

TAMILNADU GENERATION AND DISTRIBUTION CORPORATION

2 x 660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT

TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM

SPECIFICATION NO.: PE-TS-412-154-A101 R1



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



TITLE :
2 x 660MW ENNORE SEZ SUPERCRITICAL
THERMAL POWER PROJECT

TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM

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SUB-SECTION:

REV. NO. 01

DATE :27.02.2017

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PROJECT INFORMATION

SPECIFICATION FOR EPC CUM DEBT FINANCING CONTRACT VOLUME II – GENERAL & SCHEDULES

CHAPTER 1

PROJECT SYNOPSIS

1.0 GENERAL BACKGROUND AND SALIENT FEATURES

1.1 Introduction

Tamilnadu Generation and Distribution Corporation owns the proposed green-field 1320 MW (2 units of 660 MW each) Coal Based Thermal Power Station at Katupalli. This is an expansion of North Chennai Thermal Power Station (NCTPS) and located on some portion of the ashdyke of NCTPS.

1.2 Location

The proposed site for main power plant is located near Ennore port (approx 5 kms).

The nearest Railway station is at Athipattu Pudunagar (approx 5 kms)

All weather road from Pattamandri on the Thiruvottiyur-Ponneri district highway is the nearest road access.

The nearest airport is at Chennai at a distance of 60 km.

1.3 Type of Plant

The proposed 2x660 MW Super-Critical Power Project consists of coal fired steam generator connected to a reheat type steam turbine generator along with all the required auxiliaries. Circulating cooling water system is envisaged for condenser cooling.

The description and salient technical data of the Steam Generator, Steam Turbine Generator, Auxiliary systems, Electrical, Control & Instrumentation, Civil etc. are explained elsewhere in the specification:

1.4 PROJECT INFORMATION

Project Title : **2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power Project at Ash Dyke of NCTPS**

Owner : **TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)**

LOCATION

The site is located near Vayalur Village, Ennore

Latitude : 13⁰17' N to 13⁰18' N

Longitude : 80⁰18' E to 80⁰19' E

Distance from Chennai City : 35 km

Nearest Airport is at Chennai at a

Distance of : 60 km

Nearest Seaport is : Ennore

Nearest Railway Station is : Athipattu Pudunagar (approx 5 kms)

Meteorological Condition

Climate : Tropical ,very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind.

Climatological data : Ambient temp. (°C)
Annual Maximum Mean Temp 41.5(°C)
Annual Minimum Mean Temp 24(°C)
Design Ambient temperature 35(°C)

Relative Humidity

Maximum 100%

Minimum 36%

Design 75%

Annual Rainfall

Maximum 2540 mm

Average 1600 mm

Minimum 1175 mm

Prevailing Wind Direction

Nov to Jan – From NW & NE

Feb to Mar – From East & SE
Apr to May – From South & SE
June – From SW
July to Aug – From NW
Sept to Oct – From SE & SW
Wind Speed 11.8 kmph (avg)
50 kmph (max)
Seismic Zone III as per
IS:1893-2002

1.5 Access to Site

Site is well connected to all weather road from Pattamandri on the Thiruvottiyur – Ponneri district highway. Site is located adjacent to the Chennai – Howrah broad gauge line and thus well connected by rail also.

1.6 Plant Rating, Capacity, Availability, PLF

Each of the two units shall have a Turbine maximum continuous rating (TMCR) of 660 MW at generator terminals based on the following site conditions.

- Ambient air temperature
- Condenser cooling water inlet temperature of 33°C and 9°C temperature rise across the condenser.
- Generator power factor of 0.85.
- Fuel specification as given elsewhere.
- Design temperature for electrical equipment is 50°C.

The VWO capacity of the steam turbine shall not be less than 105% of TMCR flow at rated parameters. Boiler maximum Continuous Rating (BMCR) will be established to match the steam flow at VWO conditions, but BMCR flow shall not less than 108% of TMCR flow.

The capacity of the unit is selected so as to deliver the rated output even after ageing that will occur between overhauls, as a result of deposition of salts in turbine blades, wear and tear etc.

The plant load factor (PLF) being considered is 85%.

1.7 Power Evacuation

Power will be evacuated from the proposed thermal power station at 400 KV voltage level through 400 KV transmission lines. The power evacuation lines would be double circuit 400 KV lines which will act as Line in & Line out circuit.

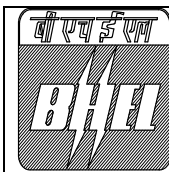
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SECTION – I
SPECIFIC TECHNICAL REQUIREMENTS
SUB-SECTION IA - Specific Technical Requirements (Mech.)
SUB-SECTION IB - Specific Technical Requirements (C & I)

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SECTION – IA

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

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1.0 SCOPE

This specification is intended to cover design, engineering, manufacture, fabrication, assembly, supply, inspection/ testing at vendor's & sub-vendor's works, painting, mandatory spares, startup 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 **2 x 660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT OXYGEN DOSING SYSTEM**.

Broad scope of work of this package includes all equipment and accessories. Please also refer C&I section for C&I scope.

The Oxygen dosing system as specified in Technical Specification shall consist of the followings:

- Entire Oxygen dosing system mounted on skid as per P&IDs and Data Sheet-A.
- Instrumentation (minimum) as per the enclosed P&ID.
- Start-up & commissioning spares as required, mandatory spares as specified.
- Racks (2 Nos.) each to hold 26 cylinders, cylinders (52 Nos.), injector assemblies (8 nos.), tees (20 nos.), elbows (20 nos.), loose tubing (400 meter), compression fittings (70 nos.) for loose tubing.
- Foundation nuts & bolts to fix each skid on the floor, as required.

1.1 SCOPE OF SERVICES

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

- ✓ Design and engineering.
- ✓ Fabrication of the skid mounted oxygen dosing system.
- ✓ Painting as per the enclosed painting schedule. However, any variation in the painting schedule as finally approved by customer shall be taken care by the bidder without any commercial and delivery implication. Color-coding scheme shall be intimated to vendor during detailed engineering.
- ✓ Inspection and testing of the skid as per the approved quality assurance plan.
- ✓ Supply of the skid mounted oxygen dosing system up to the power plant site along with all accessories as defined in the technical specification.

1.2 CIVIL SCOPE

Nil.

2.0 OXYGEN DOSING SYSTEM: (2 SKIDS PER UNIT; TOTAL= 4 SKIDS)

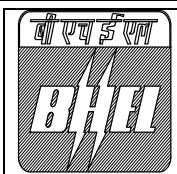
(Refer Drawing. No. PE-DG-412-154-A101 R1)

One skid of Oxygen Dosing System consists of the following:-

- ✓ One number of bank of two oxygen cylinders, dosing at downstream of Deaerator/ CPU outlet.
- ✓ Two number of Pressure Regulator as per Section D1 and Data Sheet – A.
- ✓ Associated Piping, valves, fitting as indicated in the P&ID of oxygen dosing system and Data Sheet-A enclosed and as required to make the system complete.
- ✓ Control & instrumentation as per P&ID of Oxygen Dosing System, Data sheet-A, Section IB, and IIB.

3.0 TERMINAL POINTS

- i. All field instruments (pressure and flow transmitters), solenoid valves and MFC shall be terminated at JB by the oxygen dosing vendor for further connection to DCS by BHEL.
- ii. All vent connections shall be connected via vent header and terminated at one point of the skid for further connection to atmosphere, if required, by BHEL.
- iii. Dosing termination point shall be after MFC and terminated at one point by the oxygen dosing supplier for further interconnection till dosing locations by BHEL.
- iv. 24 V-DC connection to SV-3, SV-4 and SV-5 shall be directly connected by BHEL.

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4.0 QP AND SUB VENDOR APPROVAL

- 4.1 The quality assurance plan is enclosed elsewhere in technical specification. 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.
- 4.2 The sub vendor list (Annexure- II) enclosed 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 performance certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL/ Customer.

5.0 DOCUMENTS TO BE SUBMITTED BY BIDDER ALONG WITH THE BID

BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS:

- 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 certificate (stamped & signed).
- Price Schedule duly filled in (stamped & signed).
- List of Recommended spares, if any (stamped & signed).

Note: Any other documents submitted by bidder except as asked in the bid's specification shall not be evaluated & considered as null & void.

6.0 DRAWING/ DOCUMENTS REQUIREMENT

For the drawings/ documents submission schedule, please refer ANNEXURE-III.

For the drawings/ documents submission procedure, please refer ANNEXURE-VI. 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.

7.0 SPARES

- 7.1 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.
- 7.2 The quality plan and the inspection requirement finalized for the main equipment will also be applicable to the corresponding spares.

8.0 MANDATORY SPARES

- 8.1 The list of mandatory spares considered essential by the BHEL & Customer is indicated in Annexure- V.
- 8.2 All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments.

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- 8.3 Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in one unit, unless specified otherwise, and the fraction will be rounded off to the next higher whole number.
- 8.4 Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.
- 8.5 The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.
- 8.6 Each spare part shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers, and other packages must be suitably marked and numbered for the purpose of identification.
- 8.7 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.

9.0 START-UP AND COMMISSIONING SPARES

Start-up and Commissioning spares are those which would be required during plant or equipment testing, start-up and commissioning. All spares used until the plant is finally handed over by the Contractor to the Owner come under this category. Commissioning spares if deemed necessary by the bidder for commissioning of oxygen dosing skids shall be supplied by the bidder as a part of base offer. List of commissioning spares quoted for and individual price break up of the same shall be submitted separately.

10.0 INTENTIONALLY LEFT IT BLANK.

11.0 SPECIAL 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 specialized 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.

12.0 PACKING

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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.

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.

13.0 PAINTING

Bidder to note that painting shall be as per approved painting schedule to be finalized during detailed engineering. However the same shall be prepared in line with the schedule enclosed in Section IA/ Annexure-IV.

14.0 OTHER DESIGN REQUIREMENTS

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

- All the terminal points shall be easily accessible and towards one side of skid.
- All valves shall be easily accessible for the operator.
- All equipment shall have SS name plate clearly indicating the equipment name.
- Tube fittings of the system shall be done using elbows and tees. Tube bending is not acceptable.
- All JB's shall be mounted in their respective dosing skids only.
- MFC shall also be mounted in an enclosure. DOP of enclosure shall be IP-65 minimum. Other technical requirements of this enclosure shall be in line with JB details indicated elsewhere in the specification.
- All cylinders supplied should conform to "Gas Cylinder Rules, 2004" and CCE license for the same shall be arranged by the bidder.
- All items supplied for the oxygen dosing systems shall be suitable for oxygen service. Bidder shall provide the certificates indicating items are oxygen cleaned or suitable for oxygen service.
- MOC of individual item/ equipment mentioned in the technical specification is only indicative. However, Bidder shall follow/ comply and design the oxygen dosing system in line with the following below mentioned ASTM standards.
 - o **ASTM G63:** Guide for evaluating non-metallic materials for oxygen service.
 - o **ASTM G93:** Standard Practice for Cleaning Methods and Cleanliness Levels for Material and Equipment Used in Oxygen-Enriched Environments.
 - o **ASTM G 94:** std. guide for evaluating Metals for oxygen service.
 - o **ASTM F1792-97 (2010):** Standard Specification for Special Requirements for Valves Used in Gaseous Oxygen Service.
 - o **ASTM G88:** Standard Guide for Designing Systems for Oxygen Service.
- Any change envisaged to meet the above standards and system/ service requirements during detailed engineering shall be agreed/ complied by the bidder without any price/ delivery implication to BHEL/ Customer.
- All the instruments/ equipment/ electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply.

15.0 MISCELLANEOUS REQUIREMENTS

- Finish paints for touch-up painting of equipment after erection at site in sealed container.
- 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.
- 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

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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/BHEL end, delay in review/ approval of drawing beyond one month will be to Customer/BHEL account.
- 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.
- In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- 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.
- Latest version of all codes and standards to be followed.
- For detailed dispatch instructions, Bidder to refer special condition of contract (SCC) of the project.



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DATA SHEET- A



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DATA SHEET-A

Sl. No	Description	Parameter
Mechanical Items		
1.0	No. of skid(s) for project	Four (two per unit)
2.0	Cylinders:	
2.1	Quantity mounted on skid	Two per skid (Total Eight)
2.2	Loose supply of filled Oxygen cylinders	26 loose on a rack for each unit (total 52)
2.3	Design Standard of empty oxygen cylinder	IS-7285
2.5	Water Capacity	50 liters
2.6	Gas Capacity	10 m ³
2.7	Max Working pressure at 15°C	204 Kg/cm ²
2.8	Painting of oxygen cylinder	As per IS 4379
2.10	Accessories	Two (one per unit) Cylinder storing rack (MS), each with capacity to hold 26 cylinders.
3.0	All Tubing:	
3.1	Material	SS 316
3.2	Diameter	15 NB (1/2" OD), 18 BWG
4.0	Ball Valves	
4.1	Body, Bonnet, stem	SS 316
4.2	Trim Material	SS 316
4.3	Design standard	MSS-99-2010/ Equivalent
4.4	Test standard	MSS-99-2010/ Equivalent
4.5	Size	15 NB
4.6	End Connections	Ferruled
4.7	Rating	2000 PSI
4.8	Valve operation	Manual or pneumatic as per P&ID
5.0	Check Valves/ NRV	
5.1	Body, cover, disc/piston & seat	SS 316
5.2	Design standard	MSS-99-2010/ Equivalent
5.3	Test standard	MSS-99-2010/ Equivalent
5.4	Size	15 NB
5.5	End Connections	Ferruled
5.6	Rating	2000 PSI
5.7	Valve operation	Manual
6.0	Pressure Relief Valve	
6.1	Type	Spring loaded, angle type
6.2	Body, bonnet, disc & nozzle	SS 316
6.3	Valve discharges to	Atmosphere (vent)
6.4	Back pressure	Constant
6.5	Set pressure	42 Kg/cm ² (g) for skid 1 and 22 Kg/cm ² (g) for skid 2
6.6	Inlet Connections	Ferruled
6.7	Outlet Connections	Ferruled
7.0	Fittings	SS-316
8.0	Pressure Regulator	
8.1	Quantity	Two per skid (total 8), each mounted to an oxygen cylinder
8.2	Body & trim	Brass & Monel
8.3	O-Ring	Viton
8.4	Seat	PCTFE
8.5	Filter	Bronze (40 micron)
8.6	Inlet connection	1/2 "
8.7	Cleaning standard	ASTM G 93
8.8	Outlet connection	1/2 "
8.9	Operating pressure	204 Kg/cm ² (g)
8.10	Set outlet Pressure	40 Kg/cm ² (g) for skid dosing at CPU outlet and 20 Kg/cm ² (g) for skid dosing at deaerator outlet.
9.0	Mass Flow Controller	
9.1	Expected Flow of O ₂ in process	50-400 gm/ hr. (for skid dosing at deaerator outlet); 40-300 gm/ hr. (for skid dosing at CPU outlet)
9.2	MOC-wetted parts	SS 316
9.3	Operating pressure	Pressure reducing valve set pressure (refer P&IDs)
10.0	3-way Valve Manifold	
10.1	Process End Connection	1/2 Inch NPT(F)
10.2	MOC	SS 316 & Viton O-Ring



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10.3	Design standard	MSS-99-2010
10.4	Cleaning standard	As per ASTM G 93
10.5	MAWP	250 bar
10.0	Structural steel	IS 2062
11.0	Nuts & bolts	SS 304

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ANNEXURE I

QUALITY PLAN FOR OXYGEN DOSING SYSTEM

		MANUFACTURER'S NAME & ADDRESS :		MANUFACTURING QUALITY PLAN				PROJECT PACKAGE		CONTRACT NO.		MAIN SUPPLIER		BHEL QP. NO		NTPC QP. NO	
				ITEM: OXYGEN DOSING SYSTEM SUB - SYSTEM : DEAERATOR & CEP DISCHARGE DOSING		PSI QP. NO : REV. : DATE : PAGE :											
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	D*	M	C	N	10	11			
1.0	<u>WELDER'S QUALIFICATION</u>																
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	100%	ASME IX	ASME IX	QW 483 & QW 484	P	V	V						
2	EMPTY OXYGEN CYLINDER	MTC, HYDRO TEST & RELEVANT TESTS AS PER IS 7285	MA	IS 7285	100%	APPROVED DATASHEET	AS PER APPROVED DATASHEET	MFRS CERTIFICATE	P	V	V						
3	VALVES (BODY & BONNET)	MATERIAL	MA	--	100%	APPROVED DATASHEET	AS PER MODEL DECODIFICATION MENTIONED IN MFRS CATALOGUE	MANUFACTURERS COC	P	V	V						
4	INSTRUMENTS																
4.A	PRESSURE GAUGE	MOC FOR WETTED PARTS, CALIBRATION & BOURDON OVER PRESSURE PROTECTION & TYPE	MA	MEASUREMENT	1/TYPE	APPROVED DATASHEET	AS PER APPROVED DATASHEET	MFRS CERTIFICATE	P	V	V						
4.B	PRESSURE TRANSMITTER	CALIBRATION, OVERLOAD PROTECTION & TYPE TEST CERTIFICATE	MA	MEASUREMENT	100%	APPROVED DATASHEET	AS PER APPROVED DATASHEET	MANUFACTURERS COC	P	V	V						
5	SOLENOID VALVES	MATERIAL	MA	VISUAL	100%	APPROVED DATASHEET	AS PER MODEL DECODIFICATION MENTIONED IN MFRS CATALOGUE	MANUFACTURERS COC	P	V	V						
6	CYLINDER PRESSURE REGULATOR	MATERIAL	MA	VISUAL	100%	APPROVED DATASHEET	AS PER MANUFACTURERS CATALOGUE	MANUFACTURERS COC	P	V	V						
7	TERMINATION BOX	COUNTUNITY,IR-HV-IR & DEGREE OF PROTECTION	MA	ELECTRICAL	100%	APPROVED DATASHEET	AS PER APPROVED DATASHEET	MFRS COC & INSPECTION REPORT	P	V	V						
8	TUBING	CHEMICAL & PHYSICAL	MA	CHEMICAL & PHYSICAL TEST	100%	APPROVED DRAWING DATASHEET	APPROVED DRAWING DATASHEET	LAB REPORT	P	V	V						
9	MASS FLOW CONTROLLER	CALIBRATION REPORT	MA	ELECTRICAL	100%	APPROVED DRAWING & DATASHEET	APPROVED DRAWING & DATASHEET	CALIBRATION REPORT	P	V	V						
10	FITTING	MATERIAL	MA	VISUAL	100%	APPROVED DRAWING	AS PER MODEL DECODIFICATION MENTIONED IN MFRS CATALOGUE	MANUFACTURERS COC	P	V	V						
11	FINAL ASSAMBLY	DIMENSION, ORIENTATION & COMPLETENESS.	MA	MEASUREMENT	100%	APPROVED DRAWING	APPROVED DRAWING	INSPECTION	P	W	W						
	FAT	LEAKAGE		N2 FILL FOR 2HR	100%	APPROVED DRAWING / FACTORY ACCEPTANCE TEST	NO LEAKAGE	INSPECTION REPORT	P	W	W						
12	POWDER COATING STAMPING	DFT MEASUREMENT	MI	VISUAL	100%	NTPC APPROVED PAINTING SCHEME			P	W	V						
13	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						

NOTES: ALL INSTRUMENTS SHALL BE OXYGEN CLEANED AND SUITABLE FOR OXYGEN SERVICE. MANUFACTURERS COC CERTIFYING THE SAME REGARDING OXYGEN CLEANED SHALL BE SUBMITTED FOR REVIEW DURING FINAL INSPECTION.

