

MEGHA ENGINEERING & INFRASTRUCTURES LTD.

1 X 525 MW TUTICORIN TPS

**TECHNICAL SPECIFICATION
FOR
CHEMICAL DOSING SYSTEM**

SPECIFICATION NO: PE -TS-422-154-A001



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA**

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SECTION - REV.NO. 0 DATE :

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PROJECT INFORMATION



SPECIFICATION – M0

SECTION - II

GENERAL

INFORMATION

1.00.00 INTRODUCTION

SEPC Power Private Limited (SEPC) is setting up 1 x 525 MW Tuticorin Thermal Power Project (Stage –IV) on build, own and operate basis, at Thoothukudi, Thoothukudi district in the state of Tamilnadu. The site is located about 10kms from Thoothukudi town.

2.00.00 APPROACH TO THE SITE

The proposed site is located in town of Thoothukudi. The site is approachable by rail and road. Thoothukudi is well connected by both state highways, National highways and has direct broad gauge rail link with major cities. It also has major sea port (VOCPT) within a distance of about 4km. The Thoothukudi airport is located at about 15km from the site.

3.00.00 AVAILABILITY OF LAND

Land to an extent of about 90 acres is envisaged for the plant. The land required for putting up 1x 525 Mw project has been allotted to SEPC by V.O Chidambaram Port Trust (VOCPT) on lease basis. On one side of the project site, the Korampallam Surplus canal is running and suitable embankment is envisaged for safeguarding the plant during times of flood. A corridor from the plant boundary to seaport for coal conveying, sea water intake and outfall system is planned and the right-of-way for the same has to be obtained from VOCPT. Adequate land required for township development is also identified near the plant. The green belt required for the plant is suitably located all around, inside the plant boundary. The contractor shall accommodate equipment offered under this specification, generally within the spaces allotted for such equipment in the plot plan. Specific approval from owner/consultant shall be taken by contractor/Bidder prior to any deviation or relocation.

4.00.00 AVAILABILITY OF COAL

The Project site is located at a distance of about 4km from seaport and coal will be transported from coal jetty to the plant site by the pipe conveyors. 100% imported coal is considered as the main fuel source for the plant. The coal having heating value of 5450 kcal/kg is considered for design purpose and the range of coal is 5200 – 6600 kcal/kg.

5.00.00 AVAILABILITY OF WATER

The entire plant water requirements will be met from the sea water. The estimated sea water requirement for the proposed power plant is furnished below.

SEPC - 1 x 525 MW Tuticorin Thermal Power Project Stage-IV at Thoothukudi, Tamil Nadu	VOL-II-M0-SEC-II - 1	DCPL-12Z05
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Description	Flow rate (m ³ /hr)
Desalination plant feed water	450
Cooling water make up	6,185
Total sea water requirement	6,660

6.00.00 ASH DISPOSAL

Fly ash from silos will be disposed off to consumers by trucks. Bottom ash will be disposed by trucks to ash pond.

7.00.00 PROJECT INFORMATION AND KEY PARTICULARS FOR THE SITE

1.0	Project Site	Thoothukudi, Tamil Nadu
2.0	Approach to site	
2.1	Nearest town	Thoothukudi
2.2	Nearest Railway Station	Thoothukudi
2.3	Nearest Sea Port	Thoothukudi
2.4	Nearest AirPort	Thoothukudi
2.5	Access Roads	Harbour Express Road (Running near to site)
3.0	Site Elevation	Proposed FFL is +2.300 m above M.S.L
4.0	Atmospheric conditions	Hot, humid and corrosive close to sea port
5.0	Seismic Data	As per IS:1893
5.1	Zone	2
5.2	Intensity	
	Importance factor	1.5
	Soil foundation factor	1.6
6.0	Metrological data	
6.1	Ambient Air Temperature	
	Maximum Dry Bulb Temperature	40°C
	Minimum Dry Bulb Temperature	21°C
	Multiyear Max. Temperature	40°C
	Multiyear Min. Temperature	15.3°C
	Multiyear Annual Average Temperature	28°C
	Wet Bulb Temperature (For NDCT design)	28 °C
6.2	Rainfall	
	Multiyear annual mean rain fall	808.5 mm
	Annual rainfall (Min)	450.5 mm
	Multiyear annual daily maximum rain fall	166.6 mm
6.3	Wind velocity	
	Mean wind velocity	15 km/hr

SEPC - 1 x 525 MW Tuticorin Thermal Power Project Stage-IV at Thoothukudi, Tamil Nadu	VOL-II-M0-SEC-II - 2	DCPL-12Z05
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	Max.instantaneous wind velocity	198 km/hr
	Basic Wind speed	37 m/s
	Risk coefficient (k1 factor)	1.06 for plant structure 1.00 for non plant structures
	Terrain category (k2 factor)	Category-2
	Topography factor(k3 fatctor)	1.0
	Wind direction	North, North east
6.4	Relative Humidity	
	Mean Maximum humidity (Summer)	94%
	Mean Minimum Humidity (Summer)	60%
	Maximum Humidity (Mansoon)	100%
	Minimum Humidity (Mansoon)	62%
	Mean Relative Humidity	73%

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SECTION 1

SPECIFIC TECHNICAL REQUIREMENTS

SECTION I A: SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

SECTION I B: SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

SECTION I C: SPECIFIC TECHNICAL REQUIREMENTS (C&I)

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SECTION 1 A

SPECIFIC TECHNICAL REQUIREMENTS - MECHANICAL

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1. SCOPE:

Design, engineering, manufacture, fabrication, assembly, supply, inspection / testing at vendor's & sub-vendor's works, painting, mandatory spares, start-up and commissioning spares, special tools and tackles (as applicable), forwarding, proper packing, shipment and delivery at site, preparation and submission of drawing /documents & equipment / system guarantee etc. as specified hereinafter for the **1X525 MW TUTICORIN** for following systems:-

- HYDRAZINE DOSING SYSTEM– One number skid.
- AMMONIA DOSING SYSTEM– One number skid.
- NaOH DOSING SYSTEM– One number skid.

The following drawings/ data sheets are enclosed:

- P&ID for Hydrazine Dosing System (PE-DG-422-154-A001). Rev 0
- P&ID for Ammonia Dosing System (PE-DG-422-154-A002). Rev 0
- P&ID for NaOH Dosing System (PE-DG-422-154-A003). Rev 0
- DATA SHEET - A - For above systems

2. DESIGN PHILOSOPHY:

Chemical dosing systems are designed to dose required quantity of chemicals to maintain the quality of boiler feed water. Chemicals are dosed both in low pressure side of feed water cycle as well as in DMCW system.

3. SCOPE OF SUPPLY FOR BIDDER FOR CHEMICAL DOSING SYSTEM:

Broad scope of work for bidder for this package includes all equipment and accessories. Please also refer Electrical and C&I sections (section I B & section I C) for respective scopes.

The Chemical dosing system consists of, hydrazine dosing system, ammonia dosing system for boiler feed water and NaOH dosing skids for DMCW system. The details of each dosing system are given below:

4. LOW PRESSURE CHEMICAL DOSING:

4.1 HYDRAZINE DOSING SYSTEM: (TOTAL NO. OF SKID= 1 NO.)

Residual oxygen present in feed water can be detrimental to feed cycle equipment. In order to control the same, continuous dosing of dilute solution of hydrazine is done at deaerator outlet (BFP suction) only. Though provision has been kept to dose hydrazine at CEP pump discharge, boiler fill pump also, but dosing shall be done at one place at a time. For this purpose one (1) no. skid mounted Hydrazine dosing system shall be provided for each unit. Each dosing system shall mainly comprise of the following:

4.2 HYDRAZINE PREPERATION CUM MEASURING TANK (2 nos.)

Two (2) numbers Hydrazine preparation cum measuring tank shall be provided for preparing dilute hydrazine solution. A dilute solution is prepared in these tanks using condensate and is uniformly mixed by a motorized stirrer. These tanks shall also be provided with accessories like breather with vent, level transmitter, motorized stirrer (200 rpm max.), The solution is then dosed to the required dosing point with the help of dosing pumps.

4.3 HYDRAZINE DOSING PUMPS (TOTAL 2 Nos.)

Two numbers (2X100%) Positive displacement plunger type metering pumps (electrically operated, auto adjusted) with relief valves shall be provided.
Two numbers (2 x100%) Y-type strainers common for both pumps shall be provided at pump suction and one number pulsation dampener shall be provided at each pump discharge.

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4.4 HAND PUMP (2 NO.)

Two nos. manual operated hand pump complete with flexible hose and couplings (for transferring hydrazine from storage drum to preparation cum measuring tank) shall be provided.

4.5 ASSOCIATED PIPING, VALVES ETC:

As indicated in the drawing enclosed, to make the system complete, all associated piping & valves shall be provided. All piping in the skid shall be ASTM 312 Gr. TP 304 (seamless). Valve material shall be SS-304, ASA 800 rating. All valves shall be manually operated.

Drains from tanks & pipes shall be inter-connected to a common drain header and terminated at the dosing skid itself. Level gauge drain shall not be connected to main drain header since quantity of liquid is very small and occurrence of such cases is rare. The same may be manually disposed off. As flow in drains is not continuous & of very small quantity the same shall be led to local storm water drain.

4.6 PARAMETERS FOR HYDRAZINE DOSING:

Major parameters of the equipments as calculated & provided in the system are mentioned in datasheet A.

4.7 FLUSHING

Condensate tapped from Condensate water line shall be used for flushing the various pipes lines and pumps of the system as shown in P & I drawing.

4.8 AMMONIA DOSING SYSTEM; (TOTAL NO. OF SKID= 1 NO.)

Boiler feed water/Condensate water should have proper pH in order to protect the system from corrosion. In order to control the same dosing of dilute solution of Ammonia is done at CEP discharge. Though provision has been kept to dose ammonia at deaerator outlet (BFP suction) and boiler fill pump also, but dosing shall be done at one place at a time only. For this purpose one (1) no. skid mounted ammonia-dosing system shall be provided for each unit. Each dosing system shall mainly comprise of the following:

4.9 AMMONIA PREPERATION CUM MEASURING TANK (2 No)

Two (2) numbers Ammonia preparation cum measuring tank shall be provided for preparing dilute ammonia solution. A dilute solution is prepared in these tanks using condensate and is uniformly mixed by a motorized stirrer. These tanks shall also be provided with accessories like breather with vent, level transmitter, motorized stirrer (200 rpm max.),

The solution is then dosed to the required dosing point with the help of dosing pumps.

4.10 AMMONIA DOSING PUMPS (TOTAL 2 Nos.)

Two numbers (2X100%) Positive displacement plunger type metering pumps (electrically operated, auto adjusted) with relief valves shall be provided.

Two numbers (2 x100%) Y-type strainer common for both pumps shall be provided at pump suction and one number pulsation dampener shall be provided at each pump discharge.

4.11 HAND PUMP (2 NO.)

Two nos. manual operated hand pump complete with flexible hose and couplings (for transferring ammonia from storage drum to preparation cum measuring tank) shall be provided.

4.12 ASSOCIATED PIPING, VALVES ETC:

As indicated in the drawing enclosed, to make the system complete, all associated piping & valves shall be provided. All piping in the skid shall be ASTM 312 Gr. TP 304 (seamless). Valve material shall be SS-304, ASA 800 rating. All valves shall be manually operated.

Drains from tanks & pipes shall be inter-connected to a common drain header and terminated at the dosing skid itself. Level gauge drain shall not be connected to main drain header since quantity of liquid is very small and occurrence of such cases is rare. The same may be manually

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disposed off. As flow in drains is not continuous & of very small quantity thus shall be led to local storm water drain.

4.13 PARAMETERS FOR AMMONIA DOSING:

Major parameters of the equipment as calculated & provided in the system are mentioned in datasheet A.

4.14 FLUSHING

Condensate tapped from Condensate water line shall be used for flushing the various pipes lines and pumps of the system as shown in P & I drawing.

4.15 TERMINAL POINTS

The terminal points of Dosing systems shall be as shown in P & I drawing.

4.16 CONTROL PHILOSOPHY (common for both the systems):-

This control write-up is applicable for the following LP dosing system

- i) Ammonia dosing system
- ii) Hydrazine dosing system

The operation of LP dosing system shall be as follows:

The control of dosing systems shall be realized in DDCMIS. All controls, fault indicators/alarms, interlocks, logics shall be implemented in DDCMIS. Separate local panel shall be provided for each of the above said system.

The starter of all the motors shall be clubbed with main plant MCC.

A local panel comprising of 'START' push button and 'EMERGENCY STOP' push button along with 'ON/OFF/DISTURBANCE' indication shall be provided for local operation. The 'EMERGENCY STOP' Push Button (lockable type) shall be wired directly to MCC whereas START push button shall be routed to DDCMIS. The auto stroke controller of each pump shall be provided in the local panel. The stroke position & adjustment will be done from DDCMIS & Local panel and the stroke controller shall be suitable for accepting 4-20 mA DC signals. The pumps shall be provided with Position feedback transmitter to generate 4-20 mA DC signals to indicate stroke position in DDCMIS & Local panel.

The Local /Remote selection switch (soft) shall be provided in DDCMIS and its indication shall be provided in LCP.

1. Following interlocks shall be provided at low-low Level in the preparation cum measuring tank (to be derived from LT in preparation cum measuring tank).
 - i) Running Dosing pump shall be tripped.
 - ii) Stirrer motor of the respective tank shall be tripped.
2. Following conditions to be ensured before starting a stirrer
 - i) Level in the tank adequate (NOT LOW).
 - ii) MCC not disturbed
3. Following conditions to be ensured before starting a pump
 - i) Level in the tank adequate (NOT LOW).
 - ii) MCC not disturbed.
 - iii) Differential pressure across the filter not high.
4. Following shall be provided on LCP
 - i) ON/OFF/DISTURBANCE- Lamp Indications for all drives (pumps & agitator)
 - ii) Operation 'Local selected' / operation 'remote selected'- Lamp Indication, common for all drives.
 - iii) Pump- Start/Emergency Stop & Agitator-Start/Emergency Stop –Push Buttons
 - iv) Stoke position indicator (may be a part of controller)
5. Following fault indications with alarm annunciations shall be provided on LCP:
 - i) Low level in the preparation cum measuring tank.
 - ii) Low-low level in the preparation cum measuring tank
 - iii) High level in the preparation cum measuring tank
 - iv) High/Low pressure at pump discharge header
- vi) Running agitator motor tripped due to low-low level

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SIGNAL EXCHANGE

6. Following signals shall be wired from DDCMIS to LCP. These shall be 24V DC powered signals. (PF contacts are not used to avoid the higher voltage LCP power supply reaching DDCMIS while contact interrogation).
 - i) Operation local selected
 - ii) Operation remote selected
 - iii) Pump- 1/2 & stirrer (ON/OFF/DISTURBANCE)
 - iv) Process conditions (as per clause 5 above)
 - v) Pump- 1/2 stroke length demand signal (4-20 mA)
7. Following signals shall be wired from LCP to DDCMIS. Binary signals shall be P.F. contacts.
 - i) All field signals
 - ii) START–PB commands for all drives (pumps & agitator)
 - iii) Pump- 1/2 stroke length feedback signal (4-20 mA)
8. Signal Exchange between DDCMIS & MCC
 - i) START/STOP command from DDCMIS to MCC
 - ii) ON/OFF/MCC Disturbed feedback from MCC to DDCMIS
9. Signal Exchange between LCP & MCC shall be
 - i) EMERGENCY STOP-PB for all drives (pumps & agitator)

All the field instruments i.e. level transmitter, pressure transmitter etc. & stroke actuator shall be terminated at local panel by the vendor, for taking further to DDCMIS.

4.17 NaOH DOSING SYSTEM FOR DMCW SYSTEM: (1 NO SKID)

Sodium Hydroxide (NaOH) dosing system is provided to dose NaOH solution in Equipment cooling water lines to increase pH up to 9.5. The sodium hydroxide dosing is done in the DMCW cycle during the initial fill and for the compensation of cooling water for any leakage during normal run.

The dosing system consists of following:-

4.18 NaOH MIXING CUM STORAGE TANK

One (1) no NaOH Mixing cum storage Tank complete with motorized stirrer (200 rpm), CO₂ absorber, dissolving basket, level gauge, level transmitter, vent, overflow with water seal & drain shall be provided.

4.19 NaOH DOSING PUMPS (TOTAL 2 NOS)

Two nos. (2X100%) electric motor driven positive displacement plunger type Dosing pumps (electrically operated, auto adjusted) with motor, relief valves shall be provided.

Y-type strainer set (2 x 100%) common for pumps shall be provided.

The pumps shall also be provided with a pressure relief valve and pressure gauge in the individual discharge line and pressure transmitter on the common discharge header as per the P&ID enclosed.

4.20 ASSOCIATED PIPING, VALVES ETC:

As indicated in the drawing enclosed, to make the system complete, all associated piping & valves shall be provided. All piping in the skid shall be ASTM 312 Gr. TP 304 (seamless). Valve material shall be SS-304, ASA 800 rating. All valves shall be manually operated.

Drains from tanks & pipes shall be inter-connected to a common drain header and terminated at the dosing skid itself. Level gauge drain shall not be connected to main drain header since quantity of liquid is very small and occurrence of such cases is rare. The same may be

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manually disposed off. As flow in drains is not continuous & of very small quantity thus shall be led to local storm water drain.

4.21 FLUSHING

DM Water from DM Water header shall be used for preparation of solution and flushing the tank shown in P & I drawing.

4.22 CONTROL & INSTRUMENTATION

The operation of NaOH dosing system shall be as follows:

The control of NaOH dosing systems shall be realized in DDCMIS. All controls, fault indicators/alarms, interlocks, logics shall be implemented in DDCMIS. Separate local panel shall be provided for each of the above said system.

The starter of all the motors shall be clubbed with main plant MCC.

A local panel comprising of 'START' push button and 'EMERGENCY STOP' push button along with 'ON/OFF/DISTURBANCE' indication shall be provided for local operation. The 'EMERGENCY STOP' Push Button (lockable type) shall be wired directly to MCC whereas START push button shall be routed to DDCMIS. The auto stroke controller of each pump shall be provided in the local panel. The stroke position & adjustment will be done from DDCMIS & Local panel and the stroke controller shall be suitable for accepting 4-20 mA DC signals. The pumps shall be provided with Position feedback transmitter to generate 4-20 mA DC signals to indicate stroke position in DDCMIS & Local panel.

The Local /Remote selection switch (soft) shall be provided in DDCMIS and its indication shall be provided in LCP.

1. Following interlocks shall be provided at low-low Level in the mixing cum storage tank (to be derived from LT in mixing cum storage tank).
 - i) Running Dosing pump shall be tripped.
 - ii) Stirrer motor shall be tripped.
2. Following conditions to be ensured before starting a stirrer
 - i) Level in the tank adequate (NOT LOW).
 - ii) MCC not disturbed
3. Following conditions to be ensured before starting a pump
 - i) Level in the tank adequate (NOT LOW).
 - ii) MCC not disturbed.
 - iii) Differential pressure across the filter not high.
4. Following shall be provided on LCP
 - i) ON/OFF/DISTURBANCE- Lamp Indications for all drives (pumps & agitator)
 - ii) Operation 'Local selected' / operation 'remote selected'- Lamp Indication, common for all drives.
 - iii) Pump- Start/Emergency Stop & Agitator-Start/Emergency Stop –Push Buttons
 - iv) Stoke position indicator (may be a part of controller)
5. Following fault indications with alarm annunciations shall be provided on LCP:
 - i) Low level in the mixing cum storage tank.
 - ii) Low-low level in the mixing cum storage tank.
 - iii) High level in the mixing cum storage tank.
 - iv) High/Low pressure at pump discharge header
 - v) Running dosing pump tripped due to low-low level.
 - vi) Running agitator motor tripped due to low-low level

SIGNAL EXCHANGE

6. Following signals shall be wired from DDCMIS to LCP. These shall be 24V DC powered signals. (PF contacts are not used to avoid the higher voltage LCP power supply reaching DDCMIS while contact interrogation).
 - ii) Operation remote selected

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- iii) Pump- 1/2 & stirrer (ON/OFF/DISTURBANCE)
- iv) Process conditions (as per clause 5 above)
- v) Pump- 1/2 stroke length demand signal (4-20 mA)
- 7. Following signals shall be wired from LCP to DDCMIS. Binary signals shall be P.F. contacts.
 - i) All field signals
 - ii) START–PB commands for all drives (pumps & agitator)
 - iii) Pump- 1/2 stroke length feedback signal (4-20 mA)
- 8. Signal Exchange between DDCMIS & MCC
 - i) START/STOP command from DDCMIS to MCC
 - ii) ON/OFF/MCC Disturbed feedback from MCC to DDCMIS
- 9. Signal Exchange between LCP & MCC shall be
 - i) EMERGENCY STOP-PB for all drives (pumps & agitator)

All the field instruments i.e. level transmitter, pressure transmitter etc. & stroke actuator shall be terminated at local panel by the vendor, for taking further to DDCMIS.

5. SCOPE OF SERVICE

The bidder's scope also includes following services for scope under this specification:

- a. Design and engineering.
- b. Fabrication of the skid mounted chemical dosing system.
- c. Inspection and testing of the skid as per the approved quality assurance plan.
- d. Supply of the skid mounted chemical dosing system up to the power plant site along with all accessories as defined in the technical specification.
- e. Painting as per approved painting requirement to be finalized during detailed engineering. However the same shall be prepared in line with the painting requirement enclosed in ANNEXURE IV of technical specification.

6. CIVIL SCOPE

Nil.

7. TERMINAL POINTS (ALSO REFER P & I DIAGRAM ENCLOSED)

- a. All piping beyond battery limit of skid as indicated in P&ID's enclosed with the technical specification is excluded from bidder's scope.
- b. Electrical scope shall be as per Electrical scope matrix attached in Section I B of the technical specification.
- c. All drains shall be brought at one point on the skid by the bidder via a drain header and further connection to the nearest plant drain shall be done by BHEL/Customer.

8. QUALITY PLAN AND SUB VENDOR APPROVAL

- The quality assurance plan is enclosed as **ANNEXURE-I**. However requirement of detailed QP, inspection checklist, certificate of conformance etc. for each equipment and sub-vendor shall be finalized during detailed engineering stage; decision of BHEL/Customer shall be binding on vendor in this regard. Any changes/additional tests insisted upon by Owner during approval of QAP's shall be accepted by bidder without any commercial and delivery implication to BHEL/Customer. Bidder shall submit the quality plans in BHEL format during detailed engineering stage. Bidder to note further that during detailed engineering all the QAP's/check lists etc. shall be submitted to Customer /BHEL for approval. All inspection & testing etc. shall be carried out accordingly.

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- The sub vendor list enclosed **ANNEXURE-II** is indicative only and is subject to approval / acceptance by Customer. Bidder to propose his sub vendor list with back up documents (experience list, end user certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any technical, commercial & delivery implication to BHEL.

9. DRAWINGS/DOCUMENTATION REQUIREMENT ALONG WITH BID

Bidder to furnish the following documents/information (**For Electrical and C&I please refer the respective section of the specification**).

- Deviation if any 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 schedule.(Stamped & Signed)
- Schedule of Declaration. (Stamped & Signed)
- Un Price Schedule duly filled in. (Stamped & Signed).

Bidder to note that if bidder has taken any deviation from the technical specification requirements, the same shall be clearly mentioned in the bid in the BHEL prescribed format of Schedule of Deviations attached as Section - III of this technical specification.

In case of no deviation, Bidder to furnish signed and stamped copy of "Schedule of Deviations with cost of withdrawal" stating **"No Deviation"**. No other technical document is required along with bidder's offer. Any other document submitted by bidder shall not be evaluated by BHEL and shall be considered as withdrawn. Bidder to note that any un-declared deviation mentioned in bidder offer other than specified in the scheduled of Deviations shall be considered as null and void.

10. DRAWING/DOCUMENTS REQUIREMENT (PI refer electrical & C&I portion also):-

For the drawings/ documents submission schedule, please refer **Annexure-VII**.

For the Drawings/Documents Submission Procedure, please refer **Annexure-III**. The bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and Customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

11. SPARES

All the spares for the equipment under the contract provided by the vendor will strictly conform to the specifications and documents and will be identical to the corresponding main equipment/components supplied under the contract.

The quality plan and the inspection requirement finalized for the main equipment will also be applicable to the corresponding spares.

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
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12. MANDATORY SPARES

- The list of mandatory spares is indicated in Annexure V.
- The bidder shall indicate the prices in the 'Schedule of mandatory Spares' whether or not he considers it necessary for the BHEL & Customer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item. Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.
- The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes.
- All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the unit. However, spares shall not be dispatched before dispatch of corresponding main equipment.
- Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise.
- The Bidder shall note that if there is any change/ variation in equipment / system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.

13. START-UP AND COMMISSIONING SPARES

Start-up and Commissioning spares are those which would be required during equipment or system testing, start up and commissioning. All spares used until the plant is finally handed over by the bidder to the Customer come under this category. All start-up and commissioning spares as required shall be provided by the bidder without any additional cost to the BHEL and Customer. The list of minimum start-up and commissioning spares are attached in Annexure-VI. However bidder to provide additional spares as per their system requirement without any commercial and delivery implication to BHEL/Customer during detailed engineering List of spares shall be furnished by BIDDER along with the offer.

Bidder shall be responsible for the ready and timely availability for all the start up and commissioning spares as required during various stages of testing, cleaning and commissioning up to handing over of each unit of the total plant.

An adequate stock of start-up spares shall be available at the site such that the start-up and commissioning of the equipment/systems, Performance guarantee test and handing over the equipment/ systems to the Customer will be carried out without hindrance and delay. All start-up spares which remain unused after the taking over of the plant shall remain the property of the Customer.

14. MAINTENANCE TOOLS AND TACKLES

- One set of all special tools shall be furnished and shipped with each piece of equipment for dismantling, maintenance, adjustment, and calibration of the equipment. The tools shall be shipped in separate heavily constructed wooden boxes provided with hinged covers and padlock hasps.

- The Contractor shall supply under this contract all maintenance tools for each piece of equipment / system and it shall be boxed separately and the boxes shall be appropriately marked for shipment and identification of contents.
- A weather-proof itemized list of the contents shall also be attached to the outside of each container.
- The maintenance tools shall include all special handling rigs, bars, slings, cable and all specialised equipment for control system maintenance such as extender boards, scopes, and all software and hardware. Further, Bidder shall also include a full set of regular maintenance tools and tackles required. Bidder shall also include all maintenance tools and tackles in their scope. Total price of all the maintenance tools and tackles shall be included in the quoted lump sum price.

15. The vendor warrants:

1. That all spares supplied will be new and in accordance with the contract document and will be free from defects in design, material and workmanship and shall further guarantee as under:
 - a. In case of any failure in the original component/equipment due to faulty designs, materials and workmanship, the corresponding spare parts if any, supplied will be replaced without any extra cost to the BHEL and Customer unless a joint examination and analysis by BHEL and/or Customer of such spare parts prove that the defect found in the original part that failed can safely be assured not to be present in spare parts.
 - b. The long term availability of spares to the BHEL and the Customer for the full life of the equipment covered under the contract and that before going out of production of spare parts of the equipment covered under the contract, vendor and his sub-vendors shall give the BHEL and the Customer at least 24 (Twenty Four) months advance notice so that the latter may order his bulk requirements of spares, if he so desires. The same provision will also be applicable to the sub-vendors. Further, in case of discontinuance of manufacture of any spares by the vendors or his sub-vendors the vendors and his sub-vendors, will provide the BHEL and the Customer, 2 (two) years in advance, with full manufacturing drawings, material specifications and technical information required by the BHEL and the Customer for the purpose of manufacture of such items and also the right to manufacture such spares for their own requirements.
 - c. Further in case of discontinuance of supply of spares by the vendors or his sub-vendors, the vendor will provide the BHEL and the customer with full information for replacement of such spares with other equivalent makes, if so required by the BHEL and the customer.
 - d. Notwithstanding the above, the vendor shall be responsible for supply of spares for the lifetime of the package at reasonable prices. The prices of all future requirements of spares shall be derived from the corresponding ex-works price at which the orders for such spares have been placed by the BHEL and the customer as a part of the mandatory or long term or any other kind of spares. The base indices for calculating ex-works price shall be commissioning of last equipment under main contract.
2. The vendor will indicate the delivery period of the spares, which the BHEL and the Customer may procure in accordance with this clause.
3. In case of emergency requirements of spares, the vendor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.

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4. In case the vendor fails to supply the mandatory or long term or any other kind of spares on the terms stipulated above, the BHEL and the customer shall be entitled to purchase the same from the alternate sources at the risk and the cost of the vendor and recover from the vendor, the excess amount paid by the BHEL and the customer over the rates as per the contract. In the event of such risk purchase by the BHEL or the customer, the purchases will be as per the works and procurement policy of the BHEL and the customer prevalent at the time of such purchases and BHEL & the customer at his option may include a representative from the vendor in finalizing the purchases.
5. It is expressly understood that the final settlement between the parties in terms of relevant clauses of the tender document shall not relieve the vendor of any of his obligations under the provision of long term availability of spares and such provisions shall continue to be enforced till the expiry of 30 (thirty) years period reckoned from the scheduled date of completion of trial operation of the last equipment unless otherwise discharged expressly in writing by the BHEL or the Customer.

16. PACKING:

To prevent damage to any equipment/ item of the skid during transit, wooden/ angle iron/ steel frame supports to be provided wherever required. Special attention shall be provided while packing and loading for overhead equipment.

The actuator of the pump and auto stroke controller of the control panel shall be packed in air tight packing along with the pump and panel in installed condition for preventing damage.

Bidder shall submit the packing details during detailed engineering for approval. Any changes required in packing details shall be complied by the bidder without any price and delivery implication.

17. DESIGN REQUIREMENTS

Bidder to note that design requirement of the chemical dosing skids shall be as below: -

- a. In addition to the requirements of Section-I & II the following shall also be complied under scope of this specification: The P&ID is enclosed herein in this section for bidder's compliance.
- b. The material of construction specified in Data Sheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subjects to Customer/BHEL approval during detailed engineering.
- c. All instrument-wetted parts will be suitable for requested application.
- d. All high points on any, tanks, pumps, piping or instrumentation will be vented and provided with valve. All low points on any, tanks, pumps, piping or instruments will be drained and provided with valve.
- e. All valves and instruments will be located such that they are easily accessible during normal operation and maintenance.
- f. 5mm thick IS 2062 Checker plate shall be provided covering the skid frame and for elevated platform for the preparation/measuring tank, wherever applicable. The tanks supports, pumps and pipe supports and LCP/LCP supports shall be welded to the checker plate.
- g. Stuffing box shall be provided for mounting the agitator to avoid air ingress.
- h. Vent/overflow pipe from tank shall at least reach the bottom half of the breather/water seal/CO2 absorber.
- i. SS pad shall be provided for welding MS structural supports to SS tanks.
- j. Step ladder and chemical charging platform shall be provided for easy access to top of tank.
- k. All the terminal points shall be easily accessible and towards one side of skid.
- l. All valves shall be easily accessible for the operator.
- m. All tanks/pumps shall have name plate clearly indicating the equipment name.
- n. Pipe fittings of the system shall be done using elbows and tees. Pipe bending is not acceptable.

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- o. All equipment shall have SS name plate.
- p. All LCP shall be mounted in their respective dosing skids only.
- q. All the terminal points where flange joints are involved, bidder shall terminate it along with matching counter flange, nuts, bolts, gaskets etc.
- r. KKS codes for all drives and instruments for the project have to be followed.

18. MISCELLANEOUS REQUIREMENTS

- a. Initial charge of all lubricants & grease.
- b. All special tools necessary for proper maintenance or adjustment of the equipment packaged in permanent box.
- c. Finish paints for touch-up painting of equipment after erection at site in sealed container.
- d. All the first fill and one Year's topping requirements or 10 % of first fill quantity, whichever is more of consumable such as greases, oil, lubricants, servo fluids/control fluids, gases and etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be furnished by the bidder. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.
- e. Document approval by Customer/ BHEL under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval.
- f. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to Customer and BHEL for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- g. In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at Customer/BHEL end, delay in review/ approval of drawing beyond one month will be to Customer/BHEL account.
- h. Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the BHEL's switch gear /MCC on account of changed loads.
- i. Bidder to submit BBU during detailed engineering after approval of Basic documents. BBU shall be equal to BOQ for the package and there shall be no price and delivery implication is applicable to BHEL / CUSTOMER for the same. None of the items supplied for the project as non-billable. Incomplete BBU shall not be review by BHEL.
- j. Relevant requirements as per GTR, GCC, ECC & SCC. Any statutory requirement / clearance required for the packages from government / local body shall be in bidder's scope.
- k. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- l. Vendor to attend regular engineering meeting with BHEL and Customer fortnightly in BHEL or Customer office as decided during detail engineering. Vendor will depute his entire concerned engineering representatives along with the project manager for discussion and approval. Meeting can be held at site also.
- m. Latest version of all codes and standards to be followed.
- n. For detailed dispatch instructions, Bidder to refer special condition of contract (SCC) of the project.

