be provided for the strainers.
- d) Screen (strainer) flow area shall be at least four times pipe sectional area. Flow area in any portion of Basket strainer assembly shall not be less than the pipe cross sectional area.
- e) Pressure drop in clean condition shall not be more than 1.0 mwc at full flow.
- f) Basket Strainer shall be provided with lifting lugs and suitable mounting arrangement.
- g) For DM water service, body shall be rubber lined to minimum 4.5 mm thickness (soft rubber of shore Hardness $65 \pm 5^{\circ}A$).

4.15.02 Y-Type Strainer

- a) Y-Type strainer for water application shall be constructed of following materials:

i.	Body	Cast Iron IS-210 Grade FG 260
ii.	Strainers	Wires of stainless steel AISI-316, 18 BWG 30 mesh suitably reinforced. Reinforcement material shall also be of stainless steel construction.
iii.	Drain Plug / Nuts	Gun metal (threaded construction)

- b) Y-Type strainers shall also conform to Cl. 4.15.01 (b), (c), (d), (e) and (f).
- c) Body of the Y-type strainers of alkali, and demineralised water shall be of Cast Iron (IS-210 Grade FG 260) and lined with soft or hard rubber to a thickness of 3 mm.

- d) For acid services, apart from the rubber lined body material, the screen material, shall be Polypropylene or HDPE wire cloth of suitable mesh and thickness.

4.16.00 Resin Traps

The resin traps for the Ion exchange vessels shall be provided for the collection of Ion exchange resin shall conform to the following:

- 4.16.01 The body shall be of mild steel (IS-2062) and lined internally with rubber (Hard/Soft rubber), Saran or polypropylene. The internals (rod and screen) for all resin traps shall be of AISI-316 construction. All screen components shall be welded at each intersection of wire and support rod for good strength, Resin traps screen opening shall not exceed 120 percent of the associated process vessel under drain/backwash collection header nozzle screen opening and shall be suitably selected to retain even the minimum size of the resin selected for the process.

- 4.16.02 The resin traps shall be provided with a draining arrangement with a valve for collection of trapped resins. Resin trap body shall have lifting lug for easy handling during maintenance/erection.

4.17.00 General Requirements for Valves, Gates, Strainers and Resin traps

- 4.17.01 All the items shall be suitable for service conditions i.e. flow, temperature and pressure to which they may be subjected to.

- 4.17.02 All the items shall be of proven design for the duty conditions and the Bidder or manufacturer shall have sufficient experience in using the above equipment in water treatment application in the plants supplied earlier by them.

- 4.17.03 In case Purchaser desires, the experience list/feedback from the users shall be made available to Purchaser for any or all the equipments during the detailed engineering phase.

- 4.17.04 Valves will be used to start/stop or control flow. Gates will be primarily used for isolation of flow in open channels although these should be capable of throttling the flow too. Sample valves will be used in sample collection lines.

- 4.17.05 All valves shall be suitable for service conditions i.e. flow, temperature and pressure under which they are required. All the valves shall be of standard pressure rating of the applicable design code / standard. Non standard pressure rating shall not be accepted. The pressure and temperature rating of the valve shall not be less than the maximum expected pressure and temperature plus 5% additional margin of the system in which valves are proposed to be installed.

- 4.17.06 Valves pressure classes, sizes, types, body materials, and end preparation shall generally be as described herein, unless mentioned otherwise elsewhere in Bid Specification. All valves shall conform to the requirements of the governing codes, and the requirements specified.

- 4.17.07 Valves (including safety, relief and control valves) body materials shall be compatible with the piping with which they are used. If the body material is not of the same type as the material of the connecting pipe work, the valves shall be fitted with suitable welding nozzles to avoid dissimilar butt welds at site.

- 4.17.08 Each modulating control valve shall be provided with isolation valves. Manual bypass valve shall be provided for each modulating control valve to achieve safe and reliable manual operation.
- 4.17.09 All the actuators of the valves shall be designed to handle the maximum expected pressure differential across the valves and to overcome friction forces and unbalance forces due to the flow through valve.
- 4.17.10 Valve bodies and bonnets shall be designed to support the valve operators (handwheel, gear, or motor) with the valve in any position without external support.
- 4.17.11 Valve ends and size limitations are as follows:
- a) 50mm NB and smaller valves - Class 800 minimum with socket weld ends. (For instruments connections/ isolation valves screwed ends may be acceptable)
 - b) 65mm NB and larger size valves - Class 150 minimum (butt-weld ends or flanged or wafer style).
 - c) Flanged steel butterfly valves - 750mm and larger size; pressure class per AWWA / BS-5155.
- 4.17.12 Gate, globe and angle valves shall be outside stem and yoke construction.
- 4.17.13 Valves sizes 65 mm NB and larger shall have a non-rising handwheel.
- 4.17.14 All the actuator operated valves shall be fitted with handwheel for manual operation. The pneumatic actuators shall be selected based on the available air pressure and operating air pressure (maximum and minimum). The supporting calculations for selection of actuators shall be furnished for Purchaser's approval before finalization of all the actuators.
- 4.17.15 Valves coming under the purview of IBR if any shall meet its requirements and the approval of the same shall be obtained by the Bidder.
- 4.17.16 Sizes of the valves shall be same as that of the interconnected pipe sizes except for the control valves.
- 4.17.17 The various items shall be installed such so that they are easily approachable for the operating and maintenance personnel. All valves shall be accessible without chain pulls, as far as possible. Generally Valves shall be located about 1.2 meter to 1.5 meter from the operating platform and also they shall not be located below the ground level such as beneath the trenches etc. In such cases, extended spindle shall be provided with chain operating from operating floor. Valves which are installed below the ground floor shall be provided with a floor mounted pedestal at the top of the operating floor. Valves which are installed below the ground floor shall be provided with a floor mounted pedestal at the top of the operating floor. The position indicator for such valves shall be also provided along with the stand.
- 4.17.18 All valves shall be provided with hand wheels. Wherever necessary, chain operator shall be provided so that the valve may be operated from the ground floor.
- 4.17.19 All valves shall be provided with cast heat marks on casting of Body and Bonnet.

- 4.17.20 Whenever screwed valves will be installed in a pipe line, it will always be followed by screwed three piece union of same material as that of pipe.
- 4.17.21 Short pieces used for welding of different pipe fittings and valves shall not be less than 80 mm in length.
- 4.17.22 However valves which are provided (in the buried pipe line) with a valves chamber shall have manual operator/Handwheel inside the valve chamber. The valve chamber shall be provided with built in ladders/staircases and sufficient operating space within the chamber shall also be provided for easy operation of such valves.
- 4.17.23 All the valves, strainers, resin traps etc. shall be provided with external painting as that of the interconnected piping as specified in Clause 3.03.14 above. However, surfaces such as Stainless Steel, aluminium, copper, brass, bronze and other non-ferrous materials shall not be painted. No paint or filter shall be applied until all repairs, hydrostatic tests and final shop inspections are completed, but shall be applied prior to shipment.
- 4.18.00 Rubber Expansion Joint
- 4.18.01 The inner cover (i.e. the tube) and also the outer cover shall be made up of natural or synthetic rubber of adequate thickness. The carcass between the tube and the cover shall be made up of high quality cotton and rayon cord having suitable number of plies and impregnated with rubber or synthetic compounds. Moreover, to ensure adequate strength, reinforcements consisting of metal rings embedded in the carcass, shall be provided.
- 4.18.02 In all cases, the expansion joints shall be integral flanges at both ends complete with split retaining rings.
- 4.18.03 Each of the expansion joint shall be provided with adequate number of limit rod assemblies which shall be tightened after erection of the entire suction branch of the pumps, in order to avoid transmittal of undue pressure thrust on to the pump foundation. Each of these limit rod assemblies shall consist of a long bolt and two connecting plates which are, in turn securely bolted to opposite flanges. Each plate is to be drilled with three holes, two for bolting to the flange, the third for passage of the stretcher belt. Rubber washers backed with metal washer shall be placed under the head of the bolt and under the nut.
- 4.19.00 Protective Lining and Painting
- The supply and application of Protective Lining and Painting with reference to Piping, Fittings and Valves need to be as per **Sub Section: Section-XIII of V.III-C- Technical Specification for Protective Lining and Painting**, attached herewith.
- 5.00.00 **TESTS AND INSPECTION**
- 5.01.00 Tests & Inspection for Pipes and Fittings
- 5.01.01 Shop Tests
- Shop test shall include all tests to be carried out at supplier's work, works of sub

suppliers and at works where raw materials supplied for manufacture of equipment are produced. The supplier shall carryout a comprehensive inspection and testing program during manufacture at works. Necessary Manufacturing and Field Quality Plans shall be prepared by supplier and submitted for approval by Purchaser for all checks conducted on raw materials, fabrication etc.

Calibrated instruments required for measuring / testing of pipes shall be arranged by manufacturer at their works during inspection.

Purchaser shall be given full access to all tests. The manufacturer shall inform Purchaser of the testing well in advance so that Purchaser at own option may witness the test.

All the test certificates and reports shall be submitted to Purchaser for approval.

All the mechanical and chemical tests including optional tests if any as per the applicable codes / standards shall be carried out and the test certificates for the same shall be submitted for approval by Purchaser. Material Certificate shall be furnished for each grade / lot of pipes. All material test certificates shall carry material specification, size, class, length, chemical composition, physical properties and heat number or other acceptable reference to enable correlation of the certificate with the pipe. IBR / CCE / TAC approval certificates / any other statutory approval certificates as required shall be furnished.

Welding procedure and welder performance qualifications shall be carried out. Mechanical and chemical tests shall be carried out as per code. Spot radiography check shall be carried out for all butt welds. D.P.T shall be carried out for all root run welds. Segmented flanges exceeding 30 mm thickness shall be stress relieved. Tensile test, eddy current test, bend test, flattening test and dimensional checks as per applicable code shall be carried out.

All rubber lining is to be subjected to the following tests as per IS-4682 Part I:

- a) Adhesion test.
- b) Tests to check resistance to bleeding.
- c) Measurement of thickness of lining.
- d) Shore hardness test.
- e) Spark test at High voltage 5 KV / mm of thickness.

Galvanizing shall be carried out as per IS-4736 / IS-2629 and tested as per IS-2633 / BS- 729. The test shall include weight of coating, uniformity of thickness and adhesion test.

All pipes and fittings shall be subjected to hydraulic tests as per applicable code / standard. When rubber lined, hydraulic tests shall be carried out before and after rubber lining.

Buried pipes where wrapping and coating is done, material for wrapping and coating shall be tested as per applicable code. Procedure for wrapping and coating and its testing shall be submitted for approval by Purchaser. Entire wrapping and coating shall be checked for thickness and Holiday test. Peel test shall be done to ensure

proper bonding of coating to surface.

5.01.02 Site Test

Hydraulic tests of the piping system at 1.5 times the design pressure or twice the working pressure whichever is higher shall be carried out for a period of minimum 30 minutes. However, if the Code / standard of supplied piping specifies more stringent requirements than the above criteria, then the hydraulic tests shall be conducted as per the applicable piping code / standard.

Pneumatic tests shall be carried out for all pressure piping that shall not be subjected to water filling.

The Bidder shall make all temporary closures/connections as required for hydro-static/pneumatic testing and clean/remove the same after successful completion of the test.

The procedure for hydro test and pneumatic test shall be submitted by the Bidder for review and approval by Purchaser.

All tests as indicated in FQP approved by Purchaser shall also be carried out.

5.02.00 Tests & Inspection for Valves / Gates / Strainers

5.02.01 Shop Tests

Chemical composition of all material, castings, forgings, etc. shall be tested for various components of the valves, gates, strainers and test certificates shall be submitted for approval by Purchaser.

Mechanical tests including optional tests if any shall be performed as per the applicable code / standard and the test certificates for the same shall be submitted for approval by Purchaser. The performance requirements of the valves shall also be tested as per the applicable code / standard.

Elastomer wherever coated or lined for the valves shall be tested for the corrosion resistance against the medium for which those are selected as per applicable code / standard and the test certificates shall be furnished for approval by Purchaser.

Rubber lining on Valves / Gates / Strainers / Resin Traps shall be checked in accordance with IS-4682 Part I including Spark Testing at high voltage (5 KV/mm of thickness).

All the valves shall be hydraulically tested for the body, seat, back seat and all valves shall be pneumatically tested for seat as per the applicable code / standard to which these are designed irrespective of the working pressure for which valves are selected.

Wherever specifically required, pressure drop across each type and each size of the valve at various flows shall be conducted, and test reports shall be submitted for approval by Purchaser. Type test report for this test (if already carried out by the manufacturer) may be submitted to fulfill this requirement.

Gates shall be tested against leakage and strength as required in the code / standard.

Strainer shall be hydraulically tested its strength and the pressure drop across the strainer assembly shall be verified at design flow for clean condition.

5.02.02 Site Tests

All valves, gates, resin traps, strainers and other fittings after erection at site shall be tested to hydraulic test pressure of two times the operating pressure or 1.5 times the maximum allowable pressure whichever is higher for a period of 120 minutes.

All valves / gates (Manual / Automatic) shall be operated throughout 100% of the travel manually and as well as from control panel and these should function without any trouble whatsoever.



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 1 of 1

**SECTION – D2
STANDARD TECHNICAL REQUIREMENTS
ELECTRICAL**


	<p>TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS</p>	<p>SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : II-B REV NO. : 00 DATE : 29/08/2005 SHEET : 1 OF 1</p>
--	--	--

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

	TITLE :	SPECIFICATION NO.
	GENERAL TECHNICAL REQUIREMENTS	PE-SS-999-506-E101
	FOR	VOLUME NO. : II-B
	LV MOTORS	SECTION : D
		REV NO. : 00 DATE : 29/08/2005
	SHEET : 1 OF 4	

1.0 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.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 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.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.



TITLE :
GENERAL TECHNICAL REQUIREMENTS
FOR
LV MOTORS

SPECIFICATION NO. PE-SS-999-506-E101
VOLUME NO. : II-B
SECTION : D
REV NO. : 00 DATE : 29/08/2005
SHEET : 2 OF 4

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

- i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.
- ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)
- iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor

3.4 Running Requirements

- 3.4.1 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.
- 3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 Stress During bus Transfer

- 3.5.1 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.
- 3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 CONSTRUCTIONAL FEATURES

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 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


4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.




TITLE :
GENERAL TECHNICAL REQUIREMENTS
FOR
LV MOTORS


SPECIFICATION NO.
 PE-SS-999-506-E101
 VOLUME NO. : **II-B**
 SECTION : **D**
 REV NO. : **00** DATE : 29/08/2005
 SHEET : 3 OF 4

- 4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.
- 4.5. Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.
- 4.6. In case Class ‘F’ insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class ‘B’ insulation.
 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°C.
- 4.7. **Terminals and Terminal Boxes**
- 4.7.1. 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 in the Data Sheet-A.
 Unless otherwise stated in Data Sheet-A, 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 mentioned in data sheet “A”.
- 4.7.2. unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.
- 4.7.3. 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 U W & V respectively.
- 4.7.4. 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.
- 4.7.5. 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 specified in Data Sheet-A.
- 4.7.6. Degree of protection for terminal boxes shall be IP 55 as per IS 4691.
- 4.7.7. 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.
- 4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.
- 4.7.9. Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.
- 4.8. Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

	TITLE :	SPECIFICATION NO.
	GENERAL TECHNICAL REQUIREMENTS	PE-SS-999-506-E101
	FOR	VOLUME NO. : II-B
	LV MOTORS	SECTION : D
		REV NO. : 00 DATE : 29/08/2005
	SHEET : 4 OF 4	

- 4.9.1 Motors provided for similar drives shall be interchangeable.
- 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.
- 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.
- 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.
- 4.9.5 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.
- 4.9.6 Name plate with all particulars as per IS: 325 shall be provided
- 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.
- 5.0 INSPECTION AND TESTING**
- 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.
- 5.2 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.
- 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.
- 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.
- 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT**
- a) OGA drawing showing the position of terminal boxes, earthing connections etc.
- b) Arrangement drawing of terminal boxes.
- c) Characteristic curves:
(To be given for motor above 55 kW unless otherwise specified in Data Sheet).
- i) Current vs. time at rated voltage and minimum starting voltage.
- ii) Speed vs. time at rated voltage and minimum starting 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.

 TITLE LV MOTORS DATA SHEET-A 4 X 270 MW TSGENCO BHADRADRI TPS		SPECIFICATION NO.	
		VOLUME	II B
		SECTION	D
		REV. NO.	DATE 18.12.14
		SHEET 1	OF 2
1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	160KW *
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Details of supply system		
	a)	Rated voltage (with variation)	: 415V ± 10%
	b)	Rated frequency (with variation)	: 50 Hz + 3 % to - 5%
	c)	Combined voltage & freq. variation	: 10% (sum of absolute values)
	d)	System fault level at rated voltage	: 50 kA for 1 sec
	e)	Short time rating for terminal boxes	
	o	110 kW and above (Breaker Controlled)	: 50 KA for 0.20 sec..
	o	Below 110 kW (Contactor Controlled)	: 50 KA protected by HRC fuse
	f)	LV System grounding	: Solidly
5.0	Class of insulation	:	Class 'F', with temp rise limited to class B.
6.0	Minimum voltage for starting (As percentage of rated voltage)	:	(a) 85% below 110KW (b) 80% from 110KW to 160KW (c) 85% above 160KW to 1000KW (d) 80% from 1001 KW to 4000KW (e) 75% > 4000KW
7.0	Power cables data	:	Shall be given during detailed engg.
8.0	Earth Conductor Size & Material	:	As per attached Datasheet of Earthing.
9.0	Space heater supply	:	240 V, 1 ϕ , 50 Hz (for motors above 30 Kw)
10.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW
11.0	Locked rotor current		
	a)	Limit as percentage of FLC	: As per IS 12615*
12.0	Flame-proof motor		
	a)	Enclosure suitable (As per IS: 2148)	: As per requirement
	b)	Classification of Hazardous area (As per IS: 5572 part-I)	: As per requirement
13.0	Makes	:	BHEL/ Customer approval
14.0	Paint shade	:	Shall be given during detailed engg
15.0	Degree Of protection for motor/ terminal box	:	IP 54/ IP 55

	TITLE	LV MOTORS <u>DATA SHEET-A</u> 4 X 270 MW TSGENCO MANUGURU TPS		SPECIFICATION NO.
				VOLUME II B
				SECTION D
				REV NO. DATE 18.12.14
				SHEET 1 OF 2
<p>* Continuous duty LT motors up to 160 KW Output rating (at 50 deg.C ambient temperature), shall be High efficiency (IE2) as per IEC: 60034-30/ IS:12615</p> <p>16.0 TESTING</p> <p>16.1 Type Tests</p> <p>For LT Motors above 55kW, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years from the date of bid opening shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.</p> <p>16.2 Routine Tests</p> <p>All motors shall be subjected to routine tests as per IS: 325/ IS: 12615 in the presence of customer or customer representative.</p>				

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO.	
		VOLUME	II B
		SECTION D	
		REV NO.00	DATE
		SHEET	1 OF 2

S. No.	Description	Data to be filled by successful bidder
A.	General	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	Design and Performance Data	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a) Voltage	
6	b) Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB)	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.
	MOTOR DATA SHEET - C	VOLUME II B
		SECTION D
		REV NO.00 DATE
		SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55KW$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 1 of 2

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage (e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)	
Code (see B below)			

- (A) SYSTEM VOLTAGE CODES:
 (ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
 (dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V
- (B) CABLE VOLTAGE CODES:
 A = 11KV (Power cables)
 B = 6.6KV (Power cables)
 C = 3.3KV (Power cables)
 D = 1.1KV (LV & DC system power & control cables)
 E = 0.6KV (0.5 sq. mm. Control cables)



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 2 of 2

(C) CABLE CODES

PVC Copper

A = Armoured FRLS
C = unarmoured FRLS

B = Armoured Non-FRLS
D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS
G = unarmoured FRLS

F = Armoured Non-FRLS
H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS
L = unarmoured FRLS

K = Armoured Non-FRLS
M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS
Q = unarmoured FRLS

P = Armoured Non-FRLS
R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: II B

REV 00

SHEET 1 of 1

**SECTION – D3
STANDARD TECHNICAL REQUIREMENTS
CONTROL AND INSTRUMENTATION**



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.:

VOLUME

SECTION

REV. NO.