		LEGEND :						DOC NO.		REV :		CAT :	
		* RECORDS IDENTIFIED WITH "TICKS" SHALL BE ESSENTIALLY INCLUDED BY CONTACTION IN QA DOCUMENTATION.											
MANUFACTURER/ SUB SUPPLIER		MAIN SUPPLIER		** M : MANUFACTURER/SUB-CONTRACTOR C : BHEL, N: CUSTOMER/ CUSTOMER'S CONSULTANT				FOR CUSTOMER USE					
SIGNATURE		INDICATE "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION AS APPROPRIATE, "CHP" SHALL BE IDENTIFIED IN COLUMN "N".						REVIEWED BY		APPROVED BY		APPROVAL SEAL	

	TITLE : 2 x 660MW ENnore SEZ SUPERCRITICAL THERMAL POWER PROJECT		SPECIFICATION NO.: PE-TS-412-154-A101	
	TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM		SUB-SECTION: IA	
			REV. NO. 01	DATE : 27.02.2017

TEST PROCEDURE FOR OXYGEN DOSING SYSTEM

- A Factory Acceptance Testing will be conducted at vendor's Factory. This will be for verification of the functional performance of critical equipment/instruments and hardware design when run at design pressure, temperature and flow.
- FAT will be carried out using **only the inert gas** such as **Nitrogen**. Following will be the FAT protocol.
- Checking the completeness of the system. This will include visual inspection of equipment and instruments as per the P & ID s & GA along with skid after assembling on skid.
- Soap joint leak test of tubing/fittings/valves using nitrogen at 1.25 times of maximum operating pressure.
- **(ANSI B31.8)**, for 2 hours. The allowable pressure drop would be up to 0.5 bar over 2 hours.
- Functional testing of calibrated components (equipment/ instruments) using nitrogen. The test controller will be connected to Mass flow controller. The set point will be given from test controller & this will be monitored.
- Testing of Assembly of skid, instruments, termination box will be done by BHEL as per approved Quality Assurance Plan.
- Inert test run using nitrogen to demonstrate flow.
- Final Assembly & Factory Acceptance Test will be witnessed by BHEL & CUSTOMER.

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			REV. NO. 01	DATE : 27.02.2017

ANNEXURE – II
SUB VENDOR LIST (INDICATIVE)



TITLE :
**2 x 660MW ENnore SEZ SUPERCRITICAL
THERMAL POWER PROJECT**

SPECIFICATION NO.: PE-TS-412-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

REV. NO. 01

DATE :27.02.2017

SUB VENDOR LIST - MECHANICAL



TITLE :
2 x 660MW ENNORE SEZ SUPERCRITICAL
THERMAL POWER PROJECT

SPECIFICATION NO.: PE-TS-412-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

REV. NO. 01

DATE : 27.02.2017

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	FILLING OF OXYGEN CYLINDER	FILLING OF EMPTY CYLINDERS MAY BE DONE FROM ANY CCE LICENSED OXYGEN GAS FILLER	AS APPLICABLE	
2.	EMPTY OXYGEN CYLINDERS	BPCL	ALLAHABAD	
		EVEREST KANTO	BOMBAY	
		MARUTI KOATSU CYLINDER LTD	HALOL, GUJARAT	
3.	CHECK VALVE/BALL VALVE/	HAMLET	USA	
		SWAGELOK	USA	
		PARKER	USA	
4.	VALVE MANIFOLD	HAMLET	USA	
		EXCEL HYDRO	MUMBAI	
		SCHNEIDER	GERMANY	
		HY LOK	KOREA	
		DK TECH	KOREA	
		ANDERSON GREENWOOD	USA	
		ASLACH	MUMBAI	
		HP VALVE AND FITTING	CHENNAI	
		HYD AIR	LONAVLA	
		FLUID CONTROL	MUMBAI	
		MICRO PRECISION	FARIDABAD	
		PARKER	USA	
		SWAGELOK	USA	
		BALDOTA	MUMBAI	
5.	PRESSURE REDUCING VALVE	TESCOM	USA	
		SWAGELOK	USA	
6.	TUBING	SWAGELOK	USA	
		HAMLET	USA	
		PARKER	USA	
		SANDVIK	USA	
		VIKAS INDUSTRIAL PRODUCTS	NOIDA	
7.	NEEDLE VALVE & PRESSURE SAFETY VALVE	SWAGELOK	USA	
		HAMLET	USA	
		PARKER	USA	
8.	SOLENOID VALVE	ROTEX	BARODA	
		AVCON	MUMBAI	
		ASCO	CHENNAI	
		SMC	NOIDA	
		NUCON	HYDERABAD	
9.	3 WAY VALVE	HI TECH	AHMEDABAD	
		ADVANCE VALVES PVT.LTD	NOIDA	
		BDK	HUBLI	
		FOURESS ENGG.INDIA LTD.	MUMBAI	
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI	
		INSTRUMENTATION LTD.	PALAKAD	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		VENUS PUMP & ENGG. WORKS	KOLKATA	
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI	
		STAFFORD CONTROLS LIMITED	PUNE	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
10.	PAINT	ASIAN PAINTS (I) LTD.		

	TITLE :	SPECIFICATION NO.: PE-TS-412-154-A101	
	2 x 660MW ENnore SEZ SUPERCRITICAL THERMAL POWER PROJECT		
	TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM	SUB-SECTION: IA	
		REV. NO. 01	DATE : 27.02.2017

		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		
11.	STRUCTURE STEEL	SAIL		
		TISCO		
		JINDAL		
		BHUSWAL		
12	MASS FLOW CONTROLLER	BROOK'S (EMERSON)		

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 :
2 x 660MW ENnore SEZ SUPERCRITICAL
THERMAL POWER PROJECT

TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM

SPECIFICATION NO.: PE-TS-412-154-A101

SUB-SECTION: IA

REV. NO. 01

DATE :27.02.2017

SUB VENDOR LIST C&I

SI No	Package Name	Supplier Name	Supplier Communication Address	Supplier Works 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 : parthabosebpi@gmail.com; bosepanda@vsnl.net	Works-1->Mr. Partha Bose 44, Saheed Hemanta Kumar Bose,Sarani, -Kolkata-WEST BENGAL India Phone- +91 33 2548 7220 FAX : +91 33 2548 0429, Pincode : 700074 Email : parthabosebpi@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	Works-1->Mr. Gautam Mukherjee Kusumba,Sonarpur Station Road,P.O. -Narendrapur, - Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email : gkm_ani@hotmail.com
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	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol- GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.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	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI- GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@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	Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb,Yeshwanthpur - BANGALORE-KARNATAKA INDIA Phone- 080-23370300 FAX : 080-23379890 Pincode : 560022 Email : shikhahazra@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	Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2,I.DA. NACHARAM , - HYDERABAD-TELANGANA INDIA Phone- 09866550762 FAX : 040 27152193 Pincode : 560076 Email : gshrinivasan@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	Works-1->NA NA -- Phone- FAX : Pincode : Email :
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,	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, - Kalamboli Taluka Panvel- MAHARASHTRA India Phone- 022- 27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com
9	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	Works-1->Matt Moren/Gina Cruz 16650 Schoenborn St., North Hills -CALIFORNIA- USA Phone- +1 818 894 7111, ext FAX : +1 818 830 5588 Pincode : 91343 Email : gcruz@miinet.com
10	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No.: 218- 230& 235, Industrial Estate,Makhupura, -Ajmer- RAJASTHAN India Phone- 9887865856, FAX : 0145- 2695174, Pincode : 305002, Email : rajeev.gupta@tipl.com
11	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.co m,	Works-1-> M-171 to 173, MIDC, Waluj, -Aurangabad- MAHARASHTRA India Phone- 9881000474, FAX : 0240- 2555179, Pincode : 431136, Email : Narendra.Kulkarni@wetzler.endres s.com
12	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,	Works-1->Mr. Santosh Shukla Others R-628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai- MAHARASHTRA India Phone- 9821350761, FAX : 022- 27695559, Pincode : 400701, Email : sales@panamengineers.com
13	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	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F- 61, OKHLA INDL.AREA,PHASE-I - NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com

14	TRANSMITTERS	ABB LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com	
15	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,	Works-1-> PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, -BANGALORE-KARNATAKA INDIA Phone- 080-41586000, FAX : 080-28521442, Pincode : Email : uday.shankar@in.yokogawa.com
16	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	Works-1->Mr.Kedar Tillu 53, 54, 56 & 57,Hadapsar Industrial Estate -PUNE-MAHARASHTRA INDIA Phone- 9665034625 FAX : 020 66039905 Pincode : 411013 Email : kedar.tillu@honeywell.com
17	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	Works-1->Ankit Varshney Kalwa Works, Thane-Belapur Road, Thane, -MUMBAI-MAHARASHTRA INDIA Phone-FAX : Pincode : 400708 Email :
18	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	Works-1->Kalpesh Chandan/Hrishikesh Aghor Plot No. A 145/4 TTC IND AREA,MIDC, PAWANE, -NAVI MUMBAI-MAHARASHTRA INDIA Phone- 9619688001 FAX : 022-66736000 Pincode : 400 705 Email : Kalpesh.chandan@emerson.com
19	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	
20	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	Works-1->Mr. Dineshbhai Zaveri CEO C-1/ 27&37, GIDC, Kabilpore, -Navsari-GUJARAT INDIA Phone- 02637-265140,265003 FAX : 02637-265308 Pincode : 396424 Email : flexpro@flexproltd.com

21	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, pulinh@sumip.com	Works-1->Mr.Pulin Shah/ Mr. Kaloesh Parmar 39 A/3 ,Panchratna Industrial Est,Sarkhej- Bavla Road, Changodhar - Ahmedabad-GUJARAT INDIA Phone- 98250 80339 1 FAX : 079-26932424 Pincode : 382213 Email : sales@sumip.com
22	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	
23	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.co m	Works-1->B. Srinivas Suchitra Industries, Opp No 53, Muneshwara Black Devinagar, Lottagal hal -BANGALORE- KARNATAKA INDIA Phone- 080- 23511247 FAX : Pincode : 560094 Email : suchitra_industries@yahoo.com
24	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	Works-1->JIGNESH MAHENDRA AJMERIA DENA BANK BLDG., SHREE NAGESHINDL. ESTATE,STATION ROAD, - MUMBAI-MAHARASHTRA INDIA Phone- 022 67973578 FAX : Pincode : 400 088 Email : ajmera@ajmera.net

	TITLE : 2 x 660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT		SPECIFICATION NO.: PE-TS-412-154-A101	
	TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM		SUB-SECTION: IA	
			REV. NO. 01	DATE : 27.02.2017

ANNEXURE III

DRAWING DOCUMENTS DISTRIBUTION SCHEDULE



TITLE :
**2 x 660MW ENnore SEZ SUPERCRITICAL
THERMAL POWER PROJECT**

SPECIFICATION NO.: PE-TS-412-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

REV. NO. 01

DATE :27.02.2017

ANNEXURE III

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:

- Quantity of prints may change during detailed engineering stage based on BHEL/ Customer requirement. However the same will be adhered by the bidder without any delivery/commercial implication to BHEL.
- 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.

	TITLE : 2 x 660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT		SPECIFICATION NO.: PE-TS-412-154-A101	
	TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM		SUB-SECTION: IA	
			REV. NO. 01	DATE : 27.02.2017

ANNEXURE-IV

PAINTING SPECIFICATION

CHAPTER - 6

PAINTING

1.0 SCOPE

This section defines the technical requirements for surface preparation, selection and application of paints on equipment, vessels, machinery, piping, ducts etc. However, manufacturers shall follow their standard procedures for painting their equipment. The bidder shall submit a detailed painting procedure for approval of owner/ owner's representative after the award of contract.

The following surface and material shall require painting:

- a. All un-insulated carbon steel and alloy steel equipment like columns, vessels, storage tanks, pumps, heat exchangers etc.
- b. All un-insulated carbon steel and low alloy piping, fitting and valves (including painting of identification marks).
- c. All pipe structural steel supports, walkways, platforms, handrails, ladders etc.

The following surfaces and materials shall not require painting :

- a. Non-ferrous materials
- b. Austentic stainless steel
- c. Plastic and / or plastic coated materials
- d. Insulated surface of equipment and pipes except color coating wherever required.
- e. Painted equipment like blowers, pumps, valves etc. with finishing coats in good condition and with matching color code.

2.0 CODES AND STANDARDS

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

The following Indian Standards may be referred to for carrying out the painting job :

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)

IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:158	:	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS:2932	:	Enamel Synthetic exterior (a) Undercoating (b) finishing
IS:4682	:	Code of practice for lining of vessels & equipment
SIS 559000	:	Swedish standard for blasting
ISO 8504-2	:	Preparation of steel substrates before application of paints and related products. Surface preparation methods Part 2 Abrasive blast cleaning
ISO 8501-1	:	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1 : Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
SIS 05 5800	:	Surface preparation by acid pickling
SSPC SP08	:	Surface preparation by acid pickling
IS 2629	:	Recommended practice for hot dip galvanizing of iron and steel
ASTM A780	:	Standard practice for repair of damaged galvanized coatings
SSPC	:	Steel structures painting council
NACE	:	National association of Corrosion Engineers
DIN	:	Deutsehes Institute for Normung
BS	:	British Standard
ASTM	:	American Society for Testing material
AWWA	:	American Water works association

3.0 SURFACE PREPARATION

The surface shall be prepared in a manner suitable for coatings. Chemical derusters or rust converters shall not be applied. Acid cleaning is subject to approval of Purchaser/ Purchaser's representative.

3.1 BLASTING

The surface of the part/ component shall be blasted before the coating material is applied.

Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air above 1100C. Blasting activity shall be performed at temperatures 30C above dew point and substrata temperature between 50C & 500C and relative humidity not exceeding 85% shall be maintained during painting. Necessary safety precautions for equipment and operator shall be adhered to and shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work.

Abrasive used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives are chilled iron grit, shot steel, malleable iron grit and shots of non metallic abrasive (aluminum oxide, copper slag, garnet etc.).

The grade of blasting shall be performed in line with the approved painting scheme.

The nature, quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the required surface profile depth and cleanliness.

Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and commencement of painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

The grades of surface finish

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial Blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting

(a) Blasting according to SIS 055900, Grade Sa 2½

Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer coat shall be 15-25 µm.

3.2 Manual Rust Removal

Manual rust removal shall be allowed for welded zones and for touching up installed components.

3.3 Cleaning

Removal of impurity

	Impurity	Removal
a)	Dust, Loose deposits	Vacuum cleaning, brushing
b)	Adhesive deposits	Power brushing
c)	Oils, greasy impurities	Wet Blasting, Use of Detergent Additives by agreement
d)	Salt deposits	Rinsing
e)	Markings (eg felt up pen)	Organic solvents to manufacturer's specifications eg Trichloro trifluoro ethane and solvents containing acetone (renew solvent and rag frequently)

3.4 Acid Pickling

Prior to galvanizing the surface preparation shall be done by acid pickling as per SSPC-SP-08.

4.0 PROCESSING

4.1 General Application Conditions

The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature shall be + 5°C and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3°C above dew point.

4.2 Application Procedure

The primer shall be applied by means of brush or by spary. The top coats shall be applied by means of brush, roller or spray.

At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed.

4.3 Touching Up

Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning according coating manufacturers specification. The final top shall be reapplies completely.

4.4 Uncoated Surfaces

Moving parts of machines (e.g stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating upto a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.

4.5 Bond Strength

The pill off stress determined using the pull off test method for adhesion shall not be less than 1.5 N/mm², according to ISO 4624.

5.0 SURFACE CONDITIONS OF COATING SURFACES

The coating surface shall have a uniform film thickness, shade and gloss and shall be free from inclusions, sags and wrinkles.

6.0 COATING SYSTEMS

6.1 General Requirements for Coating Systems

Coating materials according to SSPC, BS 5493 or DIN 55 928 shall be used. Intermediate coats are to be pigmented with micaceous iron oxide. The materials shall be matched with each other so that they are compatible. Coatings deviating this

specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.

The colour and gloss of top coats shall be in accordance with sub clause suggested colour codes for painting (Sub Clause 6.8)

6.2 Standard Coating System (External Coatings)

(a) Steel Surfaces

- (i) All steel structures shall receive two primer coats and two sandwich coat of MIO Epoxy paint and one finish coat of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two intermediate coats and one finished coat shall also be applied after erection.
- (ii) Steel surface which is to be painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted as explained in clause 3.1 to Sa 2½ finish as per SIS05-5900. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer shall be 60 microns.
- (iii) Two intermediate MIO Epoxy paint, and one top polyurethane coating of approved brand shall be applied. Dry film thickness of each intermediate coat shall be 90 microns and top polyurethane coating shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 330 microns. All paints shall be of approved brand and shade as per owner's requirement.
- (iv) Joints to be site welded shall have weldable primer applied within 100 mm of welding zone. Similarly where friction grip fasteners are to be used removable anti corrosive coating shall be provided. On completion of the joint the surfaces shall receive the paint as specified.
- (v) Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams, supporting gratings or chequered plate shall receive one additional coat of finish paint over the above number of coats specified before erection. Portion of steel member embedded/ to be encased in concrete shall not be painted.

(b) Gratings and Step Threads

(i) Surface Preparation

Gratings and step threads shall be cleared by acid pickling as per SSPC-SP-08

(ii) Hot Dip galvanizing

The hot dip galvanizing shall be done as per IS 2629. The average mass of coating shall be 610 gm/m².

(iii) Post Treatment

Immediately after galvanizing post treatment such as chromating shall be applied to retard white rust attack.

(iv) Touch up mechanical damages

The repair of damages coatings shall be done as per the recommended practice ASTM A780.

6.3 Painting of Indoor components such as valves, pumps, motors, electrical parts, tanks etc.

At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry film thickness 75µm.

At Site

Thorough cleaning to remove oil, grease, dirt and any other contaminants. Derusting of all mechanical damages according to SIS 055900 Grade ST3. Touch up with dry film thickness 50 µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 30-40 microns DFT each coat in approved shades.

Remarks

Equipment coated with a standard application system can be accepted if the quality of this application system is corresponding with the quality of the above mentioned system.

6.4 Painting of Outdoor equipment (external surfaces) such as piping, valves, pumps, motors, electrical parts, tanks etc.

Weather exposure, weather resistance, temperature upto 120°C as per clause 6.1 & 6.3. However

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry film thickness 75µm.

Intermediate Coat

One (1) layer 2 pack high build epoxy polyamide MIO, DFT 100µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 50 microns DFT each coat in approved shades.

6.5

Special Coating

(a) Parts exposed to temperatures above 120°C, upto 200°C, not insulated

(i) At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½ and ISO 8501-1:1958. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm.

(ii) At Site

Pretreatment

Dersuting of all mechanical damages, according to ISO 8501-1:1989, grade St 3 touch up with 1 pack inorganic ethyl zinc silicate, dry film thickness 50µm.

Intermediate Coat

1 pack silicon acrylic dry film thickness 35 µm.

Final Coat

1 pack silicon acrylic, dry film thickness as 35µm.
Total system dry film thickness 145µm.
Final coat according to colour code.

(b) Parts exposed to temperatures above 200⁰C, upto 400⁰C, not insulated

(i) At Works

Surface Preparation

Blasting according to ISO 8501-1:1958 grade Sa-2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm.

(ii) At Site

Pretreatment

Derusting of all mechanical damages, according to standard Sa 2½ to ISO 8501-1:1988. Touch up with coating system according to manufacturer's recommendations.

(c) Insulated parts continuously exposed to condensing water or parts exposed to temperatures

For parts that are provided with insulation on site.

(i) Insulated parts exposed to condensing water

At Works

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm

(ii) Insulated parts exposed to temperatures

Parts exposed to temperatures upto < 400⁰C

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.

Parts exposed to temperature above 400⁰C at works (Steam pipes, pressure tubes and parts for the HRSG, such as heating surfaces, heaters and superheaters, reheaters etc)

Temporary Primer

Varnish

(d) Intermittent exposure due to condensing water/ chemicals (Indoors)

(i) At Works

Surface Preparation

Blasting according to Sa 2½ and ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two layers of Zinc phosphate primer, total dry film thickness 75µm.

(ii) At Site

Pretreatment

Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 50µm.

Total system dry film thickness 205µm.

When exposed o weathering, weather resistance finish coat shall be applied.

(e) Water Exposure

(i) At Site/ Works

Pretreatment

Removal of all welding pearls.

Blasting according to Sa 3 to ISO 8501-1:1988

Coat

4 coats 2 pack coal tar epoxy, dry film thickness 125 µm each.

Total system dry film thickness 500µm

Touch up after erection as required.

6.6 Painting of Pipes

6.6.1 Buried Piping

Internal surfaces

- (i) Surface cleaning by sand blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note : All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

Tests to be carried out after application : Bond/ Adhesion test, Holiday test

External surfaces

- (i) Surface cleaning by Sand Blasting.
- (ii) Coal tar primer compatible with coal tar enamel grade. The number of coats shall be two with a DFT of 35 microns each.
- (iii) Coal tar enamel shall be applied. A single spiral inner wrap of glass fibre tissues shall be applied overlapping at least 25 mm ensuring impregnation of glass fibre tissues in the first coat. The second coat of enamel and second outer wrap of glass fibre felt, Type – I to IS: 7193-1974 will be applied in the same way confirming to Table – 10 of IS – 10221 – 1982.

The total thickness of the coating will not be less than 4.0 mm

- (iv) Alternatively Wrapping with coal tar based anticorrosion tape conforming to IS 15337: 2003 is also acceptable in lieu of s.no. (iii) above. Wrapping thickness shall be 4.0 mm.