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ANNEXURES

ANNEXURE I: QUALITY PLAN
ANNEXURE II: SUB VENDORS LIST
ANNEXURE III: DRAWING DOCUMENTS DISTRIBUTION PROCEDURE
ANNEXURE IV: PAINTING SPECIFICATION
ANNEXURE V: MANDATORY SPARES LIST
ANNEXURE VI: LIST OF ERECTION & COMMISSIONING SPARES
ANNEXURE VII: DRAWING/DOCUMENTS SUBMISSION SCHEDULE
ANNEXURE VIII: FORMAT FOR OPERATION AND MAINTENANCE MANUAL

ANNEXURE I:
QUALITY PLAN

ANNEXURE-I

		MANUFACTURER'S NAME & ADDRESS :		QUALITY PLAN				PROJECT 1 X 525 MW TUTICORIN TPS					
				ITEM: CHEMICAL DOSING SYSTEM		QP.NO : PE - VE-422-154A-006		PACKAGE CHEMICAL DOSING SYSTEM		CONTRACT NO.			
				REV. : 0		DATE :		MAIN SUPPLIER BHEL/PEM, NOIDA					
				SUB - SYSTEM : CHEMICAL DOSING SYSTEM		PAGE : 1 OF 4							
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY**			REMARKS	
1	2	3	4	5	6	7	8	9	M	B	C	11	
1.0	WELDER'S QUALIFICATION												
1.1	WELDING PROCEDURE SPECIFICATION (WPS)	CORRECTNESS	MA	SCRUTINY	100%	ASME IX	ASME IX	QW 482	P	V	V		
1.2	WELDER PERFORMANCE & PROCEDURE QUALIFICATION RECORD	WELD SOUNDNESS & WELDING PERFORMANCE	MA	PHYSICAL TEST	ASME IX	ASME IX	ASME IX	QW 483 & QW 484	P	V	V		
2.0	TANKS												
2.1	RAW MATERIAL :												
2.1.1	PLATE	CHEMICAL & PHY. PROPERTIES	MA	CHEM & PHY TEST	1/PLATE/HT BATCH	ASTM A 240 GR.TP 304	ASTM A 240 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	IDENTIFICATION BY BHEL	
		IGC TEST	MI	IGC TEST	1/PLATE/HT BATCH	ASTM A 262 PR.'E'	ASTM A 262 PR.'E'		P	V	V		
2.1.2	PIPE FOR NOZZLE	CHEMICAL & PHY. PROPERTIES	MA	CHEM. & PHY.TEST	1/HT BATCH/SIZE	ASTM A 312 GR.TP 304	ASTM A 312 GR.TP 304	MFG.TC/LAB REPORT	P	V	V		
		MICRO STRUCTURE	MI	GRAIN STRUCTURE	1/HT BATCH/SIZE	FOR HEAT TREATMENT	FOR HEAT TREATMENT	MFG.TC/LAB REPORT	P	V	V		
		IGC TEST	MI	IGC TEST	1/HT BATCH/SIZE	ASTM A 262 PR.'E'	ASTM A 262 PR.'E'	MFG.TC/LAB REPORT	P	V	V		
		HYDRO TEST	NA	LEAKAGE	100%	NO LEAKAGE	NO LEAKAGE	MFG. TC/IR	P	V/W	V	REFER NOTE 4	
2.1.3	FLANGES FOR TANKS	CHEMICAL & PHY PROPERTIES	MA	CHEM & PHY TEST	1/HT BATCH	ASTM A 182 GR. F 304	ASTM A 182 GR. F 304	MFG.TC/LAB REPORT	P	V	V		
2.2	IN PROCESS												
2.2.1	DISHED ENDS	DIMENSIONS	MA	MEASUREMENT WITH TEMPLATE	100%	APPD.DWG.(BY BHEL)	APPD.DWG.(BY BHEL)	MFG.TC./LAB REPORT	P	V	V		
		SURFACE DEFECTS ON WELDMENTS		DP TEST	100%	ASTM E 165	NO SURFACE DEFECTS	MFG.TC	P	V	V		
2.3	FINAL ASSEMBLY FOR TANKS:	DIMENSIONS &	MA	MEASUREMENT	100%	APPD.DWG.(BY BHEL)	APPD.DWG.(BY BHEL)	MFG.TC/INSP REPORT	P	W	W	TO BE OFFERED ALONG WITH FINAL SKID ASSEMBLY INSPECTION.	
		ORIENTATION	MA	VISUAL		APPD.DWG.(BY BHEL)	APPD.DWG.(BY BHEL)	MFG.TC/INSP REPORT	P	W	W		
2.3.1		LEAKAGE	MA	WATER FILL FOR 2 HR	100%	N.A.	NO LEAKAGE	MFG.TC/INSP. REPORT	P	W	W		
3.0	STIRRER :												
3.1	RAW MATERIAL FOR SHAFT	CHEM.& PHY. PROPERTIES	MA	CHEM & PHY TEST	1/BAR	ASTM A 479 GR.TP 304	ASTM A 479 GR.TP 304	MFG.TC/LAB REPORT	P	V	V		
		IGC TEST	MA	IGC TEST	1/HT BATCH	ASTM A 262 PR.'E'	ASTM A 262 PR.'E'	MFG.TC/LAB REPORT	P	V	V		
3.2	IMPELLER	CHEMICAL PROP.	MA	CHEMICAL TEST	1/PLATE	ASTM A 240 GR.TP 316	ASTM A 240 GR.TP 316	MFG.TC/LAB REPORT	P	V	V		
3.3	COMPLETE STIRRER UNIT WITH MOTOR	PERFORMANCE IN WATER FILLED TANK											
		- VIBRATION	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V		
		- WOBBLING	MA	VISUAL	100%	NO WOBBLING	NO WOBBLING	MFG.TC	P	V	V		
		- POWER CONSUMPTION/ CURRENT DRAWN	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V		
4.0	MOTORS:	ROUTINE TEST	MA	MFG. TC	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V		
		TYPE TEST	MA	MFG. TC	1/ SIMILAR FRAME SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V		
		DEGREE OF PROTECTION	MA	MFG. TC	1/ SIMILAR FRAME SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V		
				** LEGEND :									
MANUFACTURER/ SUB CONTRACTOR		MAIN SUPPLIER--BHEL		M : MANUFACUTRER/SUB-CONTRACTOR/SUB-VENDOR B : BHEL/NOMINATED INSPECTION AGENCY "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION				C: CUSTOMER					
SIGNATURE								SIGNATURE OF APPROVAL BY CUSTOMER					

ANNEXURE-I

		MANUFACTURER'S NAME & ADDRESS :		QUALITY PLAN				PROJECT 1 X 525 MW TUTICORIN TPS				
				ITEM: CHEMICAL DOSING SYSTEM		QP.NO : PE - VE-422-154A-006		PACKAGE CONTRACT NO. CHEMICAL DOSING SYSTEM		MAIN SUPPLIER BHEL/PEM, NOIDA		
				REV. : 0		DATE :						
				SUB - SYSTEM : CHEMICAL DOSING SYSTEM		PAGE : 2 OF 4						
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY** M B R			REMARKS
1	2	3	4	5	6	7	8	9	10			11
5.0	METERING PUMP:											
5.1	RAW MATERIAL :											
5.1.1	WETTED PARTS	CHEM & PHY. PROPERTIES	MA	CHEM. & PHY. TEST	1/BAR	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
		SURFACE TEST	MI	UT ON BAR>25 MM DIA	100%	ASTM A 388	REF. NOTE # 1	MFG.TC/LAB REPORT	P	V	V	
				DP ON M/C SURFACE	100%	ASME - E - 165	NO SURFACE DEFECTS	MFG.TC/LAB REPORT	P	V	V	
5.2	FINAL INSPECTION											
5.2.1	PUMP WITH MOTOR	LINEARITY	MA	PERFORMANCE	100%	API 675	API 675	INSPECTION REPORT	P	W	V	
		STEADY STATE ACCURACY	MA	SHOP TEST	100%	API 675	API 675	INSPECTION REPORT	P	W	V	
		REPEATABILITY	MA	SHOP TEST	100%	API 675	API 675	INSPECTION REPORT	P	W	V	
		POWER DRAWN @ 100% STROKE	MA	MEASURED AT WORK	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	INSPECTION REPORT	P	W	V	
		LEAKAGE	MA	HYDRO TEST	100%	@1.5X DESIGN PRESSURE	NO LEAKAGE	INSPECTION REPORT	P	W	V	
		DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	V	
		NOISE	MA	MEASUREMENT	100%	--	< 85 dbA AT 1 M RADIUS	INSPECTION REPORT	P	W	V	
		VIBRATION	MA	MEASUREMENT	100%	--	≤45 MICRONS (PEAK TO PEAK)	INSPECTION REPORT	P	W	V	
7.0	PRESSURE RELIEF VALVE	SET & RESET PRESSURE.	MA	PERFORMANCE	100%	BHEL APPD.DATA SHEET & API RP-520	BHEL APPD.DATA SHEET & API RP-520	MFG. TC	P	V	V	
		DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG. TC	P	V	V	
		LEAKAGE DURING PERFORMANCE TEST	MA	VISUAL	100%	NO LEAKAGE	NO LEAKAGE	MFG. TC	P	V	V	
8	VALVES (GATE, GLOBE & NRV)											
8.1	RAW MATERIAL :											
8.1.1	BODY, BONNET COVER	CHEM. & PHY PROPERTIES	MA	CHEM. & PHY TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC/LAB REPORT	P	V	V	
		HEAT TREATMENT	MA	HEAT TREATMENT	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC/LAB REPORT	P	V	V	
8.1.2	TRIM MATERIAL	CHEM. & PHY PROPERTIES	MA	CHEM. & PHY TEST	1/BAR/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC/LAB REPORT	P	V	V	
8.2	ASSEMBLY											
		LEAKAGE (BODY & SEAT)		HYDRO TEST	100%	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG TC	P	V	V	
		LEAKAGE (SEAT)		PNEUMATIC TEST	100%	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG TC	P	V	V	
		DIMENSIONS		MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG TC	P	V	V	
MANUFACTURER/ SUB CONTRACTOR		MAIN SUPPLIER--BHEL		** LEGEND : M : MANUFACTURER/SUB-CONTRACTOR/SUB-VENDOR B : BHEL/NOMINATED INSPECTION AGENCY "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION				C: CUSTOMER				
				SIGNATURE OF APPROVAL BY CUSTOMER								
SIGNATURE												
0												

ANNEXURE-I

		MANUFACTURER'S NAME & ADDRESS :		QUALITY PLAN				PROJECT 1 X 525 MW TUTICORIN TPS				
				ITEM: CHEMICAL DOSING SYSTEM		Q.P.NO : PE - VE-422-154A-006		PACKAGE CONTRACT NO. CHEMICAL DOSING SYSTEM		MAIN SUPPLIER BHEL/PEM, NOIDA		
				SUB - SYSTEM :		REV. : 0						
				DATE :		PAGE : 3 OF 4						
S.NO	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY**			
									M	B	R	
1	2	3	4	5	6	7	8	9	10			11
9.0	FITTING/FLANGES FOR PIPING:											
9.1	RAW MATERIAL	CHEM.& PHY PRPERTIES	MA	CHEM.& PHY TEST	1/HT BATCH	ASTM A 182 GR.TP 304	ASTM A 182 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		HEAT TREATMENT	MA	HEAT TREATMENT	100%	ASTM A 182 GR.TP 304	ASTM A 182 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH	ASTM A 262 PR. 'E'	ASTM A 262 PR. 'E'	MFG.TC/LAB REPORT	P	V	V	
9.2	FINAL INSPECTION	DIMENSIONS	NA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG/ ANSI B 16.11/16.5	BHEL APPD.DATA SHEET/DWG/ ANSI B 16.11/16.5	MFG.TC	P	V	V	
10.0	STRAINERS :											
10.1	RAW MATERIAL FOR BODY	PHY.& CHEM. PROPERTIES	MA	PHY. & CHEM.TEST	1/BAR/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TCLAB REPORT	P	V	V	
10.2	SCREEN	CHEMICAL	MA	CHEMICAL	1/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
		MESH SIZE	MA	MEASUREMENT	1/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
10.3	FINAL INSPECTION	DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		LEAKAGE		HYDRO TEST	100%	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG.TC	P	V	V	
11.0	PIPE (SEAMLESS)											
11.1	MATERIAL	CHEMICAL	MA	CHEMICAL	1/HT BATCH/SIZE	ASTM A 312 GR.TP 304	ASTM A 312 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		MECHANICAL TEST	MA	MECHANICAL TEST	1/HT BATCH/SIZE	ASTM A 312 GR.TP 304	ASTM A 312 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		MICRO STRUCTURE	MI	GRAINS STRUCTURE	1/HT BATCH/SIZE	FOR HEAT TREATMENT	FOR HEAT TREATMENT	MFG.TC/LAB REPORT	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH/SIZE	ASTM A 262 PR 'E'	ASTM A 262 PR 'E'	MFG.TC/LAB REPORT	P	V	V	
		HYDRO TEST	MA	LEAKAGE	100%	NO LEAKAGE	NO LEAKAGE	MFG.TC/IR	P	V/W	V	
12.0	LEVEL GAUGE :											
12.1	RAW MATERIAL	CHEM.PROPERTIES	MA	CHEM.TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
12.2	FINAL INSPECTION	DIMENSION	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		LEAKAGE	MA	HYDRO TEST	100%	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG.TC	P	V	V	
13.0	PRESSURE & DP GAUGE											
13.1	MAT. FOR WETTED PARTS & BOURN	CHEM.PROPERTIES	MA	CHEM.TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
13.2	FINAL INSPECTION	DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG.TC/LAB REPORT				
13.3	PERFORMANCE	ACCURACY & OVERLOAD PROTECTION	MA	CALIBRATION	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC	P	V	V	
14.0	SWITCHES(LEVEL, PRESURE & DP) & TRANSMITTERS (LEVEL, PRESSURE & DP):											
14.1	MAT. FOR WETTED PARTS	CHEM.PROPERTIES	MA	CHEM.TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
14.2	PERFORMANCE	FUNCTIONAL	MA	CALIBRATION & VISUAL	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		IR-HV-IR		ELECTRICAL	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		DIMENSIONS		MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG.TC	P	V	V	
		DEGREE OF PROTECTION	MI	VERIFICATION OF TYPE TEST CERT	TYPE TEST	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
				** LEGEND :								
MANUFACTURER/ SUB CONTRACTOR		MAIN SUPPLIER--BHEL		M : MANUFACUTRER/SUB-CONTRACTOR/SUB-VENDOR B : BHEL/NOMINATED INSPECTION AGENCY "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION				C: CUSTOMER				
SIGNATURE								SIGNATURE OF APPROVAL BY CUSTOMER				

ANNEXURE-I



TECHNICAL SPECIFICATION FOR
CHEMICAL DOSING SYSTEM
1 X 525 MW TUTICORIN TPS

SECTION - I
SECTION - 1A
REV NO. 0
DATE :

		MANUFACTURER'S NAME & ADDRESS :		QUALITY PLAN				PROJECT 1 X 525 MW TUTICORIN TPS PACKAGE CHEMICAL DOSING SYSTEM CONTRACT NO. MAIN SUPPLIER BHEL/PEM, NOIDA				
				ITEM: CHEMICAL DOSING SYSTEM SUB - SYSTEM :		QP.NO : PE - VE-422-154A-006 REV. : 0 DATE :						
				CHEMICAL DOSING SYSTEM		PAGE : 4 OF 4						
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY**			REMARKS
1	2	3	4	5	6	7	8	9	M	B	R	
15.0	CONTROL PANEL :	DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	CONTROL PANEL TO BE OFFERED ALONG WITH FINAL SKID ASSEMBLY.
		CONTINUITY, IR-HV-IR	MA	ELECTRICAL	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		VERIFICATION OF MAKE	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		RATING OF COMPONENTS	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		PAINT SHADES, THICKNESS	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		ADHESION	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		DEGREE OF PROTECTION	MI	VERIFICATION OF TYPE TEST CERTIFICATE	TYPE TEST	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG.TC/LAB REPORT	P	V	W	
16.0	COMPLETE SKID ASSEMBLY:	DIMENSIONS & ORIENTATION	CR	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		LEAKAGE, CHECK ON WELDMENTS		VISUAL & HYDRO TEST	100%	DISCH.PIPING - 1.5 x DISCH PR. OF PUMP	NO LEAKAGE	INSPECTION REPORT	P	W	W	
		FUNCTIONAL TEST FOR INTERLOCKS	MA	VISUAL	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
	PMI Test for SS	GRADE CONFIRMATION	MA	CHEM.TEST	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		PAINTING	MA	VISUAL & MEASUREMENT	100%	BHEL APPD PAINTING SCHEME	APPD DWG/PAINTING	INSPECTION REPORT	P	W	W	
NOTE-1) WHEN BACK WALL ECHO IS SET TO 100% OF FSH IN SOUND AREA, DEFECT ECHO SHALL NOT EXCEED 20% OF FSH. MAX BACH WALL ECHO IS 20% OF FSH. TOTAL NO OF DEFECTS SHALL BE MAX. 5 NO IN ONE METER LENGTH. MIN DISTANCE BETWEEN TWO DEFECTS SHALL BE 3 TIMES THE DIA OF BACH WALL.												
NOTE-2) CHEMICAL DOSING SKID VENDOR SHALL BE SELECTED FROM CUSTOMER APPROVED SOURCES. ALL THE BOUGHT OUT ITEMS OF THE CHEMICAL DOSING VENDOR SHALL BE PROCURED FROM BHEL APPROVED SOURCES.												
NOTE- 3) ALL VENDOR DRAWINGS/DATASHEETS SHALL BE APPROVED BY BHEL. ONLY MANUFACTURING QP(PREPARED IN LINE WITH THIS STANDARD QP) OF THE VENDOR SHALL BE FORWARDED FOR CUSTOMER APPROVAL. ALL THE BHEL APPROVED DOCUMENTS SHALL BE FURNISHED TO CUSTOMER FOR INFORMATION/RECORDS ALONG WITH O&M MANUAL. COPY OF THE SAME SHALL ALSO BE FURNISHED TO INSPECTION AGENCY DURING INSPECTION.												
NOTE 4) FOR PIPES PURCHASED DIRECTLY FROM MANUFACTURER'S OR AUTHORIZED DEALERS, APART FROM TC REVIEW, CHECK WILL BE AS PER CLAUSE 2.1.2 AND 10.0; HOWEVER FOR HYDRAULIC TEST, MANUFACTURER TC SHALL BE REVIEWED . IN CASE ON IMPORTED PIPES PURCHASED FROM OPEN MARKET, TEST SHALL BE PERFORMED AS PER CLAUSE 2.1.2 AND 10.0 (INCLUDING HYDRAULIC TEST).												
NOTE 5) FOR RAW MATERIAL (BARS/PIPES/CASTINGS/FORGINGS) WHERE HEAT TREATMENT ARE CARRIED OUT BY MATERIAL PRODUCERS ON BULK QUANTITIES, THEIR TEST CERTIFICATE SHALL BE REVIEWED (EXCEPT TIME TEMPERATURE CHART)												
NOTE 6) NDT REQUIREMENT ON WELDING (TANK, PIPE, BREATHER/WATER SEAL/CO2 ABSORBER) SHALL BE AS -- A) ON BUTT WELD-- 25% DP & 25% RT FOR PUMP SUCTION SIDE & 100% DP & 100% RT FOR PUMP DISCHARGE SIDE. B) ON FILLET WELD--100% DP TEST												
		** LEGEND :										
MANUFACTURER/ SUB CONTRACTOR		MAIN SUPPLIER--BHEL		M : MANUFACUTRER/SUB-CONTRACTOR/SUB-VENDOR B : BHEL/NOMINATED INSPECTION AGENCY C: CUSTOMER								
SIGNATURE				"P" PERFORM, "W" WITNESS, AND "V" VERIFICATION				SIGNATURE OF APPROVAL BY CUSTOMER				

	TITLE: 1 X 525 MW TUTICORIN TPS	SPECIFICATION NO. PE-TS-422-154-A001
		SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SECTION - I A
		REV.NO. 0 DATE :

ANNEXURE II:
SUB VENDORS LIST

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SECTION - I A
		REV.NO. 0 DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	METERING PUMPS	VK PUMPS	NASIK	
		MILTON ROY INDIA	CHENNAI	
		SWELLORE	AHMEDABAD	
		POSITIVE METERING PUMPS	NASIK	
		METACHEM	MUMBAI	
2.	AGITATOR	REMI PEOCESS PLANT & M/C	MUMBAI	
		FIBRE & FIBRE	MUMBAI / SILVASA	
		CEECONS	CHENNAI	
		STANDARD ENGINEERS	MUMBAI	
3.	HORIZONTAL CENTRIFUGAL PUMPS	BEST AND CROMPTON ENGG LTD.	CHENNAI	
		BHARAT PUMPS & COMPRESSORS LTD	ALLAHABAD	
		FLOWMORE LTD.	GURGAON	
		FLOWERVE INDIA CONTROLS PVT. LTD.	COIMBATORE	
		JYOTI LTD.	VADODARA	
		KIRLOSKAR BROTHERS LTD	PUNE	
		WILO MATHER & PLATT PUMPS PVT. LTD.	PUNE	
		V-FLO PUMPS & SYSTEMS CO. LTD.,	BEIJING-CHINA	
		WPIL LIMITED	KOLKATA	
		HILLER	-	
4.	BALL VALVE (MANUAL /PNEUMATIC/ ELECTRIC) CLASS 150	A.V. VALVES LTD	AGRA	
		AKAY INDUSTRIES PVT.LTD.		
		BELGAUM AQUA VALVES PVT. LTD.	BELGAUN	
		ASIAN INDUSTRIAL VALVES & INSTRUMENTS.	CHENNAI	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		DEMBLA VALVES LTD.	THANE	
		M/S GM ENGINEERING	RAJKOT	
		HAWA VALVES (INDIA) PVT. LTD.	NAVI MUMBAI	
		INTERVALVE (INDIA) LTD.	PUNE	
		LEADER VALVES LTD.	JALANDHAR	
		MICROFINISH VALVES PVT LTD.	HUBLI	
		NILON VALVES PRIVATE LIMITED	AHMEDABAD	

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SECTION - I A
		REV.NO. 0 DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		UNIFLOW	CHENNAI	
		VALTECH INDUSTRIES	MUMBAI	
		VAAS AUTOMATION PVT. LTD.	NEW DELHI	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
5.	BUTTER-FLY VALVE	ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		INSTRUMENTATION LTD.	PALAKKAD	
		INTERVALVE (INDIA) LTD.	PUNE	
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	NAVI MUMBAI	
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	KOLKATA	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
6.	DIAPHRAGM VALVE (MANUAL / PNEUMATIC) CLASS 150	WEIR BDK	HUBLI	
		CRANE FLOW PROCESS	SATARA	
		PROCON	MUMBAI	
		MAJESTIC VALVES (LABLINE)	-	
		HAWA ENGINEERS	AHMEDABAD	
7.	DUAL PLATE CHECK VALVES	ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	1. DUAL PLATE CHECK VALVE CI - CLASS 150 & UP TO 600NB, 2. DUAL PLATE CHECK VALVE CCS - CLASS 150 & UP TO 500NB
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CI ,CCS & STAINLESS STEEL SPRING ASSISTED DUAL PLATE

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SECTION - I A
		REV.NO. 0 DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
				CHECK VALVES UPTO 700 NB AND 150 CLASS RATING.
8.	Y-TYPE STRAINER / STRAINER (WATER SERVICE)	OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		GRAND PRIX	NEW DELHI	
		JAYPEE	NEW DELHI	
		GREAVES COTTON	MUMBAI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI / NOIDA	
		FILTRATION ENGINEERS (I) PVT. LTD	MUMBAI	
		FLUIDNYE	-	
		SUNGOV ENGINEERING PVT. LTD.	DELHI	
		GRAND PRIX	FARIDABAD	
		JAYPEE INDUSTRIES PVT. LTD.	DELHI	
		BHATIA ENGINEERING CO.	DELHI	
9.	RUBBER FLAP TYPE CHECK VALVES	ASHVIK VALVES	-	
		FLOW WAY VALVES	-	
		BDK	-	
		MAJESTIC VALVES (LABLINE INST)	-	
		ADVANCE VALVES	-	
10.	SOLENOID VALVES	ROTEX	-	
		AVCON	-	
11.	SS PIPES / TUBES	APEX TUBES	BEHROR (ALWAR)	
		RATNAMANI	CHATTRAL	
		REMI	TARAPUR	
		PRAKASH STEELAGE	-	
		TORRENT CABLE	NADIAD	
		UNIVERSAL CABLES	SATNA	
		GEMSCAB	BHIWADI	
12.	SAFETY SHOWER	DELTON	FARIDABAD	
		UNICARE	-	
		MOHAN INDUSTRIES	-	
13.	FRP TANKS & FITTINGS	SUPER SAFETY SERVICES	-	
		GLOBAL COMPOSITE	-	
		EPP	-	
		DEEPA COMPOSITE	-	

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SECTION - I A
		REV.NO. 0 DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		COROSEAL INDUSTRIES	-	
		CHEMICAL PROCESS & EQUIPMENT PVT LTD	-	
		J.R FIBRE INDUSTRIES PVT LTD	-	
		POLYPLAST	-	
14.	EJECTOR	ESSEM TECHNOLOGIES	-	
		RATNA PRASAD	-	
15.	STROKE CONTROLLER	V K PUMPS	NASIK	
		METACHEM	MUMBAI	
		SWELORE	AHMEDABAD	
		MILTON ROY INDIA	CHENNAI	
16.	SAFETY VALVES/RELIEF VALVES	METACHEM	MUMBAI	
		KEYSTONE	BARODA	
		V K PUMPS	NASIK	
		MILTON ROY		
17.	Y TYPE STRAINER	JAYPEE INDUSTRIES PVT. LTD.	NEW DELHI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI	
		OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		SUNGOV ENGINEERING PVT. LTD.	CHENNAI	
18.	ORIFICE PLATE	MICRO PRECISION	FARIDABAD	
		INSTRUMENTAION LTD	PALGHAT	
		CARLO DYNAMICS	HYDERABAD	
19.	STEEL GATE/GLOBE/NR VALVES	A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	(1) CARBON STEEL GATE VALVES & NON RETURN VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 300 NB (#150) (2) CARBON STEEL GLOBE VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 200 NB (#150)
		FLUIDLINE VALVES COMPANY PVT.LTD.	KAUSHAMBI	
		M/S GM ENGINEERING	RAJKOT	
		INTERVALVE (INDIA) LTD.	PUNE	A) STEEL GATE VALVES: UPTO 50NB, #800 AND

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SECTION - I A
		REV.NO. 0 DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
				65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C)SUPPLIER NOT REGISTERED FOR NR VALVES
		LEADER VALVES LTD.	JALANDHAR	
		NITON VALVE INDUSTRIES PVT LTD	MUMBAI	
		NSSL LIMITED.	NAGPUR	
		STEEL STRONG VALVES (I) PVT.LTD.,	NAVI MUMBAI	LIMITED TO RANGES & CLASSES AS AVAILABE IN VD FILE.
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CC/CSS-GATE-BBT- UPTO600NB CL UPTO300,GATE-PSBT UPTO250NB CL 1500,GLV-BBT- UPTO300NB CL UPTO600,SCNRV-BBT- UPTO600NB CL UPTO150,SCNRV-BBT- UPTO300NB CL 300,SCNRV-PSBT- UPTO150NB CL UPTO900
		VALTECH INDUSTRIES	MUMBAI	CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE- GV/150/900,GV/300/400, GV/600/300 , GV/GLV/NRV/900/250 , GLV/300/300,GLV/150/35 0/ , SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.
		V.K. VALVES PVT. LTD.,	JALANDHAR	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
20.	SLUICE GATE	H SARKAR	KOLKATA	
		JASH ENGINEERING	-	
		YASHWANT INDUSTRIES	-	
21.	3 WAY VALVE	HI TECH	AHMEDABAD	
		ADVANCE VALVES PVT.LTD	NOIDA	

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SECTION - I A
		REV.NO. 0 DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		BDK	HUBLI	
		FOURESS ENGG.INDIA LTD.	MUMBAI	
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI	
		INSTRUMENTATION LTD.	PALAKAD	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		VENUS PUMP & ENGG. WORKS	KOLKATA	
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI	
		STAFFORD CONTROLS LIMITED	PUNE	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
22.	PLUG VALVE(MANUAL)	BDK	HUBLI	
		HAWA ENGINEERS / MARCK & CARE	-	
		MICON VALVES	-	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
23.	FITTINGS (CS/SS)	M.S. FITTINGS	KOLKATA	
		METAL LLOYDS	MUMBAI	
		TRUE FORGE	FARIDABAD	
		TUBE PRODUCTS	BARODA	
		NL HAZRA	KOLKATA	
		GUJRAT INFRA PIPES	BARODA	
		EDWARDS	USA	
		PIPEFIT ENGINEERS	BARODA	
		SIDDARTH & GAUTAM	FARIDABAD	
		EBY	MUMBAI	
24.	FLANGES (SS/CS)	PRADEEP METALS LTD	MUMBAI	
		TUBE PRODUCT INCORPORATION		
		MS FITTINGS	KOLKATA	
		HAWA ENGINEERING	-	
		ALIANCE PIPE & PLANGES	KOLKATA	
		JAI AMBE	MUMBAI	
25.	PAINT			

SR. NO.		SUPPLIERS	PLACE	REMARKS
		BERGER PAINTS INDIA LTD		
		GOODLASS NEROLAC		
		JENSON & NICHOLSON (I) LTD		
		CDC CARBOLINE (I) LTD.		
		SHALIMAR PAINTS LTD.		
		ADDISON PAINTS LTD		
		GRAND POLYCOAT		
		BOMBAY PAINTS		
		HEMPLE PAINTS (SINGAPORE)		
		JOTUN PAINTS		
26.	PNEUMATIC ACTUATOR	PROCON ENGINEERS	-	
		TYCO	-	
		CRANE PROCESS	-	
		BDK	-	
		INTERVALVE	-	
		BRAY CONTROL	-	
27.	MOTORISED ACTUATOR	ROTARK	-	
		AUMA	-	
		LIMITORK	-	

1X525 MW MEIL TUTICORIN (STAGE-IV) TPS, UNIT-1 : BOI PACKAGES Of BHEL- PEM

Sl.No.	Packages	Drg/doc review/approval	Inspection Witness	Package Category	Proposed Vendors
8	CHEMICAL DOSING SYSTEM	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) ENPRO INDUSTRIES PVT.LTD. 2) Heidelberg Prominent Fluid Control India Private Ltd. 3) MR SYSTEMS 4) POWER PIPING COMPANY 5) PSI ENGINEERING SYSTEMS (P) LTD. 6) Positive Metering Pumps (I) Pvt. Ltd. 7) Rockwin Flowmeter India Pvt. Ltd. 8) SWELORE ENGG. PVT. LTD 9) TECHNO CONSULTANTS 10) TECHNOSTRENGTH PVT. LTD. 11) V.K PUMP INDUSTRIES PVT LTD
9	VIS FOR MDBFP & TDBFP FOUNDATION	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) BEIJING HUADIAN TIANHENG TECHNOLOGY DEVELOPMENT CO. LTD. 2) GERB VIBRATION CONTROL SYSTEMS PVT.LTD 3) LARA GLOBAL
10	VIS FOR ID FAN FOUNDATION	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) BEIJING HUADIAN TIANHENG TECHNOLOGY DEVELOPMENT CO. LTD. 2) GERB VIBRATION CONTROL SYSTEMS PVT.LTD 3) LARA GLOBAL
11	FLOW ELEMENT - NOZZLE	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) HYDROPNEUMATICS PVT. LTD. 2) INSTRUMENTATION LTD 3) MICRO PRECISION PRODUCTS PVT. LTD 4) MINCO (INDIA) FLOW ELEMENTS PVT. LTD. 5) STAR-MECH CONTROLS (I) PVT.LTD. 6) SEIKO FLOW CONTROL GMBH
12	FLOW ELEMENT - ORIFICE	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) STAR-MECH CONTROLS (I) PVT.LTD. 2) MICRO PRECISION PRODUCTS PVT. LTD 3) HYDROPNEUMATICS PVT. LTD. 4) Flow Star Engineering Pvt. Ltd 5) INSTRUMENTATION ENGINEERS PVT LTD 6) INSTRUMENTATION LTD
13	ROTAMETER	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD 2) Flow Star Engineering Pvt. Ltd., 3) INSTRUMENTATION ENGINEERS PVT LTD 4) SCIENTIFIC DEVICES (BOMBAY) PVT LTD,
14	LT PVC CONTROL CABLE	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) APAR INDUSTRIES LTD. 2) ADVANCE CABKLE TECHNOLOGIES (P) LTD 3) CORDS CABLE INDUSTRIES LTD. 4) CRYSTAL CABLE INDUSTRIES LTD. 5) CMI LTD. 6) Diamond Power Infrastructure Ltd. 7) DELTON CABLES LTD. 8) ELKAY TELELINKS LTD. 9) GEMSCAB INDUSTRIES LTD. 10) Govind Cable Industries, 11) GUPTA POWER INFRASTRUCTURE LIMITED, 12) HAVELLS INDIA LTD. 13) Incom Cables (P) Ltd., 14) KEI INDUSTRIES LTD. 15) KEC INTERNATIONAL LIMITED 16) MANSFIELD CABLES COMPANY LTD. 17) PARAMOUNT COMMUNICATIONS LTD. 18) POLYCAB WIRES PVT. LTD. 19) RAVIN CABLES LIMITED 20) SUYOG ELECTRICALS LTD. 21) SPECIAL CABLES PVT. LTD. 22) SRIRAM CABLES PVT. LTD. 23) Scot Innovation Wires and Cables Pvt. Ltd. 24) Sam Cables & Conductors (P) Ltd, 25) SPM POWER & TELECOM PVT. LTD, 26) THERMO CABLES LTD. 27) TIRUPATI PLASTOMATICS PVT. LTD. 28) UNIVERSAL CABLES LTD.

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06/04/16

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1X525 MW MEIL TUTICORIN (STAGE-IV) TPS, UNIT-1 : BOI PACKAGES OF BHEL- PEM

Sl.No.	Packages	Drg/doc review/approval	Inspection Witness	Package Category	Proposed Vendors
15	SCREENED CONTROL CABLE	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) CORDS CABLE INDUSTRIES LTD. 2) CMI LTD. 3) DELTON CABLES LTD. 4) ELKAY TELELINKS LTD. 5) GUPTA POWER INFRASTRUCTURE LIMITED, 6) KEI INDUSTRIES LTD. 7) MANSFIELD CABLES COMPANY LTD. 8) PARAMOUNT COMMUNICATIONS LTD. 9) SUYOG ELECTRICALS LTD. 10) SPECIAL CABLES PVT. LTD. 11) THERMO CABLES LTD. 12) T C COMMUNICATION PVT. LTD.
16	ABOVE GROUND EARTHING MATERIALS	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) INDUSTRIAL PERFORATION (I) PVT.LTD. 2) INDIA ELECTRICALS SYNDICATE 3) INDMARK FORMTECH PVT. LTD. 4) PREMIER POWER PRODUCTS (CAL) PVT. LTD. 5) PATNY SYSTEMS (P) LTD 6) PASSIVE INFRA PROJECTS PVT. LTD. 7) RUKMANI ELECTRICAL & COMPONENTS PVT LTD 8) RATAN PROJECTS & ENGINEERING CO. PVT.LTD. 9) RABI ENGINEERING WORKS PVT. LTD. 10) RAJASTHAN METAL SMELTING CO. 11) SARAL INDUSTRIES 12) UNITECH FABRICATORS and ENGINEERS PVT LTD
17	AIR RELEASE VALVES	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) A.V. VALVES LTD 2) G.M. DALUI AND SONS PVT.LTD. 3) LEADER VALVES LTD. 4) R and D MULTIPLES (METAL CAST) PVT LTD 5) UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED, 6) VENUS PUMPS AND ENGG. WORKS
18	HOSE VALVES (STEEL GATE/GLOBE/NR VALVES)	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) A.V. VALVES LTD 2) ATAM VALVES PVT. LTD. 3) FOURESS ENGG. INDIA LTD. 4) FLUIDLINE VALVES COMPANY PVT.LTD. 5) GM ENGINEERING PVT. LTD. 6) INTERVALVE POONAWALLA LTD 7) LEADER VALVES LTD. 8) NITON VALVE INDUSTRIES PVT LTD 9) NSSL LIMITED. 10) OSWAL INDUSTRIES LTD 11) STEEL STRONG VALVES (I) PVT.LTD., 12) VALTECH INDUSTRIES 13) V.K. VALVES PVT. LTD., 14) WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.
19	BALL VALVES	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) A.V. VALVES LTD 2) BELGAUM AQUA VALVES PVT. LTD. 3) ATAM VALVES PVT. LTD. 4) DEMBLA VALVES LTD. 5) GM ENGINEERING PVT. LTD. 6) Hawa Valves (India) Pvt. Ltd. 7) INTERVALVE POONAWALLA LTD 8) LEADER VALVES LTD. 9) MICROFINISH VALVES PVT LTD. 10) NITON VALVES PRIVATE LIMITED 11) UNIFLOW 12) VALTECH INDUSTRIES 13) VAAS AUTOMATION PVT. LTD. 14) WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.
20	LUBE OIL TRANSFER PUMPS	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) DELTA P D PUMPS PVT. LTD. 2) MATZ PUMPS PVT. LTD. 3) TUSHACO PUMPS PVT.LTD.
21	M.E. BELLOWS	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) B. D. Engineers 2) FLEXICAN BELLOWS AND HOSES PVT. LTD. 3) FLEXATHERM EXPANLOW PVT. LTD. 4) LONESTAR INDUSTRIES 5) MB METALLIC BELLOWS PVT. LTD. 6) METALLIC BELOWS INDIA PVT. LTD. 7) Qinhuangdao North Metal Hose Co. Ltd., 8) TEDDINGTON ENGINEERED SOLUTIONS LTD.

g. shankar
06/04/16



Wing

1X525 MW MEIL TUTICORIN (STAGE-IV) TPS, UNIT-1 : BOI PACKAGES Of BHEL- PEM

Sl.No.	Packages	Drg/doc review/approval	Inspection Witness	Package Category	Proposed Vendors
22	SELF CLEANING STRAINERS	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) AMIAD FILTRATION SYSTEMS LTD 2) FILTRATION ENGINEERS (I) PVT. LTD. 3) GEA BGR ENERGY SYSTEM INDIA LTD. 4) MULTITEX FILTRATION ENGINEERS LIMITED,
23	CONICAL STRAINERS	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) BHATIA ENGINEERING CO. 2) JAYPEE INDUSTRIES PVT. LTD. 3) MULTITEX FILTRATION ENGINEERS LIMITED 4) NISAN SCIENTIFIC PROCESS EQUIPMENT PVT. LTD. 5) OTOKLIN GLOBAL BUSINESS LIMITED 6) SUNGOV ENGINEERING PVT. LTD.
24	THERMAL INSULATION - R-MATTRESSES/P-SECN	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) GOENKA ROCKWOOL (INDIA) PVT.LTD. 2) LLOYD INSULATIONS (INDIA) LTD. 3) MINWOOL ROCK FIBRES LTD. 4) Polybond Insulation Private Limited, 5) ROCKWOOL (INDIA) PVT. LTD. 6) SHREERAM EQUITECH PRIVATE LIMITED 7) THERMOCARE ROCKWOOL INDIA PRIVATE LTD. 8) DHANBAD ROCKWOOL INSUALTION (P) LTD 9) HI-TEC ROCKFIBRE PVT LTD 10) MINSULATE MANUFACTURING COMPANY 11) PUNJSTAR INSULATION FIBRE * 12) LAPINUS ROCKWOOL P LTD * 13) ROCKWOOL INDUSTRIES *
25	AIR TRAPS	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) PENNANT ENGINEERING PVT. LTD. 2) FORBES MARSHALL STEAM SYSTEM PVT. LTD.
26	STEAM TRAPS	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) LEADER VALVES LTD. 2) PENNANT ENGINEERING PVT. LTD. 3) FORBES MARSHALL STEAM SYSTEM PVT. LTD.
27	ALUMINIUM SHEETS/COILS	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) BHARAT ALUMINIUM COMPANY LTD 2) HINDALCO INDUSTRIES LTD 3) NATIONAL ALUMINIUM COMPANY LTD. 4) Chongqing Lanren Aluminium Co. Ltd., China 5) JINDAL ALUMINIUM LTD
28	THERMAL INSULATION - CALCIUM SILICATE	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) HIL LIMITED 2) NEWKEM PRODUCTS CORPORATION
29	THERMAL INSULATION - ANCILLARY MATERIAL	All drgs/docs by BHEL	BHEL/TPIA	MINOR	1) ALLIED INSULATIONS (INDIA) 2) ENERGY SAVING AND ALLIED PRODUCTS, 3) LLOYD INSULATIONS (INDIA) LIMITED 4) SUDHIR TRADING COMPANY, 5) SURESH FASTENERS

NOTES:

1. Executing agency for all above mentioned BOIs shall be BHEL-PEM except for "MISC TANKS" package which shall be executed by BHEL-PSSR.
2. MDCC will be issued by BHEL.
3. All drgs/docs which are proposed to be approved by BHEL, required drawings/documents shall be submitted to MEIL after due approval complying to contract specification. However if there is any deviation from the contract, BHEL will seek categorical approval/acceptance from customer-MEIL.
4. As per Minutes of project KOM dated 13.01.16 (pt no. 6), approved vendors/sub-vendors as per latest PMD of BHEL units shall be applicable and is acceptable to customer MEIL.
5. BHEL Vendors as on date is indicated for package applicable for the project. BHEL-PEM shall submit list of additional vendors to customer, which shall be qualified against open tender based on PQR set by BHEL as per minutes of KOM dtd. 13.01.16 (pt no. 7).

* Vendors proposed by MEIL

ABBREVIATIONS: MEIL: Megha Engineering Infrastructure Ltd; PEM: Project Engineering Management; PSSR: Power Sector Southern Region; TPIA: Third Party Inspection Agency of BHEL; COC: Certificate of Conformance

Handwritten signature and date: 06/04/16

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PACKAGE WISE REGISTERED SUPPLIER LIST (PERMANENT CATEGORY) AS ON 1/18/2017
11:45:22 AM

Sl No	Package Name	Supplier Name	Supplier Communication Address
1	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosepi@gmail.com; bosepanda@vsnl.net
2	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
3	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
4	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
5	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
6	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
7	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
8	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
9	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
10	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,
11	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
12	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,

- 1.)The above Sub-Vendor list is tentative & reference only. However Sub-Vendor List is subject to BHEL/End user approval without any commercial /delivery implication.
- 2.)New Sub-Vendor if proposed by Vendor during contract stage shall subject to BHEL/end user approval without commercial/delivery implication.