00

DATE : 19.03.2015

SHEET

OF

PLC SPECIFICATION


	TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM	SPECIFICATION NO. PES-145-36	
		VOLUME II-B	
		SECTION D	
		REV. NO. 03	DATE: 18.03.2014
		SHEET 1	OF 11

1. SCOPE

This specification covers the Design, Manufacture, Assembly, Inspection and Testing at manufacturer's works, proper packing and delivery to site, erection & commissioning, site acceptance test of the PLC Control & Monitoring System comprising PLC Control panel/Remote I/O panel (housing Processors, I/O cards, power supply packs etc.), Operator workstations(OWS), Printers, Annunciation system, UPS, cables and all other equipment and accessories required for completeness of the system as mentioned in different sections of this specification.

2. GENERAL

- 2.1. The offered PLC shall be of Industrial Grade and from Original Equipment manufacturer (OEM).
- 2.2. The PLC shall perform protection logic, interlock and sequential control functions such as binary logic operation, set/reset operation, timers, counters, logic blocks, math functions, input quality checking engineering unit conversion, Boolean functions & PID control (Analog logic function) etc.
- 2.3. The system shall be redundant in processor, power supply and communication interfaces unless otherwise specified. The control of all drives and equipment shall be effected through the keyboard/mouse / panel mounted push button / control switches as per Data sheets-A&B. The system shall include self-diagnostic features not limited to the following:-
 - Memory Faults, both PROM and EPROM
 - Processor Faults
 - Communication Faults
 - I/O interface or address faults
 - Voltage signal discrepancy on input and output
 - Power supply faults
 - Output loop check
 - Channel level diagnostics such as fault monitoring, contact bounce filtering etc.
 - Failure of main or I/O processor
- 2.4. The system shall have facility for connecting to Main Plant's Distributed control system (DCS) using hardware/software interface for two-way transfer of signals.
- 2.5. The mimic shall be displayed on the OWS screen and may also be provided on the control desk/panel (as per Datasheet).
- 2.6. In case OWS is provided, HMI functions like trends, curves, bar charts, historical storage of data, logs and reports etc. shall be provided in addition to Plant schematics. The necessary catalogue / literature elaborating the features of HMI shall be supplied along with the bid.
- 2.7. It shall be possible to use the same OWS as programming station.
- 2.8. The PLC system shall be sized to meet process/system requirements as per the approved P&IDs and Control write-up.
- 2.9. The PLC system shall be designed to ensure that no single device failure should result in failure of any other device.

	TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM	SPECIFICATION NO. PES-145-36	
		VOLUME II-B	
		SECTION D	
		REV. NO. 03	DATE: 18.03.2014
		SHEET 2	OF 11

- 2.10. Signal multiplication where required shall be done in PLC. Use of relays for multiplication of contacts (for control, monitoring and alarm) is not acceptable. The control/ monitoring components on the control panel/ desk shall be driven through I/O modules.
- 2.11. Bidder shall provide all software on CDs along with required software licenses .The original CDs of installed operating & application software shall be maintained by bidder. Software modification and up gradation (as & when required) shall also be covered under the vendor scope without any cost implication.
- 2.12. PLC programming console shall be provided with industry proven antivirus software with perpetual license (free version not acceptable).

3. TECHNICAL REQUIREMENTS


Details of various PLC system components shall be inclusive of but not limited to the following:

3.1. CODES AND STANDARDS

- 3.1.1. The equipment covered under this specification shall meet the requirements of latest edition of all applicable codes and standards like ANSI, NEMA, IEEE, IEC, NEC & IS.
- 3.1.2. PLC shall conform to IEC: 61131
- 3.1.3. The offered PLC shall comply with safety standards as per Data sheet-A&B.

3.2. CONTROL PANEL


- 3.2.1. PLC control panel shall be freestanding type with provision for mimic display, push-button stations, control switches, indicating lamps, metering instruments like Indicators, ammeters etc. and facia windows for critical alarms.
- 3.2.2. The salient features of construction shall be:
- Sheet material: Cold rolled sheet steel
Frame thickness: Not less than 3.0mm
Enclosure thickness: Not less than 2.5 mm for load bearing sections (mounted with instruments) and not less than 1.6 mm for others
Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.
- 3.2.3. Each panel shall be identified by a name plate, which shall be of non-rusting metal or three ply lamcold, with engraved lettering.

	TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM	SPECIFICATION NO. PES-145-36	
		VOLUME II-B	
		SECTION D	
		REV. NO. 03	DATE: 18.03.2014
		SHEET 3	OF 11

- 3.2.4. Vendor shall indicate earthing details along with bid.
- 3.2.5. 25 x 6 mm Copper ground bus to be provided for each panel.
- 3.2.6. 240V AC single phase, thermostatically controlled space heaters shall be provided. Each free standing panel shall have a door switch operated fluorescent lamp and a 240V AC plug point.
- 3.2.7. Painting treatment shall be as per IS: 6005. Two coats of lead oxide primer shall be followed by powder coating. Paint shade shall be as specified in the "Data sheet for PLC system"-Data Sheet-A&B. Project specific paint shade, if applicable, shall be followed.
- 3.2.8. Panel internal wiring shall be as per NEC and NEMA standard.
- 3.2.9. TB points in terminal block shall be cage clamp type/screw type.
- 3.2.10. The annunciation system shall be facia window type, driven by the PLC. Audible alarm, Acknowledge, Reset and lamp test facility shall be provided as per ISA sequence – S18.1, M.

3.3. PROCESSORS

- 3.3.1. The microprocessors shall be 32 bit, and Hot redundant.
- 3.3.2. Hot redundancy: PLC shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete operation automatically. This transfer from main processor to standby processor shall be bump less and shall not cause any disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processor as master and other as standby.
- 3.3.3. An authorized forcing facility shall be provided for changing the status of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements.
- 3.3.4. The standby processor shall be updated automatically in line with the changes made in the working processor.
- 3.3.5. In the event of any replacement of the processor, synchronization of the replaced processor shall be automatic upon live insertion.
- 3.3.6. The cycle time for input scanning, execution of logics, overheads and output scan shall not exceed 120 m sec.
- 3.3.7. The processor & memory shall be loaded up to 50% at normal conditions and maximum up to 60% under worst loading conditions.
- 3.3.8. The memories shall be field expandable. Memory capacity shall be sufficient for complete system operation and have a capability for at least 20% expansion in future.
- 3.3.9. Memory shall be non-volatile, preferably EEPROM type. However, in case volatile memory is provided, battery backup shall be provided for a minimum of three months to keep the stored program intact. Battery drain indication shall be provided at least 1 week before the battery gets drained and same shall be annunciated in OWS.

	TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM	SPECIFICATION NO. PES-145-36	
		VOLUME II-B	
		SECTION D	
		REV. NO. 03	DATE: 18.03.2014
		SHEET 4	OF 11

3.4. INPUT / OUTPUT Modules

3.4.1. Input/output card assignments shall be modular i.e. no single card shall be assigned with more than one drive of a particular sub-system. The maximum number of channels per I/O module shall be as follows.

- Analog Input Module: 16
- Analog Output Module: 16
- Binary Input Module: 32
- Binary Output Module: 32
- Analog Input/output combined: 16
- Binary Input/output combined: 32

3.4.2. On line module replacement (hot swappable): All modules cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching off the power supply.

3.4.3. Each I/O shall be protected against the reversal of polarity of the power voltage to I/O.

3.4.4. 10% spare capacity shall be ensured in each card channel assignment. Overall minimum 20% spare channels shall be provided.


3.4.5. Output command to MCC/Switchgear shall be through coupling relays, whose mounting location shall be as per "Data sheet A & B for PLC System". In case coupling relays are located in PLC Panel, the same shall be in PLC vendor's scope of supply.

3.4.6. Status feedback from MCC shall be in the form of potential free contact.

3.5. DATA BUS/ I/O BUS

3.5.1. The Data bus connecting PLC and HMI work stations shall be TCP/IP on Ethernet.

3.5.2. The Data bus and I/O bus communication medium shall be twisted pair shield copper conductor for indoor locations and those areas not subjected to induced signals. Repeaters/signal amplifiers shall not be used. Copper conductor cable used shall be Category-5 or better. The communication medium shall be Fibre optic cable in the event any portion of communication cable run is in outdoor or where distances are beyond 500 meters.

	TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM	SPECIFICATION NO. PES-145-36	
		VOLUME II-B	
		SECTION D	
		REV. NO. 03	DATE: 18.03.2014
		SHEET 5	OF 11

3.6. OPERATOR WORK STATION (OWS)

3.6.1. The OWS and Keyboard shall be desktop mounted and shall be used for controlling, monitoring and programming function.

3.6.2. Colour CRT(s) with keyboard and mouse shall be as per Data Sheet-A&B. CRT shall have graphic display facility.

3.6.3. The OWS shall be with Windows based operating system having necessary Engineering/Configuring software.

3.6.4 Specification of OWS

(a) CPU

- | | |
|---------------------------|--|
| 1. Processor | 32 Bit or better |
| 2. Main Memory | Min. 1 GB and expandable to at least 4 GB |
| 3. Hard drive | Min 40 GB |
| 4. Floppy drive | 3.5", 1.44 MB |
| 5. Removable bulk storage | DVD (R/RW) |
| 6. Graphic memory | Min. 16 MB |
| 7. Auto controller | 16 bit or better |
| 8. Operating system | Window XP or better |
| 9. Communication ports | 2 serial, 1 parallel, 8 Nos. USB, Dual 100 MB Ethernet |
| 10. Expansion slot | 3 Nos. or more |

(b) Monitor


- | | |
|-------------------------|---|
| 1. Type | LCD colour monitor (TFT based) |
| 2. Screen diagonal | 22" (approx.) flat |
| 3. Display | XGA or better |
| 4. Degree of Protection | IP-30 |
| 5. External controls | Brightness, Contrast, Horizontal/vertical amplification & shift |
| 6. Power supply | 240 VAC, 50 Hz, 1 phase |
| 7. Version | Industrial grade |

(c) Keyboard & Mouse

- | | |
|--------------------|---|
| 1. Type | Flat spill membrane or positive depression type ASCII |
| 2. Life expectancy | 50 Million cycles per key |
| 3. Version | Industrial |
| 4. Mouse | Optical |

3.7. PRINTER

Printers shall be provided as per Data Sheet-A&B.

	TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM	SPECIFICATION NO. PES-145-36	
		VOLUME II-B	
		SECTION D	
		REV. NO. 03	DATE: 18.03.2014
		SHEET 6	OF 11

3.8. COMMUNICATION WITH PLANT DCS/ THIRD PARTY SYSTEM

- 3.8.1. The PLC system shall be provided with hardwired/serial interface for communication with plant DCS. Hardwired outputs from PLC shall be isolated. Necessary isolators shall be part of PLC.
- 3.8.2. Serial communication to / from DCS where provided shall be engineered to ensure that signal communication time from / to DCS shall not exceed 1 seconds for control / feedback.
- 3.8.3. Serial communication to DCS shall be OPC (Data access 2.0), Ethernet based TCP/IP Protocol. Alternatively the serial communication shall be MODBUS protocol on RS 485 network.
- 3.8.4. Data transmitted from PLC to DCS shall include all information necessary for the DCS graphic displays to monitor and control the process equipment and PLC. Such data may include pertinent analog and digital status information, interlock, alarms and maintenance conditions. Data transmitted from DCS to the PLC shall include necessary signals to provide operator control interface from DCS for the process/ equipment being controlled by PLC.
- 3.8.5. Bidder to include 'Light interface units, converters, Ethernet switch, accessories etc. at both ends viz PLC and DCS for connectivity to other system. The bidder's terminal point shall be Ethernet port in case of copper medium connection to DCS or LIU in case of Fiber optic medium for connectivity with plant DCS. In case distance between PLC & DCS is greater than 1.8 Km, single mode of optical fiber cable with compatible accessories shall be used. For distance less than 1.8 Km multimode optical fiber ports shall be used.


3.9. POWER SUPPLY Scheme

- 3.9.1. PLC Panel and I/O Cabinets: PLC system shall be provided with 2x100% UPS fed from Two Nos. redundant 415V, 3-ph feeders, as per the scheme PE-SD-999-145-001, sh-08 of 08. Each UPS shall have 30 minutes back up. Input feeder failure shall be monitored in the PLC system. Necessary redundant power pack and transformers shall be provided (in the PLC panel) to derive the power supply for control desk, PLC panel and input / output cabinets etc
- 3.9.2. Remote I/O panels: Similar power supply arrangement as for PLC panels shall be provided if it is not possible to extend the power cable form UPS of PLC panels.
- 3.9.3. Each OWS and associated HMI peripherals shall be provided with a feeder from Either one of the UPS

4. DRAWING/DOCUMENT AND DATA TO BE FURNISHED AFTER AWARD OF THE CONTRACT:

4.1. For Approval:

- PLC system configuration drawing along with functional write-up.
- Input/output signal list.
- BOM of PLC
- List of PLC controlled devices
- Control panel/control desk GA drawings.
- Control desk/panel component layout drawing.
- Control panel/control desk Foundation detail and cutout drawings.

	TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM	SPECIFICATION NO. PES-145-36	
		VOLUME II-B	
		SECTION D	
		REV. NO. 03	DATE: 18.03.2014
		SHEET 7	OF 11

- Power distribution scheme.
- Block logic diagrams/ Ladder diagram mimic.
- Annunciation list.
- PLC control room layout drawing.
- List of soft signal exchange with Plant DCS.
- List of mandatory spares.
- UPS load calculation details.
- Quality plan
- FAT
- Data Sheet-C
- CRT display
- Power supply scheme for PLC system, HMI & peripherals, Remote I/O etc.


4.2. For Information:

- Cable schedule and cable interconnection drawing(in BHEL approved format)
 - Between Field and PLC
 - Between Field and MCC
 - Between MCC and PLC
- Electronic earthing requirements.
- Panel Heat dissipation data
- Product/component catalogues.
- Operation & Maintenance Manual on CDs.
- Softcopy of Final/As-built drawings on CDs.
- Calculation for Processor, Memory & Data bus loading

The above list is the minimum requirements. Additional documents/calculations required shall be finalized during contract stage.

5. DRAWINGS AND DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID

- Proposed PLC system configuration drawing with write-up
- Product catalogues and specifications for PLC as well as HMI application.
- Proposed power supply schemes for PLC system, peripherals, and Remote I/O panels.

	TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM	SPECIFICATION NO. PES-145-36	
		VOLUME II-B	
		SECTION D	
		REV. NO. 03	DATE: 18.03.2014
		SHEET 8	OF 11

6. TESTING AND INSPECTION

- 6.1. The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.
- 6.2. BHEL's standard Quality Plan for PLC is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.
- 6.3. The complete PLC system, including all instrument and devices shall be subjected to standard factory tests (i.e. Type Tests and Routine Tests) as per relevant IS, NEMA, IEEE, IEC.
- 6.4. Factory Acceptance Test-FAT (Functional Tests) shall be performed prior to shipment and Owner/Purchaser shall be notified 15 days before the schedules dates of the test.
- 6.5. The certificates for following type tests, as per IEC Standard, shall be submitted: -
 - Surge protection test as per IEC-225-4
 - Dry heat test as per IEC-68-2-2
 - Damp Heat test as per IEC-68-2-3
 - Vibration Heat test as per IEC-68-2-6
 - Electrostatic discharge test as per IEC-801-2 or equivalent
 - Radio frequency Immunity test as per IEC-801-6 or equivalent
 - Electromagnetic Immunity test as per IEC-801-3 or equivalent

7. SPARES AND CONSUMABLES

- 7.1. Commissioning Spares and consumables


The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.
- 7.2. Mandatory Spares

The bidder shall offer along with main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.
- 7.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.
- 7.4. Special Tools & Tackles

The bidder shall supply all Special Tools & Tackles 'as required' during Start-up and further maintenance of the system, as part of the main equipment supply.
- 7.5. Spares, Service support

Bidder shall provide availability of spares and service support for minimum 15 years after guarantee period.

	TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM	SPECIFICATION NO. PES-145-36	
		VOLUME II-B	
		SECTION D	
		REV. NO. 03	DATE: 18.03.2014
		SHEET 9	OF 11

8. MARKING AND PACKING

8.1. Marking:

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag/serial Number and salient technical specification.

8.2. Packing:

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sunlight, high temperature, rain, moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in transit and storage in open.

9. PERFORMANCE AND GUARANTEE

The PLC system shall be guaranteed to meet the performance requirement as specified and also for trouble-free continuous operation for 12 months from the date of commissioning or 18 months from the date of delivery at site whichever is later unless specified otherwise in Vol-II B Section - B or Section - C.

10. APPLICABLE DATA SHEET FORMS

This document shall be read with the following data sheet forms :

- Data Sheet A & B for PLC system - PE-DC-999-145-I036-1
- Data Sheet C for PLC system - PE-DC-999-145-I036-2



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME


SECTION

REV. NO. 00


DATE : 19.03.2015

SHEET OF

PLC DATA SHEET

	DATA SHEET FOR PLC SYSTEM		SPECIFICATION NO.: PE-TS-411-	
			VOLUME II B	
			SECTION D	
			REV. NO. 00	DATE: 04.03.2015
			SHEET 1	OF 1
Data Sheet No.:				
Data Sheet A&B				
DATA SHEET – A FOR PLC SYSTEM (TO BE FILLED BY PURCHASER)			DATA SHEET – B FOR PLC SYSTEM (TO BE FILLED BY BIDDER)	
GENERAL	PROJECT	4X 270 MW BHADRADRI TPS		
	SERVICE			
	QUANTITY	<input type="checkbox"/> UNITISED <input checked="" type="checkbox"/> COMMON		
	LOCATION	<input checked="" type="checkbox"/> INDOOR <input type="checkbox"/> OUTDOOR <input checked="" type="checkbox"/> AC <input type="checkbox"/> NON-AC*		
PLC EQUIPMENT	MAKE / MODEL NO.	BIDDER TO INDICATE		
	PROCESSOR	REDUNDANT WITH HOT STANDBY		
	DATA BUS (HMI)	<input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC		
	DATA BUS (I/O - CPU)	<input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC		
	DATA BUS (REMOTE I/O - CPU)	<input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC		
	FIELD CONTACTS INTERROGATION VOLTAGE	<input checked="" type="checkbox"/> 24 V DC <input type="checkbox"/> 48 V DC <input type="checkbox"/> 110 V AC		
	LOCATION OF COUPLING RELAYS	<input type="checkbox"/> MCC <input checked="" type="checkbox"/> PLC PANEL		
	DESKTOP OWS QUANTITY	<input type="checkbox"/> ONE <input type="checkbox"/> TWO <input type="checkbox"/> _____ <input checked="" type="checkbox"/> DESKTOP VERSION <input type="checkbox"/> SERVER VERSION <input type="checkbox"/> WORK STATION VERSION REQUIREMENT OF OWS IN CCR <input type="checkbox"/> YES <input type="checkbox"/> NO QUANTITY _____		OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification.
	DESKTOP MONITOR TYPE	<input type="checkbox"/> 19" <input checked="" type="checkbox"/> 24" TFT/CRT MONITOR <input type="checkbox"/> GIU <input type="checkbox"/> OTHERS		
	PRINTER	INKJET <input type="checkbox"/> A3 ___NOS <input type="checkbox"/> A4 ___NOS LASER B/W <input type="checkbox"/> A3 ___NOS <input type="checkbox"/> A4 ___NOS COLOR INKJET <input type="checkbox"/> A3 ___NOS <input type="checkbox"/> A4 ___NOS COLOR LASER <input checked="" type="checkbox"/> A3_1_NOS <input type="checkbox"/> A4 ___NOS		
PROGRAMMING / CONFIGURATION FACILITY	A) <input type="checkbox"/> HAND HELD <input checked="" type="checkbox"/> LAPTOP B) ENGINEERING SOFTWARE <input type="checkbox"/> ONE OWS <input type="checkbox"/> ALL OWS <input type="checkbox"/> LAPTOP		OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification. One number Laptop is mandatory.	
SAFETY STANDARD	<input type="checkbox"/> SIL-3 <input type="checkbox"/> SIL-2 <input checked="" type="checkbox"/> NIL			
SPARE LIST	COMPUTER FURNITURE	BOQ <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO INDUSTRIAL GRADE <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> START UP & COMMISSIONING <input checked="" type="checkbox"/> MANDATORY SPARE <input type="checkbox"/> RECOMMENDED		
	SPARE LIST ATTACHED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	CPU	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
REDUNDANCY	POWER SUPPLY	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	COMMUNICATION	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	I/O CARD	<input type="checkbox"/> YES <input type="checkbox"/> NO		
	OTHER ELECTRONICS	<input type="checkbox"/> YES <input type="checkbox"/> NO		
				As per vendor practice