Tests to be carried out after application : Bond/ Adhesion test, Holiday test

6.6.2 Overground Piping

Internal surfaces

- (i) Surface cleaning by sand blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note : All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

External surfaces

- (i) Surface cleaning by Sand Blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

6.7 Internal Coatings

6.7.1 Tanks (Internal surfaces) as specified in relevant sections of specification

Industrial deionised, demineralised and potable water upto 60°C pH range 4.5-9.5

Blasting according to Sa 2½ and ISO 8501-1:1988.

Prime Coat

Two layers of Zinc phosphate epoxy primer, total dry film thickness >75µm.

Pretreatment

Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 150µm per coat.

In case of service or potable water tanks, the coating material selected shall not taint the water. The paint system shall conform to regulations issued by Food & drug administration/ National Public Health service/ AWWA/ OSHA and comply with applicable laws, regulations, ordinances etc. of the local authority, state or the nation pertains to work.

QA/ QC Procedure including pinhole inspection, shall be submitted for approval by Owner/ Owner's representative.

6.6.2 Rubber Lining of Pipes, Valves and Tanks for DM Water

Pretreatment

Blasting according to Sa 2½ and ISO 8501-1:1988

Rubber Lining

Hard rubber 5 mm for DM water applications as IS – 4682

6.7 Painting for Electrical items

6.7.1 All the steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and swarf by pickling, emulsion cleaning etc. The sheet steel shall be phosphate/ oven dried and then painted with two coats of zinc rich primer paint. After application of the primer, two coats of finishing epoxy paint shall be applied. The colour of the finishing coats inside shall be glossy white and exterior of the treated sheet steel shall be shade 631 of IS-5/ RAL 7032 for all switchboard/ MCC/ Distribution boards, control panels etc.

6.7.2 All electrical equipment shall be given tropical and fungicidal treatment and outdoor equipment shall be provided with rain hood to prevent entry of rain water into the equipment.

6.7.3 Painting of I & C equipment : Epoxy coating required for all I & C equipment.

6.8 SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
1.	Structures, platforms, galleries, ladders and handrails	Dark Admiralty Grey	632	-	-
2.	Boiler casing, ducting	Nut Brown	413	-	-

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
3.	Crane				
3.1	Crane structure	Golden Yellow	356	Black	-
3.2	Trolley & hook	Crimson	540	-	-
4.	Fans, pumps, motors, compressors	Light Grey	631	-	-
5.	Tanks (without insulation and cladding)				
5.1	Outdoor	Aluminium	-	-	-
5.2	Indoor	Light grey	631	-	-
6.	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
7.	Switchgear	Light grey (Powder coated)		-	-
8.	Control & relay panels	Light grey (Powder coated)	631/7078 of IS 1650	-	-
9.	Turbines	Light Grey	631	-	-
10.	Generators & Exciter	Light Grey	631	-	-
11.	Transformers	Aluminum	-	-	-
12.	Machinery guards	Signal red	537	-	-
13.	Piping (without insulation and cladding)				
13.1	Water System				
a	Boiler feed	Sea Green	217	-	-

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
b	Condensate	Sea Green	217	Light Brown	410
c	DM Water	Sea Green	217	Light Orange	557
d	Soft Water	Sea Green	217	French Blue	166
e	Bearing Cooling Water	Sea Green	217	French Blue	166
f	Potable & filtered Water	Sea Green	217	French Blue	166
g	Service and clarified water	Sea Green	217	French Blue	166
h	Cooling water	Sea Green	217	French Blue	166
l	Sea Water	Sea Green	217	White	-
14.	Ash Transmitting Vessels and pipe lines	Aluminium	-	-	
15.	Air System				
15.1	Station air	Sky blue	101	-	-
15.2	Control air	Sky blue	101	White	-
16.	Oil system				
16.1	Fuel oil	Light brown	410	French	166
16.2	Light oil (HSD)	Light Brown	410	Brilliant green	221
16.3	Lubricating oil	Light brown	410	Light grey	631
16.4	Transformer oil	Light brown	410	Light orange	557
17.	Gas System				
17.1	Carbon dioxide	Canary yellow	309	Light grey	631
17.2	Hydrogen	Canary yellow	309	Signal red	537
18.	Fire services	Fire red	536	-	-
19.	Effluent pipes	Black	-	-	-
20.	Vacuum pipes	Sky blue	101	Black	-

Notes :

1. This colour code basically refers to IS:2379 for piping with necessary modifications

2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

Bidder shall furnish his painting specification to suit corrosive atmosphere of coastal area along with the bid. The specification shall in general be in line with the above requirements.

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ANNEXURE-V

MANDATORY SPARES LIST



TITLE :
2 x 660MW ENNORE SEZ SUPERCRITICAL
THERMAL POWER PROJECT

SPECIFICATION NO.: PE-TS-412-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

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DATE : 27.02.2017

ANNEXURE V

MANDATORY SPARES LIST

MANDATORY SPARES FOR CHEMICAL DOSING SYSTEM			
S. No.	ITEM	QUANTITY	UNIT
C&I Mandatory Spares			
1.	Each type of lamps, PBs, ILPBs, fuse, MCB, MCCB used in the equipment/ system.	20% of installed of each type.	Nos.
2.	Indicators, Recorders, Electrical Metering and Skid Mounted Instruments		
a.	For skid mounted instruments	10% of total number of instruments for each Type and model or a minimum of one number for each model and type, whichever is more.	Nos.
b.	Indicators, recorders and meters offered from each model for the project. These instruments shall be supplied with three sets of blank scales.	10 % of Installed of each type/ model or a minimum of one number for each model and type, whichever is more.	Nos.
c.	Temperature, Transmitters and Electronic Transmitters (For Pressure, Temp., DP, Flow, Level), Temperature, Pressure, Flow & Level Switch, Safety switches, Gauges, Meters, Transducers, or any other instrument etc. meters, any other instrument etc.	10% of total number of Instruments/ transducers offered for each model and type for the project or a minimum of one number, whichever is more.	Nos.
3.	Erection hardware		
a.	Instrument valves	Ten (10) percent of each type & Size installed.	Nos.
b.	Condensate pots of each type & Size installed.	Ten (10) percent of total number of Installed or four numbers whichever is higher.	Nos.
c.	Manifold	Ten (10) percent of each type & Size installed.	Nos.
d.	Fittings	Ten (10) percent of each type & Size installed.	Nos.
4.	Each type of solenoid valve	5% or 2 nos. of each type, model etc. whichever is more.	Nos.

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:
2. 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.



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3. 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.
4. 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.
5. 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.
 - i) 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.
 - ii) 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.
 - iii) 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.

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ANNEXURE VI

DRAWING/ DOCUMENTS SUBMISSION SCHEDULE



TITLE : 2 x 660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT	SPECIFICATION NO.: PE-TS-412-154-A101	
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ANNEXURE VI

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

After award of LOI/ LOA, following minimum drawing/ documents shall be submitted by the bidder for BHEL/ 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.

S. NO.	DOCUMENT NO.	DOCUMENT TITLE	No. of weeks from LOI dated for submission
1	PE-V0-412-154-A101	P&ID for Oxygen Dosing System	2
2	PE-V0-412-154-A102	GA drawing and foundation detail for Oxygen Dosing System	2
3	PE-V0-412-154-A103	Technical Data sheet for Oxygen Dosing System	4
4	PE-V0-412-154-A104	Junction Box Termination Dwgs. for Oxygen Dosing System	4
5	PE-V0-412-154-A109	QAP for Oxygen Dosing System	2
6	PE-V0-412-154-A106	O&M Manual for Oxygen Dosing System	16

For drawings/ documents submission procedure, please refer above details. Bidder has to submit the revised drawing/ document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments/ 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. The number of drawing/ documents to be submitted by the bidder shall be as per enclosed Annexure-III.

Bidder to note 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 fortnightly, for which the bidder shall depute his concerned engineers along with project manager to PEM office or at customer office without fail.

Bidder to note 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.

Drawing/document submission shall be done through web based Document Management System (DMS). Bidder would be provided access to the DMS for drawing/document approval. Detailed methodology would be finalized during detail engineering. 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>)

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ANNEXURE –VII

FORMAT FOR OPERATION & MAINTENANCE MANUAL



TITLE :
2 x 660MW ENNORE SEZ SUPERCRITICAL
THERMAL POWER PROJECT
TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM

SPECIFICATION NO.: PE-TS-412-154-A101
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ANNEXURE-VIII
FORMAT FOR OPERATION AND MAINTENANCE MANUAL

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

Check List for Operation & Maintenance Manual

Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (√) if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	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	Index				
2.1	Showing the sections & related page nos. All the pages should be numbered section wise				
3.0	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)				
3.7	Single line/ wiring diagrams				
3.8	Control philosophy/ control write-ups				
4.0	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				



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4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	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	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				



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6.7	List of vendors & Sub-vendors with their latest 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				

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		REV. NO. 01	DATE : 27.02.2017

P&IDs FOR OXYGEN DOSING SYSTEM

DRAWING NO.

L E G E N D	
	PRESSURE REDUCING VALVE
	NEEDLE VALVE
	PRESSURE TRANSMITTER
	SOLENOID ACTUATED VALVE
	PRESSURE GAUGE
	NON RETURN VALVE
	FLOW METER WITH TRANSMITTER
	BALL VALVE
	PRESSURE REGULATOR
	PRESSURE SAFETY VALVE
	DISCHARGE TO ATMOSPHERE FOR GAS/SYSTEM
	PNEUMATIC CONTROL VALVE
	MULTI- VALVE MANIFOLD(SEE NOTES)
	CHEMICAL SEAL DIAPHRAGM
	THERMAL MASS FLOW CONTROLLER (INCLUDING FLOW CONTROL VALVE)

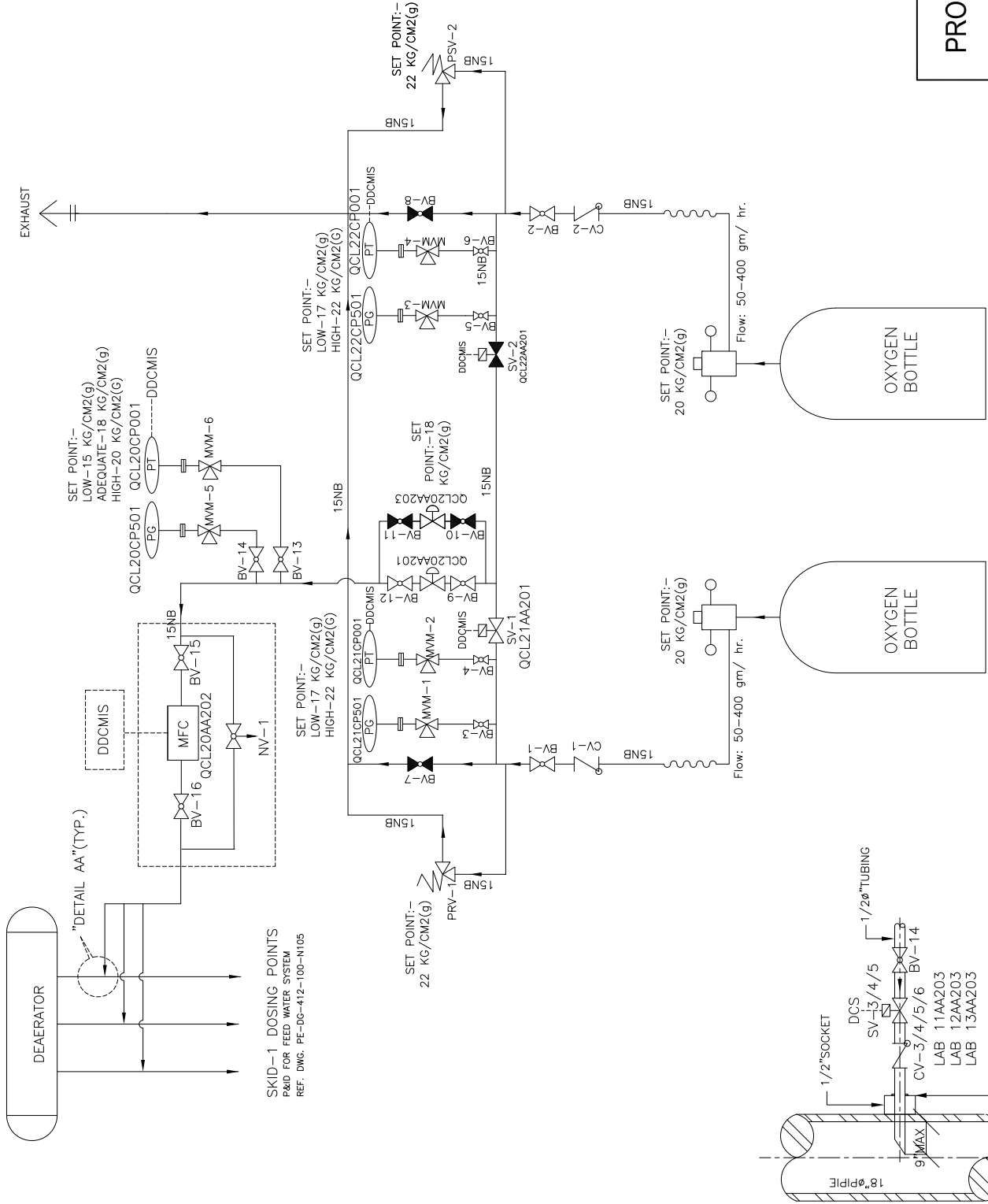
NOTES: –

- 1 THE ENTIRE SYSTEM INCLUDING THE JUNCTION BOX SHALL BE SKID MOUNTED.
- 2 ONE NUMBER SKID PER UNIT SHALL BE PROVIDED FOR DOSING AT DEAERATOR OUTLET (TOTAL=2 NOS).
- 3 THREE NUMBERS INJECTION ASSEMBLY PER UNIT SHALL BE SUPPLIED LOOSE (TOTAL = 6 NOS).
- 4 ALL THE VALVES SHALL BE OF SS 316.
- 5 ALL TUBING SHALL BE OF SS 316, 15 NB AND 18 BWG.
- 6 100 M OF TUBING PER UNIT (TOTAL 200M) OF SAME SPECIFICATION SHALL BE LOOSE WITH THE SKID.
- 7 ALL THE MULTI VALVE MANIFOLD SHALL BE 3–WAY VALVE MANIFOLDS (MOC: SS 316).
- 8 THE FOLLOWING SHALL BE THE TERMINAL POINT DETAILS: –

- TP 1: – ALL FIELD INSTRUMENTS (PRESSURE AND FLOW TRANSMITTERS), AND SOLENOID VALVES (SV1 & 2 ONLY) SHALL BE TERMINATED AT THE JB BY OXYGEN DOSING VENDOR FOR FURTHER CONNECTION TO DDCMIS BY BHEL.
- TP 2: – ALL VENT CONNECTIONS SHALL BE TERMINATED AT ONE POINT BY OXYGEN DOSING VENDOR FOR FURTHER CONNECTION TO ATMOSPHERE, IF REQUIRED, BY BHEL.
- TP 3: – DOSING TERMINAL POINT SHALL BE AFTER MCF AND TERMINATED BY THE OXYGEN DOSING SUPPLIER FOR FURTHER INTERCONNECTION TILL DOSING LOCATIONS BY BHEL.
- TP 4: – 24 V–DC CONNECTION TO SV–3, SV–4, AND SV–5 SHALL BE DIRECTLY CONNECTED BY BHEL.
- 9 THE SCHEME IS FOR ONE UNIT OF 660 MW. IT SHALL BE TYPICAL FOR SECOND UNIT.
- 10 ALL KKS TAG NOS. SHALL BE PREFIXED BY 10 & 20 FOR FIRST & SECOND UNIT OF THE PROJECT RESPECTIVELY.

PROJECT	2 x 660 MW ENNORE SEZ STPP (AT ASH DYKE OF NCTPS, CHENNAI)			
	OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED		
	OWNER'S CONSULTANT:-	DESEIN PRIVATE LIMITED DESEIN HOUSE, NEW DELHI		
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI	DEPT CODE	NAME	DATE
		A	DK	23.01.15
			MA/AKS	23.01.15
			JP/KK	23.01.15
			APPD /PK	23.01.15
TITLE P&ID FOR OXYGEN DOSING SKID AT DEAERATOR OUTLET		DRAWING No PE-DG-412-154-A101		
		SHEET	02 OF 02	REV 1

SIZE-A3



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it must not be used



TITLE :
**2 x 660MW ENNORE SEZ SUPERCRITICAL
THERMAL POWER PROJECT**

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

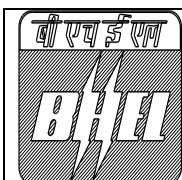
SPECIFICATION NO.: PE-TS-412-154-A101

SUB-SECTION: IB

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DATE :27.02.2017

SECTION – IB
SPECIFIC TECHNICAL REQUIREMENTS (C&I)



TITLE :
**2 x 660MW ENNORE SEZ SUPERCRITICAL
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SPECIFIC TECHNICAL REQUIREMENTS (C&I) WITH SCOPE OF SUPPLY:

- 1) OXYGEN DOSING SYSTEM shall be operated from DCS through operator work stations located in control room (BHEL Scope).
- 2) Oxygen Dosing System shall be operated from DCS through operator work station (OWS) located in common control room (CCR) and through OWS located in SWAS room (BHEL Scope).
- 3) Bidder to supply the field instrumentation, control/solenoid valve (with limit switches for open close feedback) as required and is shown in the P&ID. All local gauges as well as transmitters, sensors and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation maintenance under the scope of specification shall be provided. The necessary root valves, impulse piping, drain cock, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting / erection of these local instruments shall be furnished even if not specifically asked for. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg /Cm².
- 4) All the instruments/drives shall be terminated on JB's in field. JB's shall be in Bidder's scope. The detailed specification of instruments, JB etc. are given in detail as below.
- 5) Cable scope between BHEL & VENDOR shall be as specified elsewhere in the specification.
- 6) Number of pairs to be selected for Screen /Control cable (Size: 0.5 mm²):
 - a) F-Type: 2P/4P/8P/12P/24P
 - b) G-Type: 4P/8P/12P
 - c) 3CX2.5/5CX1.5/12CX1.5mm²
- 7) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable.
- 8) In case of any conflict and repetition of clauses in the specification, the more stringent requirements as per BHEL's interpretation shall be complied by the bidder.
- 9) The requirements given are to be read in conjunction with detailed technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section 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 BHEL's interpretation shall be complied by the bidder.
- 10) Bidder to comply with codes and standards as mentioned in the specification.
- 11) Bidder shall provide an unlimited warranty on all equipment for three years after the start of the warranty period, i.e. after satisfactory completion of initial operations. This warranty shall include repair, replacement or correction of identified software or hardware discrepancies at no cost to OWNER.
- 12) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible.
- 13) Instrument installation and accessories required for the same 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.
- 14) The solenoid valve and mass flow controller with read out shall operate at 24V DC from DCS.
- 15) Bidder to delegate /depute their persons/experts (5 working days) as per owner/consultants' requirement without any additional cost to BHEL during commissioning. Schedule of the visit shall be intimated 7 days in advance.
- 16) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system.



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17) All the instruments/ equipment/ electrical items shall be provided and designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI, at the time of supply.

18) Drawings/Documents and data to be furnished after award of the contract:

- Field instruments data sheet.
- JB GA drawing & termination details
- Any other document decided during detailed engineering.

19) C&I Mandatory spares (as applicable) to be provided as per list attached in technical specification.



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SUB-SECTION: II

REV. NO. 01

DATE :27.02.2017

SECTION – II

GENERAL TECHNICAL REQUIREMENTS

SUB-SECTION IIA - GENERAL TECHNICAL REQUIREMENTS (MECH.)

SUB-SECTION IIB - GENERAL TECHNICAL REQUIREMENTS (C&I)



TITLE :
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**TECHNICAL SPECIFICATION FOR OXYGEN
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SUB-SECTION: II A

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SECTION- IIA

GENERAL TECHNICAL REQUIREMENTS (MECH.)

	TITLE : 2 x 660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT		SPECIFICATION NO.: PE-TS-412-154-A101	
	TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM		SUB-SECTION: II A	
			REV. NO. 01	DATE : 27.02.2017

1.0 SCOPE

This specification is intended to cover design, engineering, manufacture, fabrication, assembly, supply, inspection/ testing at vendor's & sub-vendor's works, painting, mandatory spares, startup 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 **2 x 660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT OXYGEN DOSING SYSTEM**.