SI No	Package Name	Supplier Name	Supplier Communication Address
13	TEMPERATURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
14	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincode : 403525 Email : gtilworks@pyro-electric.in
15	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
16	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
17	TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
18	TEMPERATURE GAUGE	BUDENBERG GAUGE CO.LTD.	PO BOX-5, ALTRINCHAM CHESHIRE Phone- 0161-9285441 Pincode : WA14 4ER Email : dhbdelhi@vsnl.net
19	LEVEL GAUGE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com
20	LEVEL GAUGE	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com
21	LEVEL GAUGE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in
22	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com
23	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
24	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,
25	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,

SI No	Package Name	Supplier Name	Supplier Communication Address
26	TRANSMITTERS	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
27	TRANSMITTERS	ABB LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com
28	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
29	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,
30	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
31	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwiji Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com
32	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com
33	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com
34	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com
35	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in
36	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com
37	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com
38	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com

SI No	Package Name	Supplier Name	Supplier Communication Address
39	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net
40	JUNCTION BOX	AJMERIA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERIA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com
41	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
42	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
43	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
44	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
45	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
46	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
47	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
48	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
49	ULTRASONIC FLOW METERS	NIVUS GMBH	Mr. Marcus Fischer Im Taele 2, D - 75031 Eppingen Phone- 00491712233770 Pincode : Email : carolin.schuster@nivus.com
50	ULTRASONIC FLOW METERS	FLASH FORGE PVT LTD	Mr. Gautam Makker, 503, 'A'-wing, Delphi, Orchard Avenue Road, Powai Mumbai Phone- 022- 42784300 Pincode : 400076 Email : hemendrapatil@f-f.co.in
51	ULTRASONIC FLOW METERS	CHEMTROLS INDUSTRIES LTD	Mr. K. NANDAKUMAR AMAR HILL, SAKI VIHAR ROAD, POWAI, MUMBAI Phone- 022-67151261 Pincode : 400072 Email : manikandan@chemtrols.com

SI No	Package Name	Supplier Name	Supplier Communication Address
52	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
53	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
54	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com
55	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
56	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
57	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
58	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com
59	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com
60	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com
61	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com

S. No.	Deptt.	Package	PMD Vendor/ Sub Vendor
1	Electrical	LV MOTORS (NON FLAME PROOF)	ABB
2	Electrical	LV MOTORS (NON FLAME PROOF)	BHARAT BIJLEE LTD.
3	Electrical	LV MOTORS (NON FLAME PROOF)	CROMPTON GREAVES
4	Electrical	LV MOTORS (NON FLAME PROOF)	GE-POWER
5	Electrical	LV MOTORS (NON FLAME PROOF)	KIRLOSKAR ELECTRIC CO LTD.
6	Electrical	LV MOTORS (NON FLAME PROOF)	LAXMI HYDRAULICS PVT. LTD
7	Electrical	LV MOTORS (NON FLAME PROOF)	MARATHON
8	Electrical	LV MOTORS (NON FLAME PROOF)	NGEF
9	Electrical	LV MOTORS (NON FLAME PROOF)	RAJINDRA ELECT INDUSTRIES
10	Electrical	LV MOTORS (NON FLAME PROOF)	SIEMENS
11	Electrical	LV MOTORS (FLAME PROOF)	RAJINDRA ELECT INDUSTRIES
12	Electrical	MCC (FIXED TYPE)	SPACEAGE SWITCHGEARS LTD.
13	Electrical	MCC (FIXED TYPE)	ASSOCIATED SWGR & PROJ.LTD.
14	Electrical	MCC (FIXED TYPE)	BCH
15	Electrical	JUNCTION BOXES (NON FLAME PROOF)	JASPER ENGNIREES PVT. LTD.
16	Electrical	JUNCTION BOXES (NON FLAME PROOF)	Electro Controls & Devices
17	Electrical	JUNCTION BOXES (NON FLAME PROOF)	M/s Shrenik & Co.
18	Electrical	JUNCTION BOXES (NON FLAME PROOF)	M/s PHOENIX MECANO LTD.,
19	Electrical	JUNCTION BOXES (NON FLAME PROOF)	Adroit Control Engineers Pvt.Ltd.
20	Electrical	JUNCTION BOXES (NON FLAME PROOF)	M/s PHOENIX MECANO LTD.,
21	Electrical	JUNCTION BOXES (NON FLAME PROOF)	MIKA ENGINEERS
22	Electrical	JUNCTION BOXES (NON FLAME PROOF)	M/s PHOENIX MECANO LTD.,
23	Electrical	JUNCTION BOXES (NON FLAME PROOF)	BAJAJ ELECTRICALS
24	Electrical	JUNCTION BOXES (NON FLAME PROOF)	AJMERA INDUSTRIES & ENGG. WORKS
25	Electrical	JUNCTION BOXES (NON FLAME PROOF)	S.B. ELECTRICAL ENGINEERING CORPORATION
26	Electrical	JUNCTION BOXES (FLAME PROOF)	SUDHIR SWITCHGEAR
58	Electrical	LT XLPE POWER CABLE	APAR INDUSTRIES LTD.
59	Electrical	LT XLPE POWER CABLE	CORDS CABLE INDUSTRIES LTD.
60	Electrical	LT XLPE POWER CABLE	CRYSTAL CABLE INDUSTRIES LTD.
61	Electrical	LT XLPE POWER CABLE	GEMSCAB INDUSTRIES LTD.
62	Electrical	LT XLPE POWER CABLE	Govind Cable Industries,
63	Electrical	LT XLPE POWER CABLE	GUPTA POWER INFRASTRUCTURE LIMITED,
64	Electrical	LT XLPE POWER CABLE	HAVELLS INDIA LTD.
65	Electrical	LT XLPE POWER CABLE	KEI INDUSTRIES LTD.
66	Electrical	LT XLPE POWER CABLE	KEC INTERNATIONAL LIMITED
67	Electrical	LT XLPE POWER CABLE	MANSFIELD CABLES COMPANY LTD.
68	Electrical	LT XLPE POWER CABLE	PARAMOUNT COMMUNICATIONS LTD.
69	Electrical	LT XLPE POWER CABLE	POLYCAB WIRES PVT. LTD.
70	Electrical	LT XLPE POWER CABLE	RAVIN CABLES LIMITED
71	Electrical	LT XLPE POWER CABLE	SUYOG ELECTRICALS LTD.
72	Electrical	LT XLPE POWER CABLE	SPECIAL CABLES PVT. LTD.
73	Electrical	LT XLPE POWER CABLE	SRIRAM CABLES PVT. LTD.
74	Electrical	LT XLPE POWER CABLE	THERMO CABLES LTD.

75	Electrical	LT XLPE POWER CABLE	TIRUPATI PLASTOMATICS PVT. LTD.
76	Electrical	LT PVC CONTROL CABLE	Advance Cable Technologies (P) Ltd.
77	Electrical	LT PVC CONTROL CABLE	APAR INDUSTRIES LTD.
78	Electrical	LT PVC CONTROL CABLE	CMI LTD.
79	Electrical	LT PVC CONTROL CABLE	CORDS CABLE INDUSTRIES LTD.
80	Electrical	LT PVC CONTROL CABLE	CRYSTAL CABLE INDUSTRIES LTD.
81	Electrical	LT PVC CONTROL CABLE	DELTON CABLES LTD.
82	Electrical	LT PVC CONTROL CABLE	ELKAY TELELINKS LTD.
83	Electrical	LT PVC CONTROL CABLE	GEMSCAB INDUSTRIES LTD.
84	Electrical	LT PVC CONTROL CABLE	GOVIND CABLE INDUSTRIES
85	Electrical	LT PVC CONTROL CABLE	GUPTA POWER INFRASTRUCTURE LIMITED,
86	Electrical	LT PVC CONTROL CABLE	HAVELLS INDIA LTD.
87	Electrical	LT PVC CONTROL CABLE	Incom Cables (P) Ltd.,
88	Electrical	LT PVC CONTROL CABLE	KEI INDUSTRIES LTD.
89	Electrical	LT PVC CONTROL CABLE	KEC INTERNATIONAL LIMITED
90	Electrical	LT PVC CONTROL CABLE	MANSFIELD CABLES COMPANY LTD.
91	Electrical	LT PVC CONTROL CABLE	PARAMOUNT COMMUNICATIONS LTD.
92	Electrical	LT PVC CONTROL CABLE	POLYCAB WIRES PVT. LTD.
93	Electrical	LT PVC CONTROL CABLE	RAVIN CABLES LIMITED
94	Electrical	LT PVC CONTROL CABLE	SUYOG ELECTRICALS LTD.
95	Electrical	LT PVC CONTROL CABLE	SPECIAL CABLES PVT. LTD.
96	Electrical	LT PVC CONTROL CABLE	SRIRAM CABLES PVT. LTD.
97	Electrical	LT PVC CONTROL CABLE	Sam Cables & Conductors (P) Ltd.,
98	Electrical	LT PVC CONTROL CABLE	SPM POWER & TELECOM PVT. LTD,
99	Electrical	LT PVC CONTROL CABLE	THERMO CABLES LTD.
100	Electrical	LT PVC CONTROL CABLE	TIRUPATI PLASTOMATICS PVT. LTD.
101	Electrical	LT PVC CONTROL CABLE	UNIVERSAL CABLES LTD.
102	Electrical	SCREENED CONTROL CABLES	Advance Cable Technologies (P) Ltd.
103	Electrical	SCREENED CONTROL CABLES	CMI LTD.
104	Electrical	SCREENED CONTROL CABLES	CORDS CABLE INDUSTRIES LTD.
105	Electrical	SCREENED CONTROL CABLES	DELTON CABLES LTD.
106	Electrical	SCREENED CONTROL CABLES	ELKAY TELELINKS LTD.
107	Electrical	SCREENED CONTROL CABLES	GUPTA POWER INFRASTRUCTURE LIMITED,
108	Electrical	SCREENED CONTROL CABLES	KEI INDUSTRIES LTD.
109	Electrical	SCREENED CONTROL CABLES	MANSFIELD CABLES COMPANY LTD.
110	Electrical	SCREENED CONTROL CABLES	PARAMOUNT COMMUNICATIONS LTD.
111	Electrical	SCREENED CONTROL CABLES	POLYCAB WIRES PVT. LTD.
112	Electrical	SCREENED CONTROL CABLES	SUYOG ELECTRICALS LTD.
113	Electrical	SCREENED CONTROL CABLES	SPECIAL CABLES PVT. LTD.
114	Electrical	SCREENED CONTROL CABLES	THERMO CABLES LTD.
115	Electrical	SCREENED CONTROL CABLES	T C Communication Pvt. Ltd.
116	Electrical	CABLE GLANDS	ALLIED TRADERS & EXPORTERS
117	Electrical	CABLE GLANDS	ARUP ENGG & FOUNDRY WORKS
118	Electrical	CABLE GLANDS	BALIGA LIGHTING EQPT.PVT.LTD.
119	Electrical	CABLE GLANDS	COMMET BRASS PRODUCTS
120	Electrical	CABLE GLANDS	DOWELLS
121	Electrical	CABLE GLANDS	ELECTROMAC INDUSTRIES
122	Electrical	CABLE GLANDS	INCAB
123	Electrical	CABLE LUGS	DOWELLS
136	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	GE-POWER

137	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	ASIATIC
138	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	C&S ELECTRIC LTD.
139	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	EVERGREEN ENGG. CO.
140	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	TECKNIC CONTROLS
141	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	EX-PROTECTA LIGHTING EQUIPMENT
142	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	BALIGA ELECTRICALS
143	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	ENPRO ENGG.
144	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	STERLING SWGR CONTROL PVT.LTD.
145	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	ELEXPRO ELECTRICALS PVT/ LTD.
146	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	VAISHNO(HOTLINE SWGR & CONTROL)
147	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	JASPER ENGINEERS PVT. LTD.
148	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	KMG ATOZ SYSTEMS
149	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	UNILEC ENGINEERS PVT. LTD.
150	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	BCH
151	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	CANDS
152	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	SIEMENS
153	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	SCHNEIDER ELECTRIC INDIA PVT. LTD.
154	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	TECKNIC CONTROLS
155	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	UNITED ELECTRIC
156	Electrical	LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	M/s Shrenik & Co.
157	Electrical	ABOVE GROUND EARTHING MATERIALS	EROS INFRASTRUCTURES PVT. LTD.
158	Electrical	ABOVE GROUND EARTHING MATERIALS	INDUSTRIAL PERFORATION (I) PVT.LTD.
159	Electrical	ABOVE GROUND EARTHING MATERIALS	INDIA ELECTRICALS SYNDICATE
160	Electrical	ABOVE GROUND EARTHING MATERIALS	INDMARK FORMTECH PVT. LTD.
161	Electrical	ABOVE GROUND EARTHING MATERIALS	JAGANNATHAN ENGINEERING WORKS
162	Electrical	ABOVE GROUND EARTHING MATERIALS	PREMIER POWER PRODUCTS (CAL) PVT. LTD.
163	Electrical	ABOVE GROUND EARTHING MATERIALS	PATNY SYSTEMS (P) LTD
164	Electrical	ABOVE GROUND EARTHING MATERIALS	PASSIVE INFRA PROJECTS PVT. LTD.
165	Electrical	ABOVE GROUND EARTHING MATERIALS	RUKMANI ELECTRICAL & COMPONENTS PVT LTD

		TITLE:		SPECIFICATION NO. PE-TS-422-154-A001
166	Electrical	1 X 525 MW TUTICORIN TPS		SECTION I
167	Electrical	ABOVE GROUND EARTHING MATERIALS	RATAN PROJECTS & ENGINEERING CO. PVT.LTD.	SECTION - I A
168	Electrical	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	RAJASTHAN METAL SMELTING CO.	REV.NO 0
169	Electrical	ABOVE GROUND EARTHING MATERIALS	Saral Industries	DATE :
170		ABOVE GROUND EARTHING MATERIALS	UNITECH FABRICATORS and ENGINEERS PVT LTD	

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SECTION - I A
		REV.NO. 0 DATE :

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

2. DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.
3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION I
		SECTION - I A
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	REV.NO. 0 DATE :

ANNEXURE III:

DRAWING DOCUMENTS DISTRIBUTION PROCEDURE

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SECTION - I A
		REV.NO. 0 DATE :

DRAWING DOCUMENTS DISTRIBUTION SCHEDULE

Documents:	PEM-Engineering
Documents for approval	8
Documents for information	8
Schedules, diagrams, lists, tables, calculation, specifications and other documents	8
Final as-built drawings	
CD-ROMs of final as-built drawings	10
Final as-built drawings (hard copy)	14
Final O&M manuals	18
CD-ROMs of Final O&M Manuals	10
Detailed project time schedules	5

Note:

- Bidder shall submit soft copy/hard copy/CD ROMs of all the finally approved drawings and O&M Manuals as required by Customer/Customer consultant/BHEL-site/BHEL-PEM. The exact number of hard copies/CD ROMs of these documents to be submitted shall be notified to the bidder at the time of detailed engineering and bidder shall submit the same without any commercial/delivery implications to BHEL/Customer.
- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.
- Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and approval.
- The date of submission of drawing documents shall be considered as the date of submission of hard and soft copies whichever is later.
- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying these requirements shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required.
- Bidder has to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.
- Bidder to submit instrument schedule, cable schedule and valve schedule (as applicable) in MS-Excel format during detailed engineering.
- Bidder to also furnish the auto cad copy/ MS-word (as applicable) of the following documents after award of contract. However any other auto cad copy/ MS-Excel/ MS-word of any other document as per the insistence of BHEL/ customer will also be submitted by the bidder without any delivery/ commercial implication to BHEL/ Customer.
 - P&IDs.
 - GA & Foundation Drawing
 - Local Control Panel/ Junction Box Wiring Diagram

ANNEXURE IV:
PAINTING SPECIFICATION

- 3.1.2 Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. The minimum acceptable standard in case of manual or hand tool cleaning shall be St.2 or equivalent and in case of mechanical or power tool cleaning it shall be St.3 or equivalent, and in case of blast cleaning it shall be Sa2 ½ or equivalent as per Swedish standard SIS-055900. Where highly corrosive conditions exist, then blast cleaning shall be Sa3 as per Swedish Standard.
- 3.1.3 Degreasing shall be done to remove all other contaminants, oil, grease etc. by use of aromatic solvent prior to surface cleaning.
- 3.1.4 Non-ferrous metals surface shall be cleaned and made grease free. In case of galvanized surfaces, any white zinc corrosion products if present shall be removed by high pressure water washing or scrubbing. Then the substrate shall be etch primed by using Bison wash primer to facilitate adhesion of the paint film on the substrate.
- 3.1.5 Blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceeding 85%.
- 3.1.6 Irrespective of the method of surface preparation, the first coat of primer must be applied on dry surface. This should be done immediately and in any case within 4 hours of cleaning surface. However, at times of unfavorable weather conditions, the Purchaser shall have the liberty to control the time period, at his sole discretion and / or to insist on re-cleaning, as may be required, before primer application is taken up. In general, during unfavorable weather conditions, blasting and painting shall be avoided as far as practicable.

3.2.0 Procedure of Surface Preparation

3.2.1.0 Blast Cleaning

3.2.1.1 Air Blast Cleaning

The surfaces shall be blast cleaned using abrasives. Compressed air used for air blast cleaning shall be free from moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the materials for liners. On completion of blasting operation, the blank surface shall be clean and free from any scale or rust and must show a grey white metal lustre. Primer or first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bad weather without adequate protection or when there is dew on the metal, which is to be cleaned. Surface profile shall be uniform. Vacuum collector shall be installed for collecting the abrasive and recycling.

3.2.1.2 Water Blast cleaning

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Environmental, health and safety problems associated with abrasive blast cleaning limit the application of Air Blast cleaning, In such case water blast cleaning may be resorted to.

Water Blast cleaning can be applied with or without abrasive and high pressure water blasting. The water used shall be mixed with rust inhibitors. The blast-cleaned surface shall be washed thoroughly with detergents and wiped with solvent and dried with compressed Air. For effective cleaning abrasives may be used.

3.2.2.0 Mechanical or Power tool cleaning

Mechanical striking tools, chipping hammers, grinding wheels or rotating steel wire – brushes, shall be used for power tool cleaning. Excessive burnish of surface shall be avoided as it can reduce paint adhesion. On completion of cleaning, the detached rust mill scale etc. shall be removed by clean rags and / or washed by water and thoroughly dried with compressed air jet before application of paint.

3.2.3.0 Manual or hand tool cleaning

Manual or hand tool cleaning shall be used only where other methods of surface preparation is not feasible.

Hand tool cleaning normally / consists of the following:

- a. Hand descaling and / or hammering
- b. Hand scraping
- c. Hand wire brushing

Rust, mill scale spatters, old coatings and other foreign matter, shall be removed by hammering, scrapping tools, emery paper cleaning, wire brushing or combination of the above methods. On completion of cleaning, loose material shall be removed from the surface by clean rags and the surface shall be brushed, swept, dedusted and blown off with compressed air to remove all loose matter. Finally the surface may be washed with water and dried for effective cleaning.

3.3.0 Shop coat primer

The compatibility of finishing coat should be confirmed from the paint manufacturer.

3.3.1 Shop coated (coated with primer & finishing coat) equipment should not be repainted unless paint is damaged.

3.3.2 Shop primed equipment and surfaces shall only be 'spot cleaned' in damaged areas by means of power tool brush cleaning and then spot primed before applying one coat of field primer. The shop-coated primer should be completely removed before application of selected paint system for particular environment.

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- 3.3.3 For packaged units / equipment, shop primer should be as per the paint system given in this specification. However, manufacturer's standard subject to approval by Purchaser.

3.4.0 Coating Procedure and Application

- 3.4.1 Surface shall not be coated in rain, wind or in environment where injurious airborne elements exist, when the relative humidity is greater than 80% or when the ambient temperature is below 5°C.
- 3.4.2 Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hours.
- 3.4.3 To the maximum extent practicable, each coat of material shall be applied as a continuous film of uniform thickness. Any spots or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.
- 3.4.4 Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when and additional coat can be applied without the development of any detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer's instruction shall be followed for intercoat interval.
- 3.4.5 When the successive coat of same colour has been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate complete coverage of the surface. The tinting material shall be compatible with the material and not detrimental to its service life.
- 3.4.6 If equipment shall operate at temperatures above 60° C and shall not be insulated, a high temperature painting/coating system designed for the operating temperatures shall be applied.
- 3.4.7 Air spray application shall be in accordance with the following:
- a. The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied, and shall be equipped with suitable pressure regulators and gauges. The air caps, nozzles, and needles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.
 - b. Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.
 - c. Ingredients shall be kept properly mixed in the spray pots or containers during application by continuous mechanical agitation.
 - d. The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The pressure on the material

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in the pot shall be adjusted when necessary for changes in elevation of the gun above the pot. The atomizing air pressure at the gun shall be high enough to properly atomize the paint but not so high as to cause excessive fogging of paint, excessive evaporation of solvent, or less by over spray.

- e. Spray equipment shall be kept sufficiently clean so that dirt, dried paint, and other foreign materials are not deposited in the paint film. Any solvents left in the equipment shall be completely removed before next application of paint to the surface.
- f. Paint shall be applied in a uniform layer, with overlapping at edge of the spray pattern. The spray pattern shall be adjusted so that the paint is deposited uniformly. During application, the gun shall be held perpendicular to the surface and at a distance, which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke.
- g. All runs and sags shall be brushed out immediately or the paint shall be removed and the surface repainted.
- h. Areas inaccessible to the spray gun shall be painted by brush, if not accessible by brush, daubers or sheepskins shall be used.
- i. All nameplates, manufacturer's identification tags, machined surfaces; instrument glass, finished flange faces, control valve items and similar items shall be masked to prevent coating. If these surfaces are coated, the component shall be cleaned and restored to its original condition.
- j. Edges of structural shapes and irregular coated surfaces shall be coated first and an extra pass made later.
- k. If spray gun shows choking, immediately dechoking procedure shall be followed.

3.4.8 Airless spray application shall be in accordance with Steel Structure Paint manual Vol. 1 & Vol. 2 by SSPC, USA., Air less spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor is used to operate a pump to produce high pressures. Paint is delivered to the spray gun at this pressure through a single hose within the gun; a single paint stream is divided into separate streams, which are forced through a small orifice resulting in atomization of paint without the use of air. This results in more rapid coverage with less over spray. Airless spray usually is faster, cleaner, more economical and easier to use than conventional air spray.

In case of gun choking, dechoking steps shall be followed immediately.

3.4.9 Brush application of paint shall be accordance with the following:

- a. Brushes shall be of a style and quality that will enable proper application of paint.

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- b. Round or oval brushes are most suitable for rivets, bolts, and irregular surfaces, rough or pitted steel. Wide flat brushes are suitable for large flat areas, but they shall not have width over five inches.
- c. Paint shall be applied into all corners.
- d. Any runs or sags shall be brushed out.
- e. There shall be a minimum of brush marks left in the applied paint.
- f. Spray, daubers, or sheepskin shall paint surfaces not accessible to brushes.

- 3.4.10 For each coat, the painter shall know the Wet Film Thickness (WFT) corresponding to the specified Dry Film Thickness (DFT) and standardize the paint application technique to achieve the desired WFT. This has to be ensured in the qualification trial.
- 3.4.11 No paint shall be applied to surfaces within 75 mm of field welded connections. These surfaces shall be painted/coated with a consumable preservative and masked.
- 3.4.12 Cooling water pipes shall be lined with a two pack cold cured Isophthalic Polyester acrylic co-polymer glass flake filled coatings, the water vapour permeability of the coating should be less than 0.09 grams per Sw.M per 24 hours per mil, both internally and externally to provide long term corrosion protection. Coating thickness for the internal of the pipeline shall be 1.0 mm average and for external shall be 0.5 mm average.
- 3.4.13 Structural steel and miscellaneous metals including steel fabricated items such as plates and shapes, ladders, handrails, stair stringers, ducts, equipment and pipe supports, and similar fabrications, shall be abrasive blast cleaned in accordance with SSPC-SP10, Near White Metal Blast Cleaning. Profile depth shall be 40 to 50 microns. The primer shall be inorganic zinc with a total of 85 percent zinc in the dried film applied to a minimum dry film thickness of 75 microns.
- 3.4.14 The fabricated steel structures in contact with water shall be coated with a two pack cold cured Isophthalic Polyester acrylic co-polymer with flake glass. The coating thickness shall be 1.0 mm average.
- 3.4.15 Wall panels shall be finished with a three coat system consisting of a urethane primer and two fluoropolymer topcoats. The first topcoat shall be coloured and the second topcoat shall be clear. Fluoropolymer topcoats shall have a minimum of 70 percent Kynar 500 or Hylar 5000 resin by weight.
- 3.4.16 Touchup paint shall be provided for repair painting of at least 25 percent of shop finish painted equipment surfaces. The touchup paint shall be the same type and colour as the shop applied material. Surface preparation and application instructions shall be provided.
- 3.4.17 Machined surfaces and other ferrous surfaces which should not be coated, but are subject to corrosion, shall be protected with rust-preventive compounds. Additional protection shall be provided for equipment and materials which shall

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be exposed to the atmosphere for extended periods. Rust-preventive compounds shall be checked every two months while in transit and in site storage and renewed as required to maintain adequate protection.

- 3.4.18 Rust-preventive compounds which are used to protect surfaces of equipment and piping that are exposed to feedwater or steam shall be completely water soluble.
- 3.4.19 Machined surfaces of weld-end preparations shall be coated with consumable rust-preventive compounds which shall not affect the quality of the weld.
- 3.4.20 Structural steel members and steel assemblies, outdoor switchyard structures and metallic surfaces in the open atmosphere to be galvanized shall be pickled after completion of fabrication process. Pickling shall remove scale, rust, grease, and other impurities. Steel shall be hot-dip galvanized in accordance with ASTM A123 or equivalent.
- 3.4.21 For bolted connections, where either member to be bolted is galvanized, erection and structural bolts shall be galvanized in accordance with ASTM A153.

3.5.0 Field Paintings/Coatings and Linings

- 3.5.1 All surfaces of erected equipment, piping, tanks, structures, and building components shall be finish painted. Surfaces of connections, field welds, and damaged areas shall be cleaned, prepared, and primed before application of the finish system.
- 3.5.2 The final topcoat for interior metal surfaces shall be a high solid polyamide epoxy applied to a minimum dry film thickness of 125 microns. The final topcoat for exterior metal surfaces shall be a high solids aliphatic polyurethane applied to a minimum dry film thickness of 50 microns. Shop primers shall be touched up and barrier/universal coats shall be applied to a minimum dry film thickness of 50 microns to provide a suitable base for topcoat application.
- 3.5.3 Interior surfaces of shop fabricated and field erected tanks shall be cleaned and lined with materials designed for the specific application. Cleaning shall be in accordance with SSPC-SP5, White Metal Blast Cleaning.
- 3.5.4 Interior non-metallic architectural components, including concrete block/ cement plastered brick walls, in neutral environments shall be painted with low gloss water-borne materials. Finishes for metallic architectural components, including doors and frames, shall provide a smooth, semi-gloss, and durable surface.

3.6.0 Drying of coated Surfaces

- 3.6.1 No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum

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specified for it as a first coat; if it exceeds it means that the paint material has possibly deteriorated or mixing is faulty.

- 3.6.2 No paint shall be force dried under conditions, which will cause checking, wrinkling, blistering, formation of pores, or detrimentally affect the condition of the paint.
- 3.6.3 No drier shall be added to paint unless specifically called for in the manufacturer's specification for the paint.
- 3.6.4 Paint shall be protected from rain, condensation, and contamination until dry to the fullest extent practicable.

3.7.0 Colours

- 3.7.1 Colours for the identification of pipelines, ventilation ducts, electrical conduits, and related services shall be in accordance with the requirements of BS 1710 and its appendices for safety. Pipelines shall be identified with the name of the fluid or gas and the direction of flow.
- 3.7.2 Finish colour of mechanical equipment shall match the colour of the system of which it is a part.
- 3.7.3 Finish colour of high temperature surfaces shall be deep grey.
- 3.7.4 Finish colour of exterior surfaces of electrical cabinets and panels shall be light grey. Interior surfaces shall be gloss white.
- 3.7.5 Colour coding of pipelines shall be as per IS: 9404

3.8.0 Repair of damaged paint surface

- 3.8.1 Where paint has been damaged in handling and in transportation, the primer from damaged area may be removed by mechanical scraping/emery paper to expose the white metal. Blast clean the surface if possible. Apply the primer over the intact adjacent surface surrounding the damaged area.

3.9.0 Paint Material

- 3.9.1 Test Certificates from Paint manufacturer shall be obtained to cover all the characteristics of paint materials given in this specification. All the paint materials shall be of first quality and meet the requirements of this specification.

3.10.0 Storage

- 3.10.1 All paints and painting materials shall be stored only in proper place as advised by the Purchaser. All necessary precautions shall be taken to prevent fire. The storage building shall be separate from adjacent building. A signboard bearing the words "PAINT STORAGE"-NO NAKED LIGHT – HIGHLY INFLAMMABLE" shall be clearly displayed outside.

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3.11.0 Paint Application

- 3.11.1 The equivalent standards of surface preparation are listed under Clause 6.2.2. The surfaces to be painted and the different surface preparation standards and primer/ finish paints for the same are listed under Clause 6.2.2.

4.0.0 INSPECTION AND TESTING

- 4.1.1 All painting materials including primers and thinners brought to site by Tenderer for application shall be procured directly from manufacturer as per the specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable.

- 4.1.2 Purchaser at his discretion may call for tests for paint formulations. Tenderer shall arrange (at his own cost) to have such tests performed including batch wise test of wet paints for physical and chemical analysis.

- 4.1.3 The painting work shall be subject to inspection by Purchaser at all times. In particular, following stage wise inspection will be performed and tenderer shall offer the work for inspection and approval at every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection shall be as follows:

- a. Surface preparation
- b. Primer application
- c. Each coat of paint

In addition to above, record shall include type of shop primer already applied on equipment.

The Tenderer shall rectify any defect noticed during the various stages of inspection. Irrespective of the inspection, repair and approval at intermediate stages of work, tenderer shall be responsible for making good any defects found during final inspection. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make up the DFT specified without any extra cost to Purchaser.

4.2.0 Primer Application

After surface preparation, the primer shall be applied to cover the crevices, corners, sharp edges etc. in the presence of Purchaser.

- 4.2.1 The shades of successive coats should be of slightly different shade, in order to ensure application of individual coats. The thickness of each coat and complete coverage shall be checked as per provision of this specification.

- 4.2.2 The tenderer shall provide standard thickness measurement instrument with appropriate range(s) for measuring Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of blast cleaning and also holiday detectors and pin hole detectors.

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4.2.3 At the discretion of Purchase, Tenderer must provide expert technical service at site as and when required. This service should be free of cost and without any obligation to the Purchaser, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations.

4.2.04 Final inspection shall include measurement of paint dry film thickness, Adhesion, Holiday detection check of finish and workmanship. The thickness shall be measured at as may points / locations as decided by Purchaser and shall be within +10% of the dry film thickness, specified in the specification.

4.2.5 The Tenderer shall arrange for spot-checking of paint materials for Specific Gravity, flow time (ford cup) and spreading rate.

5.0.0 Documentation

Engineering submittals shall identify the painting/coating and lining systems to be applied in the shop and the field. Data to be provided shall include the surfaces to be painted, the painting/coating system manufacturer's name and product designation, the degree of surface preparation, dry film thickness, finish colour, and Material Safety and Data Sheets (MSDS)

6.0.0 DRAWINGS, DATA AND MANUALS

6.1.0 To be submitted after award of Contract

The successful Bidder shall furnish the following drawings/data for Purchaser's approval after award of the contract.

- i) All documents as per clause no. 5.0.0
- ii) Test certificates from paint manufacturer.
- iii) A comprehensive write-up or brochure on the details of surface finishing/ painting and testing facilities available with the tenderer.
- iv) Surface finish and painting quality plan and procedure for qualification trials and for actual work.
- v) Inspection and testing procedure.

6.2.0 DATA SHEETS/ SCHEDULES

6.2.1 EQUIVALENT STANDARDS OF SURFACE PREPARATION GRADE

SI.NO	Surface	Preparation	Swedish Std. SIS 05-5900	SSPC Std.	IS:9954
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SI.NO	Surface Preparation	Swedish Std. SIS 05-5900	SSPC Std.	IS:9954
1	<u>Blast Cleaning to White Metal:</u>			
	Removal of all visible rusts, mill-scales, paint and foreign matters	Sa 3	SSPC-SP-5	Sa 3
2	<u>Blast Cleaning to near White Metal:</u>			
	95% of any section of surface area is free from all rusts, mill-scales and visible residues	Sa 2 1/2	SSPC-SP-10	Sa 2 1/2
3	<u>Blast Cleaning to Commercial Quality:</u>			
	At least 2/3 of any section of the surface area is free from all rusts, mill-scale and visible residues	Sa 2	SSPC-SP-6	Sa 2
4	<u>Brush-off Blast Cleaning:</u>			
	Removal of all loose mill-scales, rust and foreign matters etc.	Sa 1	SSPC-SP-7	Sa 1
5	<u>Power Tool Cleaning:</u>			
	Very thorough scrapping and wire brushing to remove loose mill-scale, rust and foreign matters to have pronounced metallic shine	St 3	SSPC-SP-3	St 3
6	<u>Hand Tool Cleaning:</u>			
	Removal by hand brushing of loose mill-scale, loose rust and foreign matters	St 2	SSPC-SP-2	St 2

6.2.2 SCHEDULE

											TOTAL			
											DFT IN MICRONS			
ITEM DESCRIPTION	SURFACE PREPARATION	PRIMER PAINT	NO. OF COATS	DFT IN MICRONS	INTERMEDIATE PAINT	NO OF COATS	DFT IN MICRONS	FINISH PAINT (SEE NOTE)	NO OF COATS	DFT IN MICRONS	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	1 X 525 MW TUTICORIN TPS		
Various type of equipment, valves etc. (temp. upto 90 deg. C)	Degreasing and suitable surface preparation	Epoxy based polyamide cured (2) pack HB zinc phosphate primer	1	75 per coat	Epoxy based MIO pigmented polyamide cured paint	1	50 per coat	Aliphatic acrylic (2) pack glossy poly urethane paint	2	Min. 30 per coat			185	
Piping / structural / vessels etc. (Temp. upto 90 Deg. C	Degreasing and suitable surface preparation	Plasticized chlororubber medium/zinc phosphate (1) pack primer	1	75 per coat	Plasticized HB chlororubber medium /micaceous iron oxide coating	1	50-75 per coat	Plasticized chlororubber medium suitably pigmented paint / aliphatic polyurethane	2	30 per coat / 40-50 per coat			185-230/205-250	
Equipment with temp. above 90 Deg.c & upto 250 Deg C)	Degreasing and suitable surface preparation	(2) pack polyamide cured epoxy zinc rich primer	2	Min. 30 per coat	-	-	-	Heat resistant Al paint (only for non insulated surfaces)	2	20 per coat			60 (60 for insulated surfaces)	
Elect. Control panels etc.	Commercial blast or surface preparation by (7) tank process & phosphating to coating weight of 16.15gm. per sq. mtr.	Hp epoxy based polyamide cured epoxy zinc rich primer		50-75 per coat	Aliphatic acrylic (2) pack polyurethane finish paint	1	50-65	Aliphatic acrylic (2) pack glossy poly urethane finish paint	1	50-65 per coat			60	
Floor grills, ladder/rungs, steps treads. Hand rail	Hot dip galvanizing shall be done as pre is 4736										DATE :			
SEPC - 1 x 525 MW Tuticorin Thermal Power Project Stage-IV at Thoothukudi, Tamil Nadu											VOL-II-M-26 - 14		DCPL-12Z05	

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ANNEXURE V :
MANDATORY SPARES LIST

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S.No.	Description	Total Qty.
	Hydrazine Dosing System	
1.	Drive shaft cum worm	1
2.	Drive worm wheel	4
3.	Connecting rod plate	2
4.	Cross head guide bush	4
5.	Plunger	2
6.	Plug	2
7.	Oil seal	2
8.	Washer	4
9.	Gland nut	4
10.	Pump Head Complete	1
11.	Packing Ring	4
12.	Pump block complete with Key Pin	1
13.	Relief Valve	2
	Ammonia Dosing System	
1.	Drive shaft cum worm	1
2.	Drive worm wheel	4
3.	Connecting rod plate	2
4.	Cross head guide bush	4
5.	Plunger	2
6.	Plug	2
7.	Oil seal	2
8.	Washer	4
9.	Gland nut	4
10.	Pump Head Complete	1
11.	Packing Ring	4
12.	Pump block complete with Key Pin	1
13.	Relief Valve	2

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ANNEXURE VI:

LIST OF ERECTION & COMMISSIONING SPARES

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LIST OF ERECTION & COMMISSIONING SPARES

SL. NO.	ITEM DESCRIPTION	Quantity per skid (No.)	TOTAL NOS.
1.0	AMMONIA DOSING SYSTEM		
1.1	Oil Seals for drive end.	12	12
1.2	Gaskets for drive end	12	12
1.3	Guide ring for plunger.	12	12
1.4	Teflon rings for valves.	24	24
1.5	Level gauge glass	4	4
1.6	Back up fuse	3	3
1.7	Pilot lamp	2	2
1.8	Push Button	2	2
1.9	Control fuse		2
1.10	Bulb for Annunciation	4	4
1.0	HYDRAZINE DOSING SYSTEM		
1.1	Oil Seals for drive end.	12	12
1.2	Gaskets for drive end	12	12
1.3	Guide ring for plunger.	12	12
1.4	Teflon rings for valves.	24	24
1.5	Level gauge glass	4	4
1.6	Back up fuse	3	3
1.7	Pilot lamp	2	2
1.8	Push Button	2	2
1.9	Control fuse	2	2
1.10	Bulb for Annunciation	4	4
1.0	NaOH DOSING SYSTEM		
1.1	Oil Seals for drive end.	4	4
1.2	Gaskets for drive end	4	4
1.3	Guide ring for plunger.	4	4
1.4	Teflon rings for valves.	8	8
1.5	Level gauge glass	1	1
1.6	Back up fuse	3	3
1.7	Pilot lamp	2	2
1.8	Push Button	2	2
1.9	Control fuse	2	2
1.10	Bulb for Annunciation	4	4

Note: -

- Any other commissioning spare/ special tools and tackles required for the commissioning of the bidder's chemical dosing skids shall be in bidder's scope and same shall be supplied by bidder as part of his base offer and the same shall be mentioned specifically by the bidder in the un-priced schedule.
- All the commissioning spares provided shall be strictly of the same make and specification of the items it shall replace and shall be perfectly interchangeable.
- All the commissioning spares shall be separately packed and properly marked for easy identification at site.

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ANNEXURE VII

DRAWING / DOCUMENTS SUBMISSION SCHEDULE

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DRAWING/DOCUMENTS SUBMISSION SCHEDULE

After award of LOI, following minimum drawing/documents shall be submitted by the bidder for BHEL and Customer approval. However any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL.