FORM NO. PEM-6666-0

	<h2>DATA SHEET FOR PLC SYSTEM</h2>	SPECIFICATION NO.: PE-TS-411-			
		VOLUME	II B		
		SECTION	D		
		REV. NO.	00	DATE:	04.03.2015
		SHEET	1	OF	1

Data Sheet No.:

Data Sheet A&B

DATA SHEET – A FOR PLC SYSTEM
(TO BE FILLED BY PURCHASER)

DATA SHEET – B FOR PLC SYSTEM
(TO BE FILLED BY BIDDER)

No. of CHANNELS PER CARD	ANALOG INPUT	<input checked="" type="checkbox"/> 8 NOs <input type="checkbox"/> 16 NOs	
	ANALOG OUTPUT	<input checked="" type="checkbox"/> 8 NOs <input type="checkbox"/> 16 NOs	
	BINARY INPUT	<input checked="" type="checkbox"/> 16 NOs <input type="checkbox"/> 32 NOs	
	BINARY OUTPUT	<input checked="" type="checkbox"/> 16 NOs <input type="checkbox"/> 32 NOs	
	RTD**	4 NOs	
	THERMOCOUPLE**	8 NOs	
	ELECTRONIC CARD ISOLATION	<input type="checkbox"/> GALVANIC <input type="checkbox"/> OPTICAL <input type="checkbox"/> OTHER	
PANEL	QUANTITY	BIDDER TO INDICATE	
	CLASS OF PROTECTION(Refer Location of PLC)	<input checked="" type="checkbox"/> IP-42	
	REMOTE I/O PANEL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO AC REQUIREMENT <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
	COLOUR#	RAL 7032	
	BACK-UP DESK	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	
	MIMIC	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO IF YES, THEN <input type="checkbox"/> PANEL MOUNTED GUI <input type="checkbox"/> ACRYLIC	
	CONTROL HARDWARE	<input type="checkbox"/> PB <input type="checkbox"/> INDICATORS <input checked="" type="checkbox"/> FACIAS 25 Nos. <input type="checkbox"/> OTHERS	
CONFORMAL COATING	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
COMMUNICATION WITH OTHER SYSTEM	HARDWIRED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
	PURPOSE	<input type="checkbox"/> CONTROL <input checked="" type="checkbox"/> MONITORING	
	MEDIUM	<input type="checkbox"/> UTP <input checked="" type="checkbox"/> FIBRE OPTIC <input type="checkbox"/> OTHERS	
	TIME SYNCHRONIZATION SIGNAL FORMAT	<input type="checkbox"/> PULSE <input type="checkbox"/> RS-485 <input checked="" type="checkbox"/> IRIG-B <input type="checkbox"/> NTP	
	SOFTLINK	<input type="checkbox"/> MODBUS <input checked="" type="checkbox"/> OPC IF MODBUS THEN <input type="checkbox"/> RS-485 <input type="checkbox"/> ETHERNET	
	SERIAL LINK	COMMUNICATION PORT TYPE _____	
POWER SUPPLY INPUT FEEDER	PLC PANEL	BIDDER TO INDICATE LOAD DATA	
	REMOTE I/O PANEL	BIDDER TO INDICATE LOAD DATA	
POWER SUPPLY	SOURCE \$\$	<input checked="" type="checkbox"/> UPS(INDUSTRIAL GRADE) <input type="checkbox"/> 24V DC CHARGER	
	BATTERY TYPE	<input type="checkbox"/> Ni-Cd <input checked="" type="checkbox"/> LEAD ACID <input type="checkbox"/> OTHERS	
	BACK-UP TIME	<input type="checkbox"/> 30 MINS <input checked="" type="checkbox"/> 60 MINS <input type="checkbox"/> OTHERS	
	BATTERY CONFIGURATION	<input type="checkbox"/> 1X100% <input checked="" type="checkbox"/> 2X100% <input type="checkbox"/> 2X50%	As per MAX philosophy
CUSTOMER TRAINING	TRAINING	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	NO OF DAYS	3 DAYS	
	LOCATION	<input type="checkbox"/> VENDOR'S WORK <input type="checkbox"/> PROJECT SITE <input type="checkbox"/> OTHERS	

*IF THE LOCATION IS INDOOR,KINDLY SPECIFY IF PLC PANEL IS PLACED IN AC OR NON-AC ENVIRONMENT.

**SHALL NOT BE APPLICABLE IF TEMPERATURE TRANSMITTERS ARE ENVISAGED.

PROJECT SPECIFIC PAINT SHADES, IF APPLICABLE TO BE USED.

\$\$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

SHEET

OF

PLC Quality Plan

QUALITY PLAN NO.: **PE-QP-999-145-1036**
 VOLUME IIB
 SECTION D
 REV. NO. **01** DATE: 24.08.2007
 SHEET 1 OF 8

STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER



Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records P	Agency \$		Remarks
									W	V	
1.0	Materials /Components										
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA Visua	I	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2 2	1	
1.2	Power Supply/Packs, Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA Visua	I	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2 2	1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA Visua	I	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2 2	1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection <ul style="list-style-type: none"> • Identification Labels • Physical Damages • Quantity • Spare Capacity 	MA Visua	I	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2 2	1	

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

\$ P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

 PEM :: C&I	STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER						QUALITY PLAN NO.: PE-QP-999-145-1036
							VOLUME IIB
							SECTION D
							REV. NO. 01 DATE: 24.08.2007
							SHEET 2 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records P	Agency \$		Remarks
									W	V	
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, <u>Tech. Specification</u> Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2 2	1	

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics	\$	P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
---	----	--	--

QUALITY PLAN NO.: **PE-QP-999-145-1036**
 VOLUME IIB
 SECTION D
 REV. NO. **01** DATE: 24.08.2007
 SHEET 3 OF 8

**STANDARD QUALITY PLAN
 FOR
 PROGRAMMABLE LOGIC CONTROLLER**



PEM :: C&I

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records P			Remarks
								Agency \$	W	V	
2.0	Assembly										
2.1	Functional Test for HMI/OVS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2 1	1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2 2	1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2 1	1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100% F	AT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2 2	1	

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

\$ P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

QUALITY PLAN NO.: **PE-QP-999-145-1036**
 VOLUME IIB
 SECTION D
 REV. NO. **01** DATE: 24.08.2007
 SHEET 4 OF 8

STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER



Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records P	Agency \$			Remarks
									W	V		

3.0	Factory Acceptance Test (FAT)											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

\$ P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: **PE-QP-999-145-1036**

TECHNICAL SPECIFICATION NO. PE-TS-411-673A-A001

SECTION D

REV. NO. 01

DATE: 24.08.2007

SHEET 5

OF

8

FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

- a) Technical Specification of PLC.
- b) PLC System Configuration
- c) General Assembly Drawings.
- d) Panel Wiring Diagrams.
- e) Bill of Quantity for PLC System.
- f) Logic Diagram.
- g) HMI Schematics.
- h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, [to the inspecting agency](#), his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. [Check online replacement of cards, processors, power supply etc.](#)

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

- i) Redundancy

**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: PE-QP-999-145-I036		
VOLUME IIB		
SECTION D		
REV. NO. 00	DATE: 23.03.2005	
SHEET 6	OF	8

ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.

Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

4. Communication System Verification

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

5. Diagnostic Verification

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: PE-QP-999-145-I036 ___		
VOLUME IIB		
SECTION D		
REV. NO. 00	DATE: 23.03.2005	
SHEET 7	OF	8

6. Control Panel /Desk Verification

- i) PLC driven annunciation system should be checked by alarm signal simulation.
- ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.
- iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

- i). Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes
- ii). Engineering features:-
 - a) Online changing of parameters, set points.
 - b) Online modification in Control Logic Diagrams.
 - c) Online configuration of Graphics, Trends, Logs, HSR.
- iii). HMI features:-
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

Electronic equipments shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

- a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: PE-QP-999-145-1036		
VOLUME IIB		
SECTION D		
REV. NO. 00	DATE:	
23.03.2005		
SHEET 8	OF	8

ii) 48 hours test period shall be divided into 4 equal time segments of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

SHEET

OF

ACTUATOR SPECIFICATION

VOLUME: V-A

SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

- 1.00.00 **SCOPE**
- 1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves/dampers.
- 1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. All the electrical actuators shall be INTEGRAL type only.
- 2.00.00 **STANDARDS**
- 2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.
- 2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed
- i) IS -9334
- ii) IS-325
- 3.00.00 **SERVICE CONDITIONS**
- 3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.
- 3.03.00 For actuator motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.
- 4.00.00 **RATING**
- 4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.
- 4.02.00 For regulating 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.

5.00.00 PERFORMANCE

The actuator shall meet the following performance requirements:

- 5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.
- 5.02.00 Attain full speed operation before valve load is encountered and imparts an unseating blow to start the valve in motion (hammer blow effect).
- 5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.
- 5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.
- 5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 SPECIFIC REQUIREMENT**6.01.00 Construction**

- 6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring.
- 6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy. Degree of protection of enclosure for motor actuator shall be IP-65.
- 6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- 6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 Motor

- 6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.
- 6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.
- 6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.
- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be with integral starter with 3phase/3wire, 415V AC and operable from remote.

- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall de-energize automatically when the motor is energized.
- 6.05.00 **Position Indicator/Transmitter**
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, 4-20 mA current signal as position feedback, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. All wiring shall be done with 1100 V grade fire resistance PVC insulated stranded copper conductor of not less than 2.5 Sq.mm cross section. All wiring shall be identified at both ends with ferrules. All the electrical actuators shall have uniform wiring.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.
- 7.00.00 **ACCESSORIES**

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V control transformer with primary & secondary fuses.

8.00.00 TEST

The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

9.00.00 DRAWINGS, DATA & MANUALS

- 9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 To be submitted with Bid

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues. Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.03.00 To be submitted for Owner / Purchaser's Approval and Distribution

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, BOM, control & schematics, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A : Technical Specifications for Electrical Equipment & Accessories.

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

S	upply	Description	Consumer
	L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz Effectively earthed	u Motors above 0.2kW pto less than 175kW.
		Fault level 50 kA symm. for 1 sec.	
	(ii)	240V AC/415V AC	Motors upto 0.2kW.
		240V, 1Ø, 2W, 50 Hz effectively earthed	o Lighting, Space heat- ing , A.C supply for Contr- l & protective devices.
	D.C. Supply	220V, 2W, unearthed	& D.C. alarm, control protective devices
		Fault level 25* kA. for 1 sec.	

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION

A.C. Supply :

V	oltage	:	± 10%
	Frequency	:	+3% to -5%.
	Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242
---------	---	------------



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.


00

DATE : 19.03.2015

SHEET


OF

Actuator Data Sheet

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-SS-411-145-I007			
			VOLUME			
			SECTION			
			REV. NO.	00	DATE:	14.11.14
			SHEET	1	OF	3
Data Sheet A & B						
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)			

350


GENERAL*	* PROJECT	4X270 MW BHADRADRI TPS		
	OFFER REFERENCE			
	* TAG NO. SERVICE			
	* DUTY	<input checked="" type="checkbox"/> ON / OFF REQUIRED <input checked="" type="checkbox"/> INCHING (AS REQUIRED)		
	* LINE SIZE (inlet/outlet): MATERIAL			
	* VALVE TYPE	<input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> BUTTERFLY		
	* OPENING / CLOSING TIME			
	* WORKING PRESSURE			
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%		
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY		
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
CONSTRUCTION AND SIZING	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL		
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.		
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.		
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING(REGULATING) SERVICE 150 STARTS/HR MINIMUM		
HANDWHEEL	* REQUIRED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	* ORIENTATION	<input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> SIDE MOUNTED		
	TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.			
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY		
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY		
	MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT.		
	ACTUATOR APPLICABLE WIRING DIAGRAM	<input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM) A: <input checked="" type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00 C: <input type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00 D: <input type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11		
	COLOUR SHADE	<input checked="" type="checkbox"/> BLUE (RAL 5012) ENAMEL <input type="checkbox"/>		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		
	STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY		
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED INTERNALLY		
	@ ENCLOSURE CLASS OF MOTOR	<input type="checkbox"/> IP 65 <input checked="" type="checkbox"/> IP 67 <input type="checkbox"/> FLAME PROOF <input type="checkbox"/> IP 55, TOTALLY ENCL, SELF VENTILATED.		
	@ INSULATION CLASS	<input type="checkbox"/> CLASS-B <input checked="" type="checkbox"/> CLASS-F (TEMP. RISE LIMITED TO CLASS B)		
	@ WINDING TEMP PROTECTION	<input checked="" type="checkbox"/> THERMOSTAT (3 Nos., 1 IN EACH PHASE) <input type="checkbox"/> -----		

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-SS-411-145-I007	
			VOLUME	
			SECTION	
			REV. NO. 00	DATE: 14.11.14
			SHEET 2	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	

350

	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
INTEGRAL STARTER	INTEGRAL STARTER	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	<input checked="" type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS	
	TYPE	<input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)	
	STEP DOWN CONT. TRANSFORMER	<input checked="" type="checkbox"/> REQUIRED	
	OPEN / CLOSE PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	STOP PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	INDICATING LAMPS	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	LOCAL REMOTE S/S	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)	
INTERPOSING RELAY (Applicable for integral Starter)	INTERPOSING RELAYS	REQUIRED	
	INTERPOSING RELAY (QUANTITY)	<input type="checkbox"/> 2 NOs. <input checked="" type="checkbox"/> 3 NOs.	
	DRIVING VOLTAGE	<input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC	
	DRIVING CURRENT	<input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX	
	LOAD RESISTANCE	<input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms	
TORQUE SWITCH	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
LIMIT SWITCH	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2 Nos. 2 Nos. (ADJ.) <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos.	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	

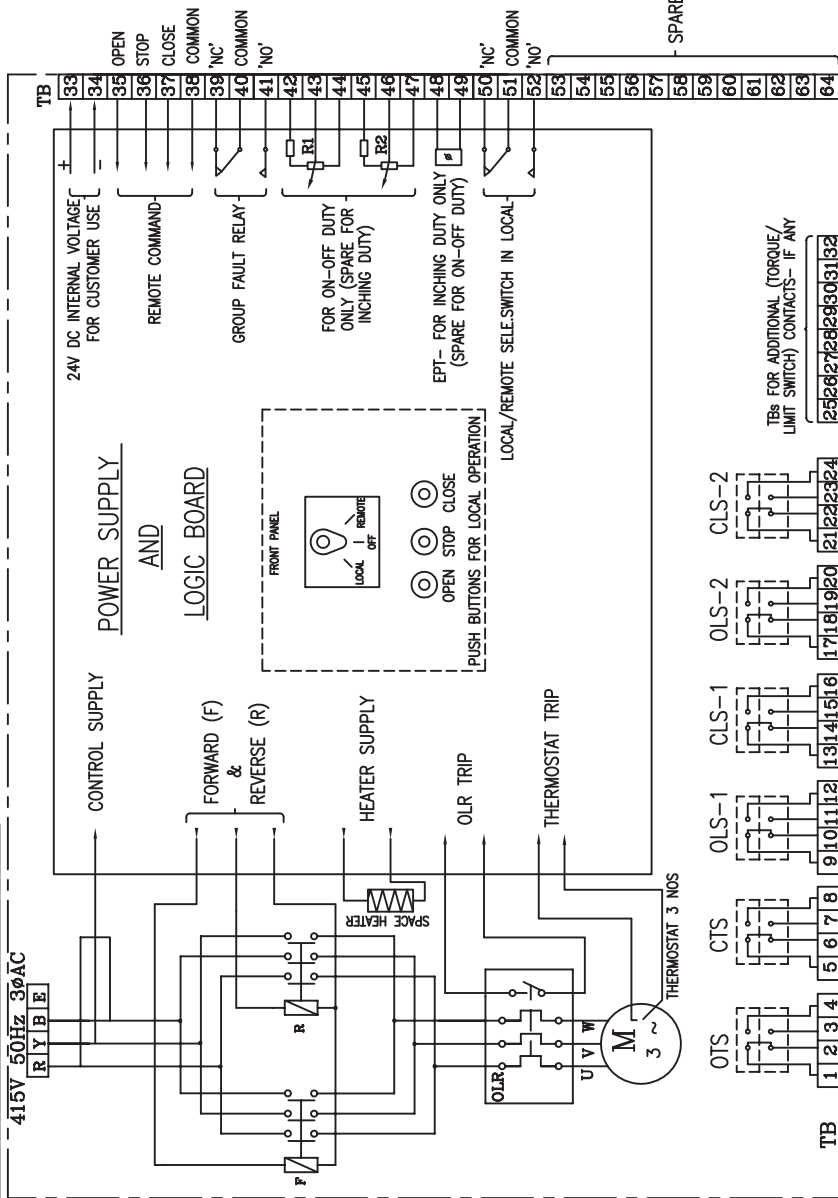
FORM NO. PEM-6666-0

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-SS-411-145-I007	
			VOLUME	
			SECTION	
			REV. NO. 00	DATE: 14.11.14
			SHEET 3	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	

350

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty)	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	<input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	<input checked="" type="checkbox"/> 24V DC <input type="checkbox"/>	
	OUTPUT	<input checked="" type="checkbox"/> 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY		
	@ RATING	415v, 3PH, AC FOR RATING > 0.2KW; SINGLE PHASE FOR RATING < 0.2KW	
TERMINAL BOX	MOTOR TERMINAL BOX	REQUIRED	
	ACTUATOR TERMINAL BOX	REQUIRED	
	ENCL CLASS MTR T.B. / ACTUATOR T.B.	<input checked="" type="checkbox"/> IP 67 @ <input type="checkbox"/> <input checked="" type="checkbox"/> IP67 <input type="checkbox"/>	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMM, LS/TS FEED BACK, PoT)	<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED <input type="checkbox"/> <input type="checkbox"/> 2 NOS. <input type="checkbox"/>	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:--DURING DETAIL ENGINEERING	
	@ SPACE HEATER CABLE GLAND	SIZE: 2C x 2.5 sq. mm	
	OTHER CONTROL CABLE GLANDS-1	INSTRUMENT CABLE SIZE FOR ON/OFF DUTY VALVES SHALL BE 8PX0.5 SQMM - ONE CABLE GLAND OF OD SIZE 20 MM. INSTRUMENT CABLE SIZE FOR INCHING DUTY TYPE VALVES SHALL HAVE TWO NO. CABLES (ONE NO. 8PX0.5 SQMM AND 2ND 2PX0.5 SQMM) - TWO NO. GLANDS OF OD SIZES 20 MM & 15 MM.	
	OTHER CONTROL CABLE GLANDS-2		
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.
NOTES: 1. SCOPE: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY. 2. CODES & STANDARDS: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722 3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C. 4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED. 5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE. 6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. 7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.			
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @= TO BE FILLED BY ES			

DRAWING NO. 2227-SSIM-A-E



SWITCH TERMINALS FOR CUSTOMER USE

NOTE:-

1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE.
ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
2. CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
3. OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
4. OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
5. CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
6. EPT - ELECTRONIC POSITION TRANSMITTER
(Contactless , FOR INCHING DUTY)
7. R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M - MOTOR 3ø 4.15V 50 Hz AC SUPPLY

CONTACT DEVELOPMENT DIAGRAM	
OTS	1-2 OPEN AT OVER TORQUE DURING OPENING TRAVEL 3-4 CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6 OPEN AT OVER TORQUE DURING CLOSING TRAVEL 7-8 CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10 11-12
CLS-1	13-14 15-16
OLS-2	17-18 19-20
CLS-2	21-22 23-24
SWITCH NO.	FULL OPEN o INTERMEDIATE b FULL CLOSE

INDICATES CONTACT CLOSED
INDICATES CONTACT OPEN
CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH			
VALVES	OPEN		CLOSE
	MAIN	BACK UP	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS #

- CLS NOT TO BE CONNECTED IN TRIP CIRCUIT
* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

TYPE OF PRODUCT ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS
(DRAWN FOR INTERMEDIATE POSITION OF VALVES)

OR NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LTD., UNIT: HIGH PRESSURE BOILER PLANT, TIRUCHIRAPPALLI-620014.		DRN N.P.ESWAR	NAME N.P.	SIGN N.P.	DATE 07.10.04	NO. OF VAR
365-121	SCALE	CHD D.DINAKARAN	DRN N.P.ESWAR	SIGN N.P.	DATE 07.10.04	NO. OF VAR
DEPT	VL	APPD K.ARUNACHALAM	DRN N.P.ESWAR	SIGN N.P.	DATE 07.10.04	NO. OF VAR
CODE	SCALE	WEIGHT (KG)	DRN N.P.ESWAR	SIGN N.P.	DATE 07.10.04	NO. OF VAR
TITLE	SCALE	WEIGHT (KG)	DRN N.P.ESWAR	SIGN N.P.	DATE 07.10.04	NO. OF VAR
WIRING DIAGRAM (TERMINAL PLAN)		CARD CODE	REFERENCE INFORMATION			
FOR ACTUATOR WITH INTEGRAL STARTER		U 01	DRAWING NO.		3-V-MISC-24227	
			REV		0	