2.0 DESIGN PHILOSOPHY

The objective of providing the dosing systems is to maintain the chemistry of the boiler feed water and also to comply with different modes of operation i.e. "Combined Water Treatment mode" during continuous plant operation and "Ammoniacal mode or AVT(O) mode" during start-up & shutdown conditions.

The chemical feed for Combined Water Treatment (CWT) involves the feed of only aqueous ammonia and gaseous oxygen. The principles, equipment selection and control philosophy of ammonia feed system has been covered separately in the Design Memorandum and P&ID for Chemical dosing system.

The following philosophy of chemical feed system is considered:-

a) During normal operation:-

- pH is maintained at 8.2-8.5 by dosing aqueous ammonia solution.
- Oxygen dosing rate recommended by BHEL is 30-150 ppb. Exact dosing rate shall be decided by the operator. For sizing of oxygen dosing system, 150 ppb continuous dosing of 99% pure oxygen has been considered.
- Dosing shall normally be done at CPU outlet. However provision shall be given for dosing at deaerator outlet also. For this purpose two separate skid based oxygen dosing systems shall be supplied for each unit. However, dosing shall be done at one place at a time only.
- Dosing rate shall be controlled from DDCMIS by regulating mass flow controller (MFC) provided on each O₂ dosing skid under full load conditions based on dissolved oxygen level at economizer inlet. Oxygen dosing rate can be adjusted in the range of 30-150 ppb from DDCMIS. However, **TANGEDCO** may also choose to manually feed a particular set point within this range and operate the oxygen dosing automatically based on this set point.
- The oxygen dosing shall automatically turn off by closing the mass flow controller (MFC), if cation conductivity in the cycle goes above 0.3 us/cm.

b) Startup sequence:-

- Deaerator vent is kept open.
- Ammonia is dosed at CPU outlet to achieve a pH of 9.2.
- Cation conductivity reaches below 0.15 μ s/cm (at 25°C) and the trend is downwards.
- Deaerator vents are closed.
- Oxygen feed is manually started from **DDCMIS**.

c) Shut down sequence:-

- Oxygen feed needs to be stopped one hour before shut down and deaerator & LP heater vents needs to be opened.
- Ammonia dosing rate needs to be increased to achieve pH in the range of 9.2.

3.0 EQUIPMENTS FOR OXYGEN DOSING (2 skids/ unit i.e. total = 4 skids for station)

As mentioned, two oxygen dosing skids shall be supplied for each unit. Each skid shall be identical unless specifically mentioned otherwise. Since per unit only one skid of the two shall be under operation at a time, the cylinder storage for the all the skids shall be common located at the vicinity of the oxygen dosing skids. Each skid (**typical**) shall consist of the following components:-

3.1 Cylinder banks:

Each oxygen dosing skid shall consist of a bank of two oxygen cylinders, dosing at downstream of deaerator/ CPU outlet. Oxygen cylinder bank is provided to cater daily requirement. The automatic change-over of cylinder



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takes place on the basis of pressure i.e. the cylinder banks dosing at Condensate Polishing Unit (CPU) outlet will switch over at 36 kg/cm²(g) and the cylinder banks dosing at deaerator outlet at 17 kg/cm²(g). Separate storage rack, for holding 26 cylinders, and 26 filled cylinders per unit shall be supplied to cater 30 days oxygen requirement.

3.2 Pressure Regulator:

The line pressure regulator is used for reducing a high supply pressure (204 Kg/cm² cylinder pressure) to 40 kg/cm² (g) pressure in skid dosing at CPU outlet and to 20 kg/cm²(g) pressure in skid dosing at deaerator outlet.

3.3 Valves, tubing, vents and instrumentation shall be as per the attached P&IDs and Data Sheet. The MOC and specification of the equipment shall be as per the attached Data Sheet- A.

4.0 CONTROL AND INSTRUMENTATION

The mode of operation of the oxygen dosing system shall be from DDCMIS only. All the logics, controls and interlocks shall be implemented in DDCMIS. Local manual intervention is not envisaged. Both manual/ automatic controls shall be implemented in DDCMIS. The provision to select "Auto" or "Manual" mode shall be provided in DDCMIS OWS only.

Control of all dosing system shall also be done from SWAS room in addition to the CCR and one no. OWS shall be provided for control & operation of all dosing system from SWAS room.

The oxygen gas shall be at high pressure (204 Kg/cm²) in the cylinders. The same shall be brought to a lower pressure by the Pressure Regulator (set pressure of 40 Kg/cm² for skid dosing at CPU outlet and set pressure of 20 Kg/cm² for skid dosing at deaerator outlet) attached with each cylinder.

Each of the two oxygen cylinders in the skid shall have a dedicated set of solenoid valve, pressure gauge and pressure transmitter. Two cylinders provided on skid are connected and one cylinder will serve at a time based on the pressure at the inlet of solenoid valve. In case the pressure at the inlet of SV1 reaches at the set point, the solenoid valve SV1 will close and solenoid valve SV2 will open and other cylinder shall be taken in to service provided the pressure at the inlet of SV2 is not low and vice versa. Alarm for pressure low at the inlet of solenoid valves shall be provided in DDCMIS.

A pressure relief valve shall be fitted at the upstream of solenoid valve to relieve system pressure if the system pressure goes above set pressure.

The pressure of the oxygen shall be further reduced & set by pressure reducing valve in the skid {set point – "ADEQUATE"-(Set points–37 kg/cm² for skid dosing at CPU outlet & 18 kg/cm² for skid dosing at deaerator outlet). The flow and pressure of oxygen can be monitored from DDCMIS by the signal from mass flow controller (MFC) and from pressure transmitter provided at the downstream of pressure reducing regulating valve. The flow of oxygen dosing will be controlled manually/automatically from DDCMIS by adjusting mass flow controller (MFC) provided on skid based on the feedback from dissolved oxygen analyzer located in the economizer inlet. The MFC shall have a position feedback transmitter that shall transmit feedback signal to DDCMIS.

The flow of Oxygen Dosing shall be controlled manually/ automatically from DDCMIS by adjusting MFC provided on skid based on feedback from the dissolved oxygen analyzer located at the economizer inlet.

All solenoid valves mounted on the oxygen dosing skids shall be 24 V DC powered from DDCMIS and routed through the local skid mounted junction box. All the field instruments, MFC and solenoid valves (SV1 & SV2) shall be terminated at a junction box in the skid by oxygen dosing vendor for further connection to DDCMIS.

At each dosing point, viz. CPU outlet and deaerator outlet, an injection assembly containing 15 NB tubing, fixing collar, solenoid valve and NRV shall be supplied loose by oxygen dosing vendor.

The set points indicated below for operation of pressure reducing valve are tentative. Final value of the same shall be decided by oxygen dosing vendor during detailed engineering as per the requirement of the flow meter-cum-transmitter manufacturer.

Bidder to provide a flame arrestor in the vent header of each of oxygen dosing skids.



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Following interlocks/ alarm annunciation facility shall be provided.

For Skid dosing at CPU Outlet:-

Signal Source	Tag Number	Set Point (suggested)	Interlock	Alarm in DDCMIS	Remarks
During Normal Operation:-					
Pressure transmitter	QCL11CP001	42 Kg/cm ² (g) (HIGH)	Not applicable	Yes (HIGH pressure at cylinder 1 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter	QCL11CP001	36 Kg/cm ² (g) (LOW)	Close SV-1 (QCL11AA201) & Open SV-2 (QCL12AA201)	Yes (LOW pressure at cylinder 1 outlet)	Auto - changeover of cylinders. Manually replace cylinder 1 with filled cylinder.
Pressure transmitter	QCL12CP001	42 Kg/cm ² (g) (HIGH)	Not applicable	Yes (HIGH pressure at cylinder 2 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter	QCL12CP001	36 Kg/cm ² (g) (LOW)	Close SV-2 (QCL12AA201) & Open SV-1 (QCL11AA201)	Yes (LOW pressure at cylinder 2 outlet)	Auto-changeover of cylinders. Manually replace cylinder 2 with filled cylinder.
Pressure transmitter	QCL10CP001	35 Kg/cm ² (g) (LOW)	Close MFC (QCL10AA202)	Yes (Oxygen dosing stopped due to low pressure)	
Pressure transmitter	QCL10CP001	40 Kg/cm ² (g) (HIGH)	Not applicable	Yes (HIGH dosing pressure)	Manual checking of pressure reducing valve reqd.
Cation Conductivity analyzer*		0.3 µs/cm (at 25°C), increasing (HIGH)	Close MFC (QCL10AA202)	Yes (Oxygen dosing stopped due to high cation conductivity in feed water cycle)	Increase ammonia pH set point to raise pH to 9.2-9.5 range
Dissolved oxygen analyzer*		30 ppb (LOW), decreasing	Gradually open MFC(QCL10AA202) to increase DO provided signal from QCL10CP001 is "NOT LOW" (i.e. < 35 Kg/cm ² (g))	Yes (Low DO level in feed water cycle)	Initial set point may be chosen as 90 ppb. However, provision may be kept to choose exact set point for operation by operator's plant chemist during commissioning within the range of 30-150 ppb.
Dissolved oxygen analyzer*		150 ppb, increasing (HIGH)	Close MFC (QCL10AA202) to decrease DO	Yes (Oxygen dosing stopped due to high DO level in feed water cycle)	
During Start up:-					
Cation Conductivity analyser*		0.15 µs/cm (at 25°C), decreasing (ADEQUATE)	Open MFC (QCL10AA202), provided signal from QCL10CP001 is "NOT LOW" (i.e. < 35 Kg/cm ² (g)) & signal from DO analyzer is "NOT HIGH" (i.e. > 150 ppb)	Yes (Oxygen dosing started)	



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For Skid dosing at deaerator Outlet:-

Source signal of	Tag Number	Set (suggested)	Point	Interlock	Alarm in DDCMIS	Remarks
<u>During Normal Operation:-</u>						
Pressure transmitter	QCL21CP001	22 Kg/cm ² (HIGH)	(g)	Not applicable	Yes (HIGH pressure at cylinder 1 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter	QCL21CP001	17 Kg/cm ² (LOW)	(g)	Close (QCL21AA201) & Open (QCL22AA201)	Yes (LOW pressure at cylinder 1 outlet)	Auto-changeover of cylinders. Manually replace cylinder 1 with filled cylinder.
Pressure transmitter	QCL22CP001	22 Kg/cm ² (HIGH)	(g)	Not applicable	Yes (HIGH pressure at cylinder 2 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter	QCL22CP001	17 Kg/cm ² (LOW)	(g)	Close (QCL22AA201) & Open (QCL21AA201)	Yes (LOW pressure at cylinder 2 outlet)	Auto-changeover of cylinders. Manually replace cylinder 2 with filled cylinder.
Pressure transmitter	QCL20CP001	15 Kg/cm ² (LOW)	(g)	Close (QCL20AA202)	Yes (Oxygen dosing stopped due to low pressure)	
Pressure transmitter	QCL20CP001	20 Kg/cm ² (HIGH)	(g)	Not applicable	Yes (HIGH dosing pressure)	Manual checking of pressure reducing regulating valve reqd.
Cation Conductivity analyzer *		0.3 µs/cm (at 25°C), increasing (HIGH)		Close (QCL20AA202)	Yes (Oxygen dosing stopped due to high cation conductivity in feed water cycle)	Increase ammonia pH set point to raise pH to 9.2-9.5 range
Dissolved oxygen analyzer*		30 ppb (LOW), decreasing		Gradually open MFC(QCL20AA202) to increase DO provided signal from QCL20CP001 is "NOT LOW" (i.e. < 15 Kg/cm ² (g))	Yes (Low DO level in feed water cycle)	Initial set point may be chosen as 90 ppb. However, provision may be kept to choose exact set point for operation by operator's plant chemist during commissioning within the range of 30-150 ppb.
Dissolved oxygen analyzer*		150 ppb, increasing (HIGH)		Close MFC(QCL20AA202) to decrease DO	Yes (Oxygen dosing stopped due to high DO level in feed water cycle)	
<u>During Start up:-</u>						
Cation Conductivity analyzer *		0.15 µs/cm (at 25°C), decreasing (ADEQUATE)		Open MFC (QCL20AA202), provided signal from QCL10CP001 is "NOT LOW" (i.e. < 15 Kg/cm ² (g)) & signal from DO analyzer is "NOT HIGH" (i.e. > 150 ppb)	Yes (Oxygen dosing started)	

***SHALL BE PART OF SWAS SCOPE.**



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SECTION- IIB

GENERAL TECHNICAL REQUIREMENTS (C&I)

CHAPTER-3**FIELD AND MEASURING INSTRUMENTS**

- 3.00.00 FIELD & MEASURING INSTRUMENTS (PRIMARY & SECONDARY INSTRUMENTS)**
- 3.01.00 GENERAL REQUIREMENTS**
- 3.01.01** Instruments, control devices and other equipment accessories covered under this specification shall be furnished in accordance with I&C specification sheets and drawings enclosed herewith and the requirements of all applicable clauses of this specification.
- 3.01.02** The instrumentation and control equipment shall conform to all applicable codes and standards
- 3.01.03** The instrumentation/control equipment and accessories shall be from the latest proven design for which the performance and high availability have been demonstrated by a considerable record of successful operation in power station service for similar applications. The bidder shall furnish sufficient evidence to fully satisfy the Owner in this regard.
- 3.01.04** For plug in type instruments, The plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections.
Signal/Electrical connection shall be screwed connection with double compression type Nickel-plated brass cable glands for Explosion proof area, Flame proof area and high vibration prone area.
- 3.01.05** Every instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuse of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
- 3.01.06** All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC article 500, class 1, Division 1 area & flame proof) and an anti corrosive paint shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange shall also be included wherever required with the field instruments.
- 3.02.00** Following minimum requirement of field instruments shall be fulfilled by Bidder (In addition, Redundancy criteria for field instruments shall be as specified else where in specification): -
- i. Level switches / pressure switches / flow switches/any other process switches etc. for OLCS / Alarms / Interlocks / Protection. Pressure switches at inlet, outlet



- of individual pumps and discharge header of pumps for protection and auto start / stop & alarms.
- ii. Level switches for sump/tank level high/normal/ low/very low interlocks.
 - iii. Level Transmitters (Type as per Owner approval) for open sump/ tank/bunker/vessel/heaters.
 - iv. Stand pipes on both side of tank for all level instruments (LT, LS & LG).
 - v. Flow elements with flow transmitter & Flow meter for flow measurement of process medium like Steam, Water, Air, Flue Gas, Fuel oil, open channel liquid, solid fuel, ash flow, DM water, Raw water, Instrument and Service air etc. as decided by owner.
 - vi. Pressure gauges and temp. Gauges at inlet and outlet of each heat exchanger and cooler.
 - vii. DPG, DPT & DPS across the filters/strainers.
 - viii. Tapping points/test points shall be provided.
 - ix. All primary Instruments, hardware & JBs etc used for measurement for HFO, LDO & Turbine Lube Oil system shall be flame proof (IEC-79.1, Part I). All primary Instruments, hardware & JBs etc used for measurement for Hydrogen shall be intrinsically safe and explosion proof as per NEC article 500, class 1, Division 1 area I.
 - x. All Thermocouples & RTDs shall be Duplex.
 - xi. All Field Instruments used in acid or alkaline atmosphere shall be with standard Anti corrosion coating i.e. the combination of Polyurethane and epoxy resin baked coating (ANSI/ISA-71.04).
 - xii. All primary instruments installed at "Minus level or Floor" shall be with protection class of IP 68.
 - xiii. Transmitters (all type) for monitoring & controls purpose.
 - xiv. Pull cord, belt sway, zero speed switches, emergency stop PB for conveyers, other limit switches, cable gland etc. of CHP which produce spark shall be provided with dust and flame proof enclosure conforming to IS-2148.
 - xv. Lockable Deinterlock switches shall be provided for CHP as per requirement.
 - xvi. Bidder shall provide electronics weighing in motion system as per IS-11547, hermetically sealed load cell of precision strain gauge type, 100% over load protection of cell and 250% overload protection for the construction; one calibrator attachment with two weighers.

- xvii All field mounted push button, selector switch etc. shall be as per IEC or NEMA 4X protection.
- xviii All limit switch shall be conform to IEC-60947-5-1.
- xix ~~At APH, temperature measuring device of different lengths forming grid shall be provided to have average temperature for variable flow of flue gas, secondary air and primary air. These temperatures may be connected to nearest remote I/O panel.~~
- xx. On both left and right sides of furnace, separate lines shall be laid and provided with **furnace pressure transmitters having wide range** than the furnace pressure transmitter.
- xxi. Temp. Transmitters are envisaged with RTD & Thermocouples for monitoring services/application only. However any RTD & Thermocouples are used for control, interlock & protection application, same shall be directly wired to DDCMIS/DCS/PLC using instrumentation & Extension cables respectively.
- xxii. As for the water flow/ steam flow measurements, **necessary flow elements/transmitters are chosen in the process line and supplied such that their algebraic summation shall be mass balanced for calculating the system efficiency.**
- xxiii. Contacts less, electronic 2-wire position transmitters shall be provided for all inching type motorised valve and dampers.
- xxiv. ~~For CW sump level, Raw water reservoir level, Turbine oil tank, coal bunkers, Ash Silo, LDO/HFO tank, DM water tanks, CS tank, Acid and alkali applications, only non contact type level transmitters like Acoustic, Ultrasonic, Radar based shall be provided by bidders as specified in NIT and as approved by owner.~~
- xxv. Considering the type of application, wireless technology to bring signals to DDCMIS may be adopted by interfacing with OPC gateway to avoid cabling for smart level transmitters specified above at sr. no. xxiv. However Wireless technology as adopted by Bidder shall be reliable and field proven in power plants and same shall be approved by Owner.
- xxvi. ~~For Turbine oil, HFO/LDO applications & H2 Gas application, zener protection on power supplies shall be included.~~
- xxvii. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. ~~For HFO, LFO Applications, SS capillary with thin wafer element with ANSI RF flanged ends are to be provided. For hazardous area, explosions proof enclosure as described in NEC article 500 shall be provided.~~

FIELD INSTRUMENTS SHALL BE SUPPLIED & OFFERED AS PER DATA SHEETS SPECIFIED BELOW:



2 x 660 MW ENNORE SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03/2013-14

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3.03.00 TRANSMITTERS, SWITCHES, GAUGES AND PANEL MOUNTED INSTRUMENTS**3.03.01 Pressure, Differential Pressure, DP type Level and Flow Transmitters (PT, DPT, LT & FT)**

Smart Transmitters of the electronic type shall be furnished.

All Transmitter shall be installed in closed LIE in the boiler area. Similarly transmitter for TG shall also be in LIE except the transmitters located in covered area on TG floor and these shall be mounted in LIR.

Transmitters shall be equipped with mounting brackets suitable for a mounting in transmitter enclosures.

In general, Transmitters are envisaged to be grouped at several places as to be decided during detailed engg. stage. For this purpose, suitable enclosures complete with all tubing, fittings, purge meters, loop cable trays etc. shall be provided.

Type/Construction	:	Sealed capacitance/ Inductance/ Silicon resonance type
Material		
- Body	:	Die cast Aluminum with epoxy coating for air & flue gas SS316 for other services
- Diaphragm	:	316 SS
- Measurement element	:	Teflon seal
- Valves	:	Carbon steel for non-corrosive Applications SS316 for corrosive applications.
Output signal	:	4 to 20 m Amp. DC (Two wires) HART Compatible
Local Indicator	:	LCD indicator (5 digit) with scale of Engg. unit
Overall Accuracy	:	$\pm 0.04\%$ or better of Span for BTG package $\pm 0.065\%$ or better of Span for BOP packages $\pm 0.2\%$ or better of span for remote seal type transmitter.
Turn down ratio	:	100:1 in general
Stability	:	$\pm 0.15\%$ of URL for 5 years.
Response time	:	150 msec.
Power supply	:	24V DC nominal
Drive capability	:	600 Ohms nominal
Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Span and Zero	:	Locally adjustable, non-interacting



Zero suppression / elevation : At least 100% of Span

Connection

- Process : 1. Half (1/2) inch NPT (F)
Quarter (1/4) inch NPT
with/without oval flanges

- Electrical : Suitable for Plug in type connection (Both side of transmitter), unused entry with blind plug.

Accessories

- For Absolute Pressure Transmitters: Two (2) valve SS316 manifold

- For Gauge & Vacuum pressure transmitter : Three (3) valve SS316 manifold

- For DP, level & flow transmitter : Five (5) valve SS316 manifold

- For oil and corrosive liquids : Separator diaphragm seals

- For all transmitters : Mounting bracket

Manifold should not be mounted on the transmitter, Manifold shall be non integral and standalone type. Snubbers/Pulsation dampners shall be used where the process media is unstable for measurement such as the discharge of a pump. Over range protection shall be used where necessary. The coil syphons & condensate pots shall be used for steam services. Transmitters shall be provided with suitable drain & vent points.