For the Drawings/Documents Distribution procedure, please refer Annexure-III. The submission of soft copy or hard copy of the drawing/document whichever is later will be considered as final date of submission of the drawing/document. The bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

- Drawing/documents submission schedule: First submission of basic drawings/ documents – (P&ID, GA & Foundation details & QAP for CHEMICAL DOSING SYSTEM) shall be within 3 weeks from the date of LOI.
- Every revised submission incorporating comments – within 7 days.
- BHEL shall provide observation / approval within 3 weeks from the date of document submission.
- Bidder further confirmed that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. . Engineering meeting shall be held fort nightly, for which the bidder shall depute his concerned engineer along with project manager to BHEL PEM office or at customer office. The meeting can also be held at site.

List and schedule of drawings/documents to be submitted after award of contract:-

S.No	Drawing/Document No.	Drawing/Document Title	No. of weeks for drawing/docume nt submission after placing LOI/PO
1.	PE-V2-420-154A-A001	P&I DIAGRAM FOR CHEMICAL DOSING SYSTEM	3
2.	PE-V2-420-154A-A002	TECHNICAL DATA SHEET--CHEMICAL DOSING SYSTEM	5
3.	PE-V2-420-154A-A003	GA DRAWING & FOUNDATION DETAILS	3
4.	PE-V2-420-154A-A004	LOCAL CONTROL PANEL (INCLUDING WIRING DIAGRAM, LOGIC DIAGRAM AND FIELD TERMINATION DETAILS)- CDS	5
	PE-V2-420-154A-A005	ELECTRICAL LOAD DATA	5
6.	PE-V2-420-154A-A006	QAP FOR CHEMICAL DOSING SYSTEM	3
7.	PE-V2-420-154A-A007	O&M MANUAL FOR CHEMICAL DOSING SYSTEM WITH CATALOGUE	8
8.	PE-V2-420-154A-A008	PACKING & FORWARDING DETAILS	8

NOTE:-

- Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification

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requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

- In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account.
- (a) Bidder to note that drawings/documents submission shall be through web based Document Management System. Bidder would be provided access to the DMS for drawings/documents approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.
- Internet explorer version – Minimum Internet Explorer 7
 - Internet speed – 2 mbps (Minimum preferred)
 - Pop ups from our external DMS IP (124.124.36.198) should not be blocked
 - Vendor's internal proxy setting should not block DMS application's link
(<http://124.124.36.198/wrenchwebaccess/login.aspx>)
 - DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
 - For quick access bidder may refer the link <http://bhelpem.com/DMSManuals/DMSManuals.html>

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ANNEXURE VII:
FORMAT FOR OPERATION AND MAINTENANCE MANUAL

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Bidder to submit operation and Maintenance manual with minimum information as listed in below check list during contract stage.

3 Check List for Operation & Maintenance Manual

- 3.1.1.1 Project name :
3.1.1.2 Project number :
3.1.1.3 Package Name :
3.1.1.4 PO reference :
3.1.1.5 Document number :
3.1.1.6 Revision number :

Sl.no. & Sections	Description	Tick (√) if included in Manual			Remarks
		Yes	No	Not Applicable	
	3.2				
1.	3.3 Cover page				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	3.4 Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	3.5 Description of Plant/System				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	3.6 Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				

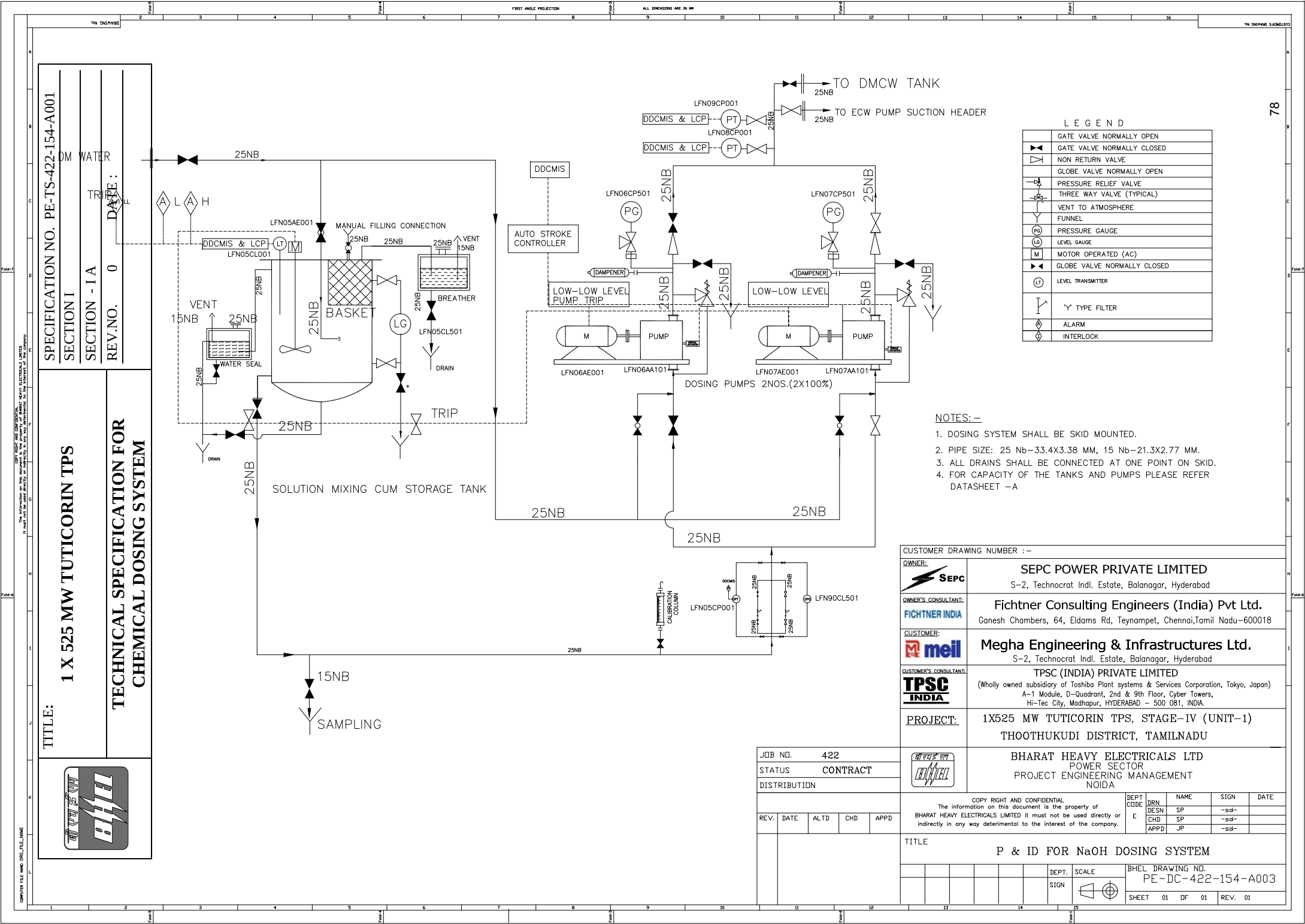
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5.0	3.7 Operation Guidelines for plant personal/user/operator				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair , Testing and calibration procedures				
6.0	3.8 Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest				

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	addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				

P&ID



LEGEND	
	GATE VALVE NORMALLY OPEN
	GATE VALVE NORMALLY CLOSED
	NON RETURN VALVE
	GLOBE VALVE NORMALLY OPEN
	PRESSURE RELIEF VALVE
	THREE WAY VALVE (TYPICAL)
	VENT TO ATMOSPHERE
	FUNNEL
	PRESSURE GAUGE
	LEVEL GAUGE
	MOTOR OPERATED (AC)
	GLOBE VALVE NORMALLY CLOSED
	LEVEL TRANSMITTER
	'Y' TYPE FILTER
	ALARM
	INTERLOCK

- NOTES:-
1. DOSING SYSTEM SHALL BE SKID MOUNTED.
 2. PIPE SIZE: 25 Nb-33.4X3.38 MM, 15 Nb-21.3X2.77 MM.
 3. ALL DRAINS SHALL BE CONNECTED AT ONE POINT ON SKID.
 4. FOR CAPACITY OF THE TANKS AND PUMPS PLEASE REFER DATASHEET -A

CUSTOMER DRAWING NUMBER :-	
OWNER:	SEPC POWER PRIVATE LIMITED S-2, Technocrat Indl. Estate, Balanagar, Hyderabad
OWNER'S CONSULTANT:	Fichtner Consulting Engineers (India) Pvt Ltd. Ganesh Chambers, 64, Eldams Rd, Teynampet, Chennai,Tamil Nadu-600018
CUSTOMER:	Megha Engineering & Infrastructures Ltd. S-2, Technocrat Indl. Estate, Balanagar, Hyderabad
CUSTOMER'S CONSULTANT:	TPSC (INDIA) PRIVATE LIMITED (Wholly owned subsidiary of Toshiba Plant systems & Services Corporation, Tokyo, Japan) A-1 Module, D-Quadrant, 2nd & 9th Floor, Cyber Towers, Hi-Tec City, Madhapur, HYDERABAD - 500 081, INDIA.
PROJECT:	1X525 MW TUTICORIN TPS, STAGE-IV (UNIT-1) THOOTHUKUDI DISTRICT, TAMILNADU
JOB NO.	422
STATUS	CONTRACT
DISTRIBUTION	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA
COPY RIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED it must not be used directly or indirectly in any way detrimental to the interest of the company.	
REV.	DATE
ALTD	CHD
APPD	
TITLE	
P & ID FOR NaOH DOSING SYSTEM	
DEPT. CODE	DRN
E	DESIN
	CHD
	APPD
NAME	SIGN
SP	-sd-
SP	-sd-
JP	-sd-
DATE	
SHEET 01 OF 01	
REV. 01	

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DATA SHEET-A

SL.No	Description	Ammonia	Hydrazine	NaOH
1	No. of skid(s)	One (1)	One (1)	One (1)
2	Preparation cum Metering tank			
2.1	No. of tanks per Skid	Two (2)	Two (2)	One (1)
2.2	Effective Capacity in litres	1000	2000	500
2.3	Type	-----Vertical cylindrical, Dished end-----		
2.4	Material of the tank	SS-304	SS-304	SS-304
2.5	Thickness	6 mm	6 mm	6 mm
2.6	Motorised Stirrer	Provided	Provided	Provided
2.7	Dissolving basket	Not Applicable	Not Applicable	Provided (30 mesh B.S.).
2.8	Type of agitator	Motor operated	Motor operated	Motor operated
2.9	MOC of agitator	SS 304	SS 304	SS 304
3	Injection pump:			
3.1	Medium to be handled	Ammonia solution	Hydrazine solution	NaOH solution
3.2	Type of pump	Positive displacement plunger type Dosing pumps. Each pump should deliver the rated volume of solution at 50% stroke.		
3.3	No. of pump-motor assembly	Two (2×100%)	Two (2×100%)	Two (2×100%)
3.4	Capacity	50 LPH	100 LPH	10 LPH
3.5	Discharge pressure	45 Kg/cm2 (g)	45 Kg/cm2 (g)	10 Kg/cm2 (g)
3.6	All Wetted parts of pumps	SS-304	SS-304	SS-304
3.7	Applicable standard	API 675	API 675	API 675
3.8	Type of stroke control	Local manual, remote manual & automatic	Local manual, remote manual & automatic	Local manual, remote manual & automatic
3.9	Connection at suction, position	1" ANSI B16.5 #150, bottom	1" ANSI B16.5 #150, bottom	1" ANSI B16.5 #150, bottom
3.10	Connection at discharge, position	1" ANSI B16.5 #300, top	1" ANSI B16.5 #300, top	1" ANSI B16.5 #300, top
3.11	Pulsation damper	Provided.	Provided.	Provided.
4	Strainers:			
4.1	No. of strainers	Two (2 X 100%)	Two (2 X 100%)	Two (2 X 100%)
4.2	Type	Y-Type	Y-Type	Y-Type
4.3	Material of screen	SS-304	SS-304	SS-304
4.4	Mesh Size	30(BS)	30(BS)	30(BS)
5	Piping:			
5.1	Material	ASTM A 312 GR TP 304 Sch 40		
5.2	Diameter	25 NB/15 NB	25 NB/15 NB	25 NB/15 NB
5.3	Main Drain	40 NB	40 NB	40 NB
6	Valves: Globe, Gate, NRV			
6.1	Body, cover, disc/piston & seat Material	ASTM A182 Gr. TP 304		

6.2	End Connections	SW ANSI B 16.11		
6.3	Design standard	ANSI B 16.34/API 602		
6.4	Test standard	API 598		
6.5	Rating	-----Class ASA 800-----		
6	PRV			
6.1	Body, bonnet, disc, nozzle & spring Material	ASTM A182 Gr. TP 304		
6.2	End Connections	SW ANSI B 16.11		
6.3	Back pressure	Constant		
6.4	Set pressure	50 Kg/cm2		
6.5	Inlet Connections	25 NB, Flanged, ANSI B16.5, 300 #		
6.6	Outlet Connections	25 NB, Flanged, ANSI B16.5, 300 #		
6.7	Fittings	Forged steel to A182 F304, Dimension to ANSI B 16.11 socket weld ends.		
6.8	Flanges (pump suction / pump discharge)	-----ANSI B 16.5 CL 150 / ANSI B 16.5 CL 300 -----		
6.9	Structural steel	IS 2062	IS 2062	IS 2062
7	Step ladder with accessing platform	IS 2062	IS 2062	IS 2062
8	Nuts & bolts (including pump foundation bolts)	SS 304	SS 304	SS 304

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
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SECTION – IB
SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

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1.0 SCOPE OF ENQUIRY

General technical requirement of LT motors are indicated in section IIB. Project specific technical requirement for motors are listed in customer specification for motor & actuators. Stipulations of Customer Specifications shall prevail, in case of conflicts between Customer specification and General technical requirements for LT Motors.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

- a) Services and equipment as per "Electrical Scope between BHEL and Vendor".
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any technical, commercial, delivery implications to BHEL/Customer.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipment's.
- d) Erection and commissioning spares.
- e) Erection & Maintenance tools & tackles.
- f) Electrical load requirement for chemical dosing system.
- g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- h) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer /BHEL approval without any commercial and delivery implications to BHEL.
- i) Various drawings, data sheet as per required format, quality plans, calculations, Type test & Routine test reports & certificates, operation and maintenance manuals, complete technical literature with catalogues etc shall be furnished as specified at contract stage. All documents shall be subject to customer /BHEL approval without any commercial implications to BHEL.
- j) The sub-vendor list for various electrical items is subject to BHEL/Customer approval without any commercial implications.

3.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer "Electrical Scope between BHEL and Vendor".

4.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

4.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:

- a) A copy of this sheet "Electrical Equipment Specification for chemical dosing system and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.

- b) List of Erection and Commissioning spares.
- c) List of Erection & Maintenance tools & tackles.
- d) Electrical load requirement.

4.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

1X525 MW TUTICORIN TPS
STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR FOR SKID MOUNTED SYSTEM

REV : 0 DATE : 23.01.2017

PACKAGE : CHEMICAL DOSING SYSTEM
SCOPE OF VENDOR: SUPPLY

PROJECT :

<u>S.NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	415V MCC	Customer#	Customer#	240 V AC (supply feeder)/415 V, 3 phase, 4 wire AC supply shall be provided by Customer based on the load data provided by the vendor at contract stage for all equipment supplied by the vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local control panel	Vendor	Vendor*	Refer C & I specification for details
3	Local push buttons	Vendor	Vendor*	
4	Power cables, ordinary control cables and screened control cables	Vendor	Vendor*	Within the skid. If starters are in MCC, then outside skid, cables scope shall be as per note no. 1.
5	Junction box for control & instrumentation cable (if applicable)	Vendor	Vendor*	
6	Any special type of cable like compensating, co-axial, prefab, MICC & fibre optical	Vendor	Vendor*	Within the skid
7	Equipment grounding	Vendor	Vendor*	Within the skid. All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by Customer/BHEL.
8	Motors with base frame and fixing hardware for motors.	Vendor	Vendor*	Makes shall be subject to customer/ BHEL approval at contract stage.

1X525 MW TUTICORIN TPS
STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR FOR SKID MOUNTED SYSTEM

REV : 0 DATE : 23.01.2017

PACKAGE : CHEMICAL DOSING SYSTEM

SCOPE OF VENDOR: SUPPLY

9	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor*	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
10	Below grade grounding	Customer#	Customer#	
11	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
12	Electrical Equipment GA drawing & skid GA drawing	Vendor	-	For necessary interface review.

NOTES :- 1. If motor starters are provided in main MCC then Customer# will provide power & control cable including supply, laying & termination.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

*E & C by vendor during factory assembling of the skid.

Customer: MEIL will provide 415V MCC, below grade Grounding.

[illegible]

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SECTION – IC

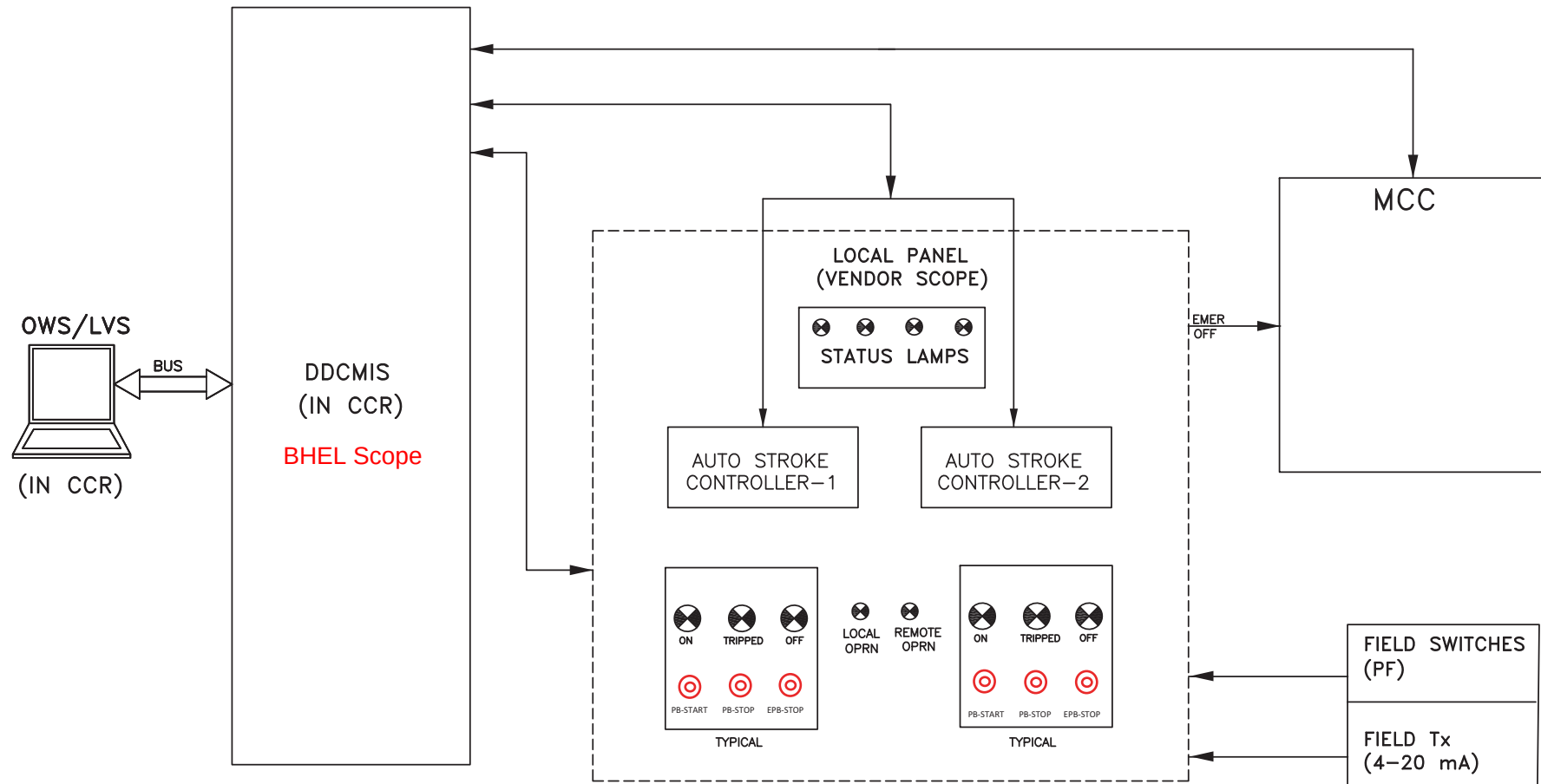
**SPECIFIC TECHNICAL REQUIREMENTS (CONTROL &
INSTRUMENTATION)**

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- CHEMICAL DOSING SYSTEM shall be operated from DCS through operator work stations located in control room (BHEL Scope). Also refer to the standard block diagram for further information.
- The Contractor shall provide complete Instrumentation and Control, monitoring and operation of entire Chemical dosing system. The requirement given are to be read in conjunction with detailed Technical specification enclosed. Further in case of any discrepancy in the requirement within the same or different section, as noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of BHEL/customer shall prevail without any commercial implication.
- The make/model of various instruments/items/systems shall be as per subvendor list attached. No implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with (decided by BHEL).
- The junction boxes and cables required for termination of instruments are in bidder's scope.
- The cable used shall be 0.5 mm², G type (2P/4P/8P/12P) for Binary signals and F type cable (2P/4P/8P/12P/20P) for Analog signals (also shown in Drive control philosophy).
- Regarding the supply scope of cables, please refer the "Standard scope of matrix of cables" in Electrical portion of the technical specification.
- The quantity of instruments for the system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any implication.
- Bidder to terminate all instrumentation and control elements in junction boxes. Bidder to provide input/output list, drives list, junction box schedule and termination details, recommended control logics / write-up etc. the list of documents to be submitted after award of contract is to be referred by bidder.
- All the transmitters supplied by Bidder shall be rack mounted. The transmitter racks shall be in Bidder's scope of supply. All transmitters shall be HART compatible.
- Bidder to perform tests of C&I items/instruments/systems as per Quality plans attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any implication.
- Instrument installation and accessories required shall be in Bidder's scope and shall be submitted after award of contract. However any instrument installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering.
- Bidder to furnish electrical load/UPS load data during detailed engineering.
- 2 Feeders of 415 V AC power supply shall be provided by BHEL at a single point, vendor shall provide feeder with auto changeover facility with indication.
- Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Bidder to submit the power requirement along with the bid.
- Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection, JB grouping, Annunciation list, SOE list, List of Instruments/devices for HART in BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.
- Interface of MCC, HT SWGR, field instruments, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.
- Local control panel required for operation shall be in bidder's scope.
- All field instruments enclosure shall be IP65 or better and local panel/cabinet enclosure shall be IP 42 or better, unless otherwise specified.
- Diaphragm seal shall be provided for Instruments as specified in the Instrument Specifications.

20. Redundancy of sensors shall be provided by bidder
 - (i) Triple redundancy for all analog and binary inputs required for protection of system/drives.
 - (ii) For all other control functions dual redundancy of the sensors shall be provided by the bidder.
21. Double root valve shall be provided for all design pressure tapings where the pressure exceeds 40kg/cm²
22. The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be provided by bidder, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, etc. for external connection including spare contacts shall be wired out to suitably located junction boxes by bidder.
23. Drawings/Documents and data to be furnished by bidder after award of the contract as mentioned in section "List of Documents/Deliverables".

STANDARD BLOCK INTERFACE DIAGRAM FOR LP DOSING SYSTEM (TYPICAL)



NOTES:

1. SIGNAL EXCHANGE BETWEEN DDCMIS & LP DOSING LOCAL PANEL SHALL BE AS PER CONTROL PHILOSOPHY.
2. FIELD INSTRUMENT SHALL BE TERMINATED IN LOCAL PANEL.
3. SIGNALS FOR INTERFACE TO/FROM DDCMIS ARE ALSO TERMINATED IN LOCAL PANEL.
4. THE LOCAL PANEL IS TYPICAL. SIMILAR PANELS SHALL BE APPLICABLE FOR

A. AMMONIA DOSING SYSTEM
B. HYDRAZINE DOSING SYSTEM C. NAOH DOSING SYSTEM

5. AUTO STROKE CONTROLLER SHALL HAVE FACILITY OF STROKE LENGTH ADJUSTMENT THROUGH PUSH BUTTONS & 4-20mA SIGNALS.

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SECTION – II GENERAL TECHNICAL REQUIREMENT

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SECTION – IIA

GENERAL TECHNICAL REQUIREMENT (MECHANICAL)

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1.00.0 GENERAL

1.01.01 Specification cover the design, material, construction features, manufacture, inspection, testing the performance at the vendor's/sub-vendor's works, delivery to site, erection, commissioning and testing of metering pumps.

2.00.0 GENERAL DESIGN FEATURES

2.00.01 Pumps shall be simplex positive displacement hydraulically operated diaphragm design, driven by squirrel cage induction motor through suitable speed reduction unit. Maximum pump stroke speed shall not exceed 100 per minute.

2.00.02 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 by manual control facility (micrometric adjusting type) to be provided locally for each of the pump. The capacity & head of each pump will be selected with 20% over all margin.

2.00.03 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 by manual control facility (micrometric adjusting type) to be provided locally for each of the pump.

2.00.04 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.

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

2.00.06 Crankcase shall be constructed of high quality cast iron, which will also house the gearbox and guides of cross head.

2.00.07 Guided, controlled travel, double-ball check valves or equivalent, shall be provided both on the suction and discharge side.

2.00.08 Material of construction of the various parts shall be as per the details furnished elsewhere in the specification. However all parts coming in contact with acid shall be of Hastelloy 'B' and for alkali it should be of SS-316 only.

2.00.09 Suitable gland seal shall be provided to prevent leakage.

2.00.10 Electric drive motor particulars should follow enclosed electrical chapters.

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 Owner for approval before conducting the tests.

3.01.02 The Owner's representatives shall be given full access to all tests for which the Manufacturer shall inform the owner allowing adequate time so that if the Owner 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 Owner.

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3.01.04 The pump casing shall be hydraulically tested at 200% pump operating pressure or 150% of design pressure whichever is higher. The test pressure shall be maintained at least for ½ an hour.

SPECIFICATION-M21

LOW PRESSURE PIPING, VALVES, SPECIALITIES AND INSULATION

1.00.00 GENERAL

This section covers the basic requirements for the all the low pressure piping systems, valves and specialties and thermal insulation to be provided for the complete plant.

2.00.00 CODES AND STANDARDS

2.01.00 In addition to the requirements spelt out in Volume II, the design, manufacture, inspection and testing of the piping, fittings, valves and specialties covered under this specification shall conform, in general, to the standards and codes (latest edition) mentioned below:

2.01.01	IS-1239	:	Mild steel tubes, tubulers and other wrought steel fittings.
2.01.02	IS-3589	:	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
2.01.03	IS-554	:	Dimensions for pipe threads where pressure tight joints are required on the threads.
2.01.04	IS-1363	:	Hexagonal head bolts, screws and nuts (size range M5 to M36)
2.01.05	IS-1364	:	Precision and Semi-precision hexagon bolts, screws, nuts and lock nuts (diameter range 6 to 39 mm)
2.01.06	IS-3138	:	Hexagon bolts & nuts (M42 to M150)
2.01.07	IS-5312	:	Swing check type reflux (non-return) valves.
2.01.08	IS-2379	:	Colour code for the identification of pipelines.
2.01.09	IS-2016	:	Plain washers
2.01.10	IS-2712	:	Compressed asbestos fibre jointing
2.01.11	ANSI B-16.5	:	Steel pipe flanges and flanged fittings
2.01.12	ANSI B-16.9	:	Wrought steel Butt welding flanged
2.01.13	ANSI B-16.11	:	Forged steel fittings, Socket-welding and Threaded.
2.01.14	API-600	:	Steel gate valves

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- 2.01.15 BS-2633 : Class I Arc welding of ferritic steel pipe work for carrying fluids.
- 2.01.16 BS-534 : Specification for steel pipes and specials for water and sewage.
- 2.01.17 BS-5351 : Specification for Ball valves.
- 2.01.18 AWWA-C-504 : Specification for Butterfly valves.
- 2.01.19 AWWA-C-208 : Dimension for fabricated steel water pipe fittings.
- 2.02.00 Equivalent codes and standards internationally accepted may also be offered by bidder. However same may be subject to acceptance by the Purchaser.

3.00.00 SCOPE OF WORK

- 3.01.00 The equipment and materials to be supplied shall include but not be limited to the following :
- a) Supply of all low pressure piping including bends, elbows, tees, branches, laterals, crosses, reducing union, couplings, caps, saddles, shoes, flanges, blank flanges, Y-pieces etc. as required for the piping system under the scope of this section.
 - b) Matching pipes, matching pieces like reducers/enlargers etc., counter flanges with bolts, nuts, washers, temporary and permanent gaskets, threaded union etc. for all terminals of other packages as required.
 - c) Supply and machining work of flanges, pipe spools and matching pipes to connect flow measuring orifices/nozzles with the main pipe work.
 - d) All isolating and regulating valves, non-return valves, steam/air traps, relief/safety valves (wherever applicable), strainers, pressure reducing orifices etc. complete with the counter flanges and matching connecting pieces as required within the terminal points of entire low pressure piping system.
 - e) Anchors, hangers and supports, etc. as required. Any platform necessary for maintenance and operation of valve and equipment located 1.5 m above any permanent floor or platform including access ladders, supporting structures etc.
 - f) All secondary structural steel members required for pipe supports from building steel structures and from embedded steel wherever provided including pipe supports in trenches. However, trench piping should be avoided to the extent possible.
 - g) Funnels, tundishes for drips and drains caps including all miscellaneous drain piping and drain piping from tundish outlet upto

drain points. All drain and vent lines shall be conveniently terminated to floor drain points/permanent drain trenches of the Power Station. Caps shall be provided for the drain/vent system which are under vacuum service.

- h) Flanges, counter flanges, blank flanges, bolts, nuts, washers, temporary and permanent gaskets, fasteners caps etc. as required for interconnecting piping, valves & fittings as well as for terminal points.
- i) Cleaning and Painting of all piping, valves & specialties at manufacturer's shop.

3.02.00 Following general requirements shall however be provided :

- a) Instrument Connections including instruments, root valves, sensing lines etc.
- b) Pipe stubs and blanking plates etc. required for chemical cleaning and hydro testing.

For conducting acceptance test, the required pressure, temperature, flow measurement points shall be provided.

3.03.00 All miscellaneous instruments.

4.00.00 GENERAL DESIGN AND CONSTRUCTION

4.01.00 General Considerations

- 4.01.01 The piping systems included in this section shall be designed to operate continuously without replacement during the plant service life of 30 years.
- 4.01.02 The piping system shall be complete in every detail and in accordance with the highest standard of workmanship. Any item of the section on which the contractor is in doubt shall be referred to the Owner for clarification.
- 4.01.03 All design and fabrication shall be in accordance with codes/standards specified.
- 4.01.04 No pipe work shall be run in trenches carrying electrical cables.
- 4.01.05 Pipe size above 50 NB shall be shop fabricated and of size 50 NB and below shall be field run.
- 4.01.06 All piping shall be identified by means of colour strips and by adequate lettering, conveniently spaced and located. Identification colours and lettering shall be as approved.
- 4.01.07 Air release and drain branches shall be provided wherever necessary depending upon the layout and arrangement so that the drains and air release valves are located for easy operation.

- 4.01.08 Unless otherwise specified, all pipework shall be suitable for a minimum pressure of 10.0 kg/sq. cm(g) at 80 deg. C or as required by the design of the different piping system, if higher.
- 4.01.09 Drain Pipe work
- a) Low pressure drains shall have an isolating valve at the point of take-off from the pipe or vessel to be drained, or as near as possible for conventional operation.
 - b) Unless otherwise stated, all drain piping shall be of 25 mm NB minimum and all vent piping shall be of 15 mm NB size minimum.
 - c) Unless otherwise stated, wherever a main or branch of any pipeline is terminated with a valve, such terminal valve shall be provided with a blank flange/blanking cap at the free end.
- 4.01.10 Specification of different pipes used in different services included in the L.P piping section has been detailed in Annexure-I.
- 4.02.00 **Material Specification**
- 4.02.01 Materials for pipes and fittings shall be as stipulated in Annexure-I. In case bidder wants to offer alternative piping material, same may be accepted by the Purchaser depending on the merits of alternative material.
- 4.02.02 Pipe attachments for supports, anchors and restraints, which are coming in direct contact with pipes, shall have similar materials as the piping concerned. All other materials of supports, anchors and restraints shall be of tested quality and as per manufacturer's standards.
- 4.03.00 **Fabrication**
- Except where otherwise specified all piping shall have butt welded connections with a minimum of flanged joints necessary for maintenance. Where flanges are adjacent to welded fittings, weld neck flanges shall be used.
- Branches shall, in general, be formed by welding. Standard fittings may be used in positions and for sizes where approval has been given in detail drawings. Pipe bends and tees shall be truly cylindrical and of uniform section. all welded branches shall be reinforced where needed as per the applicable codes/regulations.
- 4.03.01 Piping shall be fabricated in the shop in the largest transportable sections to minimize the number of field weld joints. The choice of field weld joints locations shall be based on the traverse of the pipe through walls, floors, sleeves or other restrictive areas. Support attachments for major piping shall be done at shop.
- 4.03.02 All pipes bends shall be made true to angle with no negative tolerance and shall have a smooth surface free of flat spots, crease and corrugations. A cross section through any bent portion of the pipe shall be true in diameter,

within plus or minus 3% of the pipe diameter. Pipe bends shall be made from straight pipe pieces of sufficiently higher thickness so that after thinning, the minimum thickness of bends shall not be less than the minimum thickness required for the straight pipe. Thinning allowance shall be considered as per the relevant code.

4.03.03 For bends in pipes straight piece of pipes shall be bent by the contractor to required bend radius. However, forged bends (Bend radius = 1.5 x pipe diameter) wherever required shall be provided at no extra cost.

4.03.04 The ends of Pipe and welded fittings shall be beveled according to details shown in the relevant piping code. All welding shall be made in such a manner that complete fusion and penetration are obtained without an excessive amount of filler metal beyond root area. The reinforcement shall be applied in such a manner that it shall have a smooth contour merging gradually with the surface of adjacent pipe and welded fittings. Backing rings shall not be used on any pipe welds, unless otherwise approved by the Engineer.

4.03.05 **Cutting and Beveling**

a) Carbon steel piping - End preparation for butt welding shall be done by machining/flame cutting.

b) Socket welding - Socket weld and preparation shall be done by saw or machine cutting.

4.04.00 **Hangers, Supports, Anchors**

Normally pipe supports and anchors shall be selected at those points in the buildings where provision has been made for the loads imposed. The cutting of floor/roof beams or the reinforcement in slabs will not be permitted. Piping attached to a plant item shall be supported in such a way that the weight of the piping is not taken by the plant item.

4.04.01 Support spacing shall be as per good engineering practice. However in no case it shall be less than support spacing stipulated in ANSI B31.1.

4.04.02 Accurate weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection.

4.04.03 All large pipes and all long pipes shall have at least two supports each arranged so that any length of pipe or valve may be removed without any additional supports being required.

4.04.04 Support steel shall be of structural quality. Perforated strap, wire or chain shall not be used. Support components shall be connected to support steel by welding, by bolting or by beam clamps. Bolt holes shall be drilled, not burned. Support components may be bolted to concrete using approved concrete anchors.

4.05.00 **Valves and Accessories**

4.05.01 **General Requirements**

- a) All valves shall be of approved make and type and shall have cast/forged bodies with covers and glands of approved construction and materials as specified in Annexure-II & III. The valves shall be provided with electric motors/solenoids and actuators as required.
- b) Valves and specialties to be supplied under this specification will be used for various air and water services and will be located indoor/outdoor and on horizontal/vertical runs of the pipe lines. However, mounting of valves in vertical pipe runs should be avoided as far as possible.
- c) All valves shall, unless otherwise stated, have the internal diameter same as the internal diameter of the pipes to be joined.
- d) All valves shall receive tests at manufacturer's or contractor's works in accordance with the specific requirements of the approved Codes of Practice. Valves shall be rising stem or otherwise as approved by the Purchaser.
- e) Gate valve and Ball valve have been specified with the intention of achieving isolation and tight shut-off. In full open condition, these valves should offer minimum of resistance to fluid flow.
- f) Globe valves have been specified with the intention of achieving good control of fluid passing. The plug and seat will have therefore suitable profiles for obtaining such controlling action.
- g) Check valves have been specified in order to prevent reverse flow through them.
- h) All valves shall function smoothly without sticking, rubbing or vibration on opening or closing and shall be suitable for most stringent service conditions i.e. flow, temperature and pressure under which they may be required to operate.
- i) Material, design, manufacture, testing etc. for all valves and specialties along with the accessories shall conform to the latest editions of codes.
- j) By pass valves shall be provided for larger size valves as per standards followed and as felt necessary for smooth and easy operation, even though not specifically mentioned in the specification.
- k) All flanged valves and specialties to be supplied under this section shall be provided with two (2) counter flanges, bolts, nuts, washers, gaskets etc.
- l) All valves shall be of approved design and manufacture. Where valves are of similar size and type they shall be interchangeable

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with one another. Valves shall have welded or flanged connections subject to the Purchaser's approval.

- m) All valves shall have outside screwed spindles and screwed thread of spindle shall not pass through or into the stuffing box. Where valves are exposed to the weather, protective covers shall be provided for the spindles which shall be subject to approval.
- n) Gate, Globe and Ball valves shall be provided with the following accessories in addition to other standard items:
 - i) Hand wheel with embossed open and shut directions.
 - ii) Local position indicator.
- o) Gate valves, in addition shall be provided with following extra features :
 - i) Bypass valve for larger valves
 - ii) Draining arrangement
 - iii) Enclosed Gear operators for valves 300 mm size and above for ease in operation.
- p) All gate and globe valves shall be rising stem type. All gate, globe and check valves shall be designed for reconditioning seating surfaces and replacement of stem and disc without removing the valve body from the line.
- q) All valves shall be provided with handwheels, chain, operator, extended spindle and floor stand wherever required so that they can be operated manually by a single operator from the nearest operating floor either at a lower or higher elevation as the case may be. If such a valve is provided with integral bypass then similar arrangement shall be done for the bypass valve also.
- r) All valves and specialties shall be provided with brass Tag Discs indicating Tag numbers and nomenclature of the valve including duty or service intended and the function of the valves specialties.
- s) Stems shall preferably be arranged vertically with gland at the top, however, in no circumstances must the stem be inclined downward from horizontal or gland be at the bottom. Globe valves shall be installed with the pressure under the disc. Valves shall not be fitted in inverted position.
- t) Where necessary, for accessibility, grease nipples shall be fitted at the end of extension piping and where possible these shall be grouped together and mounted on a common panel situated at a convenient position. A separate nipple shall be provided to lubricate each point. The Bidder shall supply the first fill of oil or grease for these parts. The Bidder shall supply a suitable manually operated grease gun for the standard type of nipple provided.