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

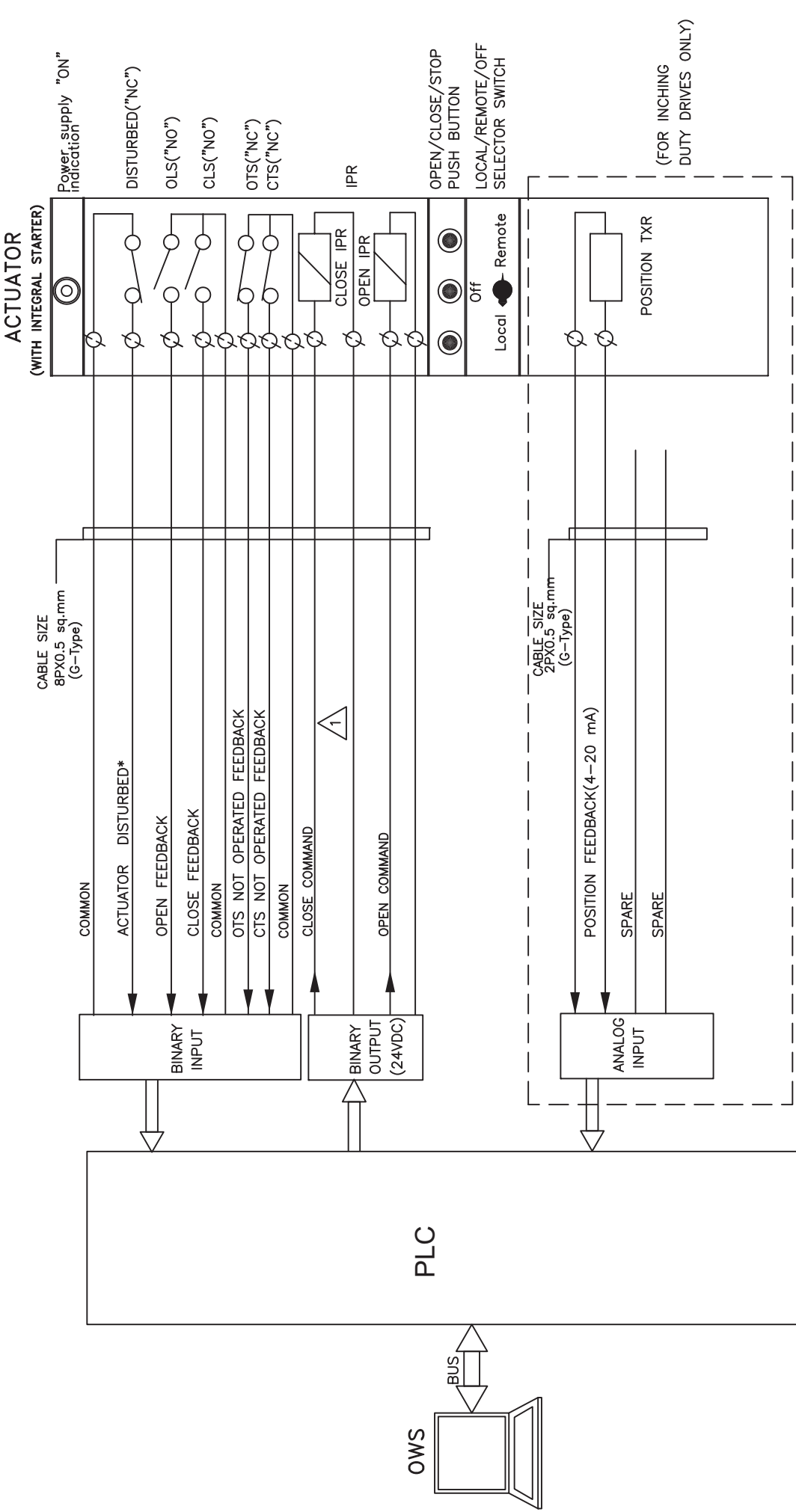
SHEET

OF

Drive Control Philosophy


PLC INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-11-673A-001

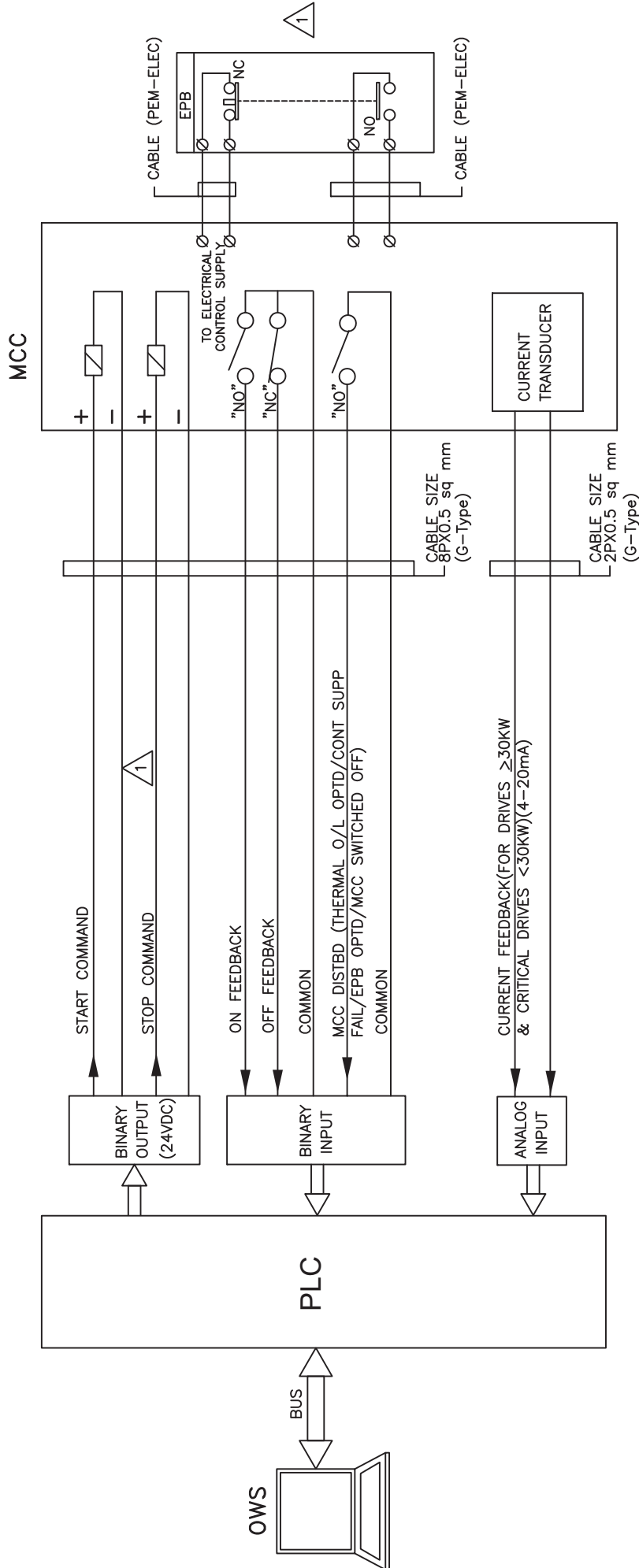



NOTE:

- * DISTURBED= Loss of Power supply (1 Phase/3 Phase)/
- Loss of control supply/ Motor thermostat trip/
- Thermal over load/
- Local/Off/Remote Sel. switch in local or off mode/
- Stop PB optd.

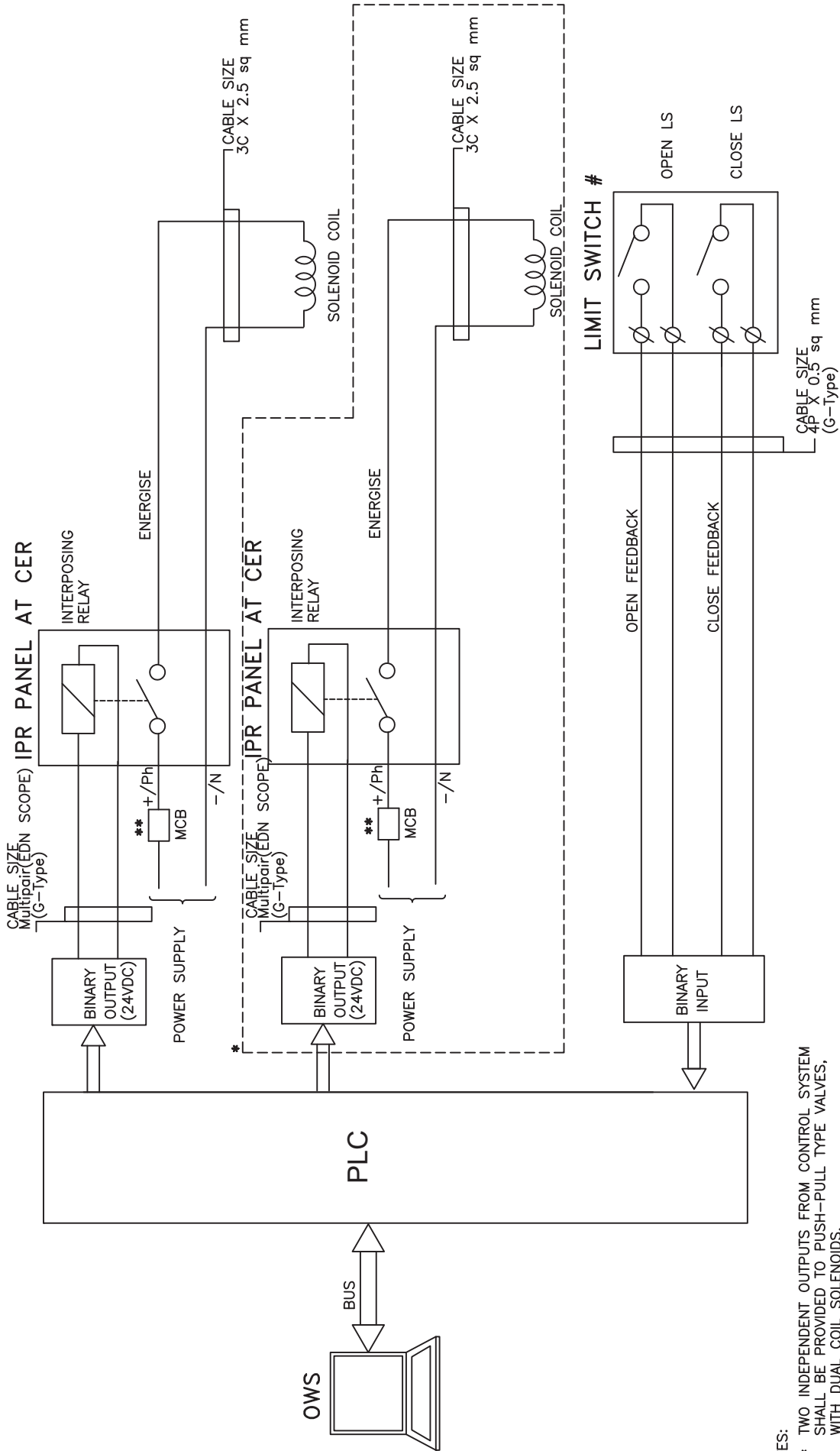
	PROJECT: 4 X 270 MW BHADRADRI TPS		DRG. NO. PE-DM-411-145-1002
	TITLE PLC INTERFACE FOR BIDIRECTIONAL DRIVE		DATE 06.02.2015
		REV. NO. 01	SHT 7 OF 11

PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE




	PROJECT: 4 X 270 MW BHADRADRI TPS		DRG.NO. PE-DM-411-145-1002
	TITLE PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE		DATE 06.02.2015
		REV.NO. 01	SHT 8 OF 11

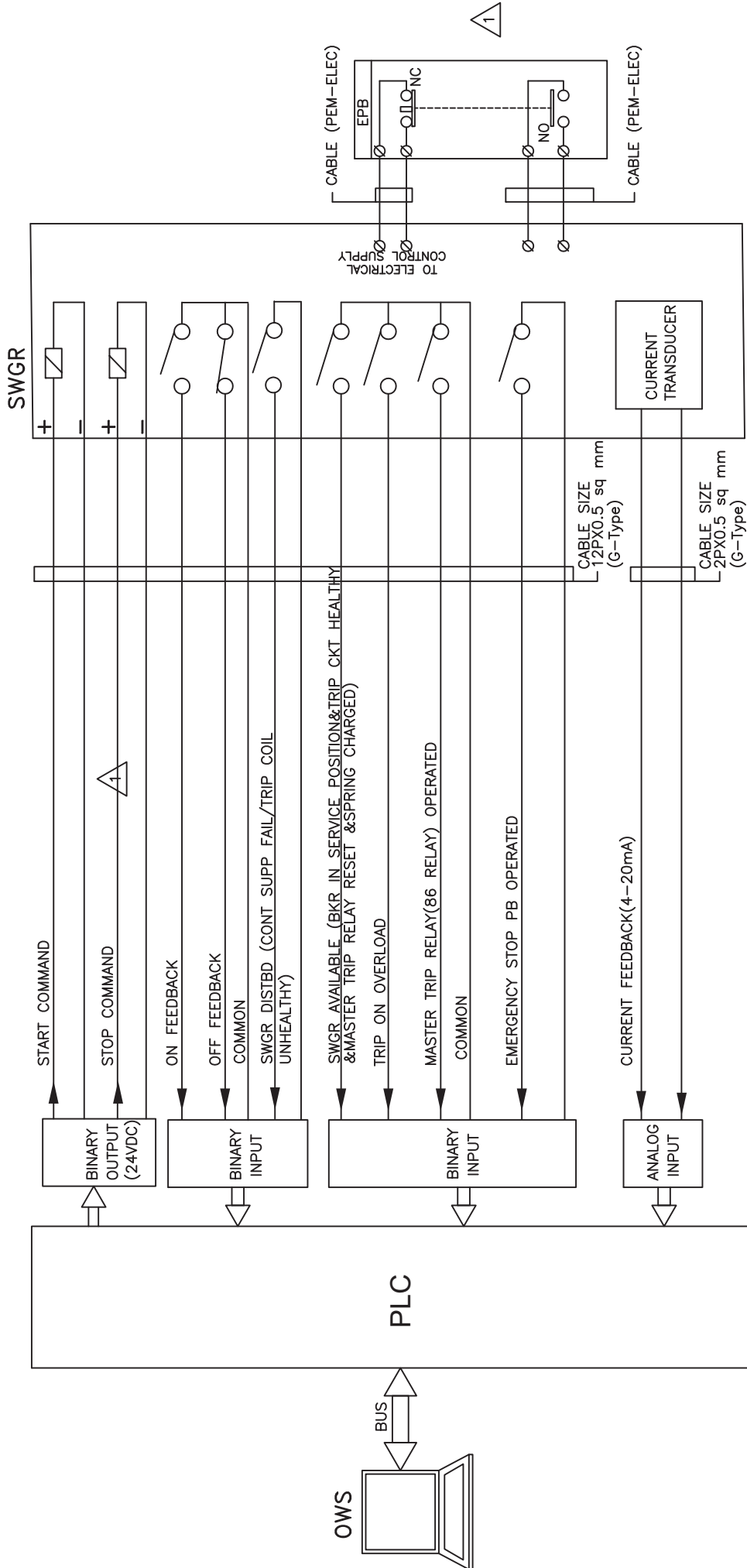
PLC INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)




- NOTES:
- * TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.
 - ** MCB SHALL BE PROVIDED FOR EACH SOLENOID
 - # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

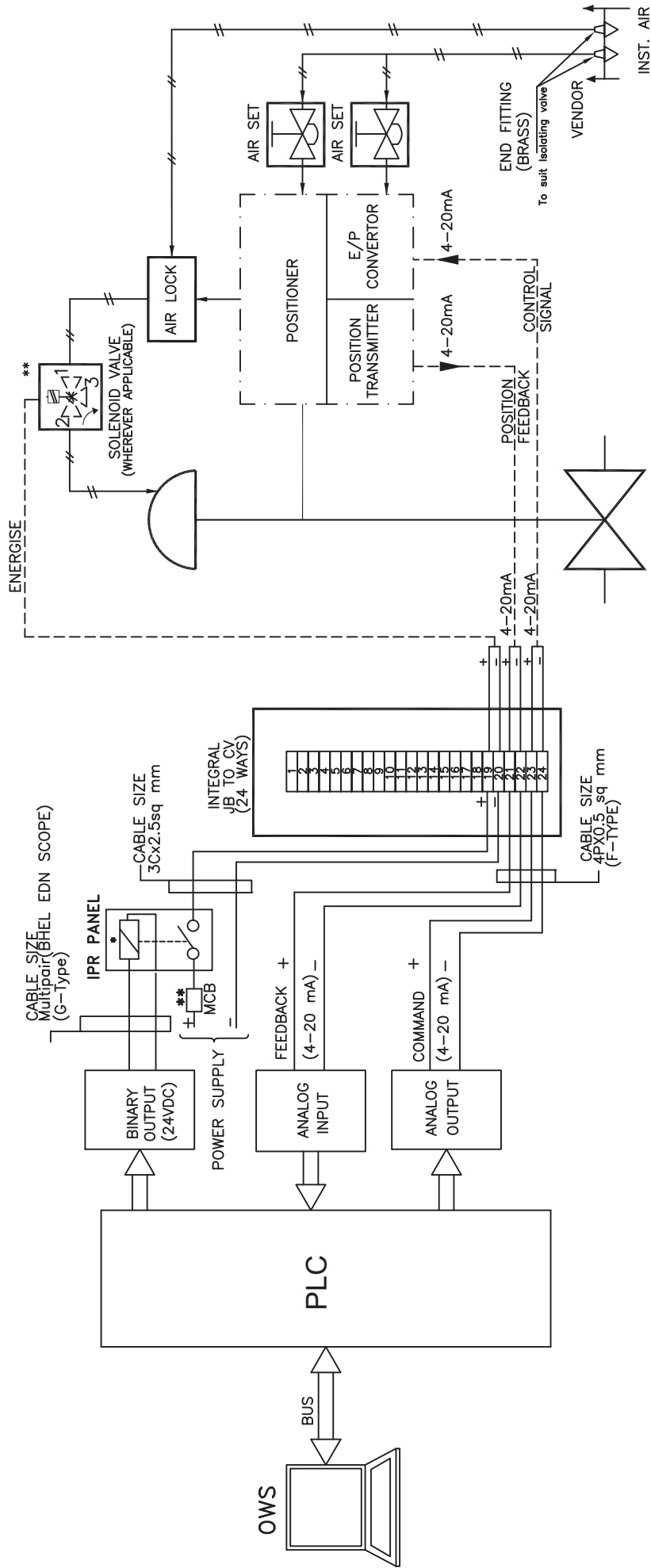
	PROJECT: 4 X 270 MW BHADRADRI TPS		DRG. NO. PE-DM-411-145-1002
	TITLE PLC INTERFACE FOR SOLENOID DRIVE		DATE 18.11.2014
			REV. NO. 00
			SHT 9 OF 11

PLC INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)



	PROJECT: 4 X 270 MW BHADRADRI TPS		DRG.NO. PE-DM-411-145-1002
	TITLE PLC INTERFACE FOR UNIDIRECTIONAL HT DRIVE		DATE 06.02.2015
		REV.NO. 01	SHT 10 OF 11

PLC INTERFACE FOR ANALOG DRIVE



NOTES:

* APPLICABLE TO VALVES WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.