3.03.01.01 Transmitters & other HART based instruments shall be supplied along with 3 Nos. of universal type hand held/portable pressure calibrators. Temperature transmitters shall be supplied along with 3 Nos. of hand held/portable mV source generators.

3.03.02 PRESSURE SWITCHES (PS) & DIFFERENTIAL PRESSURE SWITCHES (DPS)

Applicable Standards : IS3624 - 1966/ISA-RP-8.1 except as modified in spec.

Type/Construction : Bourdon/Sealed Diaphragm Piston Actuated preferable. Indicators with contacts are not acceptable.

Materials

- Bellows : 316 SS

- Bourdon tube : 316 SS

- Movement : 316 SS

- Encloser : Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.

- Protective Diaphragm : Teflon



Accuracy	:	$\pm$ One (1) percent or better
Repeatability	:	$\pm$ 0.5(half) percent or better
Setting & Differential	:	Adjustable

Contact

- Number	:	DPDT /2 SPDT
- Type	:	Auto reset with internal Adjustable snap action micro switch
- Rating	:	5 Amp, 240V AC / 0.2 Amp, 220V DC
Connection - instrument	:	Half (1/2) inch NPT Male Process
Electrical	:	Suitable for Plug in type connection. All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.
- Over range protection	:	One Fifty (150) percent of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

Accessories

- 3 / 5 valve manifold	:	As applicable for all switches
- Self cleaning type pulsation dampners/Snubber (Material SS316)	:	Pump and compressor discharge lines
- Syphon	:	For all steam lines
- Protective separating diaphragm	:	For fuel oil & corrosive liquid lines.
Mounting	:	Local (in LIE/LIR for BTG package).

3.03.03**PRESSURE & DIFFERENTIAL PRESSURE GAUGES (PG & DPG)**

Applicable standard	:	IS:3602-1966, IS/3624, ASME B 40.1
Type/Construction	:	
-760 mm to 1.0Kg/cm2	:	Bellows/Diaphragm
-Above1.0Kg/cm2	:	Bourdon Tube
- Suction side of pumps	:	Compound gauge

Materials

- Bourdon tube	:	316 SS
- Bellows	:	316 SS
- Movement	:	316 SS
- Case	:	SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating



		shall be provided for corrosive atmosphere.
- Protective Diaphragm	:	Teflon
Dial size	:	150mm with shatter proof glass
Scale Details	:	Graduations in black lines on white dial, on white dial, 270 Deg. pointer deflection scale provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges.
Accuracy	:	$\pm$ One (1) percent or better
Connection - Instrument Process	:	1/2 inch NPT Male Bottom
Mounting	:	Local
	:	1/2 inch NPT Male (Back entry) mounted on local gauge board.
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

Accessories

- 3 way needle valve/manifolds	:	For all gauges
- Self cleaning type	:	Pump and compressor discharge lines
Pulsation dampener/snubber (S316)	:	
- Syphon	:	For all steam lines
- Protective separating	:	For fuel oil and corrosive liquid lines

Other particulars

- External Zero adjustment	:	For all gauges
- Safety device	:	

Ranges 5 to 20 Kg/cm ²	:	Rubber blow out disc with open front construction.
Ranges above 20 Kg/cm ²	:	Neoprene safety diaphragm at the back with solid front construction.
- Over range protection	:	One Fifty (150) percent of full scale

Other Requirments

	:	Movement mechanism shall be glycerin filled for oil services & vibration prone area.
	:	For Fuel oil & corrosive liquid lines diaphragm type sensors required. Armored capillary of 10 M for Fuel oil & Corrosive liquid service.



- : Contact type pressure gauges are not acceptable for interlock & protection.
- : For condensate storage tank the pressure gauge in terms of 0-10000 mm wc or suitable range having **dial size of 300mm or bigger size** shall be provided.

3.03.04

TEMPERATURE TRANSMITTERS

Type	:	SMART type configurable from control room through HART protocol (HMS System).
Display type	:	Indicating type (5 digit LCD Display),
Accuracy	:	$\pm 0.10\%$,
Ambient temperature error	:	0.1% per 10°C change
Output	:	4-20 mA DC (2 wire system) HART compatible signals for analogue monitoring inputs to the distributed control system (DDCMIS), DCS & PLC.
Protection class	:	NEMA 4/IP66 or equivalent degree of protection for enclosure/ (Explosion/Flame proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable).
Material of accessories	:	SS316.
Stability	:	$\pm 0.1\%$ or ± 0.1 deg C of reading (whichever is great) for 2 years in case of RTD inputs and for 1 year in case of Thermocouples inputs.
Operating Voltage	:	16 – 48 V DC
Calibration	:	as per NIST monograph 125 for T/C & European Curve Alpha = 0.00385 for RTD .
Ref. Junction compensation	:	Provided
Span/zero adjustment	:	Locally adjustable, Non interacting
Auto calibration	:	Provided
Burn out protection upscale	:	Provided
Input - output isolation	:	Provided
Circuit ungrounded	:	Provided

Any RTD & Thermocouples shall be directly wired to DDCMIS/DCS/PLC for metal temperature application, bearing & winding temp application only.

The Temperature transmitter shall accept Universal dual inputs of all types of thermocouples & RTD, 0-5V input signals etc.



- (c) Air supply line to pneumatic interlocked block valves.
- (d) For each instrument rack, field instruments enclosure for purging.

3.03.31 **Electro-Pneumatic Convertors (E/P)**

Two wire type E/P convertors with an accuracy of $\pm 0.25\%$ accepting 4-20 mA dc signals from control system and converting to 0.2 to 1 kg/cm² air pressure to operate valve positioner of all final control elements; Housed in cast aluminum casing (with polyurethane paint); NEMA 4 or equivalent degree of protection for enclosure. Material of accessories will be SS. E/P convertors shall have fail freeze (stay put) feature also. Process connection shall be 1/4" NPT (F) and Electrical connection shall be 1/2" NPT (F). Zero/span adjustment facility shall be provided. The E to P convertors shall **retain the pneumatic signal (last value) even in failure of control signal** and shall have **self volume boosters**. Necessary air lock devices and pressure switches for air pressure low alarming shall be provided.

3.03.32 **Solenoid Valves**

Solenoid valves shall be provided with control valves / pneumatic control valves hooked up with process interlock requirements and where direct tripping is involved. The number of ways for solenoid valve shall be provided as indicated below:

- (a) Two (2) way solenoid valves shall be provided, where process line of less than 50 mm with low pressure and temperature application.
- (b) Three (3) way solenoid valve shall be provided commonly, where the pressure is admitted or exhausted from a diaphragm valve or single acting cylinder, e.g, Pneumatic operated spray water block valve.
- (c) Four (4) way solenoid valve shall be provided for operating double acting cylinders, e.g, Pneumatically operated on-off type dampers.
- (d) For operation of the fuel oil corner nozzle valves, fuel oil trip valves etc., **double coil solenoid valve** (latch coil & relatch coil) shall be adopted.
Single coil usage requires always power and loss of power leads to closure of above valves resulting the unit trip or loss of generation.
- (e) Solenoid Valve coils shall be Class-H high-temperature or Class-F construction as applicable and shall be designed for continuous duty. Three-way solenoid valves shall be designed for universal operation so that the supply air may be connected to any port. Solenoid enclosures shall be NEMA-4/ (Explosion proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I) As applicable). Body material of solenoid valve shall be Die Cast Aluminum or SS316.
- (f) All solenoid shall be with varister, LED indication, surge suppress diode and circuits.

3.03.33 **Power Cylinders (Pneumatic)**

Mounting Type	:	a) Fixed position mounting (End mounting).
	:	b) Trunnion mounting
Control Signal	:	0.2 to 1 Kg/Sq. cm. from I/P converter for modulating purposes. 24V/48VDC operated solenoid valve operating on pneumatic line.



- Failure Diagnostics
- Long Term Stability
- Fast Response
- IP 66 / NEMA4X Protection
- Supplied with Calibration Certificate Traceable to National & International Humidity Standards
- Sensor protection with sintered filter
- Local LCD Display for Dew Point

3.03.42

Junction Boxes

- | | | | |
|-------|---|---|--|
| v. | Type | : | Flame proof/weather proof |
| vi. | Enclosure | : | IP-65/Explosion/Flame Proof as per area classification. |
| vii. | Material | : | FRP with protective Coating |
| viii. | Cable entry | : | Bottom or Side |
| ix. | Cable glands | : | Double compression type – Nickel plated brass with PVC hoods. |
| x. | Mounting | : | Indoor/Outdoor |
| xi. | No. of terminals | : | As required with standardization with 20% spare of each size & type. |
| xii. | Terminals | : | Phoenix/Wago (screw less cage clamp type spring loaded) |
| xiii. | Grounding | : | Two terminals for body and shield ground |
| xiv. | Door | : | Hinged, lockable type. |
| xi. | Suitable mounting clamps and other accessories shall be in scope of bidder. | | |
| xii | The brackets, bolts, nuts, screws, glands, lugs required for erection shall be of brass, included in bidder scope of supply. High voltage & insulation resistance test shall also be conducted. | | |
| Xiii | M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.) | | |
| xiv | Gasket (Normal)- Neoprene thickness 6.0 mm | | |

3.03.43

Interposing Relays (IPR)

Electro magnetic type IPRs with modular design, plug-in type connections, suitable for channel/DIN rail mounting in cabinets; coil rating 24V D.C; 2 set of silver plated change over contacts rated for 0.5A 220 V DC/8 A 240 V AC. Free wheeling diode across relay copper coil and self reset type status LED indicator flag (electronic) shall be provided. Manual forcing/override facility is required. The test voltage for relay shall not be less than 4 KV with operating temperature from –20 deg. C to 60 deg. C. The relay shall have the necessary approvals like V0 inflammability class in accordance with UL94”, IEC60664/IEC60664A/DIN VDE 0110. Facility to stimulate IPR manually shall be provided. The VA burden of relays shall be suitable to match the capacity of output modules. Interposing relay & sockets for mounting the interposing relay shall be of same make only.

3.03.44

RECORDERS (CHARTLESS)

- | | | |
|-------------------|---|---|
| Type | : | Micro-processor based, Digital TFT display type |
| - No. of Channels | : | Forty Eight (48) point). |



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In order to ensure the target reliability the bidder shall perform necessary availability tests and burn in tests for major systems. Surge protection for electronic control systems, annunciation system and other solid state systems conforming to SWC test per ANSI C 37.90a (IEEE standard 472) and selection of proper materials, manufacturing processes, quality controlled components and parts, adequate de-rating of electronic components and parts shall be ensured by the Bidder to meet the reliability and life expectancy goals.

Continuous self checking features shall be incorporated in system design with automatic transfer to healthy/redundant circuits to enhance the reliability of the complete system.

In general, failure of equipment used for alarm purpose will cause switching to the alarm state.

Mean Time between Failure (MTBF) of the instruments shall be considerably higher than the equipments/system, they shall cater to in order to avoid shutdown on account of instrumentation failure.

All instruments and control equipments shall ensure high reliability, low down time and ease of maintenance.

2.05.04

Provenness, Standardization and Uniformity of Hardware

All C&I equipments furnished must have proven performance of working in the power plant, at least two sets of such equipment installed in a power plant of capacity as specified in BQR have been running successfully for at least two years. No prototype components shall be used. The Bidder shall state the application, the performance of the equipment furnished, including accuracy, repeatability, drift due to time and temperature, etc. and give the equipment list and the examples and statements for their application in his proposal.

To ensure smooth and optimal maintenance easy interchangeability and efficient spare parts management of various C&I instruments/equipment like vibration monitoring systems, all 4-20mA electronic transmitters/ transducers, control hardware, control valves, actuators and other instruments/ local devices etc. being furnished by the Bidder for main plant areas (eg. boiler/turbine etc.) and other plant and station auxiliaries, Off site/BOP packages for similar applications, the Bidder shall ensure that they are of the same make, series and family of hardware.

The bidder shall obtain & furnish the certification from his tieup partners (as consortium or other wise) that their design, engineering, procurement, manufacturing, erection, commissioning and shop test facility are adequate to meet the specified technical & performance/quality requirements for execution & commissioning of the package offered to the satisfaction of owner.

2.05.05

Redundancy Criteria for Sensors and Signals from MCC/SWGR

Redundancy of components and systems shall be dictated by availability criteria described under DDCMIS/DCS/PLC to ensure the system availability target as well as safety considerations in critical applications are fully met.



Bidder shall also introduce redundant control equipments or instruments wherever it is felt by owner that the introduction of the same shall lead to reduction of downtime of plant and equipments, in addition to the case/criteria clearly defined/identified in the specification.

Triple redundancy or dual redundancy for signals from MCC/SWGR, sensors and transmitters will be used for critical control /Protection application, critical monitoring application & other control/interlock applications. Where correction/ compensation for the measured signal are involved, the computed signal shall be the one transferred for control purposes. The measured value indicated shall be the duly corrected/ compensated signal.

Sensor/signals/measurements redundancy required (2 out of 3 or 1 out of 2) requirement have been specified in respective control system specifications and as specified elsewhere in the technical specification. However, sensor/signals/measurements utilization will be decided during detailed engineering. It is mandatory to use sensors/signals/measurements with 2 out of 3 logic for critical control & protection (Analog & Binary) application/service and sensors with 1 out of 2 logic for all other control & interlock (Analog & Binary) application/service as explained below

2.05.05.01 Triple measurement scheme

Triple measurement scheme for analog inputs employing three independent transmitters connected to separate tapping points shall be employed for the most critical measurements. The same shall be used in analog control functions including, the following but not limited to, furnace draft, feed water flow, Feed Water Temperature, feed water pressure before Economiser, Discharge Flow of each BFP, BFP discharge Temperature, Boiler Separator level control, Steam Pressure, Main steam & RH steam temp. control, SH spray Flow, RH spray Flow, throttle pressure, PA/SA Air Flow, PA/SA Air Temperature, PA header pressure, Mill Air Flow, Mill outlet Temperature, Feeder Speed Control, Spray water flow, SH, RH & Aux. Steam Desuperheater inlet & outlet Temp at each stage, SH Platen Steam Temperature before Desuper heater, SH Platen Steam Temperature after all super heaters, RH steam Temperature at Turbine end, Main steam Temperature at turbine end, turbine first stage pressure, deaerator level, Deaerator Flow after Last LPH, Hotwell level, GS steam Pressure, condensate flow before recirculation line, turbine speed, Turbine Control Valve position, Power measuring device, HP/LP Heater level, PA header pressure, SCAPH temp. Control, HP Bypass controls, LP Bypass controls, Light Oil Pressure, Heavy Oil Pressure, Atomising Steam Pressure, Heavy Oil Temperature, Hydrogen gas pressure of generator, and all other trip & protection logics etc.

For MFT/FSSS/BMS/Turbine protection/ Generator/Unit tripping, triple sensors shall be provided.

For Binary and analog inputs required in major equipment (Furnace, Turbine, tripping/protection of any HT drive etc.) protection triple-sensing devices shall be provided. Binary and analog inputs, which are, required for protection of more than one equipment as well as protection signals for HT Drives (fed by a supply feeder of ratings 3.3 kV onwards)/MDBFP/TDBFP etc., triple sensing devices shall be provided.

Triple sensors shall be provided for Instruments required for auto starting of HT driven pumps or pump tripping due to very low level of water/discharge pressure very low and



~~Trip of any auxiliary which will lead to substantial (50%) loss of unit availability. For lube oil protection of all the HT drives, **2 out of 3 logics and necessary pressure transmitters for lube oil pressure** shall be provided by bidder accordingly.~~

~~Left and right side shall be treated as individual path / individual parameter, and each side/path shall have own triple redundancy accordingly.~~

2.05.05.02 Dual measurement scheme

For binary and analog inputs required for other modulating control, protection and interlock purpose of other equipment and other critical monitoring application etc., min. dual sensors shall be provided.

Dual sensors shall be provided for instruments required for auto starting of LT driven pumps or LT driven pump tripping due to very low level of water/discharge pressure very low.

Dual sensors shall be provided for instruments required for Heat rate measurements & PADO calculations.

Dual measurement scheme for analog inputs employing two independent transmitters/ temperature element, connected to separate tapping points shall be employed for the remaining measurements used for analog control functions.

2.05.05.03 All the instruments/ sensors/transmitters/switches meant for redundant applications shall have completely separate and independent impulse pipes/ root valves etc. No redundant instrument shall share a single process tapping. There will be separate and independent tapping for every individual instrument.

2.05.06 Back-Up Instrumentation

- i. No full backup discrete hardwired based control or hardwired manual operation is envisaged in the 660 MW Unit control room for main plant. Bidder shall however perform a failure analysis to establish that the plant can be safely shutdown or can be brought to a safe operating condition without any damage to equipment and / or personnel during the unlikely event of catastrophic failure of DDCMIS/DCS.
- ii. Since nowadays the reliability and availability of control system is enhanced due to the redundancy path, **backup panel with mosaic and vertical type (not L type)** is to be provided with as minimum as possible for safe guarding the main equipments BTG and auxiliaries.
- iii. Hence in addition to the LVS and OWS, a limited operation from backup unit control vertical panel with mosaic is envisaged for emergency operation and to provide safe shut down of plant/equipments. The backup Unit control vertical panel with mosaic shall housed Conventional Push-button (ILPB) stations, Console inserts (SG & TG), Trip Push Buttons, Ammeters, CCTV for Furnace Flame, chartless recorders & digital display units for Boiler, Turbine & Generator Process/electrical parameters. Also bidder to refer details in Chapter 6.



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

CHECK LIST FOR TRANSMITTER
(APPLICABLE FOR PRESSURE TRANSMITTER)

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

Legend :

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

Note :

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

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

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MAKE						
	MODEL No.						
2	MATERIAL (BODY. PLUNGER/TRIM)			P	W	V	
3	PORT SIZE			P	W	V	
4	CABLE CONNECTION SIZE			P	W	V	
5	ENCLOSURE CLASS			P	W	V	TYPE TEST CERTIFICATE TO BE FURNISHED BY VENDOR
6	No. OF COILS & INSULATION CLASS			P	W	V	TEST CERTIFICATE TO BE FURNISHED FOR INSULATION CLASS BY VENDOR
7	POWER SUPPLY CHECK			P	W	V	
8	IR / HV TEST			P	W	V	
9	FUNCTIONAL TEST			P	W	V	

Legend :

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

Note :

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

**STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)****CHECK LIST FOR PRESSURE & DP GAUGE**

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

Legend :

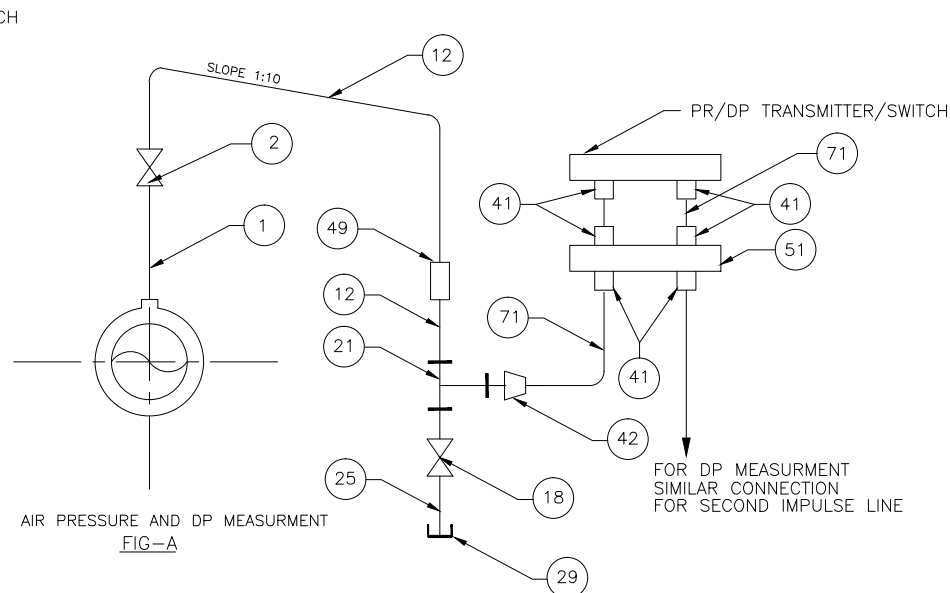
** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

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

	TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2 X 660 MW ENNORE SEZ		SPEC. NO.	
			VOLUME	
			SECTION	
			REV. NO. 00	DATE: 27.02.17
			SHEET	

INSTALLATION DIAGRAM



71	1/2"OD. IMPULSE TUBE,SS-316	AS REQD.	
51	5/3/2-VALVE MANIFOLDS,SS-316	1	1
49	3/4"SW,CS/AS BULK HEAD PIPE UNION	1	1
42	3/4"BW X 1/2"OD TUBE FITTING,SS-316	1	1
41	1/2"NPT(M) X 1/2"00 TUBE COMPRESSION FITTING,SS-316	6	6
29	3/4"NPT(F) CS CAP	1	1
25	3/4"NPS,SCH-80 X 3/4"NPS(M)CS NIPPLE	1	1
21	3/4" EQUAL TEE,CS	1	1
18	3/4" SW,CS GLOBE VALVE	-	1
12	3/4" NPS. SCH-80 CARBON STEEL PIPE	AS REQD.	
2	1/2"/3/4"/1" ROOT VALVE - SW GLOBE VALVE	1	1
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.	
TAG NO.	DESCRIPTION	A	B
		QTY.	
BILL OF MATERIAL			

QUANTITY IN COLUMN A&B TO BE DOUBLED
FOR DP TAPPING EXCEPT ITEM NO. 51

[illegible]

CHAPTER-9**ERECTION HARDWARE****9.00.00 PROCESS CONNECTION AND PIPING****9.00.01 General Requirements**

This section covers the material requirement for instrument connection to process, instrument process, piping, tubing, supports, Instrumentation cables, control cables and power cables for connecting UPS, 24/48 V DC, unregulated power supply for cubicle illumination, compensating cables/Extension cables, transmitter racks and main accessories to be furnished under this specification and the requirements of installation and routing. Impulse lines, fittings and other accessories required for the erection of complete Instrumentation and Control System supplied under various packages of this specification shall be supplied on "as required" basis. Bidder shall offer all necessary items for this section based on his experience on similar plants, plant layout diagrams, installation drawings and other applicable sections of this specification. Based on the good engineering practices Bidder shall furnish installation drawings during the engineering of the system for Owner's review and approval. The installation of the drawings shall be suitable for his installation of his range of instrumentation.