- u) The spindles for all valves for use outside the building shall have weatherproof protection covers of approved construction.
- v) All valves shall be fitted with indicators so that it may be readily seen whether the valves are open or shut. In the case of those valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.
- w) Plastic or bakelite valve hand wheels will not be accepted.
- x) All valves shall be closed by rotating the handwheel in a clockwise direction when looking at the faces of the handwheel. The face of each handwheel shall be clearly marked with the words 'Open' and 'Shut' with arrows adjacent to indicate the direction of rotation to which each refers.
- y) Wherever practicable heavy valves of total weight including actuator, drive motor, integral by-pass etc., equal to or greater than 500 kg. shall be provided with suitable lugs to permit direct suspension by hanger rod or direct resting on bottom support, as applicable.
- z) Special attention shall be given to the operating mechanism for large size valves in order that quick and easy operation is obtained and maintenance is kept to a minimum.
- aa) Eyebolts shall be provided where necessary to facilitate handling heavy valves or parts of valves.
- bb) The Bidder shall supply with his bid and in addition during the course of the Contract, comprehensive drawings showing the design of valves, test pressure and working pressure/temperatures. They should include a parts list referring to the various materials used in the valve construction.
- cc) All sampling and root valves shall be of integral body bonnet type.

4.05.02 For Design Requirements for different valves refer Annexure-II & III.

4.06.00 **Safety /Relief Valves**

Safety/Relief valves shall be of direct spring loaded type and shall have a tight, positive and precision closing.

All safety valves shall be provided with manual lifting lever.

Valves used for air and any other compressive fluid shall be of pop type.

Safety/Relief valves shall be constructed and adjusted to permit the fluid to escape without increasing the pressure beyond 10% above the set blow off pressure. Valve shall reset at a pressure not less than 2.5% and more than 5% of the set pressure.

Releasing capacity of the safety/relief valves shall be as per the applicable codes and standards and shall be subject to the approval of the Engineer.

The seat and disk of safety valves shall be of suitable material to resist erosion. The seat of valve shall be fastened to the body of the valve in such a way that there is no possibility of the seat lifting.

5.00.00 WELDING AND HEAT TREATMENT

All the treatment, welding, post and pre weld temperatures shall be as per the code ASME B 31.1.

6.00.00 UNDERGROUND PROTECTION

6.01.00 Where pipelines are buried, underground protection shall be provided with anti-corrosive tape of 4 mm thick conforming to IS-10221 and AWWA C 203-93

6.02.00 Pipe surfaces shall be cleaned by shot or sand blasting before application.

6.03.00 Tests to be carried out after application

- (a) Bond / Adhesion test
- (b) Holiday test

7.00.00 THERMAL INSULATION

Refer Data Sheet.

8.00.00 INSPECTION AND TESTS

8.01.00 Inspection and tests shall be as per specification for Inspection & Testing and approved by QAP.

9.00.00 BROAD GUIDELINES FOR ERECTION AND INSTALLATION OF LP PIPING

9.01.00 All fittings like "T" pieces, flanges, reducers etc. shall be suitably matched with pipes for welding. The valves will have to be checked, cleaned or overhauled in full or in part before erection, after chemical cleaning and during commissioning.

9.02.00 Adjustments like removal of ovalities in pipes and opening or closing the fabricated bends of high pressure piping to suit the layout shall be considered part of work and the Erection contractor is required to carry out such work as per instruction of Bidder/Owner, which shall include specified heat-treatment procedures, etc. also wherever required.

9.03.00 Certain adjustments in length may be necessary while erecting high pressure pipelines and the Erection contractor should remove the extra lengths to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures.

- 9.04.00 Suspension for piping, pressure parts, etc., will be supplied in running lengths which shall be cut to suitable sizes and adjusted as required.
- 9.05.00 All the valves, lifting equipments, actuators, power cylinders, etc., shall be serviced and lubricated to the satisfaction of Engineer before erecting the same and also during pre- commissioning. Even after commissioning, the equipments, if there are problems in the operation, they have to be attended to by the Bidder during the tenure of the contract. Welding or jointing of extension spindle for valves to suit the site conditions and operational facility shall be part of erection work.
- 9.06.00 All tubes and pipes shall be cleaned and blown with compressed air and shown to the engineer before lifting. Bigger size pipes should be cleaned with flexible wire brush, wherever necessary. After cleaning is over the end caps shall be put back in tube openings till such time they are welded to other tubes.
- 9.07.00 Fine fittings, drain piping, oil systems & other small bore piping have to be routed according to site conditions and hence shall be done only in position. As such, layout of small bore piping shall be done as per site requirement. There is a possibility of slight change in routing the above pipelines even after completion of erection which shall be carried out by the Bidder without any extra cost to the Purchaser. Work shall also include fabrication of small bends at site from straight lengths to suit the site conditions.
- 9.08.00 No temporary supports shall be welded on the pressure parts. Welding of temporary supports, cleats, etc., on the building columns shall also be avoided. In case of absolute necessity, Erection contractor shall take prior approval from Bidder/Engineer. Further, any cutting or alteration of member of the structure or platform or other equipments shall not be done without specific prior approval of Engineer.
- 9.09.00 Wherever piping erected by the Erection Contractor is connected to piping or equipment erected by some other agencies the joint at the connecting point shall be considered under this specification.
- 9.10.00
- a) All piping shall be grouped wherever practicable and shall be routed to present a neat appearance.
 - b) The piping shall be arranged to provide clearance for the removal of equipment for maintenance and for easy access to valves, instruments and other piping accessories required for operational maintenance.
 - c) Piping shall be generally routed above ground but where specifically indicated approved by the Engineer, the piping may be arranged in trenches, or buried and properly protected as per AWWA Standards.
 - d) Overhead piping shall have a minimum overhead clearance of 2.3 meters above walkways and working areas and 6 meters above roadways unless otherwise approved by the Engineer.

- e) Drains shall be provided at all low points and vents at high points as per actual layout regardless of whether some have been shown in respective drawings or not. The pipelines shall be sloped towards the drain points.

9.11.00 All drips and drains for piping and equipment whether shown in the drawings or not shall terminate on the ground floor upto station drain unless otherwise noted. Leading such drains upto station drainage is also the responsibility of the Contractor.

10.00.00 DRAWINGS, DATA, INFORMATION & MANUALS

10.01.00 Drawings, data, Information to be furnished by the Bidder besides those already mentioned in volume : II with the offer.

10.02.00 After Award of Contract

Detail drawings including fabrication drawings of all shop fabricated piping system indicating design parameters and complete bill of material (Relevant Standards and grades to be indicated) and information/data pertaining to the hydrostatic and non- destructive test requirements to be submitted progressively.

10.02.01 Detail dimensioned drawing of each valve, specialties, indicating tag no., pressure rating, manufacturing standard, the bill of materials and hydrostatic test pressures. The drawing shall include the end preparation details and shall indicate the position of the hand wheel/operator. Technical particulars of motor operators wherever applicable shall also be indicated.

10.02.02 General arrangement drawing for each hanger/support/anchor etc. indicating identification number, auxiliary supporting structural details, other details & information as required in the specification.

10.02.03 Wiring diagram for all limit switches of motor operated valves.

10.02.04 The loading data required for design of structures shall be furnished well in advance to suit Purchaser's time schedule.

ANNEXURE-I

DATA SHEET FOR PIPEWORK & FITTINGS

Sl. No.	DESCRIPTION	SPECIFICATIONS			
		DM water	Sea water, service water	RO permeate	Instrument Air, potable water, Service air
1.00	Piping -500 NB and above	--	Steel plate fabricated & welded pipes to IS: 3589 with minimum thickness as 6 mm /GRP	SS/MSRL/CPVC /GRP	--
	-200 NB to 450 NB confirming to A312TP304	ERW quality stainless steel pipes Sch.10S thick	ERW carbon steel pipes to IS: 3589 /GRP		-
	-150 NB below	ERW quality stainless steel pipes Sch.10S thick. dimensions as specified.	ERW carbon steel black pipes to IS:1239 (Part-I) heavy class plain ends, dimensions as per Table-3 of IS:1239 Part-I MSRL/HDPE/CPVC		ERW carbon steel galvanized pipes to IS:1239 (Part-I) heavy class screwed ends, dimensions as per Table-3 of IS:1239 Part-I

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Sl. No.	DESCRIPTION	SPECIFICATIONS			
		DM water	Sea water, Service air	RO permeate	Instrument Air, potable water
2.00	FITTINGS - - 200 NB & larger	Fabricated pipe fittings out of material same as pipe.	Fabricated fittings out of parent carbon steel pipe.	Fabricated pipe fittings out of material same as pipe.	--
	- 150 NB & below	Fabricated pipe fittings out of stainless steel type 304 Sch-10S thick. BW ends to ASA-B-16.9.	Hot bends out of seamless carbon steel pipes with butt welding ends to ASA-B-16.9, dimensions matching with IS:1239 Heavy Class piping.	Fabricated pipe fittings out of stainless steel type 304 Sch-10S thick. BW ends to ASA-B-16.9.	Heavy class galvanized MS screwed fittings to IS: 1239 Part-II or equivalent with screwed ends to IS: 554
3.00	FLANGES	150#ASA class carbon steel rubber lined flanges drilled to ASA-B-16.5 with a set of bolts, nuts & gaskets.	Single piece plate cut flanges out of IS: 2062 plates drilled to 150#ASA B-16.5. Multi segment flanges for large dia pipes shall be 100% radio graphed.	150#ASA class carbon steel rubber lined flanges drilled to ASA-B-16.5 with a set of bolts, nuts & gaskets.	150 # ASA galvanized screwed flanges drilled to ASA-B-16.5 with bolts, nuts & gaskets.
4.00	BOLTS & NUTS	Stainless Steel	Hexagonal head machined carbon steel bolts and hot forged carbon steel hexagonal nuts to IS: 1367 Class 4.6	Stainless Steel	Hexagonal head machined carbon steel bolts and hot forged carbon steel hexagonal nuts to IS: 1367 Class 4.6

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Sl. No.	DESCRIPTION	SPECIFICATIONS		
		DM water	Sea water, Service air	Instrument Air, potable water
5.00	GASKETS	1.5 mm thick. compressed asbestos, ring type gaskets dimensions to suit associated flange drilling details	(For Water System) 3mm thick cloth inserted white rubber full faced gaskets dimensions to suit associated flange drilling details (For Oil System) 1.5 mm thick compressed asbestos ring type gaskets dimensions to suit associated flange drilling details.	3 mm thick cloth inserted white rubber full faced gaskets dimensions to suit associated flange drilling details
6.00	JOINTS - 50 mm and smaller	Line joints socket welded type	Line joints socket welded type	Screwed
	- 65 mm and larger	Flanged	Line joints butt welded type	Screwed Flanged
	- joints at valves	Socket weld/flanged for sizes 50 NB and below	Socket weld/flanged for sizes 65 NB and above	Screwed Flanged
	- Joints at equipment	As per Manufacturers Standard	As per Manufacturers Standard	As per Manufacturers Standard

Notes: Sizes given above are nominal diameters in millimeters.

ANNEXURE-II

SPECIFICATION OF VALVES

	A. Cast Iron Body Gate/ Globe/ Check Valve	B. Stainless Steel Body Gate/ Globe/ Check/Ball Valve	C. Steel Body Gate/ Globe/Check Valves
1.00.0 Valve Classification Code	CIGC	SSGC	STGC
2.00.00 Basic Design Code			
a) Gate	a) i) IS 780 for 50 mm - 300 mm NB ii) IS 2906 for 350 mm NB & above or as per MSS-SP-70	a,b,c) ANSI-B-16.34	a) i) API 600 for 50mm NB and above/ANSI-B-16.34 ii) API 602 for size below 50mm NB/ANSI-B-16.34
b) Globe	b) MSS-SP-85		b) BS 1873/ANSI-B-16.34
c) Check	c) IS 5312/MSS-SP-71		c) BS 1868/ANSI-B-16.34
d) Ball		d) BS-5351	
3.00.00 Pressure Class	To be suitably chosen considering the pressure requirement. Refer Clause No. 4.01.08 in this regard.		
4.00.00 Construction	Cast body and bonnet/cover	Forged body upto 50mm NB and Cast body above that size.	Same as Group B

		A. Cast Iron Body Gate/ Globe/ Check Valve	B. Stainless Steel Body Gate/ Globe/ Check/Ball Valve	C. Steel Body Gate/ Globe/Check Valves
5.00.00	Material	IS-210 Gr. FG 260	ASTM-A-182 F304, & For Ball Valves: A351 CF8M for cast body, A182 F304 for forged Body	ASTM-A-216 Gr WCB for Cast Body & ASTM-A-105 for forged body
5.01.00	Body & Bonnet/cover			
5.02.00	Trim/Disc.	IS-210 Gr. FG 260	ASTM-A-182F304 for Gate, Globe, Check Valves and 351CF8M for Ball valves	13% Cr Steel as per ASTM-A-182 Gr F6 heat treated and hardened (min 250 NB) for cast body and ASTM-A-105 Hard faced with Steelite (min 350 HB) for forged body
5.03.00	Seating surface	13% Cr steel as per IS 1570	For Ball valves PTFE seats and seals	13% Cr. Steel as per ASTM-A-182 Gr. F6
6.00.00	End Preparation	Socket welded for size equal to and below 50 mm NB and flanged with counter flanges for 65 mm NB and above		
7.00.00	Testing	i) As per IS 780 for 50mm-300mm NB ii) IS 2906 for sizes equal to and above 350mm NB Hydrostatic Test as per MSS-SP-85 IS 5312/MSS-SP-71	As per ANSI B-16.34	a) API-598 b) BS-1873 c) BS-1868
	a) Gate			
	b) Globe c) Check			

ANNEXURE-III

DATA SHEET FOR THERMAL INSULATION

INSULATION CLASSES

Insulation Operating Class	Temperature (°C) (m)	Inner Outer Total Pipe Size (mm) Layer (mm) Layer (mm)
A	540 - 526	40 & smaller 65 50 - 100 50 125 - 200 65 250 & larger 80
B	425 - 261	65 & smaller 65 50 - 100 40 125 - 250 50 300 & larger 90
C	260 - 151	50 & smaller 40 65 & larger 65
D	150 - 65	250 & smaller 40 300 & larger 65
E	538 - 261	Equipment 80
F	260 - 96	Equipment 65
G	95 - 65	Equipment 40



ANNEXURE-IV

DATA SHEET FOR INSULATION MATERIAL

SR. NO.	SURFACE TEMP.	MATERIAL	DENSITY	CLADDING THICKNESS
1.	Below 450 Deg.C	Preformed Rockwool Pipe Sections as per Minimum IS:9842/Rock Wool LRB as per IS:8183	260 kg/m ³	22 CWG x 12.0 mm



SPECIFICATION-M1

MECHANICAL DESIGN CRITERIA

1.1.0 INTRODUCTION

This section covers the design criteria, which shall be used for mechanical work related to this project. In case, the following criteria, contradicts with the applicable design standard / statutory or norms / specification requirement indicated elsewhere in this document, the most stringent requirement will prevail.

1.2.0 PIPING

Piping shall be designed, selected, and fabricated in accordance with the following criteria:-

Piping shall not be installed above, or within a horizontal distance of 1 meter from electrical equipment such as switchgear, switchboards, control panels, motor controls, contractors, communication equipment, batteries, battery chargers, and motor generators unless approved by the Owner. Improperly located piping shall be removed and relocated.

Piping shall be installed with a minimum of 2.3 meters headroom over the passageways and walkways.

Out door piping shall be routed in pipe racks with a minimum headroom of 2.3 meters and 7 meters at road crossing.

Where piping is laid on pipe sleepers, it shall have hard surfacing below it, keeping a gap of 300mm from the bottom of pipes.

Pipe at road crossing shall be under culverts in general. Overhead pipe bridges may be provided for areas where pipe racks are provided.

Outdoor pipe trenches shall be avoided.

The pipe work with its supports and other components shall not obstruct gangways (minimum 1000mm width).

All branch piping shall be provided with shutoff valves at the main headers.

All piping length should be provided with flanged joints at all intervals of standard length and should be provided with drain and vent connections with ball valves/globe valves.

Valves shall be installed in such a manner that they can be operated from the main operating floors or platforms without the use of ladders or special operating devices.

Manual bypass lines with globe valves shall be provided around control valves and other equipment to facilitate equipment and/or piping warm-up.

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Piping sizes shall be based on limiting the pressure drop to an acceptable value. However, the pipe sizes shall generally be large enough to keep fluid velocities below the maximum velocities indicated in Table 1.1

1.2.1 **Design Temperature and Pressure**

The design pressure and temperature for piping shall be consistent with conditions established for the design of the associated system.

The design pressure of a piping system generally shall be based on the maximum sustained pressure that may act on the system plus 2 kg/cm² (g).

The design temperature of a piping system generally shall be based on the maximum sustained temperature which may act on the system plus 5° C.

However the minimum design temperature shall be 60 Deg°C and the minimum design pressure shall be 10 kg/ cm² (g).

TABLE 1.1 - MAXIMUM VELOCITIES IN PIPES (in m/s)

Service or Type of Fluid	Pipe Sizes (Inside Diameter)				
	<u>50 mm</u>	<u>200 mm</u>	<u>350 mm</u>	<u>500 mm</u>	<u>600 mm and larger</u>
1. All Gases, compressed air	15	20	25	25	25
2. Circulating Water					
a) Pump suction	0.6	1.2	1.5	1.5	1.5
b) Pump discharge	1.2	2.5	2.5	2.5	2.5
3. General Service Water					
a) Pump suction	0.6	1.0	1.2	1.5	1.5
b) Pump discharge	1.5	2.0	2.5	2.5	2.5
4. Water Gravity Drains	0.9	1.2	1.5	2.5	2.5

Notes:

1. For pipe sizes between tabulated values, the velocity associated with the larger pipe size shall be used.
2. Inside diameters thus calculated for various piping systems shall be checked for the allowable pressure drop.
3. Pipe shall be sized for the worst (i.e. maximum flow, temperature and pressure values) operating conditions.

1.2.2 General Design and Selection Criteria

Piping shall be designed in accordance with the requirements of the Code for Pressure Piping; ANSI B31.1-Power Piping; or other codes and standards referenced in Specification-M0

Minimum wall thicknesses of straight pipe under internal pressure shall be designed in accordance with ANSI B31.1/ IBR as applicable.

However, regardless of the calculation results, minimum wall thickness for carbon steel piping shall be (i) Sch. 80 for pipe sizes 50 NB & below; (ii) Sch. 40 for pipe sizes above 50 NB and upto 300 NB; and (iii) Sch. STD for pipe sizes 300 NB and above. Stainless steel piping shall be of minimum Sch 10S thickness.

Pipes of 150 NB & below to IS:1239 shall be of Heavy Grade and Pipes above 150 NB shall be to IS 3589

1.2.3 Vent and Drain Piping Design Criteria

Vent and drain piping shall generally be in accordance with the following criteria:-

- a) Vent connections shall be provided at all high points in water, slurry, and other piping.
- b) Drain connections shall be provided at all non-drainable lowest points in water, slurry, and all other piping.
- c) Drain connections shall be provided at all control valve stations between the inlet isolation valve and the control valve.
- d) All vent and drain connections shall be provided with isolation valves. All vents shall use globe valves. All drains shall use gate valves to resist pluggage, if possible. Otherwise, globe valves shall be used for drains.
- e) Plug valves shall be used for all slurry vent and drain applications.
- f) Vent and drain connections that require frequent operation or which may discharge significant quantities of fluid shall be piped to a suitable drain. Vent or drain connections that shall normally require operation at a time when hot fluids are discharged shall be piped to a safe termination point (drain funnel or floor area discharge). All other connections shall be provided with a closure (female plug) near the isolation valve.
- g) All piping shall be sloped towards the system low point such that slope is maintained in both hot and cold condition.

1.3.0 PUMP S

1.3.1 All pumps shall be selected with a flow margin of 10% over the design flow.

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1.3.2 The friction loss in piping shall be calculated considering above. (10% margin on flow over the design flow)

1.4.0 T THERMAL INSULATION

Insulation of equipment/ductwork/piping for personal protection shall be provided if the surface temperature exceeds 60°C.

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SECTION - IIB
		REV.NO. 0 DATE :

SECTION – IIB
GENERAL TECHNICAL REQUIREMENT (ELECTRICAL)

SPECIFICATION- E21

ELECTRICAL MOTORS

1.00.00 SCOPE

- 1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.
- 1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.
- 1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 CODES AND STANDARDS

- 2.01.00 All motors shall conform to the latest editions including all applicable amendment of relevant IS, IEC and CBIP Standards/Publications except when otherwise stated herein or in the driven equipment specification.
- 2.02.00 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.
- 2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.
- 2.04.00 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:

1)	Three phase induction motors	:	IEC:34, IS:325
2)	Crane duty motors	:	IEC:34, IS: 3177
3)	Single phase AC motors	:	IS:996
4)	DC motors/generators	:	IEC, IS:4722
5)	Degree of protection provided by enclosures for rotating electrical machinery	:	IS: 4691
6)	Terminal marking for rotating electrical machinery	:	IS: 4728
7)	Designation of methods of cooling for rotating electrical machinery	:	IS: 6362
8)	Designation for types of construction and mounting arrangements for rotating electrical machinery	:	IS: 2253
9)	Classification of maximum surface temperatures of electrical equipment for use in explosive	:	IS: 8239

	atmospheres		
10)	Flame proof enclosure of electrical apparatus	:	IS: 2148
11)	Rotating Electrical Machines – Specification	:	IS: 4722
12)	Energy efficient Induction motors 3 Ph, squirrel cage	:	IS 12615 - 2011

3.00.00 SERVICE CONDITIONS

- 3.01.00 The motors will be installed in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash. Canopy shall be provided on all outdoor motors.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.
- 3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING

4.01.00 A.C. Motors

- 4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.
- 4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.
- 4.01.03 The motor name-plate rating at 50°C shall have more than 10% margin over the input power requirement of the driven HT equipment at rated duty point unless stated otherwise in driven equipment specification or in general electrical specification.
- 4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.
- 4.01.05 All continuous running LT motors shall be energy efficient level IE3 as per IS 12615 - 2011.
- 4.01.06 The motor name plate rating shall have more than 10% margin over the input power requirement of the HT driven equipment and 15% for LT driven equipments at rated duty point. Motors located in hazardous area shall be flameproof type.

4.02.00 D.C. Motors

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4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type.

4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

Starter panel complete with all accessories shall be included in the scope of supply. DC motors shall be similar to AC motors with respect to other features like enclosure type, cooling and class of insulation.

5.00.00 PERFORMANCE

5.01.00 Running Requirements

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

Motor shall not stall if the supply voltage drops to 70% of the rated voltage two (2) second duration.

5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.02.00 Starting Requirements

Motor shall be designed for direct online starting at full voltage. Starting current shall not exceed 6 times full load current for all auxiliaries. No further tolerances are applicable on starting current specified above for HT motors. For LT motors, the applicable starting current shall be limited to 7.2 times of full load current including all tolerance.

5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.02 Motor with rigid coupling shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminal. Minimum starting requirement for fluid coupling shall be 75% rated voltage at motor terminals.

5.02.03 a) Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.

b) Cranking motor shall be capable of six equally spread starts per hour, three starts in quick succession from cold condition and one restart from hot condition. The coal conveyor and crusher motors shall be suitable for 3 consecutive hot starts with maximum 20 starts per day.

c) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.

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- 5.02.04 HT pump motors shall be suitable to start with forward rotation.
- 5.02.05 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage
- 5.03.00 **Stress During Bus Transfer**
- 5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.
- 5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.
- 5.04.00 **Locked Rotor Withstand Time**
- 5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time and upto 45 secs starting time.
- For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
- 5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage. For fluid coupling, said locked rotor withstand time and acceleration time shall correspond to the duration of starting current of motor.
- 5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

6.00.00 SPECIFIC REQUIREMENTS

- 6.01.00 **Enclosure**
- 6.01.01 All motor enclosures shall conform to the degree of protection IPW-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction.
- 6.01.02 For hazardous area approved type of increased safety enclosure shall be furnished.
- 6.02.00 **Cooling**
- 6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA). For large capacity motors, totally enclosed tube ventilation (TETV) cooling system shall be considered.

- 6.02.02 In case water cooling is required for very large motors, prior approval of the customer is to be obtained before proceeding ahead with design & manufacture.
- 6.03.00 **Winding and Insulation**
- 6.03.01 All insulated winding shall be of copper.
- 6.03.02 All motors shall have class F insulation but limited to class B temperature rise.
- 6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.
- 6.04.00 **Tropical Protection**
- 6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- 6.04.02 All fittings and hardwares shall be corrosion resistant.
- 6.05.00 **Bearings**
- 6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application.
- 6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.
- 6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
- 6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.
- 6.05.05 Grease lubricated bearings shall be prelubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.
- 6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.
- 6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.
- 6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.
- 6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.
- 6.06.00 **Noise & Vibration**
- 6.06.01 The noise level shall be as per statutory acceptance (IS/IEC).

- 6.06.02 The peak amplitude of the vibration shall be within IS/IEC specified limits.
- 6.06.03 The motors rated above 135KW shall be provided with continuous vibration monitoring and protection.
- 6.07.00 **Motor Terminal Box**
- 6.07.01 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation
- 6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 90 Deg. for HT/LT motors unless otherwise approved.
- 6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.
- 6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.
- 6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.07.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.
- 6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.
- 6.07.10 The gland plate for single core cable shall be non-magnetic type. In case of motor terminal box being not suitable for specified cable size/number, suitable adopter box/extension box shall be provided.
- 6.08.00 **Grounding**
- 6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.
- 6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows :
- | | | |
|-------------------------------|---|--------------------|
| Motor above 90 KW | : | 75 x 10 mm GS Flat |
| Motor above 30 KW up to 90 KW | : | 50 x 6 mm GS Flat |
| Motor above 5 KW up to 30 KW | : | 25 x 3 mm GS Flat |
| Motor up to 5 KW | : | 8 SWG GI Wire |

6.08.03 The cable terminal box shall have a separate grounding pad for termination of grounding conductor.

6.09.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

- a) Temperature rise in Deg.C under rated condition and method of measurement.
- b) Degree of protection.
- c) Bearing identification number and recommended lubricant.
- d) Location of insulated bearings.

6.10.00 **Construction**

a) **Stator Core**

The stator lamination shall be made of high grade silicon/magnetic steel sheet varnished on both sides and pressed to form rigid core.

b) **Rotor**

The rotor construction shall be such that in case of dislodging of the rotor bar from the end ring, it should not come out and hit the stator core/stator winding and damage.

7.00.00 ACCESSORIES

7.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 **Space Heater**

7.02.01 Motor of rating 30 KW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 phase 50 Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.03.00 **Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with six (6) nos. duplex, or twelve (12) nos. simplex type winding temperature detectors, i.e. two (2) nos. duplex or four (4) nos. Simplex per phase.

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- 7.03.02 11000V and 3300V motor bearing shall be provided with duplex type temperature detectors.
- 7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.
- 7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.
- 7.03.05 Five number of Temperature detectors / thermistors shall be provided for L.T. motors above 90 KW (3 numbers winding temperatures & 2 numbers bearing temperatures)
- 7.04.00 **Indicator/Switch**
- 7.04.01 Dial type local indicator with alarm contacts shall be provided for the following :
- 11000 V and 3300V motor bearing temperature.
 - Hot and cold air temperature of the closed air circuit for CACA and CACW motor.
- 7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.
- 7.04.03 Alarm switch contact rating shall be minimum 0.5 A at 220V D.C. and 2A at 240V A.C.
- 7.05.00 **Current Transformer for Differential Protection**
- 7.05.01 Motor 1000 KW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure. Loose 3 numbers CT for mounting on switchgear side shall be in bidder's scope.
- 7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later to the successful bidder..
- 7.06.00 **Accessory Terminal Box**
- 7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.
- 7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit cable connections.
- 7.07.00 **Drain Plug**
- Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

Electrical hoists shall be provided for the motors above 1000 kgs for maintenance of the motors

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

Motor including fan shall be painted with corrosion proof paints of colour shade (RAL-7032).

8.00.00 **TESTS**

Routine Tests are to be conducted for all HT motors and for LT motors above 60 KW rating in presence of customer's representative as per IS:325 and required copies of test certificates are to be furnished for approval. In addition, following Type tests shall have to be carried out in presence of Owner representative on all 3.3kV/11kV motors.

- a) Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-671/IS-14422 : 1995 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
11 kV	49 kV peak

- b) Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.
- c) Polarization Index Test as per IS:7816 as routine test
- d) Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu of test, provided the test motor is identical to motor being supplied.
- e) Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test has been conducted on exactly identical terminal box.
- f) Test for noise level as routine test.
- g) Test for vibration as routine test.
- h) Tan delta measurement on coils.

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- i) Surge withstand test for inter turn insulation.
- j) Test to diagnose rotor bar failure during manufacture.

Tests indicated at (h), (i), (j) shall be carried out during manufacture of the coils and shall be furnished for verification.

9.00.00 DRAWINGS, DATA & MANUALS

Drawings, data & manuals for the motors shall be submitted as indicated below:

9.01.00 Along with the bid

- a) List of the motors
- b) Individual motor data sheet as per format of the proposal data sheets.
- c) Scheme & write up on forced lubrication system, if any
- d) Type test report

9.02.00 After Award of the Contract

- a) Dimensional General Arrangement drawing
- b) Foundation Plan & Loading
- c) Cable end box details
- d) Space requirement for rotor removal
- e) Thermal withstand curves hot & cold
- f) Starting and speed torque characteristics at 80% & 100% voltage
- g) Complete motor data
- h) Erection & Maintenance Manual
- i) Test reports
- j) Data sheets to be enclosed

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11000 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors rated 1500KW & above
	Fault level 44 KA symm.	
	3300 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors above 160 KW upto and below 1500KW
	Fault level 40 KA symm.	
L.T. Supply	415V, 3Ø, 3W, 50 Hz effectively earthed	Motors upto and including 160KW
	Fault level 50 KA symm.	
	240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, space heating, A.C. control & protective devices
D.C. Supply	220V, 2W, unearthed	D.C. alarm, control & protective devices
	Fault level 25* KA.	

* 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 :

Voltage : $\pm 10\%$ Frequency : $\pm 5\%$ Combined Volt : 10% (absolute sum) + frequency

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 Volt

RATING AND REQUIREMENTS AC AND DC MOTORS

		AC Motor	DC Motor
1.0	Application	Continuous duty	
1.1	Type	Squirrel Cage Induction Motor	Shunt/compound
1.2	Voltage Level	11 KV, 3.3 KV and 415 V	220 V
1.3	Voltage variation	±10%	+10%, -15%
1.4	Frequency variation	±5%	--
1.5	Combined Voltage and Frequency variation (absolute)	10%	--
1.6	Rating HT Motors	Above 160KW up to and below 1500 KW suitable for 3.3 KV, 3 Ph, 40 KA, Non-effectively earthed system, Motors 1500 KW and above 11KV, 3 Ph, 3W, 44 KA Non-effectively earthed	
	LT Motors	160 KW & Below suitable for 415 V, 3 Ph, 3 W effectively earthed system of 50 KA fault level	
	DC Motors		220V DC, 2 wire, Unearthed system 25 KA for 1 sec.
1.7	Method of starting	Direct on Line	DC resistance Starter mounted in panel.
1.8	Protection class		
	Indoor	IP-55	
	Outdoor	IPW-55	
1.9	Class of Insulation	F	F
2.0	Temperature Rise Limit	B	B
2.1	Starting Current		

ANNEXURE-B

		AC Motor	DC Motor
	HT Motors	6 Times without further tolerance	
	LT Motors	7.2 times without further tolerance	
	DC Motor		2.5 to 3 (max.) times of FLC without any further tolerance.
2.2	Terminal box		
	Line side	Phase segregated	
	Neutral side	Phase segregated (Optional)	
2.3	Type of Cooling	Totally Enclosed Fan Cooled (TEFC)/Totally Enclosed Tubular Ventilation (TETV)/Closed Air Circuit Air Cooled (CACA)	
2.4	Space Heater	30 KW and above	
2.5	Auxiliary Supply Voltage	415V, 3 Ph/240 V, 1-Ph AC	
2.6	C. T. to be provided in neutral terminal (3 No.) & 3 No. to be supplied loose for mounting in switchgear for HT motors for Differential Protn.		
2.7	Paint shade	RAL-7032, Siemens Gray	



VOLUME-III
SPECIFICATION –E22
ACTUATOR

CONTENT

CLAUSE NO.	DESCRIPTION	PAGE	NO.
1.00.00	SCOPE		VOL.III/E22:1
2.00.00	STANDARDS		VOL.III/E22:1
3.00.00	SERVICE CONDITIONS		VOL.III/E22:1
4.00.00	RATING		VOL.III/E22:2
5.00.00	PERFORMANCE		VOL.III/E22:2
6.00.00	SPECIFIC REQUIREMENT		VOL.III/E22:2
7.00.00	TEST		VOL.III/E22:4
8.00.00	DRAWINGS, DATA & MANUALS		VOL.III/E22:5
9.00.00	NAME PALTE		VOL.III/E22:5
10.00.00	PAINTING		VOL.III/E22:5
11.00.00	PACKING		VOL.III/E22:5
12.00.00	ACTUATOR DATA SHEET		VOL.III/E22:5
13.00.00	OVERLOAD PROTECTION		VOL.III/E22:5
ANNEXUER-A	TECHNICAL DATA SHEET ACTUATOR		VOL.III/E22:7

SPECIFICATION- E22

ACTUATOR

1.00.00 SCOPE

- 1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates.
- 1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.00.00 STANDARDS

- 2.01.00 All electrical equipment shall conform to the latest editions including all applicable amendments of IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.
- 2.02.00 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.
- 2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed
- 2.04.00 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
 - iii) IS-9000
 - iv) IS-12065
 - v) IS-12075
 - vi) IS-13947

3.00.00 SERVICE CONDITIONS

- 3.01.00 The actuator shall be provided with integral starter and suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust

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- and/or fly ash and should be suitable for ambient tempt. Ranging from - 20°C to +_70°C
- 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.

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 impart 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. Actuator shall be with integral starter type. Integral starter shall have facility to hookup with DDCMIS/PLC for control and position of indication for position limit switch and Torque switches.
- 6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof NEMA-6/IP 68 suitable for outdoor use without necessity of any canopy.

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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 motor shall be designed for full voltage direct-on-line start, with starting current limited to 6 times full-load current. The motor shall be capable of starting at 85% of rated voltage and running at 80% of rated voltage at rated torque and also at 85% of rated voltage at 33% excess rated torque for a period of 5 minutes each.

The actuators shall be sized so as to open or close valves/ dampers at rated speed enclosure shall not be more than 60 degree 'C' over ambient temp. of 60 deg.C as these are subjected to higher ambient conditions due to their vicinity to operate fluid on continuous load operation. The actuators shall be suitable for a relative humidity of 95%. Class of insulation shall be class-F and type of enclosure shall be IP-68.

The actuators shall be designed to be self-locking upon loss of power. Motor shall be designed to close in 30 secs. from full open position and shall have adequate capacity to open and close under full unbalanced design pressure.

The actuators shall be flange mounted to valve bonnets or with gearing and disengaging hand wheel for dampers.

The position and torque measurement technology to be used must be latest, reliable and accurate and shall use approved and proven technology.

Each motor actuator shall have four (4) position limit switches with two for open each with 2 NO + 2NC contacts and two for closed each with 2 NO + 2 NC contacts positions, each with adjustable setting between fully open and fully closed positions. The limit switches shall have capacity of 5A at 240V AC or 0.55A at 250V DC (resistive).

Each motor actuator shall also have two (2) torque limit switches with two (2) normally opened and two (2) normally closed contacts each.

The torque switches shall have a minimum accuracy of 3% of set value. The torque switches shall be provided with calibrated knobs for setting desired torque and separate knobs shall be provided for open and close torque switches. The torque and position limit switches shall be housed in a separate enclosure with protection class as that of actuator.

The motor operators/actuators shall conform to AWWA specification and shall be capable of meeting 150 percent of unseating torque at specified voltage.

The actuator with integral starter shall be provided with Local – off – remote selector switch with local push button for open and - off – close operation. The running direction LED's shall be provided.

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The power and control cable connection shall be by plug and socket connector for actuators with power cable size upto 4 Sq.mm. The actuators with power cable size more than 4 Sq.mm shall be with Terminals connection arrangement for power and control cable connection.

The motor actuators for inching and regulating duty shall have electronic position transmitter with 4 to 20 mA output, suitable for two wire system and shall be provided by 24V DC from DDCMIS or PLC System.

Motor actuators shall be provided with clearly visible local position indicators mounted on the operator assembly itself. Suitable transducers shall be provided for remote indication of the position.

Hand wheel shall enable manual operation in case of power failure but it shall get automatically disengaged when once the motor starts functioning. The effort required to operate manually shall not exceed 18 Kg.

Torque switches shall function to stop the motor on closing. Upon actuation by the torque clutch it is restricted its attempt to open or close, thereby causing an overloading torque. Torque switches shall be non-self resetting type only (i.e.) once a particular direction torque switch operates, it will get resettled only when the equipment is operated in other direction.

All six (6) limit switches shall be changeover type and adjustable besides having the snap facility. All limit switches, contacts shall be wired up independently upto the terminal block. Provision of necessary space heater shall also be made with servomotor limit switch compartments. The space heaters shall be suitable for operation at 240V AC and its rating shall be indicated by the tenderer. Space heater circuit shall be complete with thermostat.

The terminals, terminal boards, terminal boxes, winding coils and associated equipments shall be suitable for connection to supply system having short circuit capacity specified in data sheet and clearance time determined by associated fuses. The terminal boxes shall be totally enclosed.