** MCB SHALL BE PROVIDED FOR EACH SOLENOID



PROJECT: 4 X 270 MW BHADRADRI TPS

TITLE TYPICAL HOOK-UP DIAGRAM
ANALOG DRIVE(WITH SMART POSITIONER)

DRG.NO.	PE-DM-411-145-1002
DATE	18.11.2014
REV.NO.	00
SHT	11 OF 11



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

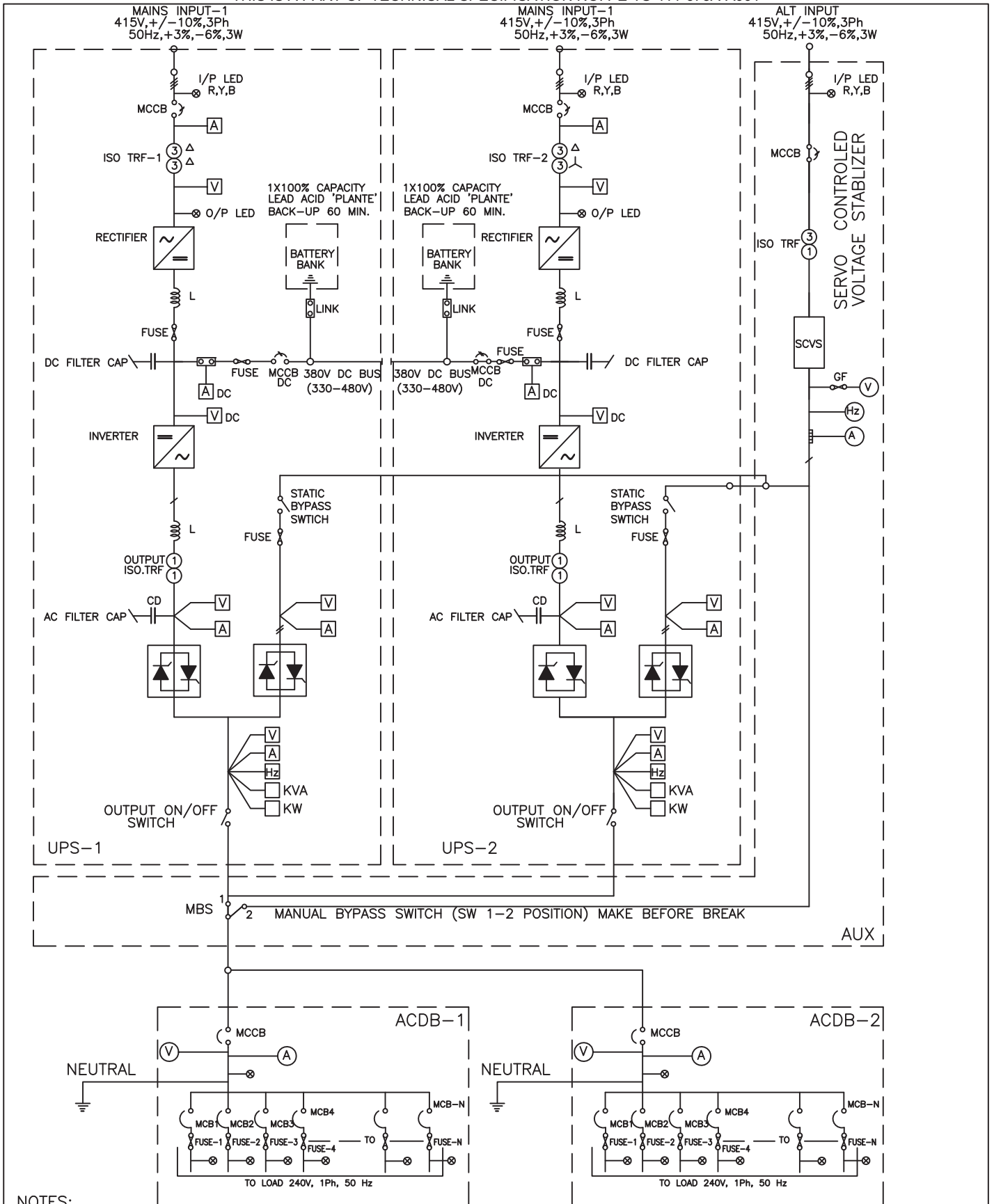
00

DATE : 19.03.2015

SHEET

OF

UPS SCHEME



NOTES:

1. ACDB-1&2 NEUTRAL TO BE GROUNDED TO A DEDICATED GROUND.
2. ALL OUTPUT FEEDERS OF ACDB SHALL BE PROVIDED WITH AN LED AFTER THE FUSE FOR FEEDER ON INDICATION WITH FEEDER DESCRIPTION.
3. REDUNDANT FEEDERS SHALL BE LOCATED IN DIFFERENT ACDBs.



4 X 270 MW BHADRADRI TPS

TITLE:-

UPS SINGLE LINE DIAGRAM

DRG. No.	PE-DG-411-145-1004		
REV. No.	00	DATE	21.03.2015
SHEET	2	OF	2



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

SHEET

OF

INSTRUMENTATION DATA SHEET

1.00.00 SPECIFICATION FOR ELECTRONIC TRANSMITTERS
1.01.00 PRESSURE TRANSMITTER

1. Working Principle : Smart (HART Compatible)
2. Type : Microprocessor based, 2 – Wire
3. Output Signal : 4-20 mA DC along with superimposed digital signal
4. Measuring Element : Capsule / Diaphragm
5. Element material : SS-316 (Stainless Steel) or better
6. Static Pressure : 150 % of maximum span continuously, without affecting the calibration
7. Turn-down ratio : 100: 1
8. Span and Zero : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
9. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
10. Output Indicator : LCD (Integral indicator of 5 digit display)
11. Nameplate : Tag number, service engraved in SS tag plate
12. Body : SS
13. Operating Voltage : 24V DC
14. Load : 600 Ohms (min.) at 24 Volts D.C.
15. Ambient Temperature : 0 - 50 °C
16. Performance: :
 - i. Accuracy : $\pm 0.075\%$ of Span or better

- ii. Repeatability : $\pm 0.05\%$ of Span or better
17. Sealing/Isolation : Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
18. Accessories :
 - a. Universal mounting bracket suitable for 2" pipe mounting
 - b. High tensile carbon steel U-bolts
 - c. Siphon for steam and hot water services
 - d. 1/2" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock
 - e. Companion flange with nuts, bolts and gaskets
 - f. 1/2" NPT cable gland
 - g. Handheld calibrator
19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system

Notes: For primary air/ secondary air/ flue gas applications, DP type transmitters shall be provided for pressure measurement. LVDT type is not acceptable.

1.02.00 DIFFERENTIAL PRESSURE TRANSMITTER / FLOW TRANSMITTER

1. Working Principle : Smart (HART Compatible)
2. Type : Microprocessor based, 2 – Wire
3. Output Signal : 4-20 mA DC along with superimposed digital signal
4. Measuring Element : Capsule / Diaphragm

-
5. Element material : SS-316 (Stainless Steel) or better
6. Static Pressure : 150 % of maximum span continuously, without affecting the calibration
7. Turn-down ratio : 100: 1
8. Span and Zero : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
9. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
10. Output Indicator : LCD (Integral indicator of 5 digit display)
11. Nameplate : Tag number, service engraved in SS tag plate
12. Body : SS
13. Operating Voltage : 24V DC
14. Load : 600 Ohms (min.) at 24 Volts D.C.
15. Ambient Temperature : 0 - 50 °C
16. Performance:
- i. Accuracy : $\pm 0.075\%$ of Span or better
 - ii. Repeatability : $\pm 0.05\%$ of Span or better
17. Sealing/Isolation : Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
18. Accessories :
- a. Universal mounting bracket suitable for 2" pipe mounting
 - b. High tensile carbon steel U-bolts

- c. Siphon for steam and hot water services
- d. ½” NPT 5-valve stainless steel manifold, constructed from SS316 bar stock
- e. Companion flange with nuts, bolts and gaskets
- f. ½” NPT cable gland
- g. Handheld calibrator

19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system

1.03.00 Displacer Type Level Transmitters

- 1. Type : Smart (HART Compatible)
- 2. Stages of operation : Continuous
- 3. Material :
- 4. i. Displacer : SS-316
- 5. ii. Suspension wire : SS-316
- 6. iii. Torque tube housing : SS
- 7. iv. Torque tube : Inconel
- 8. v. Displacer chamber : SS
- 9. vi. Transmitter Housing : SS
- 10. Operating Voltage : 24 V DC
- 11. Transmission : Microprocessor based, 2-wire
- 12. Output Signal : 4-20 mA DC along with superimposed digital signal
- 13. Static / overload : Maximum static pressure without

	pressure		permanent deformation or loss of accuracy
14.	Turn-down ratio	:	10 : 1 or better
15.	Zero & Span	:	Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
16.	Enclosure Class	:	IP-65
17.	Output Indicator	:	LCD type (Integral indicator of 5 digit display)
18.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
19.	Ambient Temperature	:	0 - 50 °C
20.	Load Impedance	:	600 Ohms at 24 Volts (minimum)
21.	Process Connection	:	2" Flanged
22.	Performance - Accuracy	:	± 0.075 % of span or better
23.	Accessories	:	<ul style="list-style-type: none"> a) Counter Flange, nuts, bolts, gaskets etc b) Weights for 5 point calibration of instruments c) Vent and drain plugs d) ½" NPT Glands e) Handheld calibrator
24.	Preferred Features	:	<ul style="list-style-type: none"> a) Test plug connection and cutout terminals physically separated from other electronics b) Electronic Damping facility (adjustable)
25.	Adjustment/Calibration/ Maintenance	:	From handheld calibrator/ HART management system

26. Applications : During detail engineering on Owner's approval
- 1.04.00 MASS FLOW METER
- 1.04.01 SENSOR
1. Measuring Principle : Coriolis Mass flow
 2. Primary Element : Flow Tube of 316SS or better
 3. Heating Arrangement : Integral
 4. Temperature Control : For heavy fuel oil application
 5. Process Connection : Flanged of rating as per process requirement
 6. Drain : Self-draining facility
 7. Enclosure : Stainless steel
 8. Accessories : Counter flanges, Mounting nuts, bolts, gaskets etc.
- 1.04.02 TRANSMITTER
1. Measured quantities : Mass Flow rate, Total Mass Flow, Density
 2. Input Signal Processing : Smart (HART compatible)
 3. Display : LCD
 4. Output : 2 nos. isolated output of 4-20mA DC selectable from four measured quantities
 5. Load : < 750 ohms
 6. Power supply : 240V AC, 50 Hz

-
- | | | | |
|-----|---|---|---|
| 7. | Turn Down | : | 100:1 |
| 8. | Accuracy | : | ± 0.2 % of measured value |
| 9. | Housing | : | IP 65 (Explosion proof) |
| 10. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 11. | Accessories | : | a) Handheld calibrator
b) Mounting U-bolts, nuts, bolts, prefab cable etc
c) $\frac{1}{2}$ "NPT cable gland |
| 12. | Adjustment/Calibration/
/Maintenance | : | From handheld calibrator/ HART management system |
| 13. | Applications | : | Fuel Oil service |

1.05.00 RADAR TYPE LEVEL MEASUREMENT

- | | | | |
|----|---------------------------|---|---|
| 1. | Type | : | Smart (HART Compatible) |
| 2. | Antenna | : | Co axial / guided wave radar /-Overspill protection |
| 3. | Principle | : | TDR (Time Domain Reflectometry) |
| 4. | Communication | : | Two wire 4-20mA DC with HART |
| 5. | Environmental temperature | : | 0 – 50 °C |
| 6. | Enclosure | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 7. | Calibration | : | a) Self calibration with internal reference
b) Zero & Span calibration |
| 8. | Process Connection | : | External cage mounting
Flanged /screwed |
| 9. | Electronic Housing | : | Epoxy painted Die-Cast aluminium |

		alloy
10. Antenna / Flange assembly	:	316 SS or Hest alloy (as required)
11. Power supply	:	24 V DC
12. Output Indicator	:	LCD
13. Accuracy	:	5 mm or 0.1% of probe length
14. Accessories	:	a) Handheld calibrator
	:	b) Counter Flange, nuts, bolts, gaskets etc
	:	c) ½"NPT cable gland
	:	d) SS Nameplate
15. Adjustment/Calibration/ Maintenance	:	From handheld calibrator/ HART management system
16. Applications	:	Vessels under vacuum or low pressure applications, solid levels
1.06.00	ULTRASONIC LEVEL TRANSMITTER	
1. Type	:	Microprocessor based, 2-wire, Smart (HART Compatible)
2. Operating Principle	:	Detection of reflected ultrasonic pulse
3. Output Signal	:	4-20 mA DC along with superimposed digital signal
4. Operating frequency	:	10 KHz to 50 KHz (typical)
5. Display	:	LCD
6. Temperature Compensation	:	Built in –Programmable
7. Power supply	:	24 V DC
8. Enclosure	:	SS, IP-65 (Explosion proof for NEC Class-1, Division 1 area)

-
- | | | | |
|-----|-------------------------------------|---|---|
| 9. | Zero & Span | : | Continuous, tamper proof, remote as well locally adjustable. It shall be possible to calibrate the instrument without any level in the sump/ tank |
| 10. | Accuracy & Repeatability | : | 0.15 % of span or better |
| 11. | Resolution | : | 0.1 % of span |
| 12. | Operating temp. | : | Transmitter- 500 C and Sensor - 800 C |
| 13. | MOC Sensor | : | SS-316/Body- PVC and Face – Polyurethane |
| 14. | Mounting | : | 4” Flanged/ 2” NPT for sensor and Transmitter on panel |
| 15. | Accessories | : | <ul style="list-style-type: none"> a) Handheld calibrator b) Weather canopy for protection from direct sunlight and direct rain c) ½”NPT cable gland d) All mounting hardware (SS-316), Prefab cable e) SS Nameplate |
| 16. | Diagnosis | : | On-line |
| 17. | Status Indication | : | Power On, HI, HI-HI, Lo, LO-LO, Fault |
| 18. | Output Contacts | : | 2 SPDT, 230V, 5A |
| 19. | Adjustment/Calibration/ Maintenance | : | From handheld calibrator/ HART management system |
| 20. | Applications | : | Coal Bunker, Water Service etc. |

1.07.00 ULTRASONIC FLOW TRANSMITTER

- | | | | | | | | | | | | | | |
|-----|---|---|--|----|---------------------|----|-------------------|----|------------------|----|--------------------------------|----|--------------|
| 1. | Type | : | Ultrasonic – Clamp On | | | | | | | | | | |
| 2. | Accuracy | : | +/- 1 % of reading | | | | | | | | | | |
| 3. | Repeatability | : | +/- 0.3 % of reading | | | | | | | | | | |
| 4. | Rangeability | : | 400 : 1 | | | | | | | | | | |
| 5. | Output Signal | : | 4-20 mA DC with HART | | | | | | | | | | |
| 6. | Measured Parameter | : | Volumetric flow, Totalized flow and flow Velocity | | | | | | | | | | |
| 7. | Display | : | LCD with internal Key Pad (Flow rate & Totalization) | | | | | | | | | | |
| 8. | Power Supply | : | 24 V DC (2 Wire) | | | | | | | | | | |
| 9. | Enclosure | : | SS (IP- 68 – Submersible) | | | | | | | | | | |
| 10. | Mounting | : | SS Chain or Strap | | | | | | | | | | |
| 11. | Accessories | | <table border="0"> <tr> <td style="vertical-align: top;">1.</td> <td style="vertical-align: top;">Handheld calibrator</td> </tr> <tr> <td style="vertical-align: top;">2.</td> <td style="vertical-align: top;">½"NPT cable gland</td> </tr> <tr> <td style="vertical-align: top;">3.</td> <td style="vertical-align: top;">Transducer cable</td> </tr> <tr> <td style="vertical-align: top;">4.</td> <td style="vertical-align: top;">All mounting hardware (SS-316)</td> </tr> <tr> <td style="vertical-align: top;">5.</td> <td style="vertical-align: top;">SS Nameplate</td> </tr> </table> | 1. | Handheld calibrator | 2. | ½"NPT cable gland | 3. | Transducer cable | 4. | All mounting hardware (SS-316) | 5. | SS Nameplate |
| 1. | Handheld calibrator | | | | | | | | | | | | |
| 2. | ½"NPT cable gland | | | | | | | | | | | | |
| 3. | Transducer cable | | | | | | | | | | | | |
| 4. | All mounting hardware (SS-316) | | | | | | | | | | | | |
| 5. | SS Nameplate | | | | | | | | | | | | |
| 12. | Adjustment/Calibration/
/Maintenance | : | From handheld calibrator/ HART management system | | | | | | | | | | |
| 13. | Applications | : | Plant water service | | | | | | | | | | |

Note: Multi-path insertion type (minimum 4 path) Ultrasonic Flow meter shall be provided for Raw water/ Cooling Water flow measurements.

2.00.00 HART HAND HELD CALIBRATOR

Hand held calibrators (5 nos. for each type) shall be provided for adjustment/ calibration/maintenance of the HART compatible

transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided.

3.00.00 PROCESS ACTUATED SWITCHES

3.01.00 PRESSURE SWITCH

1. Type :
 - i. Piston for high pressure application
 - ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
material : All other wetted part SS316
3. Case Material : SS \dagger
4. Setter Scale : Black graduation on white linear scale.
Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure
6. Adjustments :
 - a) Internal Set Point
 - b) Differential adjustment
7. End Connection : 1/2" NPT bottom connected
8. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)
9. Switch Type : Snap acting, shock & vibration proof
10. Terminal Block : Suitable for full ring lugs
11. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12. Performance :
 - a) Repeat accuracy \pm 1.0%
 - b) Accuracy of Setting Indication of \pm 1.5%
13. Ambient temperature : 0 – 50 Deg.C

14. Nameplate : Tag number, service engraved in SS tag plate
15. Accessories : a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary for corrosive/ viscous/ solid bearing or slurry type fluid applications
b) Snubbers for pulsating fluid applications
c) Siphons for steam and hot water services
d) Retention ring and screws for surface mounting
e) 1/2" NPT 2 Valve SS-316 barstock manifold
f) 1/2" NPT cable gland
16. Applications : During Detail Engineering on Owner's approval

3.02.00 DIFFERENTIAL PRESSURE SWITCH

1. Type : i. Piston for high pressure application
ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
material All other wetted part SS316
3. Case Material : SS
4. Setter Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure

-
- | | | | |
|-----|----------------------|---|---|
| 6. | Adjustments | : | a) Internal Set Point |
| | | : | b) Differential adjustment |
| 7. | End Connection | : | 1/2" NPT bottom/ back connected |
| 8. | Switch configuration | : | Two SPDT (240V, 5A AC/220V, 0.5A DC) |
| 9. | Switch Type | : | Snap acting, shock & vibration proof |
| 10. | Terminal Block | : | Suitable for full ring lugs |
| 11. | Enclosure Class | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 12. | Performance | : | a) Repeat accuracy $\pm 1.0\%$
b) Accuracy of Setting Indication of $\pm 1.5\%$ |
| 13. | Ambient temperature | : | 0 – 50 Deg.C |
| 14. | Nameplate | : | Tag number, service engraved in SS tag plate |
| 15. | Accessories | : | a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary Diaphragm seals for corrosive/ viscous/ solid bearing or slurry type fluid applications
b) Snubbers for pulsating fluid applications
c) Siphons for steam and hot water services
d) Retention ring and screws for surface mounting
e) 1/2" NPT 5 Valve SS-316 barstock manifold
f) 1/2" NPT cable gland |
| 16. | Applications | : | During Detail Engineering on Owner's |

approval

3.03.00 LEVEL SWITCH

3.03.01 FLOAT OPERATED

1. Float material : SS-316
2. Wetted parts : SS-316
3. Float chamber : Stainless steel/Carbon steel, construction welded
4. Float chamber : Side mounted
mounting
5. Fluid connection : Side – Side
6. Fluid connection size : 1" ANSI RF Flange (rubber line, if required)
7. Drain : ½ inch NPT with Plug
8. Pressure rating of chamber : Minimum 1.5 times of design pressure
9. Repeatability : +/- 1.5 mm or better
10. Switch housing : Stainless Steel
11. Switch housing type : IP- 65
12. Type of switch : Snap acting magnetically operated hermetically sealed
13. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
14. Accessories :
 - a) Counter flange, nuts & bolts, suitable gasket etc.
 - b) Steel globe type drain valve
 - c) ½"NPT cable gland

d) Stainless steel nameplate with alpha-numeric engraved for service and tag

15. Application : During Detail Engineering on Owner's approval

3.04.00 FLOW SWITCH

1. Type : Paddle /Piston/Disk
2. Wetted part material : Stainless steel or Hastelloy for acidic application
3. End connection :
 - a) Threaded upto 1" line size with integral Tee
 - b) Flanged for line size > 1 ½"
4. Enclosure material : Stainless Steel
5. Enclosure class : IP 65
6. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
7. Repeatability : 2%
8. Cable connection : ½"NPTF
9. Accessories :
 - a) Tee, Counter flange, nuts & bolts, suitable gasket etc
 - b) ½"NPT cable gland
 - c) Stainless steel nameplate with alpha-numeric engraved for service and tag