The Bidder shall furnish and test all required erection hardware, which is necessary for proper installation and interconnection of the equipment/systems furnished by the Bidder and their integration with main equipment/systems as per the enclosed installation drawings and other applicable clause. The Bidder shall furnish all hardware and accessories to ensure that the equipment/systems furnished form a complete and operational system meeting the intent and requirement of this specification.

All materials, furnished shall conform to the latest editions of America National Standard Code for Pressure piping, Power piping, ANSI B311.1, ANSI B16.11, ASME Boiler and Pressure Vessel Codes, IBR and other applicable ASME, ANSI and Indian Standards. Schedule numbers, sizes and dimensions of all carbon steel, stainless steel and alloy seamless steel pipe shall confirm to ANSI B.36.10 and of stainless steel pipe shall confirm to ANSI B 36.19 unless otherwise specified.

All materials supplied under this section shall be suitable for intended service; process operating conditions and type of instruments used and shall fully conform to the requirements of this specification.

The Bidder is responsible for the performance of the equipment furnished on system basis any shortfall in erection material observed during erection stage shall be compensated by the Bidder at no extra cost. (Installation drawings # 114-04-0000, 0100 to 0113 shall also be referred by bidder).

9.01.00 GUIDLINE FOR INSTALLATION AND ROUTING OF INSTRUMENT PIPING**9.01.01 General Requirements**

The following general erection guidelines have been enumerated here to enable the Bidder to estimate the requirement of instrument piping in plant:-



- i) All instrument piping shall be in accordance with good engineering practice. It shall be finalized during engineering stage. Instrument piping shall be complete with fittings, valves and other required accessories.
- ii) Instrument piping shall not be routed:-
 - a) Across equipment removal areas
 - b) Below mono-rails and cranes
 - c) Above or below removable gratings
 - d) Above or below cable trays.
- iii) Primary Impulse Piping System:
 - a) The primary impulse piping system shall include the instrument piping and all required accessories from process tap off point (root valves onwards) up to the respective instruments. From the same source, Tee off for instruments are not allowed. Separate tapping shall be provided for each instrument. The Bidder shall provide the necessary fittings and accessories along with impulse pipes for completeness and arrangements as per the finalized Instrument Installation Diagrams. Special accessories such as reservoirs and other devices shall be installed as required for flow primary element connection as required by the design of instruments, in accordance with the instructions of the instrument manufacturer.
 - b) The Bidder shall prepare impulse pipe routing drawings.
 - c) Impulse piping shall include a blow-down line and shut-off valve adequate for the duty requirements and for withstanding continuous design pressure and temperature of process medium. For process pressure above 40 Kg/Cm²g, double valves shall be used before connecting to the blow-down header (This arrangement shall be provided for installation for the new transmitter if the existing transmitter has the same arrangement.)
 - d) To assure a constant static head the connections from low pressure steam and low pressure liquid filled lines should preferably slope downward continuously towards the instrument as the instrument is mounted below the source point. If downward slope is not feasible or the instrument is mounted above the source point, the line should slope upward continuously and a "pigtail" installed at the instrument to assure a water seal for temperature protection. Upward sloping liquid lines should be used only if the process pressure is sufficient to assure a head of liquid at the instrument. Horizontal runs should have a slope of not less than 40 mm per meter and must be adequately supported to maintain a constant slope. Vacuum connections to the condenser should always slope upward to the instrument.
 - e) Primary process piping for steam flow, liquid flow and manometric level measurement systems should preferably slope downward from the primary element connections to the instrument. Primary piping for flue gas and air flow measurement systems should preferably slope upward from



the primary element connections to the instrument. If these requirements cannot be met, special venting or drain provisions will be required. Horizontal runs must have a slope of not less than 40 millimeters per meter and must be adequately supported to maintain a constant slope.

- f) Primary process piping from the field which enters the instrument enclosure from the bottom shall extend into the enclosure approximately 150 millimeters and be equipped with a socket weld to flare less tubing coupling of stainless steel. This coupling shall be used to connect the field primary process line to the enclosure process line. The field primary process line shall be anchored to the enclosure angle with U-bolts. Holes for supporting U-bolts shall be field or drilled.
- g) All impulse piping shall be supported rigidly at an interval not exceeding 1.5 meters so as to prevent excessive sag in piping. Process piping shall not be used for supporting impulse piping.
- h) Impulse lines subject to severe sonic pulsations such as boiler feed pump discharge, shall be of sufficient length and of suitable configuration to scatter harmful sonic wave energy before it reaches the instrument.
- i) Impulse piping shall be installed to permit thermal expansion without placing excessive stress on the piping and without affecting the gradient of slope. Long continuous straight runs of piping shall always be avoided. If required, expansion loops shall be provided at least every 2.5 meters to break the continuity.
- j) All welded and screwed fittings shall conform to ANSI B16.11. Threads of piping components shall be taper pipe thread in accordance with ANSI B2.1. All threads shall be clean machine cut with all burrs and chips removed. Lubricants shall be of dry film type. Any one of the following compounds may be used as a pipe thread sealer. Bidder shall supply adequate amount of his preferred sealer for erection purpose.
 - a) Permatex
 - b) Molycote
 - c) Neolube(Teflon tape shall not be used as a pipe thread sealer).

9.01.02

Impulse Piping System

Impulse piping system consists of primary impulse pipes/tubes, valves, fittings, valve manifolds and other accessories between the source connection point (source shut-off valve onwards) and all instruments/devices. Impulse pipe span for supporting clamp shall be 1.5 mtr. This will also include all piping and valves etc. required for instrument drain and vent connections. The Bidder shall furnish and test all items required for completeness of this specification.

9.01.03

AIR SUPPLY PIPING



The piping for air supply shall be as specified below (However the Bidder shall supply the materials as required basis to complete the system in all respect)

i) Individual Supply Lines and Control Signal Lines:-

Air lines shall be ¼ inch size, connected by brass/SS316 flare less tubing fittings. Copper/SS316 tubing shall be light drawn tampered tubing conforming to ATM B75 except copper tubing in tubing cables shall be annealed soft temper tubing conforming to ASTM B68 or B75. Fittings on the branch line to facilitate connections to the individual supply line shall be cast brass screwed type.

ii) Flexible Hoses:-

Flexible hoses shall be ¼ inch SS flexible hose pipe and with Buna-N liner steel wire braid reinforcement complete with ¼ inch brass/SS316 fittings and shall have swivel male pipe threads. Each hose shall be done meter in length.

iii) Pipe Material Specification:-

The piping material shall be carbon steel hot-dipped galvanized inside and outside as per IS-1239 or the equivalent of these standard heavy quality with screwed ends. The piping threads shall be as per ASA B.2.1.

iv) Isolating Valves:-

Gate valves as per ASTM B62 inside screw rising stem screwed female ends as per ASA B.2.1 valve bonnet shall be union type and trim shall be stainless steel body rating 150 pounds ASA. Valves sizes shall be ½ inch to 2 inch.

v) Fittings:-

Forged cast steel A234 Gr. WPM galvanized inside and outside; screwed as per ASA B2.1 dimensions as per ASA B16.11, rating 2000 pounds, elbows and soft seats. The size of the fittings shall be ½ inch through 2 inch.

vi) Air Filter Regulator Set:-

An instrument Air Filter Regulator Set with mounting assemblies shall be provided for each pneumatic device requiring air supply.

vii) Instrument Air Piping System:-

a) Instrument Air shall be made available by the bidder at 3.5 to 7.0 Kg/cm² pressure. The instrument air may be arranged as under:-

11. For the control valves and power cylinders in owner's scope but controlled by bidder's control system, the instrument air requirement for E/P converter shall be tapped from the nearby instrument air header laid by bidder / already laid existing piping with accessories available near the control valves or damper.



Complete hardware required for interfacing with Owner system shall be in bidder scope.

- b) Air supply piping shall be installed at site always with a slope of over 1/100 to prevent accumulation of condensed water within the pipe.
- c) All joints in the instrument air sub-header shall be of screwed type.
- d) Instrument air line shall be separate for each individual instrument, equipment & drive with own isolation valve and other required hardware. Tee off of instrument line for two or more same/similar services instrument, equipment & drive are not acceptable.
- e) Instrument air flushing/purging lines shall be provided for Bowl Mill DP, secondary air flow measurement instrument and other all flue gas services instruments etc.

viii) Signal / Control Air Tubing System:-

Necessary tubes with fittings and accessories for output signal from pneumatic instruments mounted in the field and control signals to final control elements shall be covered under this tubing system.

9.02.00 SPECIFICATION FOR ERECTION HARDWARE

The erection hardware shall meet the following specifications:-

	<u>Item</u>	<u>Specification</u>
9.02.01	Impulse Piping	
i)	High pressure and high temperature services (Medium: Steam & Water and furnace region)	Seamless Alloy Steel piping to ASTM A335 GR.P91/22 (schedule XXS/160 for high pressure & high temperature)
ii)	Low pressure and low temperature services (Medium: Steam & Water)	Seamless carbon steel piping to STM A106, Gr.C
iii)	Low pressure and low temperature services (Air, Flue gas)	ERW carbon steel piping to IS 1239:1973 Heavy class System)
iv)	Steam and water analysis system	Seamless stainless steel piping to ASTM A312 GR. TP-321
v)	Seamless copper tubing	ASTM B-75



9.02.02 **Fittings Double compression type**

- | | | |
|------|--|---|
| i) | Material for socket weld fittings | ASTM A105
ASTM A182,
Gr. F22
6000/3000 lbs |
| ii) | Dimensions of fittings | ANSI B16.11 |
| iii) | Fittings for steam and water analysis. | Gr. F-321 |

9.02.03 **Valves**

- | | | |
|------|----------------------------|--|
| i) | 3 – way valves | SS body/forged CS
body stellited internals and SW ends
as per requirement for 2500 lb/800 lb
ASA ratings. |
| ii) | 5- valve manifolds | FAS body/FCS body
316SS stellited internals with NPT(F)
SCRD ends for 3000/2500 lb/1500
lb/800 lb ASA ratings. Construction –
Single block (Bar stock) |
| iii) | 3-valve manifolds | FAS body/FCS body
316SS stellited internals with NPT(F)
SCRD ends for 3000/2500 lb/1500
lb/800 lb ASA ratings. Construction –
Single block (Bar stock) |
| iv) | 2-valve manifolds | FCS body, 316SS
stellited internals, NPT(F) SCR
ends. Construction – Single block
(Bar stock) |
| v) | Isolation and drain valves | Globe valves with
FAS body/FCS body, 316SS stellited
internals SW ends for 3000/2500
lb/1500 lb/800 ASA ratings. |

9.02.04	Condensation vessels	FAS/FCS body with NPT (F) SCR connection and vent plugs for 3000/2500/1500/800 lb ASA ratings.
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9.02.05	Racks and Associated Equipment	ANSI C83.9-1972
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9.02.06	Code for pressure piping, welding and Hydrostatic testing	ANSI B-31.1
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- 9.02.07** Flexible conduits with fittings Lead coated, paper insulated, heat resistant flexible metallic conduits with necessary fittings.
- 9.02.08** 3 Valve manifold shall be used, wherever Diff Pressure transmitter/switch have been used for pressure measurement.
- 9.02.09** 5 Valve manifold shall be used for Diff. Pressure & Flow measurement Transmitters/Switches.
- 9.02.10** In addition to above, table # 9.1 shall also be followed for selection of specific erection hard ware as per process requirements.

9.03.00 TRANSMITTER & SWITCHES ENCLOSURES

In general, BTG process transmitters & switches installed at outdoor location and in areas where they are subjected to splashing oil, water, steam etc., shall be mounted in closed type transmitter rack. For other areas (indoor), open type racks may be used for installation of transmitters and process switches. However the actual requirement shall be finalized during detailed Engineering considering following:-

- i) Transmitter/Switches enclosures shall be free standing, enclosed type offering protection against dust, moisture and vermin. Enclosures shall be suitable for outdoor installations, in thermal power plants.
- ii) The enclosures shall comprise of Galvanized Sheet mounting plate internally. Also external-mounting brackets in Polyamide or Stainless Steel shall be available. Alternatively transmitter enclosures can be glass Fiber Reinforced Polyester (GRP) compression moulded and shall be weather proof.
- iii) Instrument piping inside the enclosure shall conform to the specification and in line with typical installation drawings enclosed with the specification.
- iv) Blow down header shall be provided inside the enclosure as called for.
- v) Bulk head connection shall be provided to receive and terminate the impulse pipes from root valves.
- vi) Instrument tubing, fittings and isolation, drain valves shall be to ANSI code for pressure piping. Piping/tubing shall be subject to hydrostatic tests at 1.5 times maximum system pressure.
- vii) Support angles shall be provided for valve manifolds, wiring trays etc. Enclosures shall be complete with necessary bulk head fittings, junction boxes, drain header and other accessories as needed on the basis of approved hook up drawings.
- viii) Sufficient spacing among adjacent transmitters shall be maintained to offer easy accessibility and operational convenience. The enclosure shall be designed with sizes to suit the grouping and to completely include all the hardware for hooking up



the transmitters to the process on the basis of approved installation diagrams. A maximum of five (5) transmitters are envisaged to be grouped in one enclosure.

- x) A minimum of twenty (20) percent spare terminals shall be provided. Only one wire per terminal shall be used on the outgoing side of these blocks (for cable panel). Any common connections required shall be provided on the panel side of the block. All incoming power terminals are to be clearly identified in a manner distinctly different from all other terminals and grouped in a logical pattern.
- xi) Chapter no. 6 of this volume shall also be referred for designing of Transmitter/Switches enclosures.

9.04.00**LOCAL INSTRUMENTS, LOCAL BOARDS AND TAPPING POINTS**

- i) All local gauges as well as sensors, Transmitters and switches any other instruments for parameters like pressure, temperature, level, flow etc for safe and efficient operation of equipment under the scope of specification, shall be provided by bidder as approved by Owner. Such equipment shall be listed by the Bidder detailing the items with the respective functions in service. All field mounted instruments shall be mounted in such a way as not to be affected by vibration & environmental conditions. Racks to mount these instruments shall be furnished by bidder complete with requisite erection hardware, tubings and junction boxes with all terminals of the instruments duly wired complete with cable glands. Groupings of instruments, actual number of racks for instruments and its construction shall be to Owners approval.
- ii) Transmitters & Switches provided shall be mounted in transmitter/Switches enclosures to owner's approval. The junction box for electrical connections shall be outside the transmitter enclosures.
- iii) All erection hardware required for complete installation/ implementation of entire instrumentation specified is included in bidders scope. Any change in size, type, rating or in quantity deemed necessary during engineering shall be supplied within package price with no additional financial implication to owner.
- iv) Bidders scope includes providing counter flanges on pipe lines/ vessels to suit owner arranged flanged devices. Counter flanges shall be complete with gaskets, nuts, bolts and other requisite accessories for proper installation.
- v) Separate and independent tapping on equipment/associated piping shall be provided to suit the philosophy of redundant primary sensors. Separate sensors for control and monitoring etc are as decided by Owner. This shall include application such as first stage pressure. Wherever the process value being measured needs to be compensated for temp, pressure variations, the tapping points for such compensating elements shall be provided in requisite number along with the tapping for the process value.
- vi) Whereever transmitters & switches are provided, in addition Local gauges shall also be provided by bidder for local field monitoring.



- vii) Local instruments and remote sensors & transmitters to be furnished with the equipment shall generally be as indicated herein and as per redundancy criteria indicated elsewhere but not be limited to the following: -

1. Pressure Measurement

i. **Pressure Gauge for:**

- a) Shell pressures of all Deaerator, HP and LP heaters and other vessels.
- b) Mercury manometers shall be provided during air outlet flows measurement.
- c) Bleed steam pressure at extraction point for all turbine extractions and for pressure on drain lines.
- d) Pressure gauges at inlets and outlets of condensate extraction pumps, main oil pump, each auxiliary oil pump, AC standby oil pump, DC Emergency oil pump, jacking oil pumps, DM makeup pumps, DMCW pumps, BFP, or any other pumps etc.
Pressure Gauge at outlet of each type of Fan.
- e) Lube oil pressure before and after oil coolers, HPT & IPT front seal chamber leak off pressure.
- f) MS pressure downstream of ESV, after HPT control valves and after HPT first stage, HRH steams pressure after IV, Gland steam header pressure, HPT exhaust etc.
- g) Condensate pressure in condensate pump discharge header, and feed water pressure at inlet and outlet of each LP & HP heaters.
- h) LP turbine exhaust pressure and condenser pressure
- i) Relay/Lube/Control oil pressure, Drain oil lines pressure.
- j) Pressure gauges for vacuum pumps and each pump discharge.
- k) Pressure gauge at Instrument and service air header in compressor room and in the field at the main location of instrument/service air header, the pressure gauges shall be provided.
- l) Pressure gauges at inlet and outlet of each heat exchanger and cooler.
- m) Frame mounted Pressure Gauges (FMG) shall be provided for Main steam Pressure, Feed water pressure to economizer, CRH Steam Pressure, HRH Steam Pressure etc.
- n) For condensate storage tank the pressure gauge in terms of 0-10000 mm wc or suitable range having **dial size of 300 mm or bigger size** shall be provided.
- o) **U tube manometer with Hg filled for direct measurement of condenser vacuum** shall be provided in the fixed with isolation valve for local indications.
- p) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering by owner.
- q) Pressure gauge for all BoP packages as decided during detailed engineering by owner.

ii. **Pressure Switches**

- a) Pressure switches at condensate Extraction Pump Discharge header, Boiler feed pump, seal water line or any other pumps for alarm (high & low) and interlock purpose.