All wiring connections for various limit and torque switches, space heaters, position transmitters shall be brought out on separate terminal boards mounted on the valve, having liberal space for wiring and making connections to Purchaser's external circuits. There shall be atleast 5 terminals spare to terminate spare cores of cable. Size of each control terminal shall be such that two (2) nos. lugged 2.5 sq.mm cable can be terminated on each side. Power terminals shall be suitable for termination of 6 sq.mm lugged wire or as required depending on the motor capacity.

Motor terminal box and actuator terminal box shall be provided with cable glands to suit cable type and size.

Adequate earthing terminals preferably not less than 8 SWG GI wire shall be provided for suitable earthing system. Two earthing terminals shall be provided per motor; one no. each on either side of the motor.

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7.00.00 TEST

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

Following routine test shall be conducted as per IEC/IC standard. (a) Meggar Test, (b) Continuity test, (c) Functional test. Test certificates duly signed by inspecting agency shall be furnished for all actuators.

The actuator shall be type tested as per IEC/National Standard, by international/national recognized test house. The test certificates issued by this house shall be furnished.

The Type test certificates for the following tests shall be submitted for similar type of actuators

- i. Endurance test as per GDCD or any International Std.
- ii. Damp heat cycle test as per IS 12075
- iii. Noise test as per IS 12065
- iv. Enclosure protection test as per IS 13947
- v. Tests on micro switches
- vi. Motor performance test
- vii. Test for plug connectors

8.00.00 DRAWINGS, DATA & MANUALS

8.01.01 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.

8.01.02 To be Submitted after Award of Contract

- a) Actuator Data Sheet
- b) Internal wiring diagram and suggested control schematic
- c) Torque switch and limit switch contact development
- d) Manufacturer's Catalogue
- e) Instruction manual indicating clearly the installation methods, check ups and tests to be carried out before commissioning of the equipment.

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8.02.00 The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.

9.00.00 NAME PLATE

Nameplate shall be provided on the actuators with at least following data (a) Tag no. (b) Torque rating (c) Full travel time.

10.00.00 PAINTING

The actuator shall be painted with Siemens Gray RAL 7032.

11.00.00 PACKING

The actuators shall be properly packed for transport by rail/ road/sea as applicable.

12.00.00 ACTUATOR DATA SHEET

The Bidder shall furnish the information in a format of actuator data sheet, which is enclosed in Volume –III, Schedule –B2 of Technical Specification.

13.00.00 OVERLOAD PROTECTION

The actuator motor shall be provided with integral starter along with thermistor for overload protection.

TECHNICAL DATASHEET - ACTUATOR

Sl.No.	Description		
1	Type	:	Integral starter type
	Controls	:	
			Local / off / remote
		-	Open/off/close P.B with indication lamp
		-	LED's for running direction
		-	Reversing contactors
		-	Selector switch
		-	Push buttons & indicating lamps
		-	Thermal overload relay
		-	DC relay for remote operation
		-	Remote annunciation relay for supply indication
2	Motor	:	
	Voltage	-	415V, 50 Hz
	Permissible voltage variation	-	± 10 %
	Permissible frequency variation	-	±5 %
	Mounting	-	C Type Flange, B14, IS 2223
	Enclosure protection (complete assembly)	-	IP 68
	Type of cooling		Surface cooled
	Insulation class	-	F class, IS 325 (Max temp rise 140 °C)
	Starting		Direct on line
3	Type of Duty		To suit service condition
	Motor protection	-	Thermo switch
	Position Limit switches (Micro switches)	:	Open – Two nos. each with 2NO + 2NC
			Close- Two nos. each with 2NO + 2NC
	Torque switches	:	Open – One no. each with 2NO + 2NC
			Close- One no. each with 2NO + 2NC

	Micro switch contact rating	:	5A at 250V AC 0.25A at 250V DC (resistive)
4	Position Transmitter (for inching and regulation duty)	-	Non contact type with 4 to 20mA output powered from DDCMIS/PLC suitable for 2 wire system.

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

FOR

LV MOTORS

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

	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
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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	

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.

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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

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.

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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.	
4.9	General	

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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.		

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LT MOTORS

A. GENERAL

1. Manufacturer & Country of origin.
(Shall be as per approved QA make)
2. Equipment driven by motor
3. Motor type
4. Quantity

B. DESIGN AND PERFORMANCE DATA

1. Frame size
2. Type of duty
3. Type of enclosure /Method of cooling/Degree of protection
4. Applicable standard to which motor generally conforms
5. Efficiency class as per IS 12615
6. (a) Whether motor is flame proof Yes/No
(b) If yes, the gas group to which it conforms as per IS:2148
7. Type of mounting
8. Direction of rotation as viewed from DE END
9. Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)
10. Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)
11. Maximum continuous load demand of driven equipment in KW
12. Rated Voltage (volts)
13. Permissible variation of :

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- a. Voltage (Volts)
 - b. Frequency (Hz)
 - c. Combined voltage and frequency
14. Rated speed at rated voltage and frequency(RPM)
15. At rated Voltage and frequency:
 - a. Full load current
 - b. No load current
16. Power Factor at
 - a. 100% load
 - b. NO load
 - c. Starting.
17. Efficiency at rated voltage and frequency,
 - a. 100% load
 - b. 75% load
 - c. 50% load
18. Starting current (amps) at
 - a. 100 % voltage
 - b. 85% voltage
 - c. 80% voltage
19. Minimum permissible starting Voltage (Volts)
20. Starting time with minimum permissible voltage
 - a. Without driven equipment coupled
 - b. With driven equipment coupled

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21. Safe stall time with 100% and 110% of rated voltage
 - a. From hot condition
 - b. From cold condition
22. Torques :
 - a. Starting torque at min. permissible voltage(kg-mtr.)
 - b. Pull up torque at rated voltage.
 - c. Pull out torque
 - d. Min accelerating torque (kg.m) available
 - e. Rated torque (kg.m)
23. Stator winding resistance per phase (ohms at 20 Deg.C.)
24. GD^2 value of motors
25. No of permissible successive starts when motor is in hot condition
26. Locked Rotor KVA Input
27. Locked Rotor KVA/KW
28. Vibration limit :Velocity (mm/s)
29. Noise level limit (dBA)

C. CONSTRUCTIONAL FEATURES

1. Stator winding insulation
 - a. Class & Type
 - b. Winding Insulation Process
 - c. Tropicalised (Yes/No)

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- d. Temperature rise over specified maximum ambient temperature of 50 deg C
 - e. Method of temperature measurement
 - f. Stator winding connection
2. Main Terminal Box
 - a. Type
 - b. Location (viewed from NDE side)
 - c. Entry of cables(bottom/side)
 - d. Recommended cable size (To be matched with cable size envisaged by owner)
 - e. Fault level (MVA), Fault level duration (sec)
 - f. Cable glands & lugs details (shall be suitable for power cable)
3. Type of DE/NDE Bearing
4. Motor Paint shade
5. Weight of
 - a. Motor stator (KG)
 - b. Motor Rotor (KG)
 - c. Total weight (KG)

D. List of accessories.

1. Space Heaters (Applicable for 30 KW & above motor)
(Nos./Power in watts/supply voltage)
2. Terminal Box for Space Heater (Yes/No)
3. Speed switch (Yes/No)
No of contacts and contact ratings of speed switch

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4. Insulation of bearing (Yes/No)

5. Noise reducer(Yes/No)

6. Grounding pads

i) No and size on motor body

ii) Nos on terminal Box

7. Vibration pads

i) Nos and size

ii) Location

8. Any other fitments

E. List of curves.

1. Torque speed characteristic of the motor

2. Thermal withstand characteristic

3. Starting. current Vs. Time

4. Starting. current Vs speed

5. P.F. and Effi. Vs Load

F. Additional Data to be filled for each rating of DC Motor

1. Rated armature voltage (Volt)

2. Rated field excitation (Amp)

3. Permissible % variation in voltage

4. Minimum Permissible Starting voltage (volt)

5. At rated voltage

i) Full load Armature current.(Amp)

ii) Full load Field current (Amp)

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- iii) No load Armature current (Amp)
6. Full load Field current (Amp)
7. No load Armature current (Amp)
8. Minimum permissible field current(Amp) to avoid overspeeding at
 - i) Maximum permissible voltage
 - ii) Rated voltage
 - iii) Minimum Permissible Voltage
9. Resistance (indicative Values) in ohm
 - i) Armature winding (Arm + IP + Series) at 25 deg.C
 - ii) Field Winding at 25 deg. C
10. Inductance (indicative values)
 - i) Armature winding
 - ii) Field winding
11. Value of trimmer resistance (ohm) to be connected in series with the shunt field to obtain rated speed at
 - i) 220 V DC
 - ii) 250 V DC
 - iii) 187 V DC
12. Value of the external resistance (ohm) required to be connected in series with armature during starting only
13. Technical data sheet for external resistance box
14. GA drawing of motor
15. Starting time calculation

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16. Starter resistance design calculation
17. Electrical connection diagram of motor

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SPECIFICATION- E24

HV & LV POWER CONTROL CABLE

1.00.00 SCOPE OF SUPPLY

1.01.00 HV, LV Power and Control Cables ,special cables shall cover the requirement of entire plant including outside coal jetty area & sea water intake pump house . The cables shall be furnished in accordance with this specification and annexure.

Other cables including special cables if any which are necessary as per proven engineering practice for satisfactory & trouble free operation of the entire cable system of the entire plant area shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and subsystems.

1.02.00 Cable shall be furnished in accordance with this specification and the following annexures :

- a) 11 kV & 3.3 kV Power cables : Annexure - A
- b) 1100V Power Cables : Annexure – B
- c) Control Cables : Annexure – C
- d) Flexible Trailing cable : Annexure – D
- e) Fire Survival Cables : Annexure – E & F

1.03.00 All relevant drawings, data and instruction manuals.

2.00.00 CODES & STANDARDS

2.01.00 All cable and materials shall be designed, manufactured and tested in accordance with the latest editions including all applicable amendments of relevant Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.02.00 Cable and material conforming to any other standard which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

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IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS:7098(Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.
IS:7098 (Part -II)	Cross linked polyethylene insulated PVC sheathed cable for working voltage from 3.3 KV upto & including 33 KV.
IS:9968, Part I	Specification of Elastomer Insulated cables for rated voltages upto and including 1100V
IS:6380	Specification of elastomeric insulation and sheath of electric cables
IS : 3961	Recommended current ratings for cables
IS : 3975	Low Carbon Galvanized steel wires, formed wires and tapes for armouring of cables.
IS : 4905	Methods for random sampling.
IS : 5831	PVC insulation and sheath of electrical cables.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS: 5608	Specification for low frequency wires and cables with PVC insulation and PVC Sheath.
IEC:502	Extruded solid dielectric insulated power cables for rated voltages from 1.00 kV upto 30 kV
IEC:287	Calculations of the continuous current rating of cables(100% load factor)
IEC:228	Conductors for insulated cables
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
ASTM-D-2863	Standard method for measuring the minimum oxygen concentration to support candle like combustion of plastics.
IEC-754 (Part-I)	Test on gases evolved during combustion of electric cables.
IEEE-383	Standard for type test of Class IE Electric Cables.
IEC -332	Tests on Electric cables under fire conditions. Part-3 : Tests on bunched wires or cables (category -B)
IEC: 60	High voltage test techniques
IEC: 230	Impulse tests on cables and their accessories
IEC-331	Fire resisting characteristics of electric cables
NEMA-WC-5	Thermoplastic insulated wires and cables for transmission and distribution of electrical energy.

IEC: 540	Test methods for insulations and sheaths of electric cables and cords (elastomeric and thermoplastic compounds)
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3.00.00 **DESIGN CRITERIA**

3.01.00 Cables will be generally laid on ladder type trays, perforated type cable trays or drawn through rigid steel conduits.

3.02.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification which one is more stringent.

3.03.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.

3.04.00 Armouring shall be single round wire of galvanized steel for multicore cables and aluminum for single core cable for power and control cables. For fire survival control cable, the armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date. For Fire survival power cable, Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire, for multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.

3.05.00 The inner & outer sheath shall have flame retardant low smoke halogen evolution (FRLSH) characteristics or fire survival characteristics as applicable and shall meet the requirements of additional tests specified for the purpose.

3.06.00 Core identification for multicore cable shall be provided by colour coding.

3.07.00 HT cables shall be manufactured by triple extrusion dry cured (CCV) process using pressurized nitrogen.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **General Description**

All Cables shall be furnished in strict compliance with ratings and requirements and sizes as given in Annexures to this Specification.

4.02.00 **Drum Length and Tolerance**

The cables shall be supplied in non-returnable packing steel drum for 11 kV & 3.3 kV power cables, wooden drums for 1100V power and control cables, each containing minimum 500 meters single length of larger sizes of cable unless specifically asked for. For smaller sizes of cables, each drum shall contain minimum 1000 meters single length of cable. Allowable tolerance on individual drum length is $\pm 5\%$.

4.03.00 **Non-Standard Length**

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Owner/Purchaser may accept non-standard lengths upto 5% of the total ordered quantity. However the Contractor will be required to obtain Owner's/ Purchaser's approval before packing the Cables on drums. Non-standard lengths shall not be less than 100 metres in any case.

4.04.00 **Cable identification**

Cable identification shall be provided by embossing on every meter on the outer sheath the following :

- a) SEPC
- b) Manufacturer's name or trade mark
- c) Voltage grade
- d) Year of manufacture
- e) Type of insulation, e.g. XLPE/PVC/HR85 /IE2 etc.
- f) Number of core and size of cables.
- g) Type of improved fire performance, e.g. FR/FR-LSH/FS
- h) IS number
- i) Non-erasable sequential cable length marking at an interval of 1 (one) meter throughout the drum length.
- j) ISI mark.

4.05.00 **Packing**

4.05.01 Cables shall be supplied in non returnable drums. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum shall be treated by immersing in copper-nitrate solution. Drum number shall be indicated on cable drum.

4.05.02 Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment. Heat shrinkable seal shall be used for this cable ends.

4.05.03 The cable drums should carry the following details in printed form :

- a) SEPC
- b) Manufacturer's name or trade make
- c) Type of cable & voltage grade

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- d) Year of manufacture
- e) Type of insulation e.g. XLPE/HRPVC/IE2
- f) Number of core and size of cables
- g) Cable code e.g. FRLS/FS
- h) Single Length of cable on drum
- i) Direction of rotation, by arrow
- j) Approx. gross mass.
- k) IS/IEC number and ISI mark

4.06.00 **Joints and Terminations**

Materials of construction for a joint/termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations shall have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements. Straight through joints and terminations for HT cables shall be heat shrinkable type.

4.07.00 **Selection Criteria**

- 4.07.01 a) HT and LT power cables shall be selected on the basis of current carrying capacity, short circuit rating and permissible voltage drop.
- b) While sizing power cables, following aspects shall also be considered:
 - i) Ground/Ambient Air temperature
 - ii) Depth of Laying.
 - iii) Power Cables touching each other.
- c) Cables for Circuit breaker controlled feeders shall withstand short circuit current for the fault clearing time of 0.2 sec. The tie feeders shall be sized for 1 sec. Outgoing feeders where only IDMTL is provided, one sec shall be considered for cable sizing
- d) For fuse protected circuits the conductor size shall depend upon full load current subject to voltage drop limited to 3% during running of all feeders and 15 % during starting for motor feeders with rigid coupling. For motors with fluid coupling the starting voltage drop can be considered as 20%. In addition, transformer regulation shall also be considered for loads fed from 415V PCC / PMCC.

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- e) For loads fed from local panels, the total running voltage drop in cable from 415V PCC / PMCC to local panel and from local panel to individual motor shall be limited to 3% at full load motor current while the same during starting shall be limited to 15%.
- f) As per national electric code (NEC) current rating capacity of I/C & motor feeder/cables should be 125% of full load current.
- g) For welding receptacle, Flap Gate and Rack & Pinion Gate 3% running drop shall only be considered.

The minimum sizes of L.T cable to be chosen are as below:

AL - 16 mm² (3 core) & 6mm² (2 core) Cu - 2.5 mm² (3 core)

Minimum cable sizes for various motor ratings:

Motor Ratings	Cable Size
0 – 5.5 KW	3/C-2.5 / 4 / 6 / 10 mm ² Cu. As per voltage drop.
5.6 – 11 KW	3/C - 16 mm ² Al
11.1 – 22 KW	3/C – 35 mm ² Al
22.1 – 45 KW	3/C – 95 mm ² Al
45.1 – 75 KW	3/C – 185 mm ² Al
75.1 – below 90 KW	2x3/C – 185 mm ² Al

Note: 1. For incomer 220V DC supply to HT & LT switchgear and protection panels minimum sizes of F.S. cable shall be 6 sq.mm.

2. If required by cable sizing calculations which shall include appropriate derating, continuous current considering permissible voltage variations, short circuit rating, and voltage drops etc the higher sizes shall be provided.

3. Wherever the termination of Aluminium cable is not possible due to size of motor terminal box, the copper cable shall be provided.
While calculating full load of the LT board's provision is to be made for auxiliary change over/trial after maintenance of auxiliary, considering highest capacity auxiliary.

Also 20% feeders are kept spare for future loads on each LT board. Provision is to be made for these 20% future loads while sizing the incomer cable size.

- 4.07.02 Apart from above, consideration shall also be given to limit the cable to some standard sizes instead of using too many types.
- 4.07.03 The standard cable sizes, amp capacities, derating factors. as given in IS/IEC will be generally followed.
- 4.07.04 a) For breaker protected circuits minimum size of the cable shall be as follows:

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1100V Power : 240 Sq mm XLPE

11000V & 3300 V Power : 240 Sq mm XLPE

- b) For motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly following a second hot start.

4.07.05 For fuse protected circuit, the conductor size will depend on full load current subject to voltage drop not exceeding 3%. For practical purposes, the minimum size chosen is as below :

a) Aluminium : 16 Sq mm.

b) Copper : 2.5 Sq mm.

4.07.06 All control cables shall be 2.5 Sq mm copper cable.

4.07.07 Multicore control cables will generally have spare conductor (s) in accordance with the following chart :

Conductors required	Cables
1 or 2	1-3/C
3 or 4	1-5/C
5 or 6	1-7/C
7 or 8	1-9/C
9 or 10	1-12/C
Above 10	Two or more of above cables

4.07.08 Separate cables for each type of following services/functions as applicable shall be used for each feeder. Same multicore cable using different services shall not be acceptable.

- a) Power.
- b) Control, interlock and indication.
- c) Metering and measuring.
- d) Alarm and annunciation.
- e) C.T. Cables.
- f) V.T. Cables.

4.08.00 **Cable Identification**

Cable identification shall be provided by embossing on the outer sheath the following:

- a) SEPC
- b) Manufacturer's name or trade mark
- c) Voltage grade
- d) Year of manufacture
- e) Type of insulation, e.g. XLPE, HRPVC & IE2 etc.
- f) Number of core & size of cables
- g) Type of outer sheath e.g. FRLSH, FS etc.
- h) Reference standard & ISI mark.
- i) Non-erasable sequential cable length marking at an interval of 1 (one) meter throughout the drum length.

4.09.00 Selected sizes of power and control cables are given in Annexure-G

4.10.00 Fire Survival Cables shall be used for important auxiliaries / area as recommended by Standard Technical Specification by CEA as below for the following :

Fire Survival Power & Control Cables shall be used for important auxiliaries of BTG/areas like-

- i. DC emergency lube oil pump
- ii. DC hydrogen seal pump
- iii. Turbine lube oil pump/barring gear
- iv. DC emergency lighting for main building and service building
- v. DC cables for battery to charger & DC distribution boards
- vi. Jacking oil pump
- vii. Emergency turbine trip in control room
- viii. Boiler, Turbine, Generator inter trip which include the interconnection between
 - Boiler master fuel trip and turbine trip relays
 - Generator trip relays & turbine trip relays
 - Generator trip relays & generator breaker
 - Generator trip relays & field breaker
 - Generator trip relays & unit auxiliary transformer breaker
 - Incomer cables for DG board, emergency board, DC lighting

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board etc.

Also Fire Survival Power & Control Cables shall be used for important auxiliaries/areas like:

- i) DC cables for battery to charger & DC distribution boards and downstream of DCDB cables.
- ii) Incomer cables for DG board, emergency board, DC lighting board etc.
- iii) 220V DC - incomer cable for protection and control purpose to HT & LT switchgear minimum size should be 6 sq.mm FS copper.

5.00.00 TESTS

5.01.00 Shop Tests

The Cables shall be subject to shop tests in accordance relevant IS/IEC standards to prove the design and general qualities of the Cables as below :

5.01.01 Routine tests on each drum of cables.

5.01.02 Acceptance Tests on 1 drum out of every 10 or less number of drums chosen at random for acceptance of the lot for every type and size of cable.

5.01.03 Type test on each type and size of cable, inclusive of measurement of armour DC resistance of power cables. On one sample cable drum selected on random basis in each lot. Size of cable shall be read in sq.mm. in conjunction with number of cores. Type of cable shall mean voltage grade, XLPE, HRPVC, FRLS, FS etc.

5.02.00 Additional Tests

Following additional type & acceptance tests shall also be performed on each type of cables having inner & outer sheath with improved fire performance (Type FRLS, FS)

5.02.01 Oxygen index test

The Oxygen index shall not be less than 29.

5.02.02 Temperature Index Test

The measured value of temperature index shall be 21 at a temperature of 250°C for FRLS cables and 350°C for FS cables

5.02.03 Flame Retardance test on single cable and on bunched cables

After the test, there should be no visible damages on the test specimen within 300mm from its upper end.

After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable

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assembly. 3 Hours fire rating test shall be carried out for FS cable as per IEC331

5.02.04 **Halogen acid gas evolution test**

The level of HCL evolved shall not exceed 20 per cent by weight. HCL evolved shall not be exceed 2% for FS cable.

5.02.05 **Smoke density test**

The cables shall meet the requirements of light transmission of minimum 40% after the test. Minimum transmission shall be 80% for FS cable

5.02.06 **Test for specific optical density of smoke**

The cables shall meet the requirements of IS/IEC.

5.02.07 **Test for rodent & termite repulsion property**

The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.

Flammability test shall be carried on finished cables as per following standards:

- a) Swedish Chimney test – SS:424-14-75 (as indicated in Annexure-H)
- b) IEEE std.383 – 1974 latest
- c) IEC std. 332-1 and IEC 331

5.03.00 **Test Witness**

Tests shall be performed in presence of Owner/Purchaser's representative. The Contractor shall give at least thirty (30) days' advance notice of the date when the tests are to be carried out.

5.04.00 **Test Certificates**

5.04.01 Certified reports of all the tests carried out at the works shall be furnished for approval of the Owner/Purchaser.

5.04.02 Test reports shall be completed with all details and shall also contain IS/IEC specified limit values, wherever applicable, to facilitate review.

5.04.03 The cables shall be dispatched from works only after receipt of Owner/Purchaser's written approval of the test reports.

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6.00.00 DRAWINGS, DATA & MANUALS

6.01.00 Drawings, Data and Manuals shall be submitted with the bid and for approval/ reference and subsequent distribution after the issue of Letter of Intent in quantities and procedures as specified in General condition of contract and/or elsewhere in this specification.

6.02.00 To be submitted with the Bid

- a) Manufacturer's catalogues giving cable construction details and characteristics.
- b) Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.
- c) Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables.
- d) Type test reports on 11 KV, 3.3 KV Power, LT FRLSH Power & control, FS power and control cables
- e) Filled-up proposal particulars.

6.03.00 To be submitted after award of contract

6.03.01 Guaranteed Technical Particulars

6.03.02 Quality assurance plan

6.03.03 Shop Test reports

6.03.04 Instruction manuals

The manual shall clearly indicate method of laying, termination, check-ups and tests to be carried out before commissioning.

6.04.00 The bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, information, etc required to fully describe the cable are to be submitted with the bid.

RATINGS AND REQUIREMENTS (POWER CABLE)

11 KV & 3.3 KV Power Cable

- 1.0 11000/11000V & 3800/6600V grade 90⁰ C continuous rating under normal condition and 250⁰ C rating under short circuit condition heavy duty XLPE power cable suitable for use in 11000V & 3300V non-effectively earthed system conforming to following requirement and in line with IS-7098, IS-8130, IS-5831 & IS-3975 ,manufactured by Triple Extrusion Dry Cure(CCV) process using pressurized Nitrogen.
- 1.1 Conductor : Stranded and compacted circular aluminium conductor of grade H2 & class 2 for all sizes, generally conforming to IS:8130.
- 1.2 Conductor Screen : Extruded semi-conducting compound.
- 1.3 Insulation : Extruded cross linked polyethylene (XLPE) conforming to IS7098 (Part-2)
- 1.4 Insulation Screen : Extruded semi-conducting compound in combination with a layer of lapped copper tape of thickness not less than 0.1mm. For single core armoured cables, the armouring shall constitute the metallic part of screening. The semi-conducting tape shall be easily strippable.
- 1.5 Core Identification : By coloured strips applied on (For three core cables) cores or by numerals.
- 1.6 Inner Sheath : Extruded HRPVC FRLS compound conforming to type ST2 of IS: 5831 for three core cables. Single core cables shall have inner sheath. Filler material shall also be of type ST2 PVC.
- 1.7 Armour: Galvanised single round steel wire armour for twin and multicore cables.

Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables.
- 1.8 Overall Sheath : Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
- 1.9 Drum : Steel Drum

1100V LV POWER CABLE (XLPE TYPE)

- 1.0 1100 V grade, 90° C continuous rating under normal condition and 250°C under short circuit condition rating, XLPE heavy duty, power cable conforming to following requirement and in line with IS 7098 Part-I. IS 8130 & IS 5831 and IS 3975.
- 1.1 Conductor : Stranded and compacted plain aluminium of grade H2 and class 2 stranded, high conductivity annealed plain copper for cable sizes upto 2.5 mm² conforming to IS:8130.
- 1.2 Insulation : Extruded cross-linked polyethelene (XLPE) conforming to IS:7098(Part-1)
- 1.3 Core Identification : By color coding
- 1.4 Inner Sheath : Extruded HRPVC FRLS compound conforming to type ST2 of IS:5831 for multicore cable. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2
- 1.5 Armour : Galvanized single round steel wire armour for twin and multicore cables.

Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables.
- 1.6 Overall Sheath : Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
- 1.7 Drum : Conforming to IS-10418 (Wooden drum)

CONTROL CABLES

- 1.0 1100 V grade 85° C continuous rating under normal condition and 160°C under short circuit condition rating HRPVC Control cable (YWW) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.
- 1.1 Conductor : Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
- 1.2 Insulation : Extruded HRPVC type-C compound conforming to IS: 5831. The minimum volume resistivity of insulation shall be 3.5×10^{14} ohm-cm at 27°C and 3.5×10^{11} OHM-CM at 85°C.
- 1.3 Core Identification : By color coding and numbering at interval of 100mm or less
- 1.4 Inner sheath : Extruded HRPVC compound conforming to type ST2 FRLS of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2.
- 1.5 Armour: : Galvanised single round steel wire for twin and multicore cables.
- 1.6 Overall sheath : Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
- 1.7 Drum : Conforming to IS: 10418 (Wooden drum)

FLEXIBLE TRAILING CABLE**i) 3300 V Unearthed Grade**

Flexible trailing cable, annealed plain copper conductor, Class-5 of IS-8130, insulated with EPR, conductor and insulation shielded with EPR, cores screened with ATC wire braiding, cores laid up, HD CSP inner sheathed, proof cotton taped and FRLSH HD CSP sheathed overall, conforming to IS:9968. Alternatively PCP sheathing may be acceptable.

ii) 1100 V Grade

1100 V Grade trailing cable shall be plain copper of Class-5 of IS-8130, heat resistant elastomeric compound based on EPR insulation, inner sheath of heat resistant elastomeric compound PCP sheath, nylon cord reinforcement and heat resistant, oil resistant and flame retardant heavy duty elastomeric compound FRLSH CSP outer sheath.

1.1KV GRADE COPPER CONDUCTOR FIRE SURVIVAL POWER CABLES

Fire Survival Power Cables shall be 90 deg C rating under normal condition & 250 deg C for under short circuit condition generally as per IS 9968 Pt-I latest, with 3 hr fire rating.

- 1.1 Conductor : Conductor shall be of stranded construction, consisting of high conductivity annealed plain copper wires conforming to Class-II of IS 8130.

A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.

- 1.2 Insulation : The insulation shall consist of heat resisting electrometric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS:6380/1984 amended up to date.

- 1.3 Laying up of cores (For multicore cables only) : The core shall be suitably identified in accordance with IS:9968 (Part-I).The suitable fire retardant material fillers shall be used for filling in the interstices. Two layers of plain glass fibre binder tape shall be applied over the laid up cores.

- 1.4 Inner Sheath : An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric(HOFR) compound of black colour conforming to Type SE-3 of IS – 6380/1984,ammended up to date, shall be provided over the laid up cores. This shall be provided even for single core cables after providing two layers of plain glass fibre tape over the insulation.

- 1.5 Armour : For Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire.For multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanised steel wire.

- 1.6 Outer Sheath : The extruded outer sheath shall be of special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision.

Minimum value of 'Tensile Strength' and 'Percentage elongation at rupture' shall be 8 Newton/sq.mm. and 250% respectively.

The colour of outer sheath shall be black or any other colour agreed mutually between Owner & supplier.

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1.1K V GRADE COPPER CONDUCTOR FIRE SURVIVAL CONTROL CABLES

Fire survival Control Cables shall be 90 deg C rating under normal condition & 250 deg C for under short circuit condition generally as per IS 9968 Pt-I latest, with 3 hr fire rating.

- 1.1 Conductor : It shall be of stranded construction, consisting of high conductivity annealed tinned copper conductors conforming to IS:8130 / 1984 amended upto date. A suitable heat barrier tape, preferably glass mica tape shall be provided over conductor.
- 1.2 Insulation : The conductor insulation shall consist of heat resisting elastomeric material EPR (Ethelene Propylene rubber) and shall conform to type IE-2 of IS:6380/1984 latest revision.
- 1.3 Laying up of cores (For multi-core cables only) : The core shall be suitably identified in accordance with IS:9968 (Part-I).The suitable fire retardant material fillers shall be used for filling in the interstices. Two layers of plain glass fiber binder tape shall be applied over the laid up cores.
- 1.4 Inner Sheath : An inner sheath of extruded very low halogen (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound of black colour or any other natural colour with prior approval from Owner conforming to Type SE3 of IS 6380 / 1984 amended upto date shall be provided over the laid up cores.
- 1.5 Armour : The armouring over inner sheath shall consist of single layer of wire / round galvanised steel wire as per IS 3975 amended upto date.
- 1.6 Outer Sheath : The outer sheath shall be of special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS:6380 latest revision.The colour of outer sheath shall be black or any other natural colour with prior approval of the Owner.

CABLE SIZES

Sl. No.	Cable Size	Conductor	Insulation
1.0	H. T. CABLES		
1.1	1 core 630 Sq.mm	AL	XLPE (FRLSH)
1.2	1 core 500 Sq.mm	AL	XLPE (FRLSH)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLSH)
1.4	3 core 300 Sq.mm	AL	XLPE (FRLSH)
1.5	3 core 70 Sq.mm	AL	XLPE (FRLSH)
2.0	L. T. POWER CABLES		
2.1	3 core 2.5 Sq.mm	CU	XLPE (FRLSH)
2.2	2 core 16 Sq.mm	AL	XLPE (FRLSH)
2.3	3 core 16 Sq.mm	AL	XLPE (FRLSH)
2.4	4 core 16 Sq.mm	AL	XLPE (FRLSH)
2.5	2 core 35 Sq.mm	AL	XLPE (FRLSH)
2.6	3 core 35 Sq.mm	AL	XLPE (FRLSH)
2.7	4 core 35 Sq.mm	AL	XLPE (FRLSH)
2.8	3 core 95 Sq.mm	AL	XLPE (FRLSH)
2.9	3.1/2 core 95 Sq.mm	AL	XLPE (FRLSH)
2.10	3 core 185 Sq.mm	AL	XLPE (FRLSH)
2.11	3.1/2 core 185 Sq.mm	AL	XLPE (FRLSH)
2.12	3 core 240 Sq.mm	AL	XLPE (FRLSH)
2.13	3.1/2 core 240 Sq.mm	AL	XLPE (FRLSH)
2.14	3 core 300 Sq.mm	AL	XLPE (FRLSH)
2.15	3.1/2 core 300 Sq.mm	AL	XLPE (FRLS)H
2.16	1 core 630 Sq.mm	AL	XLPE (FRLSH)
3.0	CONTROL CABLE		
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Sl. No.	Cable Size	Conductor	Insulation
3.1	2 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
3.2	3 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
3.3	5 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
3.4	7 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
3.5	9 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
3.6	12 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
3.7	20 core 2.5 Sq.mm	Cu.	HRPVC (FRLSH)
3.0	FS POWER CABLES		
3.1	3 core 2.5 Sq.mm	CU	EPR
3.2	2 core 16 Sq.mm	CU	EPR
3.3	3 core 16 Sq.mm	CU	EPR
3.4	4 core 16 Sq.mm	CU	EPR
3.5	2 core 35 Sq.mm	CU	EPR
3.6	3 core 35 Sq.mm	CU	EPR
3.7	4 core 35 Sq.mm	CU	EPR
3.8	3 core 95 Sq.mm	CU	EPR
3.9	3.1/2 core 95 Sq.mm	CU	EPR
4.0	FS CONTROL CABLE		
3.1	2 core 2.5 Sq.mm	Cu.	EPR
3.2	3 core 2.5 Sq.mm	Cu.	EPR
3.3	5 core 2.5 Sq.mm	Cu.	EPR
3.4	7 core 2.5 Sq.mm	Cu.	EPR
3.5	9 core 2.5 Sq.mm	Cu.	EPR
3.6	12 core 2.5 Sq.mm	Cu.	EPR

TEST PROCEDURES FOR MODIFIED SWEDISH CHIMNEY TEST

Modified Swedish Chimney Test :-

This test to be conducted to determine flame propagation along the surface of the cables.

A. Test Specimen Details:-

Three-test specimens are prepared from the drawn sample. Power Cables having overall diameter in the range of 20mm to 35mm preferably armoured, 4C, Al conductor are coated with the drawn sample all over the surface including the top and bottom cut faces in 2 or 3 coats to recommended thickness.

The length of the cables for each specimen shall be 850mm. On curing of the applied coating on the cables from the drawn samples the cables are tested in a Modified Swedish Chimney test set up one by one.

The Modified Swedish Chimney test set up consists as follows:

TEST CHIMNEY	:	Fabricated from GP/GI Sheet.
Thickness of Sheet	:	18 gauge
Length of Chimney	:	800mm
Diameter of Chimney	:	125mm
Windows	:	60mm long x 15mm wide along one vertical axis tangential to the surface of the chimney. Total 6 nos. equidistant.

The upper end is covered by an adjustable lid closed at the top.

B.FLAME SOURCE :

One Number LPG Bunsen Burner for obtaining a flame source that can give sufficient heat flux to achieve calibration temperature of the chimney as per chimney calibration procedure.

TEST DETAILS:

a. THE CALIBRATION OF THE CHIMNEY

The calibration of chimney is carried out to obtain a temperature of $250^{\circ}\text{C} \pm 5^{\circ}\text{C}$ at the 6th window from the bottom at the end of 3rd minute from the ignition time.

SPECIMEN TESTING :

The test is conducted by positioning the sample specimen one at a time inside the chimney in such a way that the lower end of the cable hangs about 50mm below the bottom end of the chimney. The tip of the burner position and gas flow to the burner is

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kept unchanged from the state. The chimney is cool down to normal condition after completion of the test for each sample specimen.

PASSING CRITERIA :

The sample specimen passes the test if there is no damage on the specimen with in 50% length out of 800mm, cable hung from the top in the Swedish Chimney. The time of exposure to flame is determined as per following formula i.e. $T = K + D/5$.

Where T = Time of exposure of test specimen to flame source(in minutes)

K= Constant (K=1 for single conductor cables and K=2 for Multi conductor cables.)

D = Overall diameter of coated cable.

The length of the cable damaged during the chimney test is measured for each test specimen tested.

Soot, changes in color, brittleness or cracks as well as marks from the fixing devices are not considered damages for coating materials.

IS:3324	Holders for starters for tubular fluorescent lamps.
IS:4013	Dust-tight electric lighting fittings.
IS:6616	Ballasts for high pressure mercury vapour lamps.
IS:8224	Electric Lighting fittings for Division 2 areas.
IS:9900	High-pressure mercury vapour lamps.
IS:9974	High Pressure Sodium vapour lamps.
IS:10276	Edison screw lamp holders.
IS:10322	Luminaires.
IS:13021	AC Supplied Electronic Ballasts for tubular fluorescent lamps.

4.01.02 **Lighting Panels, Switch-boxes, Receptacles and Junction Boxes**

IS:13947	Degree of protection provided by enclosures for low-voltage switchgear and control gear.
IS:1293	Plugs & socket outlets of rated voltage upto and Including 250volts & rated current upto and including 16 Amps.
IS:2551	Danger notice plates.
IS:13947	Low voltage switchgear and control gear
IS:3854	Switches for domestic and similar purposes.
IS:13703	Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto and including 1000 V AC and 1200V DC.
IS:13703	Low voltage fuses for voltages not exceeding 1000V AC or 1500 V DC.

4.01.03 **Conduits, Pipes and Accessories**

IS:2667	Fittings for rigid steel conduit for electrical wiring.
IS:3837	Accessories for rigid steel conduits for electrical wiring.
IS:9537	Conduits for electrical installations.

4.01.04 **Lighting Wires/Cables**

IS:694	PVC insulated cables for working voltages upto and including 1100 V
IS:3961	Recommended current ratings for cables (PVC Insulated and PVC sheathed heavy duty cables and light duty cables).
IS:8130	Conductors for insulated electric cables and flexible cords.
IS:10810	Methods of tests for cables.

4.01.05 **Electrical Installation Practices & Miscellaneous**

8.15	Code of practice for phosphating iron & steel	IS 6005
8.16	Wrought aluminium and aluminium alloys for electrical purposes	IS 5082

7.03.00 The following miscellaneous equipment are to be supplied:

- I. Local push button stations
- II. Junction boxes (JBs)
- III. Danger boards
- IV. Rubber mats.

7.04.00 **LOCAL PUSH BUTTON STATIONS (LPB)**

7.04.01 Local push button station shall be provided for all the drive motors of the plant (415V motors and 3.3 kV motors) (start stop push buttons for all motors; only start push button for emergency motors).