3.05.00 RF LEVEL SWITCH

-
- | | | |
|-----------------------------|---|--|
| 1. Type | : | RADIO FREQUENCY |
| Sensing probe | | |
| 2. Material | : | SS-316 |
| 3. Mounting | : | Threaded |
| 4. Application | : | 250°C (Max.) |
| Temperature | | |
| Electronic Controller | | |
| 5. Input Supply Voltage | : | 240V AC ±10%, 50 Hz. |
| 6. Relay Output | : | 2 SPDT (240V AC, 5A) |
| 7. Ambient Temperature | : | 50 °C |
| 8. Enclosure Protection | : | IP-66 |
| 9. Enclosure Housing | : | SS |
| | | Normal Level |
| | | Power On |
| 10. Local LED Indication | : | Alarm Level |
| | | Probe Healthy |
| 11. Switching Repeatability | : | ±0.5% |
| | | Co-axial cable for probe connection to |
| | | controller |
| 12. Accessories | : | SS Tag plate |
| | | ½" NPT Cable Glands |
| 13. Application | : | Solid level |

3.06.00 CONDUCTIVITY TYPE LEVEL SWITCH

- | | | |
|------------------|---|-----------------------------|
| 1. Type | : | Conductivity discrimination |
| 2. Probe MOC | : | SS-316 |
| 3. Mounting | : | Flanged on external cage |
| 4. Application | : | 250°C (Max.) |
| Temperature | | |
| 5. Test Pressure | : | Two times rated pressure |

- | | | | |
|-----|----------------------|---|--|
| 6. | Input Supply Voltage | : | 240V AC \pm 10%, 50 Hz.
Four independent channel with |
| 7. | Input | : | selectable switching threshold for water conductivity |
| 8. | Relay Output | : | 2 SPDT (240V AC, 5A) |
| 9. | Ambient Temperature | : | 50 °C |
| 10. | Enclosure Protection | : | IP-65 (Explosion proof for NEC Class-1, Division-1 area) |
| 11. | Enclosure Housing | : | SS
HI,LO, HIGH-HIGH, LOW-LOW |
| 12. | Local LED Indication | : | Power
Fault |
| 13. | Accessories | : | <ul style="list-style-type: none"> a) Interconnecting cable from probe to electronics b) Mounting accessories c) External cage d) Washer & Gasket e) 1/2" NPT Cable Glands f) SS Tag Plate |
| 14. | Application | : | During Detail Engineering on Owner's approval |

3.07.00 TEMPERATURE SWITCH

- | | | | |
|----|-----------------------------|---|--------------------------|
| 1. | Type | : | Bimetallic or gas filled |
| 2. | Sensing Element
Material | : | SS-316 |
| 3. | Bulb Material | : | SS-316 |
| 4. | Capillary | : | Stainless Steel armored |

-
5. Movement Material : Stainless Steel
6. Case material : Stainless Steel with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
- 7.. Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
8. Over range Protection : 120 %
9. Instrument connection : Bottom
10. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)
11. Switch type : Snap acting, shock and vibration-proof
12. Adjustability : Internal Set point adjustable over span range
13. Compensation : a) Capillary compensation with invar wire throughout the capillary length
b) Case compensation
14. Performance
- a) Scale Accuracy : ± 1.0 % of full scale
- b) Repeatability : < 0.5 % of full range
- c) Response time : Less than 40 seconds with thermowell
15. Capillary length : 5 meters (minimum) for local mounting/15 meters for local panel mounting
16. Nameplate : Tag number, service engraved in stainless steel tag plate
17. Accessories : Mounting accessories, 1/2" NPT cable gland
18. Applications : During Detail Engineering on Owner's

approval

4.00.00 LOCAL INSTRUMENTS
4.01.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

- | | | |
|--------------------------|---|--|
| 1. Type | : | Bourdon/Bellows/Diaphragm |
| 2. Sensing & Socket | : | SS-316 |
| 3. Movement Material | : | SS-316 |
| 4. Case Material | : | Stainless steel. IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 5. Dial Size | : | Generally 150 mm |
| 6. Scale | : | Black lettering on white in 270 O arc. |
| 7. Window | : | Shatterproof glass |
| 8. Range Selection | : | Normal process pressure: 50~70 % of range |
| 9. Over-range Protection | : | 125% of maximum range by internal stop. External stop at zero |
| 10. Adjustment | : | For Zero adjustment (Micrometer screw external)
For Range adjustment (Micrometer screw internal). |
| 11. Element Connection | : | Argon welding |
| 12. Process Connection | : | 1/2" NPT (M) Bottom for local, back for panel mounting |
| 13. Performance | : | Accuracy of ± 1.0 % of span or better |
| 14. Operating ambient | : | 0 - 50 °C |
| 15. Safety Feature | : | Blow out disc /diaphragm at the back |
| 16. Accessories | : | a) Snubbers for pulsating fluid application.discharge
b) Stainless steel Diaphragm seals |

- for corrosive/ viscous/ solid bearing or slurry type fluid applications
- c) 3-Way SS316 Gauge cock for pressure gauges
- d) 5-valve SS316 manifold from barstock for differential pressure gauge
- e) Siphons for steam and hot water services
17. Nameplate : Tag number, service engraved in stainless steel tag plate

4.02.00 LEVEL INDICATOR (FLOAT & BOARD TYPE)

1. Type : Float and Board
2. Float Material : SS-316
3. Float Cable : SS-316
4. Indicator Assembly : Epoxy painted Aluminium
5. Guide wire spring assembly : SS-316 (2 Nos.)
6. Guide Wire Anchor : SS-316
Anodized Aluminium with engraved marking (Minimum graduation 10mm),
7. Scale Board :
mounting brackets and suitable hardware required as per tank height
8. Elbow Assembly : Anodized Aluminium
9. Flanges : RF , ANSI 150 , SS (3 Nos.)
10. Accuracy : ± 10 mm or better
11. Accessories : All mounting accessories including counter flange, nuts & bolts, suitable

gasket etc. as applicable, SS Tag plate

4.03.00 GAUGE GLASS

- | | | | |
|----|----------------------------------|---|---|
| 1. | Type | : | Reflex /Transparent |
| 2. | Material | : | Toughened borosilicate resistant to thermal shock |
| | Glass | : | Carbon Steel Stainless Steel |
| | Body Material | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 3. | Integral cocks & valves/Fittings | : | i. SS 316 |
| 4. | | : | Rubber lined corrosion resistant
ii. stainless steel (for DM/RO service) |
| 5. | Vessel Connection | : | ANSI Flanged SS316 |
| 6. | Accessories | : | i. Integral cocks
ii. Drain Valves
iii. Companion Flanges, Bolts, nuts, gaskets, SS Tag plate
iv. Illuminating lamps, Mica shield as required
v. Calibrated scale |
| 7. | Pressure rating | : | Twice the maximum working pressure |
| 8. | Temperature | : | 300 °C
For larger lengths (greater than 1200mm), additional gauge glasses shall be provided with minimum of 50 mm overlap. |
| 9. | Other details | : | |

-
- 4.04.00 SLIGHT GLASS
1. Type : Flap-type.
 2. End connection : Screwed / Flanged
 3. Material
 - a) Body : SS- 304
 - b) Cover plate : SS- 304
 - c) Indicator : SS- 316
 4. Sight Glass : Toughened Borosilicate
 5. Gasket : Neoprene
 6. Bolts & Nuts : High tensile steel.
 7. Hydraulic Test Pressure : 1.5 times maximum working pressure
 8. Accessories : Companion Flanges, Bolts, nuts, gaskets as required, SS Tag plate.
- 4.05.00 ROTAMETER
1. Type : ON-LINE for line upto and including 50 mm NB.
: Borosilicate BY-PASS for line size above 50 NB
 2. Metering tube : Toughened Borosilicate
 3. Float : SS-316
 4. End fittings : SS-316
 5. Packing material : Teflon / PTFE
 6. Casing : Stainless Steel
 7. Gland Rings : Stainless Steel
/Followers/ Other :
wetted parts
 8. Orifice Plate : Stainless Steel (for bypass type)
 9. Operating Temperature : 0-50 Deg. c

- | | | |
|------------------------|---|--|
| 10. Test Pressure | : | 200% of maximum operating pressure |
| 11. Scale | : | 250 mm nominal length |
| 12. Graduation | : | Direct reading |
| 13. Process Connection | : | Flanged (RF) to line size as per ANSI standards (150#) |
| 14. Tapping | : | D & D/2 |
| 15. Accuracy | : | +/- 2% of full scale reading |
| 16. Reproducibility | : | Within 0.5% of instantaneous reading |
| 17. Accessories | : | SS Tag Plate, orifice plate |

5.00.00 TEMPERATURE ELEMENTS & ACCESSORIES
5.01.00 RESISTANCE TEMPERATURE DETECTOR

- | | | |
|----------------------------------|---|--|
| 1. Type | : | Platinum (Duplex), Ungrounded |
| 2. Platinum (Duplex), Ungrounded | : | 100 ohm at 0 °C |
| 3. Base | : | Wound on ceramic (anti-inductive) |
| 4. Wiring | : | 3 Wire |
| 5. Protecting Tube | | |
| a) O.D. | : | 6 mm |
| b) Material | : | SS-316, Seamless |
| c) Filling | : | Magnesium oxide (Purity above 99.4%). |
| 6. Response time | : | a) 15 sec. (bare).
b) 30 sec. (with thermowell) |
| 7. Calibration | : | DIN 43760 |
| 8. Accuracy | : | ± 0.5% |
| 9. Head | | |
| a) Type | : | IP-65 universal screwed type |

- b) Material : Stainless Steel
- c) Terminal blocks : Nickel plated Brass-screw type / silver plated
- d) Cable connection : ½" NPT gland and grommet
- e) Others : Terminal head cover with SS chain and suitable gasket.
- Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).
- Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT] with thermowell connection
10. Accessories :
- a) Compression fittings/unions
- b) Flanges etc. (for flanged connections only)
- c) Thermowell (As specified below)
- d) Thermowell connection : ½" NPT (M) or 150 RF Flanged
11. Thermowell connection
12. Nameplate : Tag number, service engraved in stainless steel tag plate

Note: The specifications for RTDs of winding/ bearing of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, the type of RTD shall be Pt-100.

5.02.00 THERMOCOUPLES

1. Type :
 - a) 16 SWG wire of Chromel Alumel) (Type-K)
 - b) Duplex
 - c) Ungrounded
2. Protecting Tube
 - a) O.D. : 6 mm
 - b) Material : SS-316, Seamless
 - c) Filling : Magnesium oxide (Purity above 99.4%).
3. Response time :
 - a) < 20 seconds for measurement
 - b) < 10 seconds for control
4. Accuracy : $\pm 1.1^{\circ} \text{C}$ up to 300°C & 0.4% of measured temperature range above 300°C
5. Head
 - a) Type : IP-65 universal screwed type
 - b) Material : Stainless Steel
 - c) Terminal blocks : Nickel plated Brass-screw type / silver plated
 - d) Cable connection : $\frac{1}{2}$ " NPT gland and grommet
6.
 - e) Others : Terminal head cover with SS chain and suitable gasket.

Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

7. Accessories :
- a) Adjustable nipple-union-nipple [1/2" Sch 80 X 1/2" NPT] with thermowell connection
 - b) Compression fittings/unions
 - c) Flanges etc. (for flanged connections only)
 - d) Thermowell (As specified below)
8. Thermowell connection : 1/2" NPT (M) or 150 RF Flanged
9. Nameplate : Tag number, service engraved in stainless steel tag plate

5.03.00 TEMPERATURE GAUGE

1. Type : Expansion type (Liquid filled system)
2. Sensing Element Material : Bourdon – SS-316
3. Bulb and Capillary Material : SS-316
4. Capillary Tubing : Inner sheath - solid drawn Material
copper tube
Outer sheath - PVC tube
5. Movement Materials : Stainless Steel / Direct Bourdon tip connection to pointer spindle
6. Case Material : Stainless Steel stove enameled, black finish, threaded bezel ring, clear glass

		cover conforming to IP 65.
7.	Dial size	: 150 mm
8.	Scale	: Black lettering on white background in 270 Deg.C arc
9.	Over range protection	: 125 percent of FSD
10.	Capillary Glanding	: 1/2" NPT(M) x compression fitting (SS) to suit capillary
11.	Instrument Connection	: Bottom connection for local mounting, back connection for panel mounting
12.	Process Connection	: 1/2" NPT (M) or 150 RF Flanged
13.	Extension Neck Length	: 50 mm
14.	Compensation	: a) Capillary compensation
15.		: b) Case compensation
16.	Performance	: a) Accuracy : + /- 1.0 percent of full scale Deflection
		: b) Repeatability : Less than 0.5 percent of full range
		: c) Response time: 15 seconds (max.).
17.	Capillary length	: 3.0 meters (local) / 15.0 metres (local panel)
18.	Other features	: Shatter proof glass
19.	Nameplate	: Tag number, service engraved in stainless steel tag plate
20.	Accessories	: SS316 Thermowell
5.04.00	THERMOWELL	
1.	Material	: SS-316
2.	Manufacture	: Drilled from bar stock, Hex Head, Tapered design (As per ASME PTC 19.3)

- | | | | |
|-----|------------------------|---|---|
| 3. | Process connection | : | M33x2 |
| 4. | Certification | : | Not applicable |
| 5. | Bore concentricity | : | +5% of wall thickness |
| 6. | Identification mark | : | Tag number punched on head |
| 7. | Surface treatment | : | Polish after machining |
| 8. | Element connection | : | ½" NPT (M) or 150 RF Flanged |
| 9. | Head | : | Hex |
| 10. | Length of the hex head | : | 31.75 mm (min.) |
| 11. | Accessories | : | SS Plug and chain for test thermo wells
SS Nameplate, Flange with companion
flange & all required accessories for
flanged connections. |

Note: Wake frequency calculations shall be furnished for all thermowells for approval.

Thermowells shall be designed such that the resonant frequency is above the exciting frequencies generated by vortex shedding in the process fluid.

5.05.00 METAL TEMPERATURE THERMOCOUPLE

- | | | | |
|----|----------------------------|---|---|
| 1. | Measuring medium | : | Metal temperature |
| 2. | Type | : | Chromel Alumel (Type-K)
Duplex, Ungrounded |
| 3. | Insulation | : | Mineral Insulation Magnesium Oxide |
| 4. | Wire gauge | : | 16 AWG |
| 5. | Protective sheath | : | SS |
| 6. | Protective sheath diameter | : | 8 mm O.D. |
| 7. | Characteristics | : | Special limits of error as in ANSI thermocouple MC 96.01 |
| 8. | Accessories | : | ½" BSP SS sliding end connector, weld pad, clamps of heat resistant steel |

- | | | | |
|----|----------------|---|-----------------------------|
| 1. | Type | : | Hydrometer Type |
| 2. | Mounting | : | On line |
| 3. | Accuracy | : | +/- 2% of range |
| 4. | Scale | : | Black letter on white scale |
| 5. | End connection | : | PVC flange |

9.06.00 DENSITY/ CONCENTRATION METER

- | | | | |
|----|--------------------|---|---|
| 1. | Wetted Part | | Stainless Steel |
| 2. | Enclosure | | Stainless Steel (IP-65) |
| 3. | Power Supply | | 24 V DC |
| 4. | Output signal | : | 4-20 mA DC (isolated) into 600 ohms |
| 5. | Accuracy | | ±0.001 g/cc |
| 6. | Indication | : | LCD display |
| 7. | Temp. Compensation | : | Integral |
| 8. | Accessories | | Mounting hardware, integral amplifier
(if required), cable glands, tag plate
etc. |

10.00.00 SOLENOID VALVES

- | | | | |
|----|---------------------|---|--------------------------------------|
| 1. | Operating Principle | : | Electromagnetic (noiseless) |
| 2. | Coil voltage rating | : | 240 V AC /24 V DC (as required) |
| 3. | Ways | : | 2/3/4 way |
| 4. | Port size | : | 1/4" NPT all ports |
| 5. | Body | : | SS bar stock |
| | Trim | : | SS-316 |
| 6. | Duty | : | Suitable for continuous energization |
| 7. | Sealing | : | Airtight and leak proof |
| 8. | Ambient Temperature | : | 0 - 50 ° C |

- | | | | |
|-----|-------------------|---|--|
| 9. | Fluid Temperature | : | 0-150 ° C (approx.) |
| 10. | Coil Enclosure | : | Stainless Steel |
| 11. | Insulation | : | Class-H |
| 12. | Coil Casing | : | IP-65 (Explosion proof for NEC Class-1, Division-1 area) |
| 13. | Mounting | : | On pipe or on panel |
| 14. | Cable Connection | : | ½" NPT |
| 15. | Accessories | : | Cable glands, SS Tag plate |



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

SHEET

OF

Instrumentation Check List



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks	
				M	C	B		
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V		
	1.1 MODEL NO/TAG NO							
	1.2 RANGE							
	1.3 END CONN							
	1.4 NO. OF CONTACT							
2	CALIBRATION				P	V	V	
	2.1 REPEATABILITY							
	2.2 SET POINT ADJUSTMENT							
	2.3 DIFFERENTIAL							
3	OVER PR & LEAK TEST				P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V		
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V		
	5.1 SENSOR							
	5.2 MOVEMENT							
	5.3 PROCESS CONNECTION							
	5.4 HOUSING							
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V		
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V		

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and the same alongwith test certificates to be verified by BHEL



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS	P		W	V		
6	EFFECT OF TEMP VARIATION ON ACCURACY	P		W	V		
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION		P	W	V		
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW	V	V	V		

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- When material correlation are not available manufacturer's compliance to be provided.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION	ONE	APPROVED SPEC./ DATA SHEETS	P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT	APPROVED SPEC./ DATA SHEETS	V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- When material correlation is not available, MFR's compliance to be provided
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION	ONE / LOT		P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR			P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 19.03.2015

SHEET OF

LCP & JUNCTION BOXES SPECIFICATION

1.00.00 **GENERAL REQUIREMENT**

1.01.00 ENCLOSURES FOR INSTRUMENTS AND OTHER EQUIPMENT

1.01.01 All panels, cabinets, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall have suitable environmental protection as detailed in Section-I of this volume of the specification.

1.02.00 SURFACE PREPARATION & PAINTING

1.02.01 All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below.

1.02.02 Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.

1.02.03 Two spray coats of inhibitive epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:

- Exterior – Opaline green shade 275 of IS: 5 or equivalent international code..
- Interior - Brilliant White.

1.02.04 Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.

1.03.00 WIRING

1.03.01 All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All intercommunications between sections of panels/desks shall be furnished.

1.03.02 Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized ink print shall be used with cross- identification.

1.03.03 All wire termination shall be made with insulated sleeve and crimping type lugs. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

- 1.03.04 Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables. Internal wiring shall be grouped so that all outgoing wiring to each particular remote location is terminated on adjacent terminal blocks. Interior wiring and jumperings shall be arranged so that external connections can be made from internal side of terminal blocks. Common connections shall be limited to two (2) wires per terminal.
- 1.03.05 Wiring shall be arranged to ensure free access to all instrument or devices for maintenance. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices
- 1.03.06 Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- 1.03.07 Shield wires shall be terminated on separate terminal blocks. Common connections shall be limited to two wires per terminal. Signal circuit shields shall be grounded at the power supply end only or as recommended by manufacturer.
- 1.03.08 All low level signal cables shall be separately bundled to from control cable and maintained at 300 mm minimum spacing from control bundles.
- 1.03.09 Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- 1.03.10 Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring. Shielded wires used in such cases for panel internal wiring shall be continuous and ungrounded with the shield terminated individually and separately in panel terminal block.
- 1.03.11 Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue failure of the conductor.
- 1.03.12 Internal wiring in factory pre-wired electronic systems cabinets may be installed according to the Contractor's standard wire size, insulation, and method of termination on internal equipment. Insulation for all wiring, including circuit board wiring, back panel wiring, power supply wiring and interconnecting cables between devices shall pass the vertical flame test per IPCEAS-1981. Identification of conductors may be done by insulation color-coding identified on drawings or by printed wiring lists.