- b) Pressure switches for steam supply to LP/HP heaters.
- c) Pressure switches for initiation of turning gear.
- d) Pressure switches for control oil, jacking oil and lube oil pressure for all required alarms and interlocks.
- e) Steam pressure downstream of ESV, steam pressure after first stage of HPT, gland steam header pressure and suction line from turbine glands to Gland cooler.
- f) Pressure switches for condenser vacuum low, very low alarms & interlocks.
- g) Condenser water box pressure for alarm interlocks.
- h) Pressure switches (low & high) for individual pumps/blowers suction/discharge and discharge header – alarms, interlocks and protection
- i) At the main location of instrument air header the pressure low switches shall be provided for alarms in DDCMIS
- j) Pressure switches/any other process switch etc. for OLCS / Alarms / Interlocks / Protection. Pressure switches at inlet, outlet of individual pumps and discharge header of pumps for protection and auto start / stop & alarms.
- k) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria by owner.
- l) Pressure switches for all BoP packages as decided during detailed engineering. by owner.

iii. **Differential Pressure Transmitters, Diff Pressure Switches & Diff. Pressure Gauges**

- a) Pressure across strainers and filters.
- b) Diff. Pressure Transmitters/switches/Gauges for all BoP packages as decided during detailed engineering by owner.
- c) Diff. Pressure Transmitter across condenser on CW lines, Air pre heaters on air & flue gas lines, on PA lines, CEP suction strainers, Feed control station etc.
- d) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria by owner.

iv. **Pressure Transmitters**

- a) For all services as mentioned for Pressure gauges & Pressure Switches.
- b) Pressure Transmitters at condensate Extraction Pump individual Discharge and discharge header, Boiler feed pump individual Discharge and discharge header, seal water line or any other pumps/fans/HT/LT unidirectional drive for alarm (high & low) and interlock purpose.
- c) Pressure transmitter for wind box (Left/Right) & pulverizer seal air fans discharge pressure.
- d) Pressure Transmitters as on required basis for monitoring, interlocks & controls as per redundancy criteria and approved by owner.
- e) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria and approved by owner.
- f) Pressure Transmitters for all BoP packages as decided during detailed engineering by owner.



- ii) Condensate flow measurements
 - iii) DM/hotwell makeup to condenser.
 - iv.) Condensate dump flow to CST
 - v) Gland Steam Condensate flow measurements
- l) For DM water flow & Ash Slurry flows measurements online electromagnetic flow meter shall be used.
- m) At CW & ACW pump discharge headers flow transmitters shall be provided (Non Contact ultrasonic Type are preferable). In addition flow measurement shall also be provided for CW water used any where except condenser service.
- n) Instrument and Service Air - Vortex/Swirl type Flow meter
- o) Flow transmitters for general applications shall be of the differential pressure type
- p) Flow switches for OLCS / Alarms / Interlocks / Protection.
- q) Lubricating oil Flow transmitter/meter with switch shall be provided for Bearing systems of APH, FD, PA, etc.,
- r) Sight glasses flapper indication type shall be provided on lube oil cooling water piping as required to ensure indication of fluid flow.
- s) On line Fuel flow & velocity measurement facility in each Pulverized Fuel (PF) pipe for each coal pulveriser shall be provided by bidder for accurate, absolute and simultaneous measurement of coal velocity, coal density, coal mass flow rate and air-to-fuel ratio. The equipments shall comprise of sensors working on micro wave technology.
- t) In addition to the **conventional triple DP measurement techniques** involving venturi/Airfoil for secondary air flow measurement, One number **Flow measurement** system each on Left side and Right side shall be provided as **redundant/checking measurement for secondary air flow** which could be used in the optimization package.
- On line secondary air flow & velocity measurement facility in each on left side & right side shall be provided by bidder for accurate, absolute and simultaneous measurement of air velocity & flow rate. The equipments shall comprise of sensors working on tribo-electric (Correlation technique) technology.
- u) Any other flow element/meter required for system shall be finalised as per system requirement and as per approved drawings/documents by owner.

9.05.00

Process Connections

The type of instrument source connection shall depend upon the process parameters and the tapping size. The source connection drawings shall be finalised during the engineering stage.



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Project at Ash Dyke of NCTPS
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Size of tapping point stub, number and size of root valves for different types of measurements are as follows:

Sl. No.	Quantity of root valves	Size of stub and root valve	Service Condition
Pressure and Differential Pressure Measurement			
(i)	2	25NB	≥ 40 bar(g) OR 425°C
(ii)	1	15NB	< 40 bar(g) AND 425°C .
Level Measurement			
(a) Level Gauge & Switch			
(i)	2	25NB	≥ 40 bar(g) OR 425°C
(ii)	1	25NB	< 40 bar(g) AND 425°C
(b) Level transmitter (displacement type)			
(i)	2	40NB	≥ 40 bar(g) OR 425°C
(ii)	1	40NB	< 40 bar(g) AND 425°C
(c) Stand pipe for level measuring instrument			
(i)	2	80 NB	≥ 40 bar(g) OR 425°C
(ii)	1	80 NB	< 40 bar(g) AND 425°C
Flow Measurement			
(i)	2	25NB	≥ 40 bar(g) OR 425°C
(ii)	1	25NB	< 40 bar(g) AND 425°C
Sampling system measurement (Steam and Water Service)			
(i)	2	25 NB	≥ 40 bar(g) OR 425°C
(ii)	1	25 NB	< 40 bar(g) AND 425°C

Technical Specifications for C&I Systems-Table-No. 9.1

S.No.	System/Line Description	Piping Class	Impulse Pipe material	Schedule (Size)	Materials for fitting/ valve body	Valve steam material	Rating of Piping Fitting	Pressure Class of valve
1	Main steam, Up steam & down stream of HP bypass and up stream of auxiliary steam pressure reducing valve.	A	ASTM-A335 Gr.P-91/22 (Note-2)	XXS (½ Inch)	Note-3	Note-3	9000lb	3000 SPL
2	BFP discharge/ superheater attemperator/spray to PRDS	B	ASTM-A106 Gr. C	160 (½ Inch)	Note-3	ASTM-A-182 Gr.F6a	6000lb	2500 SPL
3	Reheater attemperator	C	ASTM-A106 Gr. C	160 (½ Inch)	ASTM-A-105	ASTM-A-182 Gr.F6a	6000lb	1500 SPL
4	Hot. Reheat/Down stream of Aux.Steam pressure reducing valve upto desuperheater/flash tank drain manifold, HRH upstream & down stream of LP Bypass valve.	D	ASTM-A335 Gr.P-91/22 (Note-2)	160 (½ Inch)	ASTM-A182 Gr.F-22	Note-3	3000lb	2500 SPL
5	Cold reheat upto Tee-off for HP bypass.	E	ASTM-A335 Gr.P-22	80 (½ Inch)	ASTM-A182 Gr.F-22	ASTM-A-182 Gr.F6a	3000lb	800
6	Cold reheat down steam of Tee-off (HP Bypass)	F	ASTM-A106 Gr. C	80 (½ Inch)	ASTM-A105	ASTM-A-182 Gr.F6a	3000lb	800



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7	BFP suction/condensate system/Extraction to LPH/HPH and Extractions to BFPT, Desecrator, auxiliary steam.	G	ASTM-A106 Gr. C, ASTM-A335 Gr.P-11/22	80 (½ Inch)	ASTM-A105	ASTM-A-182 Gr.F6a	3000lb	800
8	Air/Flue gas outside furnace.	M	ASTM-A106 Gr.B/C	80 (¾ Inch)	ASTM-A105	ASTM-A-182 Gr.F6a	3000lb	800
9	Air flue gas inside furnace	N	ASTM-A335 Gr.P-22	80 (¾ Inch)	ASTM-A182 Gr.F-22	ASTM-A-182 Gr.F6a	3000lb	800
10.	Purge Air	O	ASTM-A106 Gr.C	80 (¾ Inch)	ASTM-A105	SS316	3000lb	800
11.	DM Cooling water	P	ASTM-A312 TP 316	80/40 (1/2 Inch)	ASTM – A 182 F 316	SS316	3000lb	800
12.	CW & ACW	Q	ASTM-A106 Gr.C	80 (1/2 Inch)	ASTM-A105	SS316	3000lb	800

Note:-

- 1). Above requirements are minimum to be complied by bidder. Rating of piping / fittings / valves etc. is subjected to be approved by owner as per the final design pressure & temperature finalized during the detailed engineering, as per ANSI B 31.1.
- 2). In case temperature is more than 540 deg C, the material shall be P-91 only.
- 3). Material shall be compatible with that of the impulse pipe material and design parameter.
- 4). For DM Plant or DM water services, complete erection Hardware material shall be SS316 only.



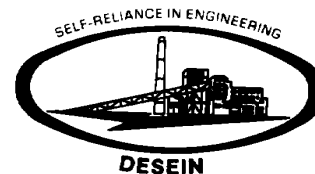
9.06.00 INSTRUMENTATION AND CONTROL CABLES**9.06.01 General**

Bidder's scope of supply, laying, erection & commissioning of instrumentation and control cables shall include the following:-

- a) Bidder shall supply, lay, erect, *terminate* all type of cables required for power plants i.e. the control, instrumentation, *interfacing (coaxial, fibre optic) cables etc.* irrespective of other end scope.
- b) All interconnecting cables and prefabs between bidder's supplied instruments, local JB, local instrument/transmitters, cabinets, panels and termination cabinets and interconnecting cables between Bidder's panels to equipment / instruments/ Plant Control Room. All field JB's / all field instruments/MCC/SWGR to DDCMIS/DCS cabinets in CER/ PLC cabinets/Relay cabinets/local control panels/desk etc. All power, Signal & Special cables from Sensor to JB, JB to MCC, JB/Drives to PLC/DDCMIS/DCS, MCC/SWGR to DDCMIS/DCS/PLC cabinets wherever one end or two ends are in EPC bidder's scope. Complete Cables shall be supplied, laid, terminated & commissioned by EPC bidder including preparation of Cable schedule and supply of cable Trays irrespective of other end scope.
- c) All co-axial cables/*fibre optic cables* and any other special cables for *interfacing with other packages via soft link (covering all packages irrespective of scope).*
- d) K Type Thermocouples Extension cables, T Type thermocouple Extension cables and S/R type Thermocouple Compensating cables
- e) Interfacing cables (*Coaxial, fibre optic etc*) between owner supplied PLC/control systems (if any) to DDCMIS.
- f) Fire survival cable
- g) Preparation of Complete cable schedule, Interconnection diagram & JB schedules shall be in bidder scope.
- h) All others cables not included above however required for completeness and operation of plant.
- i) The cables shall be provided in non returnable wooden drums. The drum length shall be 1000 m $\pm$ 5% up to & including 12 pair cables and 500 m $\pm$ 5 % for above 12 paired cables.

The quantity of the above types of cables shall be estimated by the Bidder based on his experience.

Any shortfall in cable quantity during actual laying at site shall be compensated by the Bidder at no extra cost to the owner.



Bidder shall supply the specified type of cable on as required basis for different cabling and interconnection work, provided the same meet the requirements of Bidder's I&C application.

9.06.02 SPECIFICATION AND STANDARDS

9.06.02.01 Except where specified otherwise all materials , cables and construction shall conform to the Indian Electricity Act and Rules and the Indian and other international standards with latest revisions and amendments issued up to date.

9.06.03 MATERIAL SPECIFICATIONS

9.06.03.01 General

9.06.03.02 All materials shall be new and of tested quality conforming to applicable National and Manufacturer's Standards and Indian Electricity Rules.

9.06.03.03 All materials shall be transportable to and suitable for installation at site with ease and without any damage. It shall give continuous reliable operation over long period under worst specified site conditions.

9.06.03.04 All materials shall be designed to withstand extremes of all magnetic, electrical, mechanical and thermal stresses which may be encountered during normal and abnormal operating conditions.

9.06.04 Cables – Design Criteria

9.06.04.01 Cables shall be so designed and manufactured that damage does not occur in handling, during transit, storage, installation and operation under any or all the climatic and operating conditions which they may be subjected to. Outer sheath of cables shall have rodent and termite repulsion property.

Cables shall be suitable for laying in conduits, ducts, trenches, trays or for direct burial in ground in both and wet locations.

9.06.04.02 Cables shall be capable of operating satisfactorily under the power supply voltage and frequency variations as specified in the specification. Current ratings and ratings factors of cables shall not be worse than the ones specified in IS: 3961.

9.06.04.03 Performance characteristics of cables shall be based on the following conditions of laying:

1. All cables shall be laid in multilayer and touching each other.
2. Cables shall be suitable for laying in duct or burying in ground upto a depth of 1.5 meters with uncontrolled back fill and chances of flooding by water.

9.06.04.04 Fillers in multiple conductor cables shall be flame retardant and moisture resistant.



- 9.06.04.05 All cables shall be provided with marking including manufacturer's name, insulation material, conductor sizes, no of pairs, voltage ratings, type of cable, etc, progressive markings to read marking of the length of the cable at each meter interval and "FRLS".
- 9.06.04.06 All cables shall be suitable for continuous operation at 85 deg C except for high temperature resistant Teflon insulated cables, which shall be suitable for continuous operation at 205 deg C.
- 9.06.04.07 All the cables used in the Hot/high temp. Zone (Combustor region), for emergency trip push buttons, Fire alarm system, safety critical circuits, Trip protection circuits and for other services specified elsewhere in the specification shall be fire survival cable conforming to IEC 60331, BS6387 (CWZ), BS6207 standard and this specification. The instrumentation cables in other area shall be FRLS conforming to IEC 60332 standards and this specification.
- 9.06.04.08 All external field signals for DDCMIS/DCS/PLC shall be terminated in separate marshalling/termination cabinets. Under no circumstances, Field cabling to be directly terminated in DDCMIS/DCS/PLC system cabinets.
- 9.06.04.09 All cables shall be paired cables.
- 9.06.04.10 All cables shall be provided with anti termite, Anti Rodent & moisture resistant properties.
- 9.06.04.11 All spare contacts/terminals on relays, control switches, limit switches or similar devices, process switches, duplex RTDs & Duplex T/Cs shall be wired to accessible terminal blocks/JBs for Owner's future connections. All wiring leaving a junction box or enclosure shall leave from terminal blocks and not from other devices in the enclosure. Two (2) pair (individual & overall shielded) cables shall be provided for terminating the thermocouples, transmitters & switches i.e Analog & Binary signals to local JB's. Similarly four (4) pair (individual & overall shielded) cables shall be provided for terminating the Duplex (3/4 wire) RTD to local JB's.
- 10% spare pairs or min 1 pair cable (which ever is more) shall be provided with all type of cables.
- 9.06.03.12 Cable size & type shall be as below for different type of signals and control system.
- Cables for analog signals shall be instrumentation cable of 0.5 sq. mm copper conductor size, with individual pair shielding & over all shielding as per cl. No. **9.06.04.02** mentioned below.
 - Cables for binary signals shall be instrumentation cable of 0.5 sq. mm copper conductor size as per cl. No. **9.06.04.02** mentioned below with exceptance of over all shielding only.
 - Cables for binary signals in relay based system and Fire protection & detection system shall be instrumentation cable of 1.5 Sq.mm conductor size, overall shielded as per cl. No. **9.06.04.01** mentioned below.



- d) Cable for power supply to each solenoid valves shall be control cable of 3C x 2.5 Sq.mm copper conductor size. Specification shall be as mentioned elsewherein the Electrical part.
- e) For cables single length more than 500 meters, the size of conductor shall be 1.5 sq. mm only irrespective of type of signals.

9.06.05 Cable Specification

9.06.05.1 The Instrumentation cables shall function without breakdown for surges experienced in the control system. Voltage class and insulation levels shall be compatible with the signals they convey.

9.06.05.2 Cable Specifications

Cable shall have the following specification: -

<u>Sr.No.</u>	<u>Description</u>	<u>Cable N</u>
1.	Voltage Grade and Type	660 V/1100 V grade multipair annealed tinned copper conductor overall shielded armoured instrumentation cable.
2.	IS Reference	IS: 1554 (Part-I Generally)
3.	Conductor	Nominal 1.5 Sq. Area concentric lay Annealed tinned high conductivity Stranded 7x0.53 mm dia. Electrolytic Copper conductor.
4.	Insulation	Extruded HR PVC type – C to IS:5831
5.	Shield	Minimum 0.06mm thick aluminum mylar tape shall be provided on each pair with hundred percent coverage, 25% overlap and tinned copper drain wire of diameter 0.8mm with 7 strands.
6.	Inner sheath	FRLS HR PVC type ST-2 to IS:5831/VDE 0207. Colour Black.
7.	Armouring	Galvanized steel wire/strip to IS:3975 & IS 1554 Part II
8.	Outer sheath	FRLS HR PVC type ST-2 to IS:5831/VDE 0207. Colour Blue.
9.	Lay	Twisted pair with 25 - 40lay/mt
10.	Tests for FRLS Properties	1. <u>Flammability Test</u> The cables shall pass The requirement of IEEE-332 part B fire propagation test in this regard.



2. Smoke generation by Sheath under fire
When tested as per ASTM-2843, the cable shall meet the requirement (60%) smoke density.
3. Acid gas generation of sheath during fire
When tested as per IEC-754-1, the maximum Acid gas should be less Than 20% by weight.
4. Oxygen Index Test
The oxygen index when tested under ASTM D 2863 shall be minimum 29.
5. Water immersion test shall be carried out as per VDE 0815
6. Swedish Chimney Test

Other Tests:

1. Fire resistance test to IS-5831 for 20 minutes. (PVC insulation & sheath of electrical cables)
2. Thermal stability at 200 deg. C to IEC-540 for 100mts.
3. Rodent and termite proof.
4. Heat shock test to IEC-502.

11. Conductor and Pair : The wires of pairs shall be coded by base colours on insulation which are repeated in every unit. Base colours of the pairs in a unit shall be as follows:

Pair	1	2	3	4
------	---	---	---	---

- | | | | | | |
|----|------|------|--------|-------|-------|
| a) | wire | Blue | Grey | Green | White |
| b) | wire | Red | Yellow | Brown | Black |

The units shall be coded by colours of rings on the insulation cores as tabulated below in order to distinguish between wires of various units in cables :

Unit: Ring Colour: Ring Group



1.	PINK	I
2.	PINK	II
3.	PINK	III
4.	PINK	IIII
5.	PINK	IIIII
6.	ORANGE	IIIIII
7.	ORANGE	IIIIIII
8.	ORANGE	IIIIIIII

The vertical lines under column (Ring Group) in the above table indicate number of rings at intervals of approx 60 mm length of the wires of the units. For cables above 4 pair, each 4 pair units shall be open helically lapped with numbered binder taped for the purpose of binding & unit identification.

12. Marking Marking on length of the cable shall be at every meter interval on the outermost PVC sheath of cables.

13. **Electrical Properties at 20 Deg.C:**

- | | | |
|----|---|--|
| a) | Conductor resistance of the loop not greater than | 78.4 Ohms/Km
for 0.5 sq mm. Conductor size. |
| | | 24.6 Ohms/Km for 1.5 sq mm. Conductor size. |
| b) | Insulation resistance not less than | 100 Meg
Ohms/Km |
| c) | Mutual capacitance at 0.8 KHz not greater than | 100 nF/Km |
| d) | Test Voltage-cond/cond. and cond/shield | 2000 Vrms |
| e) | Characteristic impedance at 0.8 KHz | 370 Ohms for 0.5
sq mm. Conductor size. |
| | | 230 Ohms for 1.5 sq mm. Conductor size. |
| f) | Image attenuation at 0.8 KHz | 0.11 dB/100 m |
| g) | Image attenuation at 10 KHz | 0.29 dB/100 m |
| h) | Cross talk attenuation at 0.8 KHz greater than | 70 dB/Km |
| i) | Coupling capacitance at 0.8 KHz not greater than | 200 pF/100 m |
| j) | Min Vol. Resistivity | : 3.5 x 10 ¹⁴ at 27 deg C |



3.5 x 10¹¹ at 85 deg C

k)	High Voltage Test	:	Duration
	Conductor to Conductor	:	2000 Vrms, 50 Hz for 1 min.
	Conductor to Shield	:	2000 Vrms, 50 Hz for 1 min.

9.06.05.3 Cable Specifications

Cables shall have the following specifications:-

<u>Sr.No.</u>	<u>Description</u>	<u>Cable – M</u>
1.	Voltage Grade and Type	660V/1100 V grade multipair annealed tinned copper conductor individual pair and overall shielded armoured instrumentation cable.
2.	IS Reference	IS:1554 (Part-I) (Generally)
3.	Conductor	Nominal 0.5 Sq.mm. area concentric lay annealed tinned high conductivity stranded 7 x 0.307 mm dia. Electrolytic Copper conductor
4.	Conductor size	: Overall dia of each conductor including insulation should be between 1.4 to 1.65 mm. For 0.5 sq mm. size conductor.
5.	Insulation	Extruded HR PVC type-C to IS:5831
6.	Shield	Through aluminum mylar tape min 0.06 mm (0.075 mm) with min 25% overlap and 0.8 mm dia tin coated copper drain wire (7 stranded) laid under the contact with aluminum side of the tape.
7.	Inner sheath	FRLS HR PVC type ST-2 to IS:5831/VDE 0207, Colour Black
8.	Armouring	Galvanised steel wire/strip to IS:3975
9.	Outer sheath	FRLS HR PVC type ST-2 to IS:5831/VDE 0207, Colour Black
10.	Test for FRLS properties	"See details as specified in Cable Type N".
11.	Colour Coding & Marking	- do-
12.	Electrical Properties	- do-

9.06.05.4 Specification for Co-axial Cables Cable-C

Co-axial cables are used for high frequency equipments and systems for transmission and reception purposes and computers. Co-axial cable should have minimum following characteristics:-



Construction	:	Solid silica coated, annealed tinned copper conductor.
Di-electric	:	Low loss solid polyethylene foam, semi and spaced construction.
Outer conductor	:	Braided or longitudinal tube of copper or Aluminum giving 100% coverage with slight overlap.
Outer sheath	:	FRLS PVC type ST2
Diameter over Di-electric	:	7.24 sq.mm.
Outer diameter	:	10.29 sq.mm.
Nominal impedance	:	75 ohms
Nominal capacitance	:	20.5 pF/ft.
Nominal attenuation	:	8 dB at 1000 MHz Per 100 ft.