7.04.02 The degree of protection of LPBs shall be IP55 with canopy for outdoor and IP54 for indoor applications.

7.04.03 All PBs shall be push to actuate type and the stop PB shall be lockable in off position.

7.04.04 All push buttons shall be provided with 2 nos. NO and 2 nos. NC contacts for various interlocking purposes. One contact of stop PB shall be directly wired to the switchgear module for direct tripping and another contact to the control system.

7.05.00 **JUNCTION BOXES (JBs)**

Junction boxes as required for the power plant shall be supplied. The JB's used in outdoor areas shall be of weatherproof type. Sheet steel thickness of the JB's shall be minimum 2 mm; the sheet steel shall be hot dip galvanised.

7.05.01 Junction boxes/marshalling boxes (JB/MB) shall be provided to enable running large core cables from/to control panels, terminal cabinets, etc. Junction boxes shall be used for marshalling each CT/CVT core from the switchyard CTs/CVTs so as to use 4 core cables from JB to the relay panels/ control panels. In case of 400 kV/220KV CTs, CVTs & EMVTs, marshalling boxes shall form part of the respective equipment package.

7.05.02 Danger boards shall be provided in line with statutory requirements.

7.05.03 Rubber mats shall be provided to meet the safety and other statutory requirements.

8.00.00 **DRAWINGS, DATA & MANUALS**

8.01.00 To be submitted after Award of Contract

- a) Outline dimensional drawings showing general arrangement, space requirements and bus duct/cable entry points.

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5.02.06 Equipment ground connections, after being checked and tested by the Engineer, shall be coated with anti-corrosive paint.

5.02.07 Whether specifically shown or not, all conduits, trays, cable armour and cable end box, electrical equipment such as motors, switchboards, panels, cabinets, junction boxes, lockout switches, fittings, fixtures, etc. shall be effectively grounded.

5.02.08 If there is no provision to ground the L.T. transformer neutral at transformer end, to make an effectively earthed 415V system the neutral bus of all 415V distribution boards shall be connected to ground grid at two different and distinct points.

5.02.09 The underground mat will be made of mild steel rods laid underground in length and breadth of the area at a depth shown in drawing but not less than 1 metre below grade level. All crossings and straight run shall be arc welded for good electrical continuity. Ground conductors, when crossing underground trenches, directly laid underground pipe and equipment foundation, if any, shall be at least 300 mm below the bottom elevation of such trenches/pipes as shown in the relevant drawing.

The Contractor will plan and organise works to lay the grounding mat in the same sequence in which the building and equipment foundation is being done.

5.02.10 Ground Electrode

Ground electrodes will be 40 mm(min) dia and 3 metre long M.S. rod. These are to be fabricated and driven into the ground by the side of mat conductor. All connections to the conductors shall be done by arc welding process.

5.02.11 Risers

Risers are required for connecting the equipment and structures with the ground mat. These will be 1 Number 40 mm (min) dia M.S. rod, laid from ground mat to above ground level properly clamped or supported along the outer edge of the concrete foundation. Connection to the ground mat shall be done by arc welding and the other end is to be kept free at least 300 mm above grade level/concrete floor level.

5.02.12 Column Grounding

All columns are required to be grounded by 1 number 40 mm(min) dia M.S. rod from ground mat. Laying, supporting along with foundation, connecting at ground mat are within the scope of this specification. At least 300 mm length of the above rods shall be left free above the grade level/concrete floor level for connection with columns.

5.03.00 Painting

5.03.01 The Contractor shall paint steel fabrications at site with two (2) coats of red oxide primer and two (2) coats of battleship grey (shade number 632 of IS:5) synthetic enamel paint.

- 2.05.04 Miscellaneous devices such as junction boxes, pull boxes, pushbutton stations, lockout switches, cable end boxes, lighting fixtures, receptacles, switches etc. shall be effectively grounded whether specifically shown or not.
- 2.05.05 The Diesel generator neutrals, transformer neutrals, earthing terminals of lightning arrestors, coupling capacitor shall be directly connected to Pipe Earth Electrode which in turn shall be connected to station grounding mat. Pipe Earth Electrode shall be 100 NB, 3000 mm long heavy duty C.I. Pipe. Treated Earth Pits shall be provided for Diesel Generator & transformer neutral earthing.
- 2.05.06 Grounding mat comprising closely spaced conductors shall be provided below the operating handles of isolator and circuit breaker operating box located in outdoor high voltage substation. The operating handles shall be properly bonded with flexible conductors.
- 2.05.07 Metallic conduits and pipes shall not be used as earth continuity conductor. These shall be grounded at both ends.
- 2.05.08
- The cable trays inside the cable trenches shall be grounded thru' one (1) number 40 mm (min) dia M.S. Rod at an interval of ten (10) metres. One end of this rod is connected with riser from grounding mat and the other end which is projected inside the cable trench shall be connected with one (1) 75x10 mm G.S. flat which runs horizontally along the cable trench. This earthing conductor shall be securely attached to each tray section of cable tray/trays forming a solidly grounded tray system through 75x10 mm G.S. flats.
 - A continuous 75x10 mm G.S. flat earthing conductor shall run along the supporting structure of overhead cable trays/cable shafts. This earthing conductor shall be attached to each section of cable tray/trays through 75x10 mm G.S. flats.
- 2.05.09 Fence within the ground grid shall be bonded to the plant ground system at regular interval not exceeding ten (10) metres. Fence gate shall be separately grounded with flexible connection to permit movement.
- 2.05.10 The street lighting poles, junction boxes mounted on the poles etc. shall be connected to ground grid at minimum two points.
- 2.05.11 The steel columns, metallic stairs, hand-rail etc. of the building where electrical equipment are located shall be connected to the nearby ground mat by earthing conductor. Electrical continuity shall be ensured by bonding the different sections of handrails and metallic stairs.
- 2.05.12 The railway tracks within plant area shall be bonded across fish plates and the rail tracks shall be connected to grounding grid at different locations. The rail tracks leaving the plant boundary shall be made electrically discontinuous from the rail tracks inside the plant area by providing suitable arrangements at fish plate joints.
- 2.05.13 The overhead crane rails shall be grounded at both ends. In addition all joints shall be bonded to provide electrical continuity.

6.12.00 Special Requirement

- 6.12.01 All outdoor illumination fixtures, unless it is fed from photo cell/time switch controlled lighting panel, has to be provided with outdoor type local switches.
- 6.12.02 In all the air filtration units and air handling units, one marine type lamp (of 100 Watt approx.) shall be supplied and the wiring & fixing of the same has to be done by the contractor.

6.13.00 Lighting Cables & Wires

- 6.13.01 Lighting Cable shall be heavy duty, 1100 Volt grade, multicore stranded aluminium conductor, XLPE insulated, extruded PVC inner sheath, single round G.I. wire armoured and overall PVC sheathed with FRLSH conforming to IS 1554.

- 6.13.02 Lighting wires shall be 1100 Volt grade, PVC insulated, stranded conductor, single core cable conforming to IS 694, colour coded as below :

RED	for	R-Phase	BLACK	for	Neutral
YELLOW	for	Y-Phase	WHITE	for	+Ve D.C.
BLUE	for	B-Phase	GREY	for	-Ve D.C.

- 6.13.03 Wire size shall be as follows :

For point wiring beyond lighting panel : 10 Sq.mm. Aluminium.
i.e from lighting Panel to junction
box (main run) Stranded conductor

From Junction box to lighting fixture : 2.5 Sq.mm. Copper.
Stranded conductor.

6.14.00 Conduits and Accessories

- 6.14.01 Conduits shall be rigid steel, hot-dip galvanised, furnished in standard length of 3 metres, threaded at both ends.
- 6.14.02 Thickness of conduits up to and including 25 mm dia shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 20 mm.
- 6.14.03 Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushings at both ends.
- 6.14.04 Flexible conduits shall be made with bright, cold rolled annealed and electro-galvanised mild steel strips and coated with PVC.

6.15.00 Junction Box

- 6.15.01 Junction boxes shall be of 16 SWG sheet steel hot-dip galvanised, dust and damp proof, generally conforming to IP-55.

- 6.15.02 Junction boxes shall be complete with gasketed inspection cover, conduit knock out/threaded hub and terminal blocks.
- 6.15.03 Junction boxes for outdoor use shall be weatherproof IPW-55 and those for hazardous location shall be flame-proof type.
- 6.15.04 Junction boxes shall have following indelible markings :
- Circuit numbers on top
- Circuit numbers with ferrules (inside) as per drawing
- DANGER** sign in case of 415V circuit

6.16.00 **Terminals**

- 6.16.01 Multi way terminal blocks of approved type, complete with screws, nuts, washers and marking strips shall be furnished for connection of incoming/outgoing wires.
- 6.16.02 Each terminal shall be suitable for connection up to 2 numbers 10 Sq.mm stranded aluminium conductors without any damage to the conductor or looseness of connectors.

6.17.00 **Portable Emergency Lighting Unit**

The portable emergency lighting unit shall be complete with 6volt storage battery (rechargeable), inverter, automatic charger, twin 6 watts fluorescents tube lamp and test switch. Contractor shall furnish make, type and catalogue.

6.18.00 **24 V Supply Module**

Each 24V A.C. supply module shall have one (1) no air cooled two winding, 500VA, 1-phase, 50HZ, 240/24V transformer with 6A (240V side) and 16A (24V side) HRC fuse and necessary 240V and 24V terminals for incoming and outgoing connections. The 240V terminals of 24V AC supply module shall be fed from respective lighting panels. A group of 6A, 24V AC receptacles located near Boiler access doors and condenser area shall be wired up from 24V side of each 24V A.C. supply module.

The 24V A.C. supply modules shall be sheet steel enclosed with louvers and shall be suitable for outdoor use. The 24V A.C. supply modules shall be suitable for wall/steel structure/column mounting. Switches shall be mounted at the front on sheet steel enclosure.

- 6.18.01 Minimum 15 nos. portable 24 V AC supply modules having sheet steel enclosure with louvers as per above shall be supplied for all the three units 24V halogen automobiles lamps with reflector along with 1100 V, twin core PVC sheathed, 2.5 mm² stranded copper wire of 20 m lengths as handset .

Exact requirement will be finalized during detail engineering and accordingly the bidder shall furnish the same.

6.19.00 **Nameplate**

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- 7.09.04 For lighting fixtures, connection shall be teed off through suitable round conduit or junction box, so that the connection can be attended without taking down the fixture.
- 7.09.05 For vertical run of wires in conduit, wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/ junction box.
- 7.09.06 A.C. and D.C. circuits shall not be run in the same conduit and junction boxes. Circuits fed from different transformers shall be run through different conduits and Junction boxes.
- 7.09.07 Receptacle circuits shall be kept separate and distinct from lighting and fan circuits.
- 7.09.08 Separate neutral wire shall be provided for each circuit. Wiring throughout the installation shall be such that there is no break in the neutral wire in form of switch or fuse.
- 7.10.00 **Cabling**
- 7.10.01 In outdoor areas, main runs from lighting panels shall be by means of XLPE cables, directly buried in ground or laid in trenches for the underground portion and through conduit for the over ground portion.
- 7.10.02 Buried cables shall be laid and covered with sand/ riddled earth, and protected from damage by bricks at sides and pre cast concrete slab at top. Buried cables shall have cable markers at 50M interval and projecting 150 mm above ground. At cable bends and joints markers shall be provided.
- 7.10.03 When buried cables cross road/railway track, additional protection to be provided in form of hume / G.I. pipe.

- 7.11.00 **Grounding**
- 7.11.01 All lighting panels, junction boxes, receptacles, fixtures, conduit etc. shall be grounded in compliance with the provision of I.E. Rules.
- 7.11.02 Ground connections shall be made from nearest available station ground grid. All connections to ground grid shall be done by arc welding.
- 7.11.03 Panels/Boards shall be directly connected to ground grid by two numbers 35 x 6 mm G.I. flats. (for panels)/two numbers 50x6 mm G.I. flats (for distribution boards).
- 7.11.04 All junction boxes, receptacles, lighting fixtures etc. shall be grounded with 16 SWG G.I. wire. A continuous ground conductor of 16 SWG GI wire will be run along each conduit run and bonded to it every 600mm by not less than two turns of the same size of wire. This conductor will be connected to each lighting panel ground bus.
- 7.11.05 Each street lighting Pole shall be grounded at two points by two numbers 50x6 mm G.I flat risers from two (2) numbers earthing spike 40 mm dia & 3m long directly driven into ground at a depth of 1m from ground level. The junction box at each lighting pole is grounded at two (2) points from two (2)

2.09.00 **JUNCTION BOXES**

- 2.09.01 Junction boxes shall be of die cast aluminium alloy or 16 SWG sheet steel hot-dip galvanized, dust and damp proof, generally conforming to IP-55.
- 2.09.02 Junction boxes shall be complete with gasketed inspection cover, conduit knockouts/threaded hubs and terminal blocks.
- 2.09.03 Junction boxes for outdoor use shall be weatherproof and those for hazardous areas shall be flameproof type.

2.10.00 **NAMEPLATE**

Nameplates shall be furnished for identification of devices and circuits. All switches, controls and indications shall be permanently and legibly marked in English so as to specify their functions.

2.11.00 **PAINTING**

All sheet steel enclosures shall be chemically cleaned, rinsed, phosphated and dried. After the treatment, steel surfaces shall be given undercoats of primer and finished with two coats of sprayed-on enamel or lacquer of approved shade.

2.12.00 **SAMPLES**

Owner reserves the right to call for samples if considered necessary and the same shall be submitted by the Bidder free and without any obligation.

3.00.00 **SPECIFIC REQUIREMENTS - SERVICES**

3.01.00 **MANDATORY SPARES, CONSUMABLE AND HARDWARE**

3.01.01 The Contractor shall furnish all consumables, hardware and erection materials as required for the completed installation. Also, the Contractor is required to submit a list of mandatory spares for further action by the Purchaser.

3.01.02 These materials shall include but not limited to :

- a) Consumables : Welding rods & gas, oil & grease, cleaning fluids, paints, cotton waste, electrical tape, soldering materials etc.
- b) Hardware : Bolts, nuts, washers, screws, brackets, supports, hangers, saddles, cleats, clamps etc.
- c) Materials : Conduits & accessories, junction boxes terminal blocks, connections, lugs, ferrules, brass glands, ground wires, sockets etc.

- i) The cables shall be 0.63 mm. dia annealed high conductivity electrolytic copper, polythene insulated, colour coded, twisted into pairs, laid up, jelly filled, polythene sheathed, galvanized steel tape armoured, overall polythene sheathed etc. conforming to ITD specification no. S/WT-129 as amended and revised upto date.
- ii) The cable sizes shall be standardized in terms of the number of pairs, which shall be 100 pairs, 50 pairs, 20 pairs, 10 pairs and 5 pairs only.

2.03.00 CONDUITS

2.03.01 Conduits shall be rigid steel, hot dip galvanized, minimum size of conduits shall be limited to 20 mm.

2.03.02 Each standard length (5M) of conduit shall be threaded at both ends.

2.03.03 Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.

2.03.04 Conduits shall be sized so that conduit fill (ratio of total cable area to conduit area) shall not exceed the following :

- One cable : 53%
- Two cable : 31%
- Three cables & up : 40%

2.03.05 Conduit runs shall be provided with necessary bends as required.

2.03.06 Flexible conduits shall be made with bright, cold rolled annealed and electro-galvanized mild steel strips and coated with PVC.

2.04.00 MAIN DISTRIBUTION FRAME (MDF), SUB-DISTRIBUTION FRAME (SDF) AND JUNCTION BOXES

2.04.01 The MDFs, SDFs and junction boxes shall be sheet steel enclosed, corrosion resistant, dust and weather proof complete in all respects with inspection covers, terminal strips etc. The covers shall be gasketed.

2.04.02 The MDFs shall be of minimum 14 SWG M.S. sheet enclosed over suitable angle iron frame work, base channel etc. The MDFs shall be installed indoor. The MDFs shall be complete with requisite number of test jack assemblies. All incoming & outgoing telephone cables to/from MDF in the telephone Exchange room for the subject EPABX type exchange shall be terminated on the MDF in Telephone Exchange Room for which suitable connecting facilities shall be provided on the MDF in Telephone Exchange Room.

2.04.03 The SDFs & Junction Boxes shall be of minimum 14 SWG M.S. sheet enclosed over suitable angle iron framework with base channel, pedestals etc. as required for outdoor installation.

2.04.04 Numbering/identification in Main Distribution Frame (MDF) Sub- Distribution Frames (SDF), Tag Blocks and distribution pillar boards shall be carried out by the contractor.

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	1 X 525 MW TUTICORIN TPS	SECTION I
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SECTION - IIC
		REV.NO. 0 DATE :

SECTION – IIC
GENERAL TECHNICAL REQUIREMENT (CONTROL AND
INSTRUMENTATION)



7.00.00 FIELD INSTRUMENTS / ANALYSERS / ELECTRICAL SYSTEMS METERS AND ACCESSORIES

7.01.00 FIELD INSTRUMENTS

This section provides general hardware guidelines for field instruments and equipment to be supplied under this specification.

Field transmitters shall be smart type with **HART** protocol. Temperature & Pressure switches shall be of Dual Snap type for vibration prone areas.

7.01.01 PRESSURE TRANSMITTER

- | | | |
|--|---|--|
| 01. Working Principle | : | Smart(HART) |
| 02. Type | : | 2 - Wire |
| 03. Output Signal | : | 4-20mA DC with HART protocol. |
| 04. Signal Processing | : | Silicon solid state electronic circuitry |
| 05. Measuring Element | : | Capsule / Diaphragm |
| 06. Measuring element material | : | AISI-316 (Stainless Steel) or better. |
| 07. Static Pressure | : | 150 % of maximum span continuously, without affecting the calibration. |
| 08. Turn-down ratio | : | 100: 1 minimum. |
| 09. Span and Zero | : | Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span. |
| 10. Enclosure Class | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 11. Output Indicator (Digital display) | : | LCD type in % and engineering unit and LCD failure shall not affect the transmitter operation. |
| 12. Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 13. Body | : | Forged Carbon Steel for air and flue gas application and SS for other application. |
| 14. Operating Voltage | : | 16 - 48 Volts D.C. |
| 15. Load | : | 600 Ohms (min.) at 24 Volts D.C. |
| 16. Ambient Temperature | : | 0 - 50 °C |

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17. Performance:

- i) Accuracy : $\pm 0.1\%$ of calibrated Span or better
- ii) Repeatability : $\pm 0.05\%$ of calibrated Span or better
- iii) Response Time : 100msec or better.
- iv) Warranty & stability : min. of 5 yrs or better

18. Sealing/Isolation : 6 meters SS armoured capillary with suitable fill fluid and flange remote seal diaphragm of SS 316 or suitable material as per application, for corrosive, viscous and dirty fluid application.
Flange size and pressure rating as per application.

19. Accessories :
- a) Universal mounting bracket suitable for 2" pipe and wall mounting.
 - b) High tensile carbon steel U- bolts.
 - c) Installation accessories as per relevant installation drawing.
 - d) Syphons for steam and hot water services.
 - e) $\frac{1}{2}$ " NPT 2-valve stainless steel manifold, constructed from SS316 bar stock.
 - f) Companion flange with nuts, bolts and gaskets.
 - h) $\frac{3}{4}$ " ET cable gland
 - i) Flushing facility at process end diaphragm.
 - j) Reverse polarity protection required.

7.01.02 DIF FERENTIAL PRESSURE TRANSMITTER/FLOW TRANSMITETR

- 01. Working Principle : Smart (HART)
- 02. Type : 2-Wire
- 03. Output signal : 4-10mA DC with HART protocol.

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04. Signal Processing Unit : Silicon solid-state electronic circuitry
05. Measuring element : Capsule/Diaphragm
06. Measuring element Material : AISI-316 (Stainless Steel) or better.
07. Static Pressure/
Overload Pressure : Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy
08. Turn-down ratio : 100: 1 minimum
09. Span and Zero : Locally adjustable, non-interacting
10. Enclosure class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
11. Zero suppression /
Elevation : At least 100% of Span
12. Output Indicator
(Digital display) : LCD type in % and Engineering units
13. Nameplate : Tag number and Service engraved in stainless steel tag plate
14. Body : Forged Carbon Steel for air & flue gas application
15. Ambient temperature : 0 - 85 ° C
16. Operating Voltage : 18 - 36 Volts DC
17. Load : 750 Ohms at 24 Volts DC
18. Performance:-
 - i) Accuracy : ± 0.1 % of calibrated span or better
 - ii) Repeatability : ± 0.05 % of calibrated span or better.
 - iii) Response Time : 100msec or better.
19. Sealing/Isolation : 6 meters SS armoured capillary with suitable fill fluid and flange remote seal diaphragm of SS 316 or suitable material as per application, for corrosive, viscous and dirty fluid application.

Flange size and pressure rating as per application.

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20. Accessories

- :
- a) Universal mounting bracket suitable for 2" pipe and wall mounting.
 - b) High tensile carbon steel U-bolts.
 - c) Installation accessories as per relevant installation drawing.
 - d) Syphons for steam and hot water services.
 - k) 1/2" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock.
 - e) Companion flange with nuts, bolts and
 - g) 3/4" ET cable gland
 - h) Flushing facility at process end diaphragm.

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7.01.10 P RESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

- | | | |
|-----------------------------------|---|--|
| 01. Type | : | Bourdon/Bellows/Diaphragm |
| 02. MOC Sensing & Socket | : | AISI-316 SS |
| 03. Movement Material | : | AISI-304 SS |
| 04. Case Material | : | Stainless steel. Enclosure IP-65. |
| 05. Dial Size | : | Generally 150 mm (100 mm for SWAS gauges) |
| 06. Scale | : | Black lettering on white background in 270 Deg. arcs. |
| 07. Window | : | shatterproof toughened glass |
| 08. Range Selection | : | Normal process pressure – 50 ~ 70 % of range (approximately). |
| 09. Over-range Protection | : | 125% of maximum range by internal stop. External stop at zero |
| 10. Adjustment | : | Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment. |
| 11. Element Connection | : | Argon welding |
| 12. Process Connection | : | 1/2" NPT (M) Bottom connection for local mounting, back connection for panel mounting. |
| 13. Performance | : | Accuracy of ± 1.0 % of span or better. |
| 14. operating ambient Temperature | : | 0 - 50 °C |
| 15. Safety Feature | : | Blow out disc. /diaphragm at the back |

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16. Accessories : a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge.
- b) Stainless steel 316 Diaphragm with Teflon coated seals for corrosive, viscous and solid-bearing or slurry type process fluids.
- c) 3-Way stainless steel Gauge cock for pressure gauges. Process connection 1/2" NPT.
- d) 5-valve SS316 manifold constructed from barstock for differential pressure gauge. Process connection 1/2" NPT.
- e) Union, nut & tail piece and other Installation accessories as required.
17. Applicable standard : IS-3624 / 1996
18. Electrical Contact rating : 240V, 5A AC/ 220V, 0.5A DC (for gauges with alarm contact). Number of Contacts:2 SPDT
19. Nameplate : Tag number, service engraved in stainless steel tag plate



7.01.29 GAUGE GLASS

01. Type : Reflex
02. Glass : Toughened borosilicate. Resistant to mechanical and thermal shocks.

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|-----|--------------------|---|--|
| 03. | Body material | : | SS-304 / 316 / Carbon steel – As per process requirements (Flanged Connection) |
| 04. | Pressure rating | : | Twice the maximum working pressure |
| 05. | Temperature rating | : | 300 ° C |
| 06. | Bolts and nuts | : | Rust proof alloy steel |
| 07. | Accessories | : | Suitable ball check valves of SS- 304/316 body, gaskets, companion flange etc. |

8.00.03 INSTRUMENTATION PAIR SIGNAL CABLE

- 01. Conductor type : Stranded (7) annealed tinned copper
- 02. Conductor size : 0.5 / 1.0 / 1.5 Sq.mm (as required)
- 03. Conductor resistance : 39 Ω /Km/18 Ω /Km/12 Ω /Km
- 04. Conductor Insulation : HR PVC Type-C (IS-5831,1984) 0.6 mm thick
- 05. Operating Voltage : 300 / 500V RMS (Core to earth / core to core)
- 06. Twisting : Twin twisted with lay of 60 mm
- 07. Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape.
- 08. Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μ m (min.) for individual pair screen and 60 μ m (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%.

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Metallic side of the screen shall be in contact with drain wire.

* Analog signals- Individual pair & overall shield to be considered.

* Binary signals- overall shield to be considered.

- | | | |
|----------------------------|---|---|
| 09. Drain wire | : | Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm) |
| 10. Inner Sheath | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)

HR PVC Type ST2 of IS-5831,1984

Thickness as per IS-1554, Part-I 1976 |
| 11. Rip Cord | : | Non metallic under sheath |
| 12. Armouring | : | GI wire / strip as per IS 3975 |
| 13. Outer Sheath | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)

HR PVC Type ST2 of IS-5831,1984

Thickness as per IS-1554, Part-I 1976 |
| 14. Filler | : | Non hygroscopic with FRLS property. |
| 15. Temperature Range | : | 85 °C |
| 16. Insulation at 20 Deg.C | : | 100 MOhms/Km [Min] |
| 17. Capacitance at 800 Hz | : | 120 nf/km |
| 18. Cross talk | : | 60 dB |
| 19. Attenuation | : | 1.2 dB/Km |
| 20. Codes & Standards | : | a) IPCEA-S-61-402
b) BS 5308
c) IEC 332-1
d) ASTM-B-33
e) IS-8130-1984
f) IS 1554 Part-1 |

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- g) IS 10810
21. Sheath colour : Inner- Black and Outer- Gray
22. Tests :
- a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)
 - b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I
 - c) Temp Index : Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863)
 - d) Smoke Density Rating : Max.60% (ASTM-D-2843).
 - e) Flammability Test : as per IEC 332 Part-I
 - f) Swedish Chimney Test-SS-424-1475 F3
 - g) Insulation Resistance 100 M Ohm / Km Min
 - h) High voltage test
 - Core to core- 1.5 KV for 1 min.
 - Core to screen- 1.0 KV for 1 min.
 - i) Rodent & Termite repulsion test (Presence of lead shall be confirmed)

23. Colour of core for Instrumentation Cable (As per IS-9938)

PAIR	CORE	COLOR
1st	1st	Blue
1st	2nd	Red
2nd	1st	Gray
2nd	2nd	Yellow
3rd	1st	Green
3rd	2nd	Brown
4th	1st	White
4th	2nd	Black

Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit.

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Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.

Cables near high temperature zone shall be capable of withstanding high temperature and terminated in junction box / panel in normal temperature zone. Teflon insulated and sheathed thermocouple extension cables and copper conductor cables shall be used in high temperature zone. Conductor and sheath shall be extruded FEP (Teflon) as per VDE 0207 Part 6 and ASTM D 2116. These cables shall be pair, multipair, triad, multitriad and twisted & shielded.

9.00.00 E RECTION HARDWARE

9.01.00 ELECTRICAL JUNCTION BOX

01. Type of Enclosure : Dust tight, Weatherproof and Waterproof, generally conforming to IP 65.
02. Material : 3mm sheet steel
03. Type of Cover : Solid unhinged with retention chain
04. Paint : 631 IS:5 Epoxy Powder Coated.
05. Mounting : Surface
06. Cable Entry : 3mm (mim) Gland plate.
07. Gasket : Neoprene
08. Grounding : Brass earth lug with green screw head
External-2 Nos, Internal-1no.M6.
09. Number of Drain Holes : Two at bottom capped.
10. Tag Plate :
 - a) JB Number
 - b) Cable Numbers Tag
 - c) Cable numbers with ferrules (side)
11. Accessories :
 - a) Rail mounted cage clamp type screw less terminals with markers.
 - b) Cable gland
 - c) Canopy at top.

Bidder shall provide at least 20% terminals as spares

9.02.00 Cable Gland

01. Type : Double compression
02. Entry Thread : NPT
03. Material : Brass
04. Finish : Cadmium Plated.

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|-----|-------------|---|--|
| 05. | Protection | : | IP – 54 or better |
| 06. | Accessories | : | Neoprene gasket, locknuts, reducers etc. |

9.03.00 CABL E TRAY

- | | | | |
|-----|-------------|---|----------------------|
| 01. | Material | : | Mild steel |
| 02. | Thickness | : | not less than 2.0 mm |
| 03. | Finish | : | Hot dip galvanized |
| 04. | Perforation | : | As per MFR standard. |
| 05. | Cover | : | Suitable for tray |

6.00.00 C ONTROL BOARD

CONTROL DESK / CONSOLE / PANEL CONSTRUCTION

- 01. Applicable for : Indoor Panel, Desk & console.
- 02. Material of construction : Cold rolled steel sheet (Metal and plastic - Heat resistant, shrinkage free for mosaic tiles).
- 03. Thickness of Sheet : a) 3.0 mm for faces supporting instruments / terminals.
b) 2 mm for other sides and top.
- 04. Construction : Welded throughout as per (metallic parts) approved National Standards.
- 05. i) Corners : 7 mm inner radius
ii) Dimensional Tolerances : a) In height & length - 3 mm

SEPC - 1 x 525 MW Tuticorin Thermal Power Project Stage-IV at Thoothukudi, Tamil Nadu	VOL-VI-SCH-D - 18	DCPL-12Z05
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- b) In height between adjacent sections - 2 mm.
- c) Total for a group - 6 mm
- 06. Doors : Double, recessed, turned back edges
 - 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.
- 07. Color of interior : Brilliant white
- 08. Colour external : Light grey 631 to shade IS5.
- 09. Protection of painting : Epoxy Power Coated or Better.
- 10. Gland plates : Removable 4 mm thick (bottom)
- 11. Cable entry : Bottom
- 12. Hardware :
 - a) anti vibration pad-15mm.
 - 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 fans.



13. Enclosure Protection Class : IP-42 or as per environment condition.



2.08.05 ANNUNCIATION SYSTEM (~~FOR SWAS, AND OTHER~~ LOCAL PANEL BASED SYSTEMS)

- a) Minor modifications in the desk/panels, if required, shall be carried out.
- b) Contractor shall check the fascia inscriptions and their positions with respect to drawings and carry out any rearrangement or reallocation of existing fascia inscriptions.
- c) Annunciation push buttons (Accept/Test/Reset) and hooters shall be mounted in position and wired up to fascia terminal block or logic cabinet, as required.
- d) The testing of annunciation system shall comprise of -
 - System test for sequence
 - Point wise status acceptance test (initiation test)
 - I.R. check at logic cabinet and fascia w.r.t ground
 - Operation of push buttons and hooters.

Tentative list of fascia annunciations required on LCP.

1. LOW LEVEL MIX CUM STG TANK-A
2. LOW LOW LEVEL MIX CUM STG TANK-A
3. HIGH LEVEL MIX CUM STG TANK-A
4. LOW LEVEL MIX CUM STG TANK-B
5. LOW LOW LEVEL MIX CUM STG TANK-B
6. HIGH LEVEL MIX CUM STG TANK-B
7. DIFFERENTIAL PRESS HIGH STRAINER CHOKED
- 8.DOSING PUMP-A FAULT
9. DOSING PUMP-B FAULT
- 10.MIXING CUM STG TANK-A STIRRER FAULT
11. MIXING CUM STG TANK-B STIRRER FAULT
12. DOSING PUMP ON DISCHARGER HEADER PRESSURE LOW
- 13.HIGH PUMP DISCHARGE HEADER PRESSURE
- 14.LOW LOW LEVEL STIRRER MIX TANK DOSING PUMP TRIP

7.10.00 Panels, Cubicles And Enclosures

7.10.01 General

- a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, necessary provision for convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories as per IS: 5039-1969 and as required for completeness.
- b) The nameplates and terminal blocks shall be provided on as required basis for panels cubicles and enclosures.
- c) The Ventilations available in the panel shall be provided with required filters having necessary microns size.
- d) Provision of cooling fans of required rating at the top of the panels shall be provided.
- e) All the panels shall have locking facility.

7.10.02 Surface Preparation And Painting

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

- a) 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 sanded 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.



- b) 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 – shall be indicated by Owner/Consultant during engineering
 - Interior - Brilliant White.
- c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.



6.02.00 CLOSED TYPE TRANSMITTER RACKS

These racks shall be used for dust prone areas like Boiler, Mill, Coal and Ash handling, ESP and Deaerator etc.

6.02.01 Required number of transmitter racks shall be furnished to house transmitters, switches and converters by grouping them suitably, area-wise / function-wise.

6.02.02 The transmitter enclosures shall be constructed of suitable thick steel plate. The enclosures shall preferably be of modular construction and with two end plate assembly bolted to the frame.

6.02.03 The modules shall approximately be 1200 millimeters wide, 1000 millimeters deep and 2350 millimeters high to allow easy access to the internals. Racks shall be reinforced as required to ensure true surfaces and to provide adequate support for instruments and equipment mounted therein. Double interlocking doors shall be provided and shall be arranged for maximum possible access to the interior. Center posts or any member which would reduce access shall not be provided.

6.02.04 Doors shall have concealed quick removal type pinned hinges and locking handles. Doors locks shall accept the same key all over the plant. Gaskets shall be used between all mating sections to achieve dust proof enclosure rating for the modules and a IP-65 waterproof and dust tight rating on the terminal boxes.

6.02.05 All racks shall have a common closed drain trough to connect transmitter drain points to a common header after suitable pressure breaking.

6.03.00 OPEN TYPE TRANSMITTER RACKS

6.03.01 Open type transmitter racks may be provided for mounting transmitters, switches, gauges, converters and other accessories in rooms, buildings and closed areas like the power house building.

6.03.02 The open type racks may be shop or site fabricated. Transmitters, switches, converters and transducers of enclosure class IP-65 or better can be directly mounted on open racks

6.03.03 Racks shall be constructed on structural members of adequate strength and rigidity to ensure proper support to the mounted instruments and equipment. Racks shall be of welded construction throughout. Each rack shall be provided with a canopy to protect the instrument from dripping water or falling objects.

6.03.04 For operational convenience, the open type racks shall be used for mounting pressure and temperature gauges and switches and the local operating stations for electrical drives in the vicinity. Gauges mounted in racks shall be bottom connected and secured by double lock nuts.

SIGNL EXCHANGE BETWEEN DRIVES & DCS (DCP)

(DCP FOR LP DOSING SYSTEM

a) Drives for LP Dosing system

Control of LP Dosing system shall be realized in DDCMIS and comprises of both the analog and binary type of drives. The DDCMIS interface of Binary drives is as follows:

- i. The normal operation of LP dosing system shall be from remote i.e. from CCR including ON/OFF command to individual pumps.
- ii. A local control panel comprising of 'ON' and Emergency Stop push button (EPB) along with ON/OFF indication shall be provided. LCP shall be located on dosing skid. Manual starting & stopping of dosing system drives is envisaged through LCP.
- iii. EPB shall be wired directly to MCC whereas ON push button shall be routed to DCS. The starter of all the motors shall be clubbed with main plant MCC.
- iv. Necessary electrical protections for the drive shall be realized in the MCC, whereas process interlocks and protections are realized in DDCMIS.
- v. The local /remote selection along with remote control shall be provided in OWS only, however indication for Dosing system operation selected DDCMIS/LCP shall be provided in LCP. All controls, fault indicators/alarms, interlocks, logics shall be implemented in DDCMIS only.
- vi. Following signal exchange shall take place between MCC & DDCMIS
 - a. Drive start & stop command
 - b. Drive on/off feedback.
 - c. MCC disturbed (thermal overload optd or control supply fail or EPB operated or MCC isolated)
- vii. Following 24V DC signal shall be given to LCP from DCS for Lamp indication
 - a. Drive ON & OFF indication
 - b. Drive tripped indication
 - c. Dosing system operation selected DDCMIS/LCP

The DDCMIS interface of Analog drives is as follows:

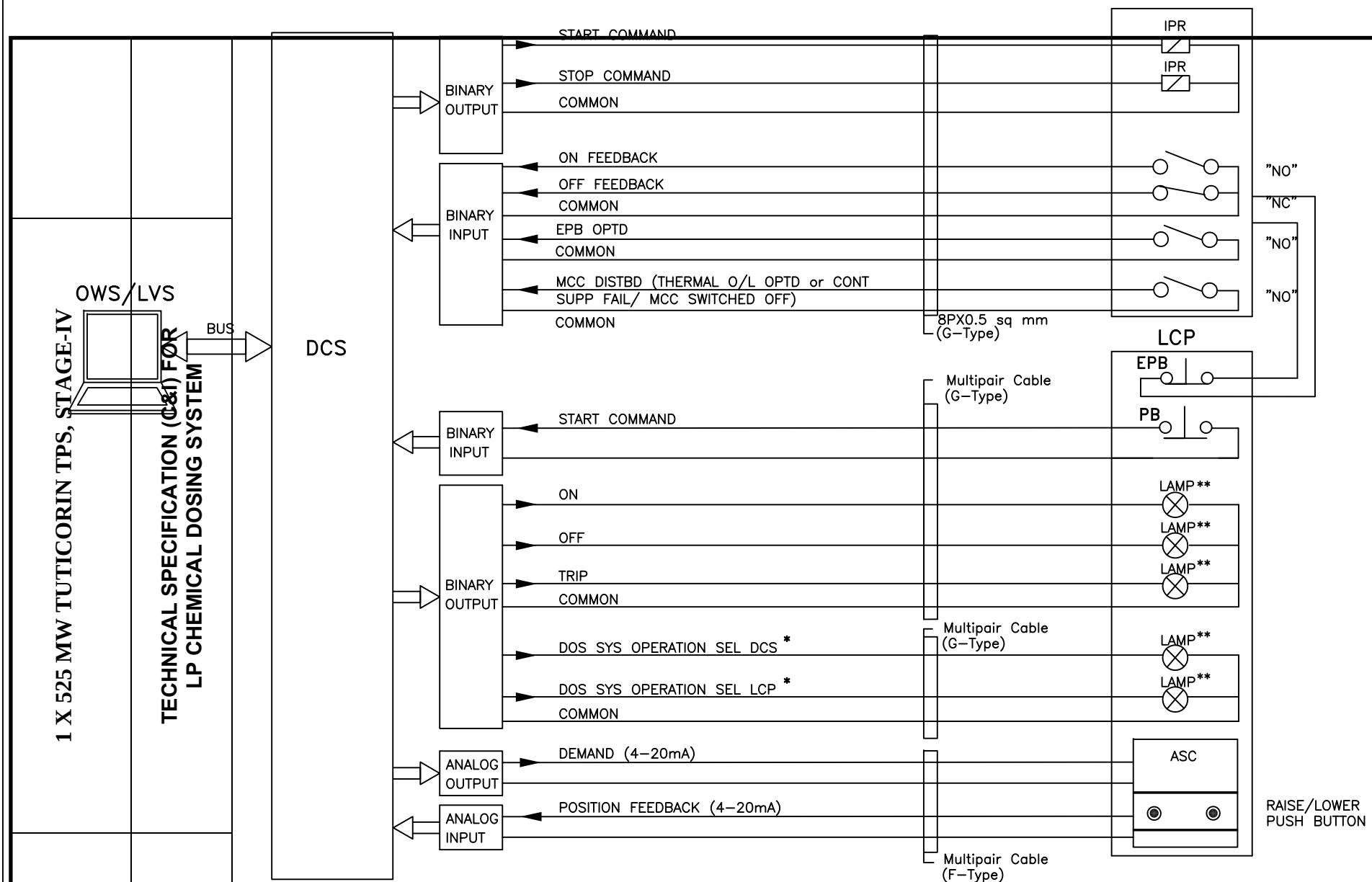
- i. The auto stroke controller of dosing pumps shall be provided in Local Control Panel located on the dosing skid.
- ii. The stroke position & adjustment shall be done from DDCMIS and LCP and the stroke controller shall be suitable for accepting 4-20 mA DC signals.
- iii. Auto/Manual operator control and display for various control systems shall be provided through OWS/LVS.
- iv. Following signal exchange shall take place between auto stroke controller and DCS:
 - a. 4-20 mA demand signal
 - b. 4-20mA position feedback signal

The above DDCMIS interface is indicative only and vendor drawings are to be referred for further details.