- 1.04.00 TERMINAL BLOCKS
- 1.04.01 All terminal blocks shall be rail mounted/ post mounted type, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 Deg C. The terminal blocks in field mounted junction boxes, instrument enclosures racks etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room termination/ marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by Bidder shall be subject to Owner.
- 1.04.02 All terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, small partitions, transparent covers, support brackets, distance sleeves, warning level, marking etc. For RTDs ring - tong type lugs shall be used at Junction Boxes.
- 1.04.03 The characteristics of the terminal blocks shall be as follows.
- i) High contact force, independent of conductor cross-section and large contact surface area.
 - ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
 - iii) Inspection and maintenance free (resistant to thermal aging and vibration)
 - iv) Low and constant voltage drop
- 1.04.04 The insulation of the terminal blocks shall be of suitable thermoplastic material.
- 1.04.05 The spacing between Terminal blocks channels in panels and cubicles shall be adequate for routing the cable troughs and to allow adequate free workspace for termination and removal of wires. The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and junction box walls.
- 1.04.06 Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.
- 1.04.07 Terminal blocks shall be provided with white marking strips / self-adhesive marker cards and where permitted by the safety codes and standards, shall be without covers. Power terminals and high voltage (above 48 volts) terminals shall have protection covers. All terminals shall be provided with permanent terminal identification numbers on both sides.
- 1.04.08 At least 20% spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable.

- 1.04.09 The bottom of the terminal block shall be at least 200 mm above the cable gland for bottom entry type panels.
- 1.04.10 For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- 1.04.11 Other requirements of the terminal blocks are as follows:
- i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.
 - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
 - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
 - iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.
 - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
- 1.05.00 **GROUNDING**
- 1.05.01 Separate Protective and Electronic system ground as required shall be provided.
- 1.05.02 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus (Frame ground), bolted to the panel structure at bottom on both sides and effectively ground the entire structure. The bolts shall face inside of panels.
- 1.05.03 For electronic system cabinets the electronic system ground bus (Electronic ground) shall be similar but insulated from the cabinet and shall be separately connected to the system ground .The same ground may be used to earth the shield of shielded signal cables, otherwise a separate ground bus shall be provided for connecting the signal cable shields. Cable shields shall be grounded at the panel end only and shall never be left open .The electronic ground between panels of a shipping section shall be firmly looped.
- 2.00.00 **CONTROL DESKS & PANELS**
- 2.01.00 **GENERAL**
- 2.01.01 All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, utility receptacles, grounding, ventilation, space heating, anti-vibration pads, internal piping &

accessories as required for completeness of the system.

- 2.01.02 The design shall conform to the EN ISO 11064 (Ergonomical design of Control Room), Part 1, 2 and 3.
- 2.01.03 The exact dimensions, material, construction details, grounding, general arrangement etc. shall be as per actual requirement and shall be finalized during detail engineering and subjected to Owner's approval.
- 2.01.04 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.
- 2.01.05 For Control desk/ panel mounted instruments/ devices etc. which are to be powered from UPS, all required conversion of interface equipments/ accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.
- 2.01.06 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.
- 2.01.07 Nameplate
- a) Nameplate shall be provided for instrument or device mounted on the panel.
 - b) Nameplates for panels shall be provided both in front and rear.
- 2.02.00 CONTROL DESK
- 2.02.01 Control desk shall be free standing, floor mounting, table top type with doors at back and shall be constructed of 3 mm thick (minimum) CRCA steel or Aluminium extrusion. Aluminium structure shall be anodized or powder coated paint finish. The top surface of control desk shall be 30 mm (minimum) thick with the top 12 mm (minimum) of acrylic solid surface and the remaining 18 mm of laminated medium density fibre (MDF) board.
- 2.02.02 Monitors with retractable keyboard shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate.
- 2.02.03 Desks shall be of modular, scalable and industrially ruggedized design and shall have connections for PA system handsets & telephone sets.
- 2.02.04 Desks shall have concealed cable trays for wire dressing. Both Horizontal & Side Managers (2 separate horizontal cable routing wire baskets for power & data cables) shall be provided.

Each User station will be provided with 2 separate power distribution units (1 for Main line & 1 for UPS line). Each power distribution unit will have 6 points of 5/13 Amp sockets, Mains MCB On/Off Switch & Indicator.

Adequate heat management provision for Exhaust of heat from within the Console Desk Assembly shall be provided. There will be multiple fans provided in the Main Control Desk. Each Fan will be of 230 VAC 250 CFM Ball Bearing based. Ventilation louvers will be provided on both Front & Rear Modesty with special Air Filters. Adequate space for CPU & Other equipments placed with in the desk.

2.02.05 Design shall include Earthing bolts.

2.02.06 Back installed items shall be suitably concealed from front view.

2.02.07 All operator workstations for SG, TG, Auxiliaries & Off-site Plants shall be mounted on this Control Desk. The cabling / wiring between OWS & CPUs, power supply cables etc. shall be aesthetically routed and concealed from view.

2.02.08 **HARDWIRED DEVICES ON CONTROL DESK (DRAW OUT SECTION)**

Release and Lamp Test push buttons shall be provided for a set of push buttons (decided during detail engineering stage). Depending on the type of control/ function, required number of push buttons/ indicating LEDs & their color, push button stations shall be selected. The size of push button stations shall be 24 x 48 mm or 25 x 50 mm and shall have service inscription details at the front. Emergency push buttons (with cover) shall be mounted on top of Control Desk.

2.03.00 **BACK UP PANEL**

2.03.01 Construction shall be from CRCA steel of thickness not less than 3mm.

2.03.02 Upright back-up panel shall be provided where hardwired devices shall be mounted on a mosaic grid type console. The mosaic grid tiles shall be of 24 mm x 48 mm (or 25 mm x 50 mm) size, made of heat & flame retardant, self extinguishing and non-hygroscopic material with flat matt finish without glare and non reflecting type.

2.03.03 DDCMIS Back-up Panel (referred as Unit Control Panel-UCP) shall also mount annunciation fascia (minimum 500 nos.) and the flame monitoring cameras along with other hardwired devices as decided during detail engineering stage by Owner. Color coding shall also subject to Owner's approval.

2.03.04 Colored Mimic for different Off-site plant control systems (as enumerated elsewhere in this specification) and hardwired annunciation system shall also

be mounted on the back up panels.

2.04.00 PANELS/CABINETS

2.04.01 All DDCMIS system modules, power supply components and other Local Control panels (PLC/Relay based) shall be housed in cabinets as specified below.

2.04.02 The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings prior to shipment to the project site.

2.04.03 The Bidder shall ensure that the cabinets are complete & ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets shall only involve connections through multi-pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to Control Desk/ Back up Panel.

2.04.04 All electronic cards, network components, power supply modules etc. located shall be suitably housed in cabinets and shall be neatly arranged in sub-racks. Network components shall be visible in door closed condition (e.g. Glass doors etc.) as approved by Owner.

2.04.05 Bidder shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate.

2.04.06 The packaging density of panels shall be such that the temperature rise within the panels shall never exceed 10°C above ambient even under worst operating conditions. Cooling Fans shall be provided wherever required and this shall be of industrial grade.

2.04.07 TECHNICAL PARTICULARS

- | | | | |
|----|--------------------------|---|---|
| 1. | Material of Construction | : | Cold Rolled Coal Annealed (CRCA) steel sheet |
| 2. | Thickness of Sheet | : | a) 2.0 mm for faces supporting instruments / terminals
b) 1.6 mm for other sides and top |
| 3. | Construction | : | Welded throughout as per approved National Standards |
| 4. | Post welding operation | : | a) Grounding of all welds to smoothness
b) Rounding of corners |

- : c) Cleaning of weld spatters
- 5. Panel height : 2300 mm (approx)
- 6. Corners : 7 mm inner radius
- 7. Dimensional Tolerances :
 - a) In height & length - 3 mm
 - b) In height between adjacent sections - 2 mm
 - c) Total for a group - 6 mm
- 8. Doors : Double, recessed, turned back edges, full height front & rear
 - i) Thickness of Sheet : 2 mm
 - ii) Hinges : Stainless steel
 - iii) Door latches : Three point type
 - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure
 - v) Opening of the doors : Outward
 - vi) Louvers : With removable wire mesh to ensure dust and vermin proof
- 9. Gland plates : Removable in sections
4 mm thick (bottom)
- 10. Cable entry : Bottom
- 11. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC – 100 or equivalent for all sides
 - c) Stainless steel buff- finished 2 mm thick kick plate for all sides
 - d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws
 - e) Rubber strips to ensure air

- tightness between kick plate and finished floor
 - f) Lifting hook / Eye bolt
 - g) Drawing pocket
 - h) Door switch, lamps, thermostat, heaters and industrial grade cooling fans,, illumination fixtures
12. Name Plate : Both at front and back surface of the panel
13. Fixing of name plate : Stainless steel pan head screws
14. Name plate material : Laminated phenolic (3 layers)
15. Lettering : Black with white engraved
16. Mounting of terminal blocks : Vertical angle support bracket tack welded on sheet steel plate, screwed on internal wall of enclosure

2.05.00 FURNITURE

All the furnitures in the Central / Local control Room (s), Engineers' rooms, Instrument laboratory , SWAS Room & any other rooms with C&I equipments located in different plant buildings under Bidder's scope shall be included in Bidder's scope of supply. Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe.

2.05.01 WORK STATION FURNITURE

Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (A4/A3 color laserjet) etc. shall be provided.

2.05.02 PC RACK

PC Racks shall be provided to mount CPUs of workstations/PCs of OWS/LVS etc. in control room. For each PC / workstation / monitor at least one chair shall be included.

2.05.03 CHAIRS

Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

2.05.04 TABLES

Industry standard computer tables shall be provided & shall be as approved by Owner during detailed Engineering. Glass top teak wood horse shoe shaped table with vertical file mounting arrangement (two layers to house approx. 40 Nos of files and lockable drawers at both ends) for Engineering Room shall be provided.

2.05.05 ALMIRAHs

Steel Almirahs shall be provided for keeping documents in the documentation room. Glass doors for each rack shall be provided such that the documents are visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed Engineering.

2.05.06 KEYPAD

One keypad per unit shall be provided for the storing of keys of relevant areas of the unit in the control room.

2.05.07 LOCKERS

Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel. Also, lockers of bigger size shall be provided in documentation Room for storing of personal documents. Details shall be finalized and approved by Employer during detailed engineering.

3.00.00 **LVS PANEL**

3.01.00 An arc shaped Large Video Screen (LVS) panel shall be supplied for mounting large video screens in number of tiers in various Control rooms as specified elsewhere in this specification.

Bidder shall provide and fix ACP cladding around the LVS screen including covering the LVS back side and LVS stand. The cladding will be from floor finish to 600 mm above LVS screen like a self-standing partition with necessary openings for system requirement. ACP paneling shall be with 304 grade & approx. 0.5 mm mirror finish SS strip.

3.02.00 The profile, dimensions and the general arrangement shall be finalized & approved by Owner during detailed engineering. Recommendations, if any, for the control room lighting in order to ensure continuous proper viewing of the LVS screen by the operator & shift incharge (without any fatigue) shall be

- clearly brought out by the Contractor in his offer, alongwith all relevant details/basis.
- 3.03.00 Any other requirement for proper LVS mounting & functioning & viewing shall also be specifically brought out by the Contractor in his offer, along with all relevant details.
- 4.00.00 **LOCAL INSTRUMENT RACK (LIR) & LOCAL INSTRUMENT ENCLOSURE (LIE)**
- 4.01.00 GENERAL
- 4.01.01 Devices (Transmitters/ Switches) located in the field shall be suitably grouped together to the extent possible and installed in the LIE (Closed Rack) and LIR (Open Rack) in Boiler/TG Building and Off-site plant areas.
- 4.01.02 Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
- 4.01.03 No more than six instruments shall be grouped in a single rack / enclosure.
- 4.01.04 Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
- 4.01.05 Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- 4.01.06 Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging
- 4.01.07 Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- 4.01.08 Earth stud shall be furnished at rack for safety grounding.
- 4.02.00 LOCAL INSTRUMENT ENCLOSURE (LIE)
- 4.02.01 Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load - bearing posts shall be suitably supported by gusset plates or moment members.
- 4.02.02 Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- 4.02.03 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any

- member, which would reduce access, shall be avoided.
- 4.02.04 Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- 4.02.05 Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box. All enclosures shall have access doors on front side.
- 4.02.06 Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- 4.02.07 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings within transmitter racks both open and closed type, is admissible.
- 4.02.08 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..
- 4.02.09 Each rack shall be provided with one receptacle, light fixtures with wire guard and one lighting switch each at instrument & Junction box compartments with wire guard. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.
- 4.02.10 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.
- 4.02.11 Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations
- 4.03.00 LOCAL INSTRUMENT RACK (LIR)
- 4.03.01 Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or

falling objects and shall be epoxy painted. Canopy shall be of CRCA steel sheet of at least 3 mm thickness.

4.03.02 Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Center posts or any member, which would reduce access, shall be avoided.

4.03.03 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.

4.03.04 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.

4.03.05 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..


Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack


4.03.06 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.04.00 JUNCTION BOX

- | | | |
|----------------------|---|--|
| 1. Type of Enclosure | : | Dust tight & weatherproof conforming to IP 65 |
| 2. Material | : | 3 mm sheet steel / fiberglass reinforced polyester(UV stabilized) |
| 3. Type of Cover | : | Solid unhinged with retention chain / Screwed at all four corners |
| 4. Paint | : | i) Exterior : Opaline green shade 275 of IS: 5
ii) Interior - Brilliant Glossy White. |

5. Mounting : Surface / Two (2) inch Pipe stanchion
: (At a dry compartment at one side of the enclosure / rack with front opening type door)
6. Cable Entry : 3 mm (min) Bottom / side Gland plate
7. Gasket : Neoprene
8. Grounding : Brass earth lug with green screw head
: External-2 nos , Internal-1no. (M6)
9. Number of Drain Holes : Two at bottom capped
10. Identification : Label for JB and Tags for cable
11. Accessories : Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
- b) Cable gland (Brass) & raceways
 - c) Ferrules & lugs (Brass)
 - d) Aluminum back panel
 - e) Canopy at top
 - f) Mounting brackets
 - g) bolts and nuts made of brass etc.

	THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-411-67-3A-A001		SPECIFICATION NO.: PE-SS-999-145-054A		
	DATA SHEET FOR LOCAL PANELS				
	VOLUME		SECTION		
	REV. NO.	02	DATE: 16.09.2013		
SHEET 1 OF 3		TAG No. Qty.....			
Data Sheet A & B			Data Sheet No.: PES-145A-DS1-0		
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
GENERAL	MANUFACTURER				
	CONSTRUCTION		<input checked="" type="checkbox"/> FOLDED <input type="checkbox"/> WELDED		
	ENCLOSURE SHEET THICKNESS (As per Section 8.13, Volume V of contract specification)	FRONT	<input type="checkbox"/> 2.0 mm		
		OTHER	<input type="checkbox"/> 2.0 mm		
		DOOR	<input type="checkbox"/> 1.6 mm		
HEIGHT		<input type="checkbox"/> 2365 mm for stand alone panels. <input type="checkbox"/> Other			
	OTHER	<input type="checkbox"/> Load bearing sheet front shall have 3mm thickness			
TECHNICAL	INPUT POWER SUPPLY * (As per Electrical specification) (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY)		<input type="checkbox"/> 240V 50 Hz AC <input type="checkbox"/> 220V DC <input checked="" type="checkbox"/> 415V 3 PHASE 3W <input type="checkbox"/> 400V 3 PHASE 4W		
	NO. OF FEEDERS (As per Electrical specification)		<input type="checkbox"/> ONE <input type="checkbox"/> TWO		
	STARTER WITH MCC		<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED		
	IPR POSITION		<input checked="" type="checkbox"/> MCC <input type="checkbox"/> RELAY PANEL		
	CONTACT RATING OF RELAY		<input checked="" type="checkbox"/> 5 Amp, 230 V AC <input checked="" type="checkbox"/> 0.25 Amp, 220V DC		
	CONTROL SUPPLY		<input type="checkbox"/> 110V AC <input type="checkbox"/> 220V AC <input type="checkbox"/> 220V DC <input type="checkbox"/> Other. (As per requirement)		
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____ NOS. (AS REQUIRED)		
	TEMP SCANNER (IF REQUIRED –NO. OF CHANNELS TO BE SPECIFIED UNDER SEC-C)		<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED		
	PAINT TYPE (As per Annex-1, Section 7.6, Volume IV of contract specification)		<input type="checkbox"/> EPOXY ENAMEL <input type="checkbox"/> EPOXY POWDER COATED		
	MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)		<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	PANEL COLOUR (EXTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		<input type="checkbox"/> LIGHT GREY <input type="checkbox"/> OPALINE GREEN		
	FINISH (EXTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		<input type="checkbox"/> MATT <input type="checkbox"/> GLOSSY <input type="checkbox"/> SEMI GLOSSY		
	PANEL COLOUR (INTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		<input type="checkbox"/> WHITE <input type="checkbox"/> CREAM <input type="checkbox"/> OFF WHITE		
	FINISH (INTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		<input type="checkbox"/> MATT <input type="checkbox"/> GLOSSY <input type="checkbox"/> SEMI GLOSSY		
	CLASS OF PROTECTION		<input checked="" type="checkbox"/> IP-55 (FOR INDOOR SERVICE) <input checked="" type="checkbox"/> IP-67 (FOR OUTDOOR SERVICE) <input type="checkbox"/> ANY OTHER		
	CONTROL HARDWARE		<input checked="" type="checkbox"/> RELAY BASED		
FOUNDATION ARRANGEMENT		<input type="checkbox"/> FOUNDATION BOLTS <input type="checkbox"/> ANCHOR FASTENERS			
WEIGHT OF PANEL (Kg.)	(Vendor to specify)			

	THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-411-67/3A-A001		SPECIFICATION NO.: PE-SS-999-145-054A	
	DATA SHEET FOR LOCAL PANELS			
	VOLUME			
	SECTION			
REV. NO. 02		DATE: 16.09.2013		
SHEET 2		OF 3		
TAG No. Qty.....		Data Sheet No.: PES-145A-DS1-0		
Data Sheet A & B				
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	PANEL TYPE	<input type="checkbox"/> PRESSURISED <input type="checkbox"/> UNPRESSURISED As per Requirement		
	CABLE GLAND	<input checked="" type="checkbox"/> DOUBLE COMPRESSION		
	AMMETER (TYPE OF INPUT) *	<input type="checkbox"/> 1 Amp CT <input type="checkbox"/> 4-20 mA		
	SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING	<input type="checkbox"/> APPLICABLE <input checked="" type="checkbox"/> NA		
	* TO BE CO-ORDINATED WITH PEM ELECTRICAL			
NAME DESIGNATION SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME: SIGNATURE: DATE:
	AANCHAL CHOUDHARY	SACHIN SRIVASTAVA	MA MANSOORI	
	SR.ENGR	DY.MNGR	D. GM	
	16.09.2013	16.09.2013	16.09.2013	

FORM NO. PEM-6666-0


	<h2 style="margin: 0;">DATA SHEET FOR LOCAL PANELS</h2>	SPECIFICATION NO.: PE-SS-999-145-054A			
		VOLUME			
		SECTION			
		REV. NO.	02	DATE:	16.09.2013
		SHEET	3	OF	3

TAG No. Qty.....	Data Sheet No.: PES-145A-DS1-0
Data Sheet C	

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER			
	CONSTRUCTION	<input type="checkbox"/> FOLDED <input type="checkbox"/> WELDED (As per requirement EDN)		
	ENCLOSURE SHEET THICKNESS	FRONT		
		OTHER		
		DOOR		
		HEIGHT		
OTHER				
TECHNICAL	INPUT POWER SUPPLY			
	NO. OF FEEDERS			
	CONTACT RATING OF RELAY			
	TEMP SCANNER			
	CONTROL SUPPLY			
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)			
	PAINT TYPE			
	PANEL COLOUR (EXTERNAL)			
	FINISH (EXTERNAL)			
	TYPE OF MIMIC MATERIAL OF MIMC THICKNESS OF MIMIC			
	PANEL COLOUR (INTERNAL)			
	FINISH (INTERNAL)			
	CLASS OF PROTECTION			
	CONTROL HARDWARE			
	FOUNDATION ARRANGEMENT			
	WEIGHT OF PANEL (Kg.)			

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.: PE-SS-999-145-054A	
	VOLUME				
	SECTION				
	REV. NO. 02		DATE: 16.09.2013		
SHEET 3		OF 3			
TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0		
Data Sheet C					
DATA SHEET-C FOR LOCAL PANEL (TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)					
	PANEL TYPE				
	CABLE GLAND				
	AMMETER (TYPE OF INPUT)				
	SCOPE OF SUPERVISION				
NAME SIGNATURE DATE	PREPARED BY		CHECKED BY		APPROVED BY
	AANCHAL CHOUDHARY		SACHIN SRIVASTYAVA		MA MANSOORI
	16.09.2013	16.09.2013	16.09.2013		DATE:
					COMPANY SEAL
					NAME:
					SIGNATURE:



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.