Co-axial cable shall be low smoke (ASTM- E 662), flame retarded (IEEE 383) and halogen free (IEC 754: 1 & 2), MIL C-17 G.

9.06.05.5 Extension & Compensating Cables

1. Applicable Standards : ANSI MC96.1; IS:1554 (Part-I) IS:5831-1984
2. Type : Single / Multipair twisted and shielded type as per ANSI MC96.1
3. Conductor Size : 1.31sqmm, solid alloy (16 AWG)
4. Conductor Diameter : 1.29 mm
5. Insulation : PVC insulated, heavy duty, Self extinguishing type. Colour coded extruded PVC inner sheathed with overall PVC sheathed Type ST2 FRLS IS: 5831. Insulation of each wire with high grade 0.6 mm 85 deg.C Extruded HR PVC Type C as per IS: 5831, voltage grading shall be 1.1 kV.
6. Lay : Twisted pairs within 50 mm max. lay.
7. Shield : Single pair cable assembly only. Multiple pair - each pair and cable assembly. Each conductor shall be individually and overall shielded Through aluminum mylar tape min 0.06 mm (0.075 mm) with min 25% overlap & 100% coverage and 7 strand 20 SWG minimum size tin coated copper drain wire.
8. Outer sheath : FRLS HR PVC type ST-2 to IS:5831
9. Conductor Identification : See "Cable Details" as below
10. Armour : Galvanised steel wire/strip to IS:3975
11. Multiple pair identification : Each pair numbered every 250 mm



12. Electrical Parameters:

Thermo electric specification, limit of error shall be as per IEC, ANSI

Description	KX type	SX/RX Type	TX Type
E.M.F at 100 Deg.C	4.095mV	0.646/0.647 mV	4.279 mV
E.M.F at 200 Deg.C	8.137mV	1.441/1.469 mV	9.228 mV
Tolerance	± 2.2 °C from 0°C to 200°C	± 1.5 °C from 0°C to 200°C	± 1.0 °C from 0°C to 100°C
Conductor loop resistance for 1.31 sq. mm (16 AWG) size as per ANSI MC96.1 at 20 Deg.C Ohms/K.Mtr	760 (Typ)	95 (Typ)	390 (Typ)

Insulation Resistance (min) : 100 M ohm x KM

Mutual Capacitance at 0.8 resp. 1 KHz (max):

- Single pair and pair screened : 120nf/KM
- upto 4 pair overall screened : 96 nf/KM
- above 4 pairs overall screened : 80 nf/KM

13. CABLE DETAILS

ANSI Type	Conductor Material		ANSI Colour Code		
	Positive	Negative	Positive	Negative	Overall
KX type Extension cable for K type Thermocouple	(NICH/NIAI) Cromel	(Nicht/NiAl) Alumel	Yellow	Red	Yellow
SX/RX type Compensating cable for type S & R thermocouple	Cu (Copper)	Cu Ni (Copper-Nickel alloy)	Black	Red	Green
TX type Extension cable for type T thermocouple	Cu (Copper)	Constantan	Blue	Red	Blue

14. Tests to be conducted:

- Thermo-e.m.f characteristics
- Continuity test
- Measurement on capacitance, inductance and loop resistance.
- Insulation resistance
- High voltage tests as per IS(latest)
- Tensile and elongation tests
- Flame retardency as per IEC 332
- Oxygen index test



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9.06.05.6 Fiber Optic Cable

A	Fiber: The optical fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withdraw temperature of about 80 Deg C (continuous). Fiber Optic cables shall be suitable for installation on cable tray, duct bank, cable trench, direct burial as necessary.		
1	Type	Multiple single mode & Multi-Mode Fiber to avoid usage of any repeaters.	
2	Core Diameter	Multimode Fiber cable	Singlemode Fiber cable
		62.5 $\pm$ 2 microns or 50 $\pm$ 2 microns depending upon distance between source & destination.	9 $\pm$ 1 microns
3	Cladding Diameter	125 $\pm$ 2 microns	
4	Fiber Proof test	As per IEC/EIA & other international standard.	
5	Coating Diameter Test	As per IEC/EIA & other international standard.	
6	Number of Fibers/core	Six (Colour Coded) with min. 100% spare core (Fibers)	
B1	Optical Characteritics – Bandwidth, Attenuation & Numerical Aperture	For multimode fiber cable with core diameter 62.5 $\pm$ 2 microns:	For multimode fiber cable with core diameter 50 $\pm$ 2 microns:
1	Bandwidth @ 850 nm Bandwidth @ 1300 nm	160 MHz-Km min 500 MHz-Km min	500 MHz-Km min 500 MHz-Km min
2	Attenuation @ 850 nm Attenuation@ 1300 nm	3.0 dB/Km max 0.8 dB/Km max	3.0 dB/Km max 0.8 dB/Km max
3	Numerical Aperture	0.275 $\pm$ 0.015	0.200 $\pm$ 0.015
B2	Optical Characteritics - Attenuation	for Singlemode fiber cable outside plant:	for Singlemode fiber cable inside plant:
1	Attenuation@ 1310 nm Attenuation@ 1550 nm	0.35 dB/Km max 0.2 dB/Km max	1 dB/Km max 1 dB/Km max



C	Cable Construction:	
	Fiber Optic cable shall be of loose tube design. Typically, fibres shall be housed in groups of 6 (minimum) within gel-filled buffer tubes to protect against ingress of moisture and vibration. The tubes shall be manufactured with industry standard material tools & practices. The buffer tubes shall be stranded around the central strength member utilizing reverse oscillating lay (ROL). Blank fillers shall be used as necessary to maintain circular cable structure. Fillers shall be flame retardant and moisture resistant. The cable shall be of dual jacket & armoured. Optic Fibre cable shall be polymer coated, galvanised corrugated steel taped armoured, fully water blocked with central dielectric material for outdoor/indoor application so as to prevent any physical damage. Two highly visible ripcords are placed under the jacket to aid in sheath removal. A co-polymer coated steel tape is corrugated and wrapped around the inner jacket to provide additional cable compression strength and Termite & rodent protection. A ripcord is also placed underneath the armour for easy outer jacket removal.	
1	Outer Colour	Orange
2	Outer Jacket	Polyethylene minimum 1.5mm thick, Flame retardant & UV resistant.
3	Inner Jacket	Core-locked flame retardant polyethylene
4	Filler / Strength member	As per Manufacturer's standard
5	Central Strength member	FiberGlass reinforced plastic (FRP) and Buckle resistant material to provide both tensile and anti bucking strength to the cable.
6.	Details marked at every meter on outer sheath.	Manufacturer's Name, Month and Year of Manufacturer, Coded description of the cable based on telcordia's (bellcore) SR-2014 suggested optical cable code (SOCC), Sheath identification Number, Sequential Length marking in meter, A telephone Handset symbol to distinguish communication from power cable as per NESC section-35G.
7.	Life Expectancy	Fiber Optic cable shall provide a long life expectancy of minimum 25 years under continuous operation without degradation to optical or mechanical performance.
D	Stripping Ability	All layers easily removed with Commercially available tools
E	Installation:	
1	Minimum bending radius	20 X D (D=core Diameter) - During Installation , Short Term , loaded 15 X D (D=core Diameter) – Installed, Long



		Term , No load
2	Maximum Tensile Load/Strength	During Installation: 2200 N Installed: 1500N
3	Method of laying	Directly laid in cable trays / duct bank / clamped with available structure
4	Pulling	Ordinary cable grips
F	Storage Temperature	- 20 ° C to 60 ° C
G	Operating Temperature & Humidity	- 20 ° C to 70 ° C & 100%
H	Data Speed performance	10 Gbps minimum
I	Test Specification (EIA/TIA – STD455 or Equivalent):	
1	Impact Resistance	2000 Impacts minimum
2	Crush Resistance	4000 N/10cm minimum
3.	Compressive Strength	3000 N minimum
J	Moisture/Water Resistance	Water blocking layer, Cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end.
K.	Optical time Domain reflectometer	a. A recording optical time domain reflectometer (OTDR) will be utilized to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall be equipped with data storage, printer, help feature, compare trace features and OTDR software. The data storage unit must include a built-in floppy disk drive capable of storing a minimum of 100 test traces. b. Data traces saved to disk shall include the following labels. i. Fiber Identification (ID) with a minimum of 10 characters. ii. Cable ID with a minimum of 10 characters iii. OTDR location with a minimum of 20 characters iv. Far End location with a minimum of 20



		characters. v. Test operator initials with a minimum of 3 characters. c. The printer shall preferable be internal. The printer shall be able to print data traces within 30 seconds or less. The machine setting used to repeat tests at a later time shall include index, range, wavelength, average time, pulse width and scale settings. The test results (on printout) shall provide information including: loss, distance, reflectance, data and time. d. The requirements for the compare trace feature include the ability to recall two historical traces from a diskette and display them simultaneously for analysis and printing. The compare trace must compute and display a single graph representing any differences between two traces. The compare trace must be able to recall historical traces from a discrete and perform the same tests on connected live fibers. The compare trace shall perform a two point loss measurement test for any two particular fibers in a comparison analysis. The losses between the two points on the each fiber shall be displayed, and the differences between the two readings clearly shown. e. The OTDR must be equipped with software to support all of the required functions. The software shall provide for printing of whole set of traces (batch print) with minimal commands eliminating the time spent for printing traces individually. f. Bidder shall provide all mounting accessories, cables and connectors required to establish data communication.
L.	Fiber Optic splicer, terminator and tool kit box	Bidder shall provide new unused tools comprise of splicer and fusion jointer and tool kit comprise of cutter, stripper,



		polishing tool, handheld microscope, heat shrinkable sleeve, scissor, knife etc as required for maintenance and commission.
M.	Standards	Optical cable shall be conform to i) IEC 60794/IEC 60793 & EIA/TIA 455. ii) Low smoke(IEC 1034 -light transmittance of 80%). iii) Halogen free(IEC 754: 1&2-maximum acid gas generation shall be 2% by weight and PH >4.3). iv) Fire & flame retarded (IEC 331,IEEE 383). v) Rodent resistant. vi) Crush Resistant (EIA -455-41). vii) Impact Resistant (EIA -455-25). Bidder shall submit Type test report for review ,conform to IEC 60794, IEC 60793, IEEE 383, IEC 754: 1 & 2,IEC 331 ,IEEE 1034 and EIA/TIA standard. Colour codes shall be as per EIA/TIA 598-A.
N.	TESTS	Following minimum test as per any approved standard shall be carried out on the cables: a. Attenuation and Dispersion characteristics tests b. Proof Tests c. Macro-Bend resistance Test d. Mechanical Test e. Low and High Temperature cable Bend Test f. Impact resistance Test g. Compressive strength Test h. Tensile strength Test i. Cable Twist test j. Cable cyclic flexing test k. Environmental characteristics Test l. Temperature cycling test m. Colour permanence Test n. Cable Aging test o. Water penetration test p. Lightning Test q. Kink Test r. Crush Test

9.06.05.7

Data Cable:



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Data transmission cables are control & signal cables used in electronics of computer system, electronic control equipment etc. in power plant data processing system. The cable has an overall screening which suppresses external electrical influences and ensures precise pulse transmission. The screen braiding of tinned copper wires is wrapped around the core or inner sheath.

i) Min. bending radius for flexing	:	15x cable diameter.
ii) Temp. Range	:	(-30 to +80) deg. centigrade
iii) Loop resistance	:	Max.78.4 ohm/km.
iv) Inductance	:	0.65 mH / Km.
v) Coupling	:	200 pF / Km.

Co axial and fibre optic cables are also used as data cables.

9.06.05.8 **NOTE:** All cables near high temperature zone shall be high temp cables, which shall be terminated at a junction box in normal temperature zone. Thermocouple extension cables and copper conductor cables for high temperature applications shall be with insulation of individual conductor and outer sheath of extruded FEP (i.e. Teflon) as per VDE 0207 Part 6 and ASTM D 2116. The thickness of insulation shall be 0.5 mm nominal (i.e. 0.4 mm minimum). These cables shall be single / Multipair twisted & shielded.

9.06.05.9 Fire survival instrumentation Cables shall be similar to the Fire survival control cables specified in electrical section (Vol. IV) except that Cables for analog signals shall be annealed tinned copper conductor 0.5 sq. mm sized, with individual pair shielding & over all shielding and Cables for binary signals shall be annealed tinned copper conductor 0.5 sq. mm sized with over all shielding only. In addition the cables shall have high degree of immunity from electromagnetic interference.

9.06.06 TYPE AND ACCEPTANCE TESTS FOR INSTRUMENTATION CABLES

9.06.06.01 After completion of manufacture, type and acceptance tests as specified in relevant standards and herein shall be conducted and requisite number of copies of test certificates as per Distribution Schedule shall be furnished.

9.06.06.02 The Owner may, at his discretion, waive type tests provided type tests reports of tests carried out on identical materials(s) manufactured by the Bidder in India in last 5 years are furnished. The Bidder shall furnish copies of such type test reports with the Bid or indicate when they expect to make these available.

After completion of manufacture, following minimum type and acceptance tests as specified in relevant standards and herein shall be conducted and requisite number of copies of test certificates shall be furnished. The Owner may, at his discretion, waive type tests provided type tests reports of tests carried out on identical materials(s) manufactured by the Bidder in India are furnished. The Bidder shall furnish copies of such type test reports with the Bid or indicate when they expect to make these available.

I. TYPE TESTS:



The type tests shall be carried out on one drum out of every 10 drums or less for each size of cable in each lot, in presence of Owner's representative as per applicable standards in Govt. approved Laboratory if adequate testing facility is not available at works of the supplier.

Sr. No.	Name of Test	Governing standard	Special requirements as per owner's specification.
1.	Annealing test (for copper)	IS : 8130/84	As per IS: 8130/84
2.	Conductor resistance test & Diameter test	IS : 10810	As per approved G.T.P.
3.	Per sulphate test (for tinned copper wire)	IS : 8130/84	As per IS: 8130/84
4.	Test for armours wires / strips	IS : 3975	As per IS:3975
5.	Test for measurement of DC resistance of armour	IS: 1554 (I)	As per approved G.T.P.
6.	Test for measurement of thickness of insulation & sheath & other dimensions.	IS : 1554 (I)	As per approved G.T.P.
7.	Measurement of volume resistivity of HRPVC insulation	IS : 5831-1984	i. 3.5×10^{14} Ohm-cm at 27°C / room temp.(Min). ii. 3.5×10^{11} Ohm-cm at 85°C (Min.)
8.	Tensile strength and elongation test for insulation & sheath.	IS:5831/1984	As per IS:5831/84
9.	Ageing test for insulation & sheath. Loss of mass test for PVC insulation & sheath.	IS:5831/1984	As per IS:5831/84
10.	Shrinkage test for PVC insulation & sheath.	IS:5831/1984	As per IS:5831/84
11.	Shrinkage test for PVC insulation & sheath	IS:5831/84	As per IS:5831/84
12.	Hot deformation test for PVC insulation & sheath	IS:5831/1984	As per IS:5831/84
13.	Cold bend test for PVC insulation.	IS:5831/1984	As per IS:5831/84
14.	Cold impact test for PVC sheath.	IS:5831/1984	As per IS:5831/84
15.	Heat shock test for PVC insulation & sheath.	IS:5831/1984	As per IS:5831/84
16.	Thermal stability test for PVC insulation and sheath.	IS:5831/1984	As per IS:5831/84



17.	Test for bleeding and blooming of pigments for PVC insulation of sheath.	IS:5831/1984	As per IS:5831/84
18.	Colour fastness to water.	IS:5831/1984	As per IS:5831/84
19.	Colour fastness to day light.	IS:5831/1984	As per IS:5831/84
20.	High voltage test (water immersion test)	IS:1554(I)	IS:1554(I)
21.	Test for rodent & termite repulsion property of sheath.	-	Presence of lead shall be detected.
22.	Oxygen index test on inner & outer sheath material.	ASTM:D-2863/77	Min.29
23.	Temp. index test on inner & outer sheath material	ASTM:D-2863/77	Min.250°C
24.	Acid gas emission test on inner & outer sheath material.	IEC-754-1	Acid gas generation shall be less than 20% by weight.
25.	Smoke Density test on inner & outer sheath material	ASTM-D-2843/77	Min. 40% light transmission during test.
26.	Flammability test on finished cable samples as per following methods: i. Swedish chimney test ii Vertical tray flame propagation test. iii. Single vertical cable fire resistance test.	SS-424-14-75 Cl. F-3 IEEE-383 IEC-332-1	SS-424-14-75 Cl. F-3 IEEE-383 IEC-332-1
27.	Tests for all electrical properties at 20°C & maximum operating temp. as per GTP.	As per GTP	As per approved G.T.P.
28.	Oxygen index test & Acid Gas generation test for Fillers	ASTMD – 2863, IEC 60754-1	As per approved GTP
29.	Continuity test, Shield thickness, Overlap test of Al Mylar shield	As per GTP	As per approved GTP
30.	Noise interference test, Cross talk test, Mutual capacitance, Drain wire continuity test.	IEEE Transaction, VDE 0472	As per approved GTP

II Routine Test:

Routine test shall be carried in presence of owner's representative for all types of cables.



2 x 660 MW ENNORE SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
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- | | | | |
|----|---------------------------|-------------|------------------------------|
| 1. | High voltage test | IS:1554 (I) | 2 KV (RMS)
for one minute |
| 2. | Conductor Resistance Test | IS:8130/84 | As per GTP |

III Acceptance Tests:

Following tests shall be carried out on 1 drum out of every 10 drums or less for each size of cables in each lot, in presence of owner's representative.

- | | | | |
|----|--|--------------|--|
| 1. | High voltage test | IS:1554 (I) | 2 KV (RMS)
for one minute |
| 2. | Conductor Resistance Test | IS:8130/84 | As per NIT |
| 3. | Volume Resistivity | IS:5831-1984 | (i) 3.5×10^{14} -cm
at 27 deg C/room
temp (Min)
(ii) 3.5×10^{11} ohm-cm
at 850C Min. |
| 4. | Measurement of Mutual capacitance at 0.8 KHZ | | 100 NF/Km (max) |
| 5. | Calculation & Verification of Characteristic impedance on the basis of value obtain for mutual capacitance at 0.8 KHZ with the help of following formula | | |

$$Z = \frac{R}{2fc} \quad 320 \text{ Ohms(nominal)}$$

where Z = characteristic impedance in ohm

R = Loop resistance of cable per km in ohms at 20 °C
f = Frequency of test in Hz (800)
c = mutual capacitance per km.

- | | | | |
|-----|--|--------------------|------------|
| 6. | Measurement of thickness of insulation and sheath & other dimensions | IS:1554 (I) | As per NIT |
| 7. | Tensile strength and elongation at break of insulation & sheath | IS:5831/84 | IS:5831/84 |
| 8. | Oxygen index test on inner & outer sheath at room temp. | ASTM-D-2863 Min.29 | |
| *9. | Temp. index test on inner & outer sheath | --do-- | Min.250°C |



*10.	Acid gas emission test on inner sheath & outer sheath.	TEC-754-1	Max.20% by weight
11.	Smoke density test on inner sheath & outer sheath	ASTM-D-2843	Min.40% light transmission during test.
12.	Flammability test	SS-424-14-75	SS-424-14-75
13.	Additional Test	Class F-3 IEC 331	Class F-3 for fire survival characteristics

* (If no. of drums selected for acceptance test for a particular cable size are more than one, the tests marked with * i.e. 5 no. 9&10 under acceptance tests shall be carried out on one drum only).

9.07.00**SHOP TESTS FOR ERECTION HARDWARE**

i) General Requirements:-

- a) The equipment as per this section shall be subject to shop tests.
- b) The Conductor shall furnish all