The above drive interfaces with DDCMIS are diagrammatically

DCS INTERFACE FOR LP DOSING SYSTEM

MCC



NOTE:- INTERPOSING RELAYS (IPRs) TO BE SUPPLIED ALONG WITH MCC.

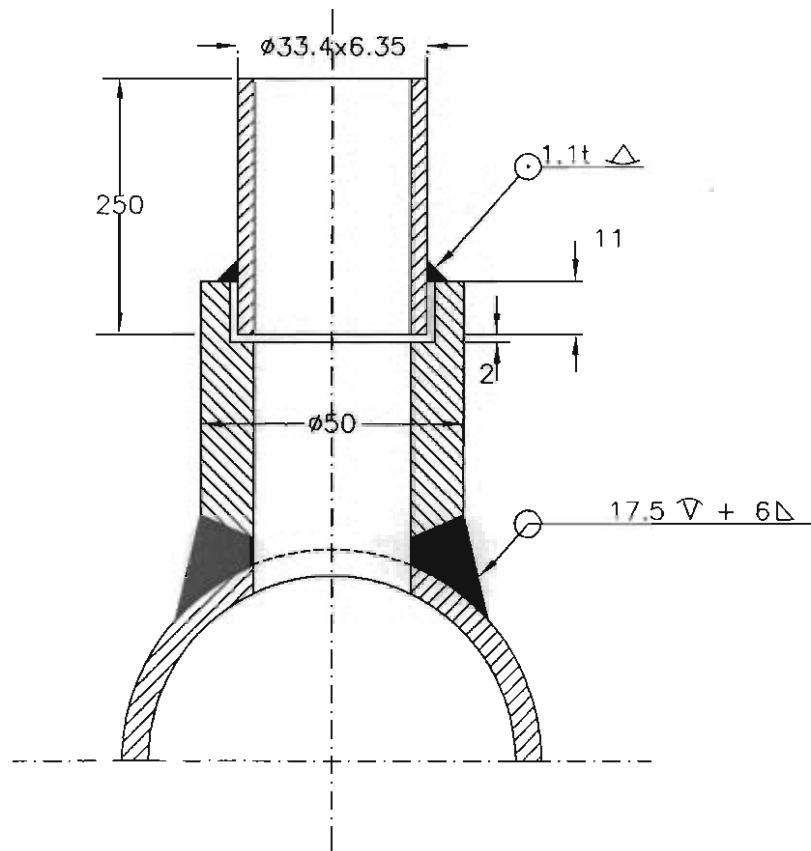
* COMMON SIGNAL FOR ONE COMPLETE SKID.

** ALL LAMPS ARE 24V DC DRIVEN.

THIS DRIVE INTERFACE IS INDICATIVE ONLY.

LAMP INDICATION FOR CONTROL SUPPLY ON SHALL ALSO BE PROVIDED BY BIDDER.

INSTRUMENT STUB DETAILS



NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
4. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
5. STUB LENGTH SHALL BE 64mm UPTO 200Nb, 45mm ABOVE 200Nb PIPE SIZE.
6. THE ACTIVITIES OF WELDING THE COUPLING (OR BOSS) ON THE PIPE, DRILLING PRESSURE CONNECTION HOLES (SAME AS ID OF NIPPLE) IN THE PIPE IN ALIGNMENT WITH HOLE IN COUPLING WILL BE COMPLETED AT THE SHOP.



TITLE :
INSTRUMENT STUB DETAILS
FOR PRESSURE MEASUREMENT

(APPLICABLE FOR TEMP < 500 DEG C, CLASS 6000#)

DRG. NO.
PE-DG-422-145-I101
REV. 00
SH. 03 OF 10 SHS.



6.00.02 Generally, the following latest edition of Codes and Standards prevailing at the time of submission of bid shall be applicable

2) Pressure Measurement

- a) Instrument and apparatus for pressure measurement - **ASME PTC 19.2 (1964).**
- b) Bourdon tube pressure and vacuum gauges - **IS: 3624/1996.**

4) Electronic Measuring Instruments and Control Hardware

- a) Automatic null balancing electrical measuring instruments - **ANSI C 39.4 (Rev. 1973), IS 9319**
- b) Safety requirements for electrical and electronic measuring and controlling instrumentation - **ANSI C 39.5 / 1974.**
- c) Compatibility of analog signals for electronic industrial process instruments - **ISA-S 50.1: ANSI MC 12.1 / 1975.**
- d) Dynamic response testing of process control instrumentation - **ANSI MC 4.1 (1975) - ISA -S26 (1968).**
- e) Surge withstand capability (SWC) tests - **ANSI C 3 7.90A (1989), IEC-255.4.**
- f) Printed circuit boards - **IPC TM-650, IEC 326C.**
- g) General requirements and tests for printed wiring boards - **IS-7405 (Part-I)/1973.**
- h) Edge socket connectors - **IEC 130-11.**
- i) Requirements and methods of testing of wire wrap terminations--**DIN 41611 Part-2.**

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- j) Dimensions of attachment plugs and receptacles- **ANSI C73-1973**.(Supplement **ANSI C73a – 1980**)

6) Enclosures

- a) Types of enclosures – **IS 13947 (Part-I) 1993**.
- b) Racks, panels and associated equipment -**EIA: RS-310-C-1983 (ANSI C83.9 - 1972)**.
- c) Classification of degree of protection provided by enclosure – **IEC 529**

7) Apparatus, Enclosures and Installation Practices in Hazardous Area

- a) Classification of hazardous area - **NEMA Article 500, Volume-6, 1978**.
- b) Electrical Instruments in hazardous dust locations - **ISA-RP 12.11**.
- c) Intrinsically safe apparatus - **NFPA Article 493 Volume-4 1978**.
- d) Purged and pressurized enclosure for electrical equipment in hazardous location - **NFPA Article 496 Volume-4, 1978**.

9) Annunciators

- a) Specifications and guides for the use of general-purpose annunciators - **ISA RP 18.1**.
- b) Surge withstand capability tests -**ANSI C37.90 a -1971 and IEEE Standard 472-1974**.

13) Instrument Tubing

- a) Seamless Carbon Steel Pipe - **ASTM-A-106**.
- b) Materials for socket weld fittings - **ASTM-A-105**.
- c) Dimensions of fittings - **ANSI-B16.11**.
- d) Code for pressure piping, welding, hydrostatic testing - **ANSI-B 31.1**.
- e) Nomenclature for instrument tube fittings - **ISA-RP 42.1 / 1982**.
- f) Seamless Stainless Steel Tubes ASTM A-312 TP 304
- g) Alloy Steel Pipe ASTM A 335 Gr P22

14) Cables

- a) Thermocouple extension wires / cables - **ANSI MC96.1**.
- b) Color-coding of single or multi-pair cables - **IPCEA S-61-402**.
- c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) - **IEEE Standard 422**.
- d) Requirements of vertical tray flame test - **IEEE 383**.

SEPC - 1 x 525 MW Tuticorin Thermal Power Project Stage-IV at Thoothukudi, Tamil Nadu	VOL-IV-SEC-I1 - 16	DCPL-12Z05
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TECHNICAL SPECIFICATION (C&I) FOR LP CHEMICAL DOSING SYSTEM

- e) Standard specification for tinned soft or annealed copper wire for electrical purpose - **ASTM B33**.

15) Electronic Cards, Subassemblies and Components

a) Unpackaged

- i) Vibration : IEC-68.2.6
- ii) Shock : IEC-68.2.27
- iii) Drop & Topple : IEC-68.2.31

b) Packaged

Vibration, Drop & Static Compression - NSTA.

c) Electromagnetic Compatibility

- i) Electrical Fast Transient : IEC-801.4
- ii) Surge Withstand : IEC-255.4
- iii) Radiated Electromagnetic Field : IEC-801.3
- iv) Electrostatic Discharge : IEC-801.2
- v) Electromagnetic Emissions : VDE 0871, Class-B

16) Cable Trays, Conduits

- a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits) IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979.
- b) Galvanizing of carbon steel cable trays - ASTM A-386.

INSTRUMENT INSTALLATION DRAWING

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

TENDER PURPOSE ONLY

						TITLE :	TYPICAL INSTRUMENT INSTALLATION DIAGRAM	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI			
						PROJECT :	TUTICORIN THERMAL POWER PROJECT STAGE IV-1x525MW (UNIT-I) TUTICORIN DISTRICT, TAMILNADU STATE				
						OWNER :	 SEPC SEPC POWER PRIVATE LIMITED				
GE	SKP	SB	FIRST SUBMISSION	00	09.10.12				JOB NO. 12Z05	SCALE NIL	SHT. 1 OF 20
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE				DWG. NO. SEPC-12Z05-DWG-I-224		REV. 00

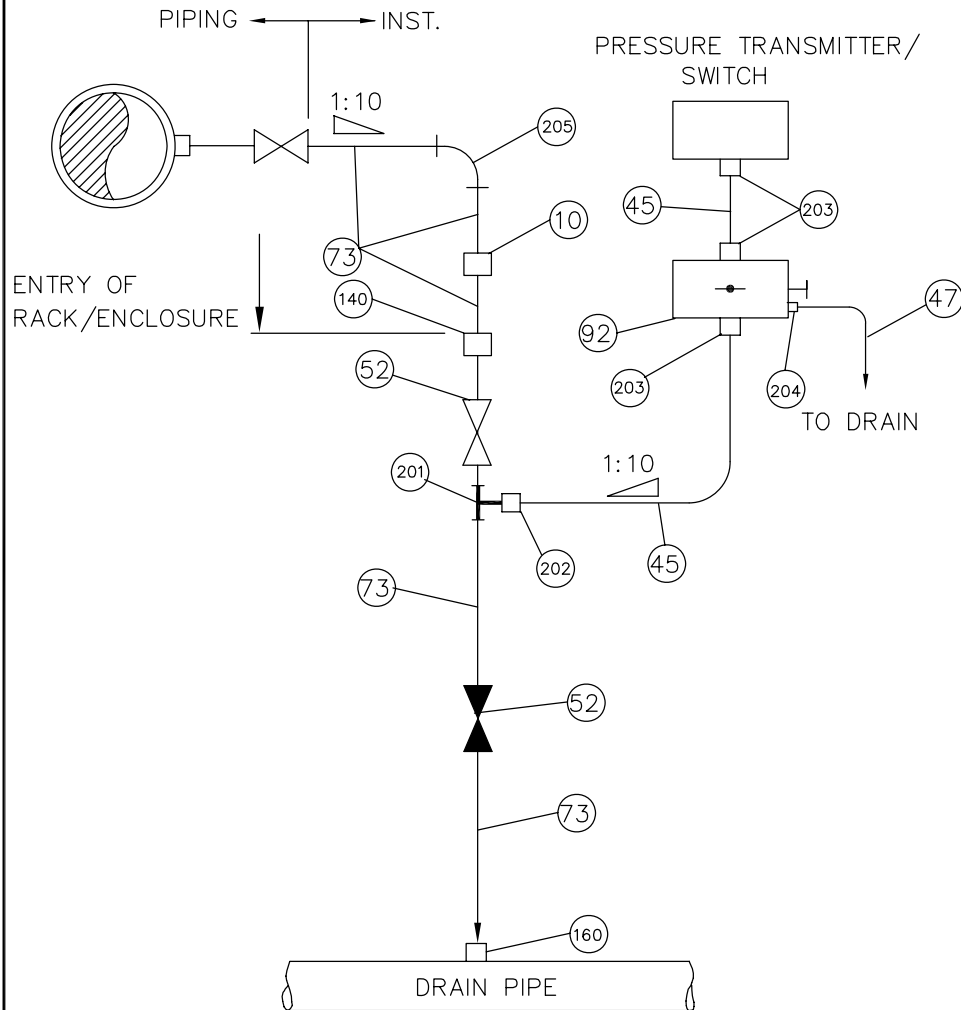
NOTES :

- 1..PROVISION OF SINGLE OR DOUBLE ROOT VALVE AND DRAIN VALVE SHALL BE IN ACCORDANCE WITH THE PRESSURE/TEMPERATURE REQUIREMENT. FOR DESIGN PRESSURE EQUAL TO OR GREATER THAN 40 KG/SQ.CM 2 NOS ROOT VALVE AND 2 NOS DRAIN VALVE SHALL BE REQUIRED.
- 2..MATERIAL, SIZE AND RATING OF THE PROCESS HOOK UP ITEMS SHOWN IN THE DRAWING ARE INDICATIVE ONLY. ACTUAL REQUIREMENT SHALL BE AS PER PROCESS CONDITION & SPECIFICATION VOL.II-E.
- 3..DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2" NB SCH 80.
4. All the wetted parts of the instruments including the accessories like root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments as well as valves shall be of SS-316 material ,suitable pressure class and same shall be in bidder's scope.

TENDER PURPOSE ONLY

						TITLE : TYPICAL INSTRUMENT INSTALLATION DIAGRAM	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
						PROJECT : TUTICORIN THERMAL POWER PROJECT STAGE IV-1x525MW (UNIT-I) TUTICORIN DISTRICT, TAMILNADU STATE			
						OWNER :  SEPC SEPC POWER PRIVATE LIMITED			
GE	SKP	SB	FIRST SUBMISSION	00	09.10.12		JOB NO. 12Z05	SCALE NIL	SHT. 2 OF 20
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE		DWG. NO. SEPC-12Z05-DWG-I-224		REV. 00

**PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT**



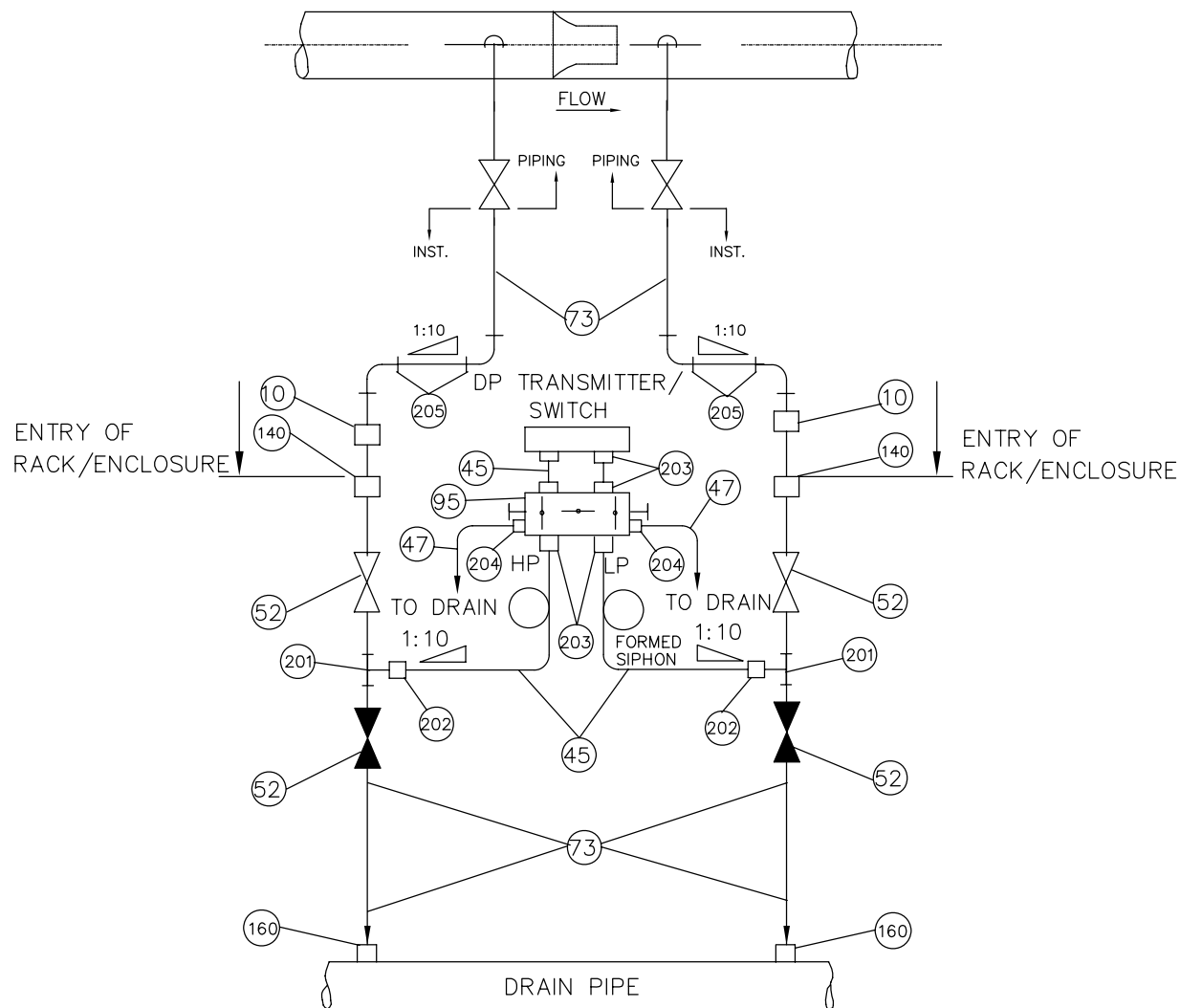
BILL OF MATERIAL		
ITEM NO.	QTY./INST.	DESCRIPTION
201	1	EQUAL TEE (FEMALE) 1/2" SW 6000lbs
202	1	MALE CONNECTOR 1/2" PE 1/2" OD 6000 lbs
52	2	GLOBE VALVES 1/2" SW 600lbs
45	3 Mtrs	TUBE 1/2" OD 2.1 MM THICK
203	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	15Mtrs.	IMPULSE PIPE 15 NB GR.B SCH 80
92	1	2 VALVES MANIFOLD 1/2" NPT(F)
10	1	FULL COUPLING 1/2" SW 6000lbs
47	0.15Mtrs.	TUBE 8 MM OD 1.0 MM THICK
204	1	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
205	1	90° ELBOW 1/2" SW 6000lbs
140	1	BULK HEAD UNION/COUPLING CL: 6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11
160	1	HALF COUPLING CL: 6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : CONDENSATE, FEED WATER ETC.

TENDER PURPOSE ONLY

						TITLE : TYPICAL INSTRUMENT INSTALLATION DIAGRAM	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
						PROJECT : TUTICORIN THERMAL POWER PROJECT STAGE IV-1x525MW (UNIT-I) TUTICORIN DISTRICT, TAMILNADU STATE			
						OWNER :  SEPC SEPC POWER PRIVATE LIMITED			
GE	SKP	SB	FIRST SUBMISSION	00	09.10.12		JOB NO. 12Z05	SCALE NIL	SHT. 4 OF 20
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE		DWG. NO. SEPC-12Z05-DWG-I-224		REV. 00

**DIFF. PRESS. TRANSMITTER/DIFF. PRESS. SWITCH
MOUNTED BELOW SOURCE POINT**



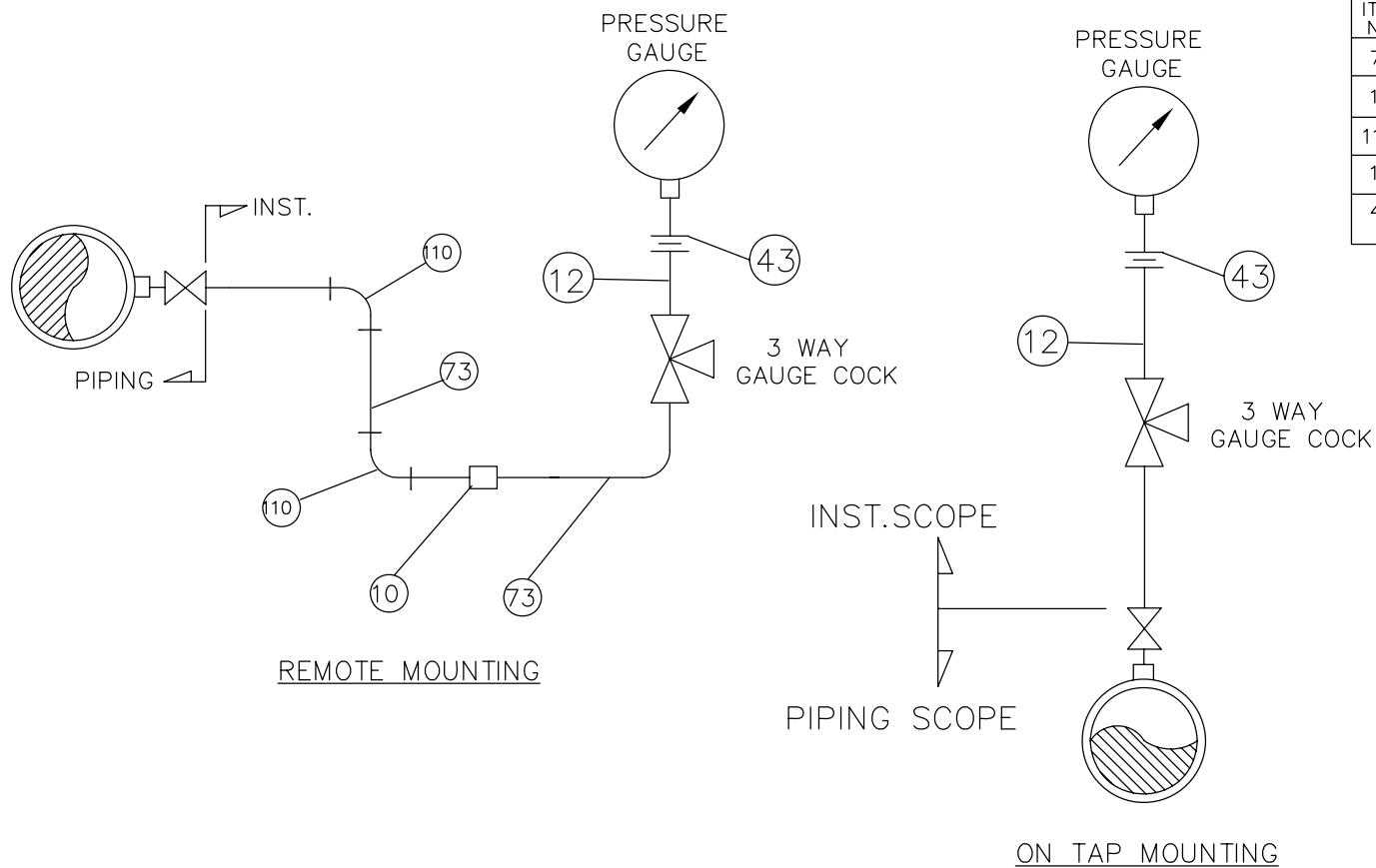
BILL OF MATERIAL		
ITEM NO.	QTY./INST.	DESCRIPTION
201	2	EQUAL TEE (FEMALE) 1/2" SW 6000lbs
202	2	MALE CONNECTOR 1/2" PE X 1/2" OD 6000 lbs
52	4	GLOBE VALVES 1/2" SW 600lbs
45	6 Mtrs	TUBE 1/2" OD 2.1 MM THICK
203	6	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	30Mtrs	IMPULSE PIPE 15 NB GR.B SCH 80
95	1	5 VALVE MANIFOLD 1/2" NPT(F)
10	2	FULL COUPLING 1/2" SW 6000lbs
47	0.3Mtrs	TUBE 8 MM OD 1.0 MM THICK
204	2	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
205	4	90° ELBOW 1/2" SW 6000lbs
140	2	BULK HEAD UNION/COUPLING CL: 6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11
160	2	HALF COUPLING CL: 6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : CONDENSATE, FEED WATER ETC.

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

TENDER PURPOSE ONLY

						TITLE : TYPICAL INSTRUMENT INSTALLATION DIAGRAM	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI		
						PROJECT : TUTICORIN THERMAL POWER PROJECT STAGE IV-1x525MW (UNIT-I) TUTICORIN DISTRICT, TAMILNADU STATE			
						OWNER :  SEPC SEPC POWER PRIVATE LIMITED			
GE	SKP	SB	FIRST SUBMISSION	00	09.10.12		JOB NO. 12Z05	SCALE NIL	SHT. 7 OF 20
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE		DWG. NO. SEPC-12Z05-DWG-I-224		REV. 00

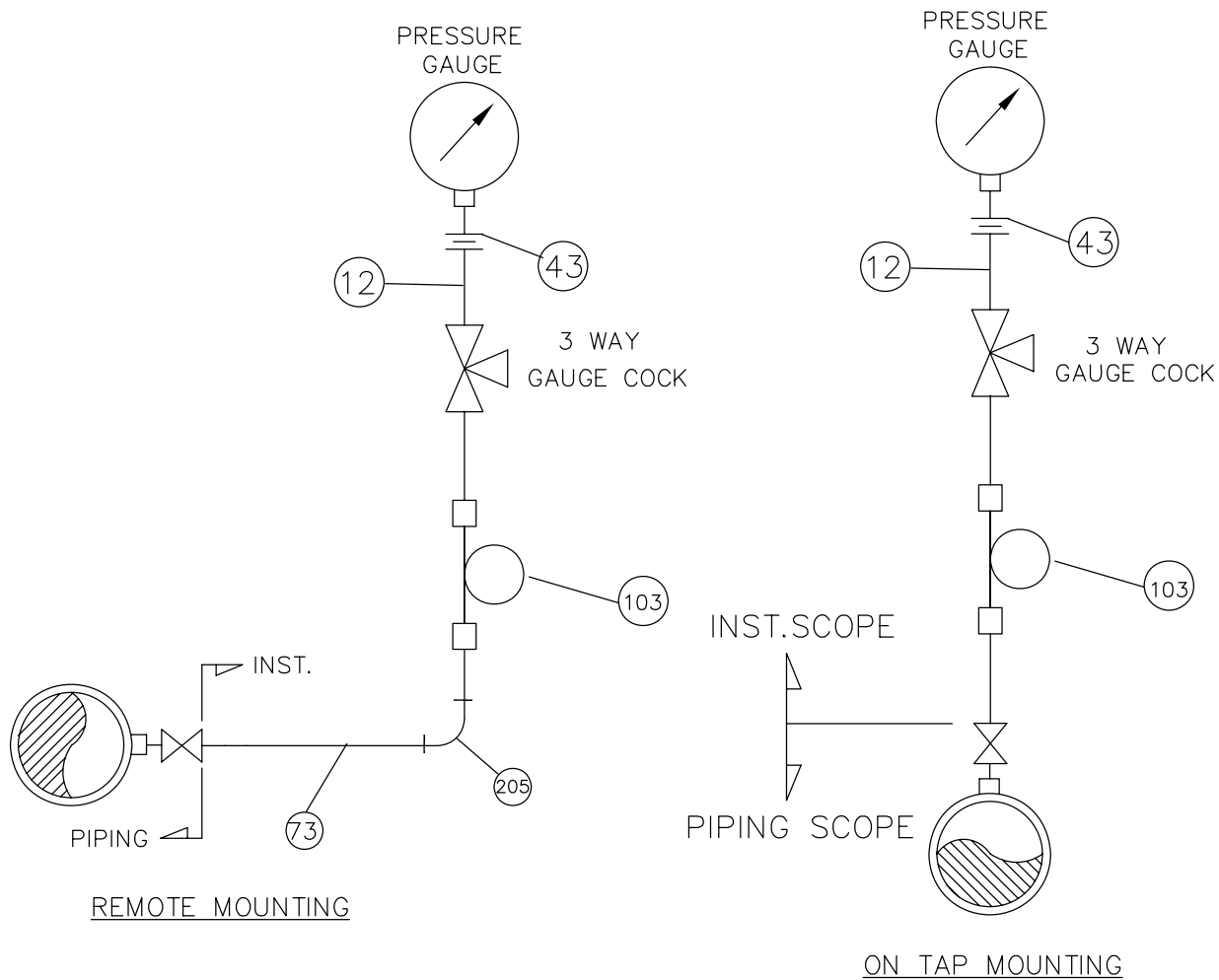


BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
73	15Mtrs	IMPULSE PIPE 15 NB SCH.80
10	1	FULL COUPLING 1/2" SW 3000lbs
110	2	90° ELBOW 1/2" SW 3000lbs
12	1	1/2" NPT(M) X 1/2" PE 4" LONG NIPPLE
43	1	NUT & TAIL FITTING WITH CU WASHER 1/2" NPT(F) X 1/2" PE

SERVICE : WATER, CONDENSATE ETC.

TENDER PURPOSE ONLY

						TITLE : TYPICAL INSTRUMENT INSTALLATION DIAGRAM			 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI			
						PROJECT : TUTICORIN THERMAL POWER PROJECT STAGE IV-1x525MW (UNIT-1) TUTICORIN DISTRICT, TAMILNADU STATE						
						OWNER :  SEPC SEPC POWER PRIVATE LIMITED						
GE	SKP	SB	FIRST SUBMISSION	00	09.10.12				JOB NO. 12Z05		SCALE NIL	SHT. 11 OF 20
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE				DWG. NO. SEPC-12Z05-DWG-I-224		REV. 00	



BILL OF MATERIAL		
ITEM NO.	QTY./ INST.	DESCRIPTION
73	15Mtrs	IMPULSE PIPE 15 NB SCH.80
205	2	90° ELBOW 1/2" SW 6000lbs
12	1	1/2" NPT(M) X 1/2" PE 4" LONG NIPPLE
43	1	NUT & TAIL FITTING WITH SS WASHER 1/2"NPT(F) X 1/2" PE
103	1	SYPHON 1/2" OD SCH.80

SERVICE : STEAM, FEED WATER

TENDER PURPOSE ONLY

GE	SKP	SB	FIRST SUBMISSION	00	09.10.12
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TITLE :	TYPICAL INSTRUMENT INSTALLATION DIAGRAM
PROJECT :	TUTICORIN THERMAL POWER PROJECT STAGE IV-1x525MW (UNIT-I) TUTICORIN DISTRICT, TAMILNADU STATE
OWNER :	SEPC SEPC POWER PRIVATE LIMITED



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. 12Z05	SCALE NIL	SHT. 12 OF 20
DWG. NO. SEPC-12Z05-DWG-I-224	REV. 00	

9.04.00 PROCESS HOOKUP ACCESSORIES & SPECIFICATION

Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval.

INSTRUMENTATION CABLE, CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

9.00.00 CONTROL & INSTRUMENTATION CABLE

- 9.00.01 Cables shall be suitable for the area through which they are routed. All cable shall be flame retardant low smoke (FRLS / Teflon) type. Suitable distance shall be maintained in routing and laying instrumentation cables so that the interferences from electrical HT & LT cables are minimized. Cables carrying redundant instrument signals shall be alternately routed. In hazardous areas cables of suitable R/L ratio shall be provided for intrinsic safety.
- 9.00.02 Durable marking shall be provided on the surface of the cable at intervals not exceeding 5 mtrs. Marking shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs / triads / type of thermocouple), Insulation material, FRLS. Sequential length marking shall also be provided at every metre interval on outer sheath of cable.
- 9.00.03 Standard Drum to be of minimum 500 M length. Drum shall be anti rodent, anti termite and smooth finish.
- 9.00.04 From JB to field devices Teflon insulated (for conductor and overall shielded) heat proof cables shall be specified for all areas.

KKS TAGGING PHILOSOPHY

KKS NUMBERING PHILOSOPHY		
HYD DOSING SYSTEM		
SL NO	KKS TAG	DESCRIPTION
1	LFN40AE001	HYD DOS PREP MET TANK-A AGTR
2	LFN41AE001	HYD DOS PREP MET TANK-B AGTR
3	LFN40CL001	HYD DOS PREP MET TANK-A LVL
4	LFN41CL001	HYD DOS PREP MET TANK-B LVL
5	LFN40CL501	HYD DOS PREP MET TANK-A LVL
6	LFN41CL501	HYD DOS PREP MET TANK-B LVL
7	LFN51AP001	HYD DOS PUMP-A
8	LFN52AP001	HYD DOS PUMP-B
9	LFN51AA101	HYD DOS PUMP-A STRK CONTR
10	LFN52AA101	HYD DOS PUMP-B STRK CONTR
11	LFN50CP001	DP ACRS HYD DOS SUC FILTER
12	LFN50CP501	DP ACRS HYD DOS SUC FILTER
13	LFN51CP501	HYD DOS PUMP-A DISCH PRESS
14	LFN21CP501	HYD DOS PUMP-B DISCH PRESS
	LFN51CP001	HYD DOS PUMP DISCH HDR PRESS
16	LFN52CP001	HYD DOS PUMP DISCH HDR PRESS
AMMONIA DOSING SYSTEM		
SL NO	KKS TAG	DESCRIPTION
1	LFN70AE001	AMMO DOS PREP MET TANK-A AGTR
2	LFN71AE001	AMMO DOS PREP MET TANK-B AGTR
3	LFN70CL001	AMMO DOS PREP MET TANK-A LVL
4	LFN71CL001	AMMO DOS PREP MET TANK-B LVL
5	LFN70CL501	AMMO DOS PREP MET TANK-A LVL
6	LFN71CL501	AMMO DOS PREP MET TANK-B LVL
7	LFN81AP001	AMMO DOS PUMP-A
8	LFN82AP001	AMMO DOS PUMP-B
9	LFN81AA101	AMMO DOS PUMP-A STRK CONTR
10	LFN82AA101	AMMO DOS PUMP-B STRK CONTR
11	LFN80CP001	DP ACRS AMMO DOS SUC FILTER
12	LFN80CP501	DP ACRS AMMO DOS SUC FILTER
13	LFN81CP501	AMMO DOS PUMP-A DISCH PRESS
14	LFN82CP501	AMMO DOS PUMP-B DISCH PRESS
15	LFN81CP001	AMMO DOS PUMP DISCH HDR PRESS
16	LFN82CP001	AMMO DOS PUMP DISCH HDR PRESS

SODIUM HYDROXIDE DOSING SYSTEM		
SL NO	KKS TAG	DESCRIPTION
1	LFN05AE001	NaOH DOS PREP MET TANK AGTR
2	LFN05CL001	NaOH DOS PREP MET TANK LVL
3	LFN05CL501	NaOH DOS PREP MET TANK LVL
4	LFN06AP001	NaOH DOS PUMP-A
5	LFN06AP001	NaOH DOS PUMP-B
6	LFN06AA101	NaOH DOS PUMP-A STRK CONTR
7	LFN07AA101	NaOH DOS PUMP-B STRK CONTR
8	LFN05CP001	DP ACRS NaOH DOS SUC FILTER
9	LFN05CP501	DP ACRS NaOH DOS SUC FILTER
10	LFN06CP501	NaOH DOS PUMP-A DISCH PRESS
11	LFN07CP501	NaOH DOS PUMP-B DISCH PRESS
12	LFN08CP001	NaOH DOS PUMP DISCH HDR PRESS
13	LFN09CP001	NaOH DOS PUMP DISCH HDR PRESS
NOTES:- 1.IF THE NUMBER OF EQUIPMENT/INSTRUMENTS CHANGES, THE KKS FOR THE SAME SHALL BE FINALIZED DURING DETAILED ENGINEERING. 2.FOR INSTRUMENTS KKS 6th AND 7th PLACE VALUE OF KKS CODE SHALL BE CHANGED FOR CORRESPONDING EQUIPMENT AS FOLLOWS:- 1.FOR PRESSURE -CP 2.FOR TEMPERATURE/GT/AT/TEMP SENSOR-CT 3.FOR LEVEL-CL 4.FOR FLOW-CF FOR INSTRUMENTS 8th,9th AND 10th PLACE VALUE OF KKS CODE SHALL BE CHANGED FOR CORRESPONDING EQUIPMENT AS FOLLOWS:- 2.FOR PRESSURE/LEVEL GAUGE-501 3.FOR LEVEL SWITCH-201		

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION III
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION -
		REV.NO. 0 DATE :

SECTION-III

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION III
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION -
	REV.NO. 0	DATE :

SCHEDULE OF PRE-BID CLARIFICATION

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

	TITLE:	SPECIFICATION NO. PE-TS-422-154-A001
	1 X 525 MW TUTICORIN TPS	SECTION III
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB SECTION - REV.NO. 0 DATE :

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. Performance guarantee test parameters shall stand valid till the satisfactory completion of Performance guarantee test and its acceptance by BHEL/Customer.
11. Prices for recommended spares (if any) for three year operation shall be furnished separately and not to be included in the base price.

	TITLE: 1 X 525 MW TUTICORIN TPS	SPECIFICATION NO. PE-TS-422-154-A001 SECTION III SUB SECTION -
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	REV.NO. 0 DATE :

DECLARATIONS

Icertify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated and there is no deviation to the specification.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Bidders Company Name

Authorized representative's
Signature

Name

Bidder's Name The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated

DEVIATION SHEET (COST OF WITHDRAWAL)**1 X 525 MW TUTICORIN TPS****TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM****TECH SPC NO: PE-TS-420-154-A001****TENDER ENQUIRY REFERENCE:-****NAME OF BIDDER:-**

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
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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.