00

DATE : 19.03.2015

SHEET

OF


LCP Quality Plan

 STD QUALITY PLAN NO.: PE-QP-999-145-1056 VOLUME IIB SECTION D REV. NO. 01 DATE: 22-02-2008 SHEET 1 OF 7		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL											
		Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$		
									P	W	V		
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Relevant standard	Relevant standard	Test Certificate	3	---	2		
		2. Bend Test	CR	Mech. test	Sample	Relevant standard	Relevant standard	Log Book	2	---	---		
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---		
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---		
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---		
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1		
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Relevant standard	Relevant standard	Log Book	2	---	---		
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---		
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---		
		4. Mill marking	MA	Visual	100%	Relevant standard	Relevant standard	Log Book	2	---	1		
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---		
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---		

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

\$ P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.


1 - BHEL
 2 - Vendor
 3 - Sub-vendor

 STD QUALITY PLAN NO.: PE-QP-999-145-1056 VOLUME IIB SECTION D REV. NO. 01 DATE: 22-02-2008 SHEET 3 OF 7		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										
		Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$	Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make 2. Surface defects 3. IR / HV on Terminal Blocks	MA MA MA	Visual Visual Electrical	Sample Sample Sample	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	Log Book Log Book Log Book	2 2 2	---	---	---
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions 2. Surface defects after bending	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Factory Standard	Approved Mfr. drgs. Factory Standard	Log Book Log Book	2 2	---	---	---
7.0	Nibbling / Punching	1. Cutout Sizes 2. Deburring	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Approved Mfr. drgs.	Approved Mfr. drgs. Approved Mfr. drgs.	Log Book Log Book	2 2	---	---	---
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions 2. Alignment 3. Welding Quality 4. Surface defects	MA MA MA MA	Measurement Measurement Visual Visual	100% 100% 100% 100%	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Log Book Log Book Log Book Log Book	2 2 2 2	---	---	2 2 2 2


LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

\$ P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

 STD QUALITY PLAN NO.: PE-QP-999-145-1056 VOLUME IIB SECTION D REV. NO. 01 DATE: 22-02-2008 SHEET 4 OF 7		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL											
		Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$		
										P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process 2. Process parameters like bath temp. concentration etc. 3. Dipping / Removal Time 4. Surface quality after every dip 5. Primer after phosphating 6. Putty Application & Rubbing after primer 7. Paint first coat 8. Putty Application and Rubbing after first coat of paint 9. Paint second coat	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
			MA	Measurement	Periodic	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
			MA	Measurement	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
			MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
			MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
			MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
			MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
			MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
			MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		


LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics
 \$ P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.
 1 - BHEL
 2 - Vendor
 3 - Sub-vendor

 STD QUALITY PLAN NO.: PE-QP-999-145-1056 VOLUME IIB SECTION D REV. NO. 01 DATE: 22-02-2008 SHEET 5 OF 7		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL											
		Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$	Remarks	
											P	W	V
10.	Panel Wiring	1. Wiring Layout 2. Wiring Termination (Crimped Lugs) 3. Ferrule numbers 4. Colour of wiring 5. Size of Conductor	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---		
			MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---		
			MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---		
			MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1		
			MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1		
11.	Component Mounting	1. Correct components 2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---		
			MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---		
12.	FINAL Final Inspection	1. Workmanship 2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components 3. Components identification Marking / Name plates	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.	
			MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
			MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		


LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

\$ P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

 STD QUALITY PLAN NO.: PE-QP-999-145-1056 VOLUME IIB SECTION D REV. NO. 01 DATE: 22-02-2008 SHEET 6 OF 7		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										
		Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$	Remarks
										P	W	V
5.		Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
6.		Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
7.		Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
8.		Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
9.		Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	
10.		Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1	
11.		Wire Termination	MA	Pulling manually	Sample	----	Firm termination	Inspection Report	2	1	1	
12.		Continuity	MA	Electrical	100%	----	Continuity OK	Inspection Report	2	1	1	

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics	\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
---	---	--

 STD QUALITY PLAN NO.: PE-QP-999-145-1056 VOLUME IIB SECTION D REV. NO. 01 DATE: 22-02-2008 SHEET 7 OF 7		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										
		Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$	Remarks
										P	W	V
13.	TYPE TEST	Degree of Protection		CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IEC-60947, IEC-60079	BHEL approved spec., drg relevant IEC-60947, IEC-60079	Type Test Certificate	3	---	1
14	ROUTINE TEST	IR before & after HV Test		CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant standard	BHEL approved spec., drg., BOM & relevant standard	Test Report	2	1	1
15	FUNCTIONAL TEST	1. Control Logic Operation		CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1
		2. Instrument Calibratio		CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1
		3. Temperature rise		CR	Electrical	100%	BHEL approved spec./drg. & relevant standard	BHEL approved spec/drg & relevant standard	Inspection Report	2	1	1

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics	\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
---	---	--



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.


00

DATE : 19.03.2015

SHEET

OF

PC SPECIFICATION

	<p style="text-align: center;">Technical specification for Computer For 4X270 MW BHADRADRI TPS</p>		SPEC NO.: PE-TS-411-145-I	
			VOLUME	
			SECTION	
			REV. NO. 00	DATE : 19.03.2015
			SHEET 1	OF 2


SPECIFICATION FOR PC

a. CPU

1. Processor : Intel core i5 or better, 32 bit
2. RAM : 4 GB min. and expandable to 16 GB
3. Hard Drive : 500 GB or more
4. Removable bulk storage : DVD (R/RW)
5. Graphic accelerator : 8MB (minm.)
6. Graphic Memory : dedicated 1GB or better
7. Operating System : Windows 7 or better
8. Audio controller : 16 bit
9. Communication Port : 2 serial, one parallel, 8 USB, Dual 100Mbps Ethernet
10. Expansion Slot : 3
11. Cache : 512 KB Level 2
12. Video Card : PCI

b. MONITOR

1. Type : LCD COLOUR MONITOR
2. Screen Diagonal : 24" (approx.) flat
3. Display : XGA or better
4. Resolution : 1024 by 768 or better
5. Degree of Protection : IP-30
6. External Controls : Brightness, contrast, Horizontal/Vertical, amplification & Shift
7. Version : To suit Industrial application

	Technical specification for Computer For 4X270 MW BHADRADRI TPS	SPEC NO.: PE-TS-411-145-I	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE : 19.03.2015
		SHEET 2	OF 2

c. KEY BOARD & MOUSE

1. Type : Flat spill proof membrane or positive depression type ASCII
2. Life Expectancy : 50 million cycles per key
3. Version : To suit Industrial application
4. Mouse : Optical mouse

d. SOFTWARE

Diagnostic Software, Anti Virus, Microsoft office, Acrobat Adobe Software and other application software.



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME


SECTION

REV. NO. 00

DATE : 19.03.2015

SHEET OF

FURNITURE SPECIFICATION

	Technical specification for FURNITURE For 4X270 MW BHADRADRI TPS	SPEC NO.: PE-TS-411-145-I	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE : 19.03.2015
		SHEET	OF

SPECIFICATION FOR FURNITURE

- a) 4 Nos. cushioned revolving, independently adjustable seat and back chairs.
- b) Glass top Teak wood / MDF table for mounting Operator Station monitors.
- c) Printer tables.
- d) Glass top Teak wood / MDT table for System Engineering Room / Engineering stations with drawer at end.
- e) Glass top teak wood / MDF table with vertical file mounting arrangement (two layer to house approx. 40 Nos of files and lockable drawers at both end) for System Engineering Room / Engineers.



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 19.03.2015

SHEET OF

CABLE BOQ

CABLE BOQ FOR 4 X 270 MW BHADRADRI TPS PROJECT JOB NO. 411 (PER UNIT)		
Sl no.	Cable Type	Qty (in Km)
G-TYPE		
1	2P X 0.5 sqmm	40
2	4P X 0.5 sqmm	40
3	8P X 0.5 sqmm	90
4	12P X 0.5 sqmm	5
F-TYPE		
1	4P X 0.5 sqmm	60
2	8P X 0.5 sqmm	30
3	12P X 0.5 sqmm	15
4	24P X 0.5 sqmm	10
CONTROL CABLE		
1	3C X 2.5 sqmm	20
2	5C X 2.5 sqmm	8
3	12C X 1.5 sqmm	7



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.


00

DATE : 19.03.2015

SHEET

OF

KKS PHILOSOPHY

	DOCUMENT TITLE
	KKS NUMBERING PHILOSOPHY
4X 270 MW BHADRADRI TPS	

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:


X	X	X	A A Y			Y B B		
---	---	---	-------	--	--	-------	--	--

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-1**.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

	DOCUMENT TITLE
	KKS NUMBERING PHILOSOPHY
4X 270 MW BHADRADRI TPS	

ANNEXURE-1

List of System / Sub-System Codes used in Power Plant:

- 1) Compressed air system : QEA, QEC
- 2) Ventilation System : SAA TO SAZ
- 3) Fire Detection & Protection System + Fire Water pumps : SGM, SGN, SGO, SGP
- 4) Sewage Treatment : SJA TO SJZ
- 5) Pre-treatment Plant : GBI, GBM, GBV
- 6) RO DM Plant : GCI, GCM, GBV


ANNEXURE-2

Standard Equipment Codes:

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holders, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

	DOCUMENT TITLE
	KKS NUMBERING PHILOSOPHY
4X 270 MW BHADRADRI TPS	

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level
CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level

- i) Use 10, 20, 30, To distinguish between main systems having same Alpha Codes. Examples:
 - a) Main Steam (Left) and Main Steam (Right)
 - b) BFP – A/B/C
 - c) ID Fan – A/B, FD Fan A/B, AH – A/B
- ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.
- iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

- i) Valves and Dampers --- *Equipment Code – AA*

N1

N2 N3

DOCUMENT TITLE	
KKS NUMBERING PHILOSOPHY	
4X 270 MW BHADRADRI TPS	
Motorised (<i>on/off duty</i>)	- 0 01 to 50
Motorised (<i>inching duty</i>)	- 0 51 to 99
Pneumatic (Control)	- 1 01 to 50
Motorised (<i>thyrestor Control</i>)	- 1 51 to 99
Sol. Operated (Open / Close duty (Valves, NRVs, Gate)	- 2 01 to 99
Hydraulic	- 3 01 to 99
NRV (Without actuation)	- 4 01 to 99
Manual	- 5 01 to 99
Manual	- 6 01 to 99
Relief & Safety Valves	- 7 01 to 99
Reserve	- 8 01 to 99
Reserve	- 9 01 to 99
 ii) Field Instruments	
Field Transmitters & Analog Signals	- 0 01 to 99
Field Switches & Binary Signals	- 1 00 to 99
PG Test Point	- 4 00 to 99
Gauges	- 5 00 to 99
Automatic Turbine Tester (ATT)-HWR	- 2 00 to 99
(Reserved for protection Signals used by Hardwar)	
 Example of Numerical Key Usage:	
<p>In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, Where system code is same.</p>	



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPS

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 19.03.2015

SHEET OF

LIST OF DELIVERABLES

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR MAUX PACKAGES						
4 X 270MW BHADRADRI TPS						
DOCUMENT NUMBER PE-GL-411-145-I100						
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER
INSTRUMENTATION						
1	PE-V9-411-XXX-1901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I
2	PE-V9-411-XXX-1902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I
3	PE-V9-411-XXX-1903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	A	-	VENDOR	C&I
4	PE-V9-411-XXX-1904	FIELD JB TERMINATIONS /GROUPING DOCUMENT	I	-	VENDOR	C&I
5	PE-V9-411-XXX-1905	QUALITY PLANS (CV,FE, Tx and Analyser)	A	-	VENDOR	C&I
PLC PANEL						
1	PE-V9-411-XXX-1906	PLC CONFIGURATION DRAWING	A	A	VENDOR	C&I
2	PE-V9-411-XXX-1907	PLC PANEL GA (INTERNAL & EXTERNAL) DRAWING	A	-	VENDOR	C&I
3	PE-V9-411-XXX-1908	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I
4	PE-V9-411-XXX-1909	PLC INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I
5	PE-V9-411-XXX-1910	UPS BATTERY CHARGER/ BATTERY DATASHEET & SLD	I	\$\$	VENDOR	C&I
6	PE-V9-411-XXX-1911	UPS SIZING CALCULATIONS	I	-	VENDOR	C&I
7	PE-V9-411-XXX-1912	BATTERY SIZING CALCULATIONS	I	-	VENDOR	C&I
8	PE-V9-411-XXX-1913	CONTROL DESK LAYOUT / GA DRAWING	A	-	VENDOR	C&I
9	PE-V9-411-XXX-1914	PLC-OWS/PRINTER FURNITURE BOM	A	-	VENDOR	C&I
10	PE-V9-411-XXX-1915	PLC CONTROL ROOM LAYOUT DRAWING	A	-	VENDOR	C&I
11	PE-V9-411-XXX-1916	PLC CATALOGUE	I	-	VENDOR	C&I
12	PE-V9-411-XXX-1917	PLC QUALITY PLAN & FAT PROCEDURE	A	-	VENDOR	C&I
13	PE-V9-411-XXX-1918	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	-	VENDOR	C&I
14	PE-V9-411-XXX-1919	PROCESS GRAPHIC MANUSCRIPTS PLC	I	-	VENDOR	C&I
15	PE-V9-411-XXX-1920	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I
16	PE-V9-411-XXX-1921	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS	I	-	VENDOR	C&I
17	PE-V9-411-XXX-1923	PANEL & ELECTRONIC EARTHING REQUIREMENT	I	-	VENDOR	C&I
18	PE-V9-411-XXX-1924	PANEL HEAT DISSIPATION DATA	I	-	VENDOR	C&I
19	PE-V9-411-XXX-1925	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I
20	PE-V9-411-XXX-1926	PLC O & M MANUAL	I	-	VENDOR	C&I
21	PE-V9-411-XXX-1927	PLC EARTHING SCHEME	I	-	VENDOR	C&I
	Notes:	411 - Project No				
		XXX -SI No of MAX Package				
		\$\$ -Approval by BHEL if Vendor BBU Item Approval by Customer if Customer BBU Item				



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: III

REV 00

SHEET 1 of 4

VOLUME III



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: III

REV 00

SHEET 2 of 4

LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- Technical pre-bid clarification if any strictly in the enclosed Schedule of pre bid clarification s only with mention of specification clause for which clarification is being asked. (Stamped & Signed).
- Technical Deviation if any strictly in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed).
- Compliance cum confirmation certificate (Stamped & Signed).
- Un Price Schedule duly filled in (Stamped & Signed).
- Electrical Load List in BHEL format (Stamped & Signed).
- List of Start-up & commissioning spares if any (Stamped & signed).
- List of tools & tackles (Stamped & signed).



TITLE

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: III

REV 00

SHEET 3 of 4

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.
2. QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.
3. QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.
4. All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.
5. There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.
6. The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.
7. The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).
8. All sub vendors shall be subject to BHEL/CUSTOMER approval.
9. Any special tools & tackles, if required, shall be in bidder's scope.
10. Demonstration test parameters shall stand valid till the satisfactory completion of Demonstration test and its acceptance by BHEL/Customer.

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

**TITLE**

**4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
SEWAGE TREATMENT PLANT**

SPECIFICATION NO.

PE-TS-411-673A-A001

VOLUME: III

REV 00

SHEET 4 of 4

PRE BID CLARIFICATION SCHEDULE

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				COMPANY SEAL
NAME	DESIGNATION	SIGNATURE	DATE	

THIS IS A PART OF TENDER TECHNICAL SPECIFICATION PE-TS-411-164A-A001

SCHEDULE OF TECHNICAL DEVIATIONS WITH COST OF WITHDRAWAL



PROJECT:-4 X 270 MW BHADRADRI TPS

SEWAGE TREATMENT PLANT

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF withdrawal OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF withdrawal OF DEVIATION IS APPLICABLE	NATURE OF COST OF withdrawal OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
-------	-----------------	----------	------------	--	-----------------------------------	---------------------------------	--	--	------------------------------

TECHNICAL DEVIATIONS

COMMERCIAL DEVIATIONS

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATIONS	SIGN & DATE

NOTES:

- For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
- For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
- All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
- Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
- Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
- Bidder shall furnish price copy of above format along with price bid.
- The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
- Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
- For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
- Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
- All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
- Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
- In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
- In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

PROJECT: 4X270 MW BHADRADRI TPS

SUGGESTIVE PRICE SCHEDULE

SEWAGE TREATMENT PLANT

THE PRICES SHOULD BE SUBMITTED IN THE ENCLOSED PRICE SCHEDULE FORMAT ONLY. FOLLOWING PRICE SCHEDULE FORMATS ARE ENCLOSED

LUMP SUM PRICES AND MAJOR BREAK-UP OF PRICES

Bidder shall furnish this price schedule in his offer only

Particulars of bidder / authorised representative

Name	Designation	Signature	Date	Company seal

ANNEXURE -A

1	Total lump sum firm price on FOR site basis to cover design, engineering, manufacture, fabrication, assembly, inspection & testing at vendor's & sub-vendor's works, painting, forwarding, supply and delivery at site including start up and commissioning spares, mandatory spares, properly packed for transportation, loading/unloading / handling and storage at site, in site transportation, assembly, erection and commissioning, trail run, preparation and submission of "As Built" drawings, site testing, carrying out demonstration tests at site and handover in flawless operating condition to end customer as per the details elaborated in different sections / volumes of technical specification (PE-TS-411-673A-A001) for SEWAGE TREATMENT PLANT for 4X270 MW BHADRADRI TPS
a)	Bidder to note that total price indicated above at 1 shall be considered for evaluation and hence should be complete in all respect for the full scope defined and considering all terms and conditions agreed.
b)	In case, price indicated above does not match with item wise break-up given at 2, the highest price so calculated shall be considered for evaluation but in case of order, the same shall be placed at the lowest price.

2	MAJOR BREAK-UP OF PRICES GIVEN IN 1 ABOVE	
2.1	Total lumpsum firm price for EQUIPMENT (SUPPLY, DESIGN & ENGINEERING) i.e.manufacture, fabrication, assembly, inspection and testing at vendor's & sub-vendor's works, painting, startup and commissioning as required, forwarding, proper packing, shipment and delivery at site, inclusive of all taxes & duties for the complete scope of supply of entire Sewage Treatment plant as per the details in different sections / volumes of technical specification (PE-TS-411-673A-A001) for 4X270 MW BHADRADRI TPS.	
2.2	Total lump sum firm price for all services including loading/unloading / handling and storage at site, in site transportation, assembly, erection and commissioning, trail run, preparation and submission of "As Built" drawings, site testing etc. required for completion of entire Sewage Treatment plant as per the details in different sections / volumes of technical specification (PE-TS-411-673A-A001) for 4X270 MW BHADRADRI TPS.	
2.3	Price for demonstration test and handing over the plant to the customer.	
2.4	Price for Mandatory spares (as per list indicated in Section C1 of tender technical specification).	
3.0	Break-up (%) of prices given at SI No-2.1 above (To be used during contract execution for payment).	
3.1	Lumpsum firm price for supply of Atmospheric tanks / vessels inclusive of all taxes, duties and other levies as applicable.	16% of sl no 2.1 above.
3.2	Lumpsum firm price for supply of Valves inclusive of all taxes, duties and other levies as applicable.	14% of sl no 2.1 above.
3.3	Lumpsum firm price for supply of control panel Instruments inclusive of all taxes, duties and other levies as applicable.	18% of sl no 2.1 above.
3.4	Lumpsum firm price for supply of Pumps & Blowers with motor inclusive of all taxes, duties and other levies as applicable.	13% of sl no 2.1 above.
3.5	Lumpsum firm price for supply of Piping & Fittings inclusive of all taxes, duties and other levies as applicable.	15% of sl no 2.1 above.
3.6	Lumpsum firm price for supply of agitators, strainers inclusive of all taxes, duties and other levies as applicable.	5% of sl no 2.1 above.
3.7	Lumpsum firm price for supply of tubes and media for inclusive of all taxes, duties and other levies as applicable.	5% of sl no 2.1 above.
3.8	Lumpsum firm price for supply of Balance items inclusive of all taxes, duties and other levies as applicable.	9% of sl no 2.1 above.
3.9	Submission & approval of all documents comprising of following documents as minimum requirement (i.e. basic engineering documents, O&M Manual, demonstration procedure, Recommended control scheme & write-up, Input/output list, Drive List, List of alarm & SOE with set points, Grouping of Instruments, JB details, Graphics/Mimic, Power supply requirement for instruments).	5% of sl no 2.1 above.

Bidder shall furnish this price schedule in his offer only

Particulars of bidder / authorised representative

Name	Designation	Signature	Date	Company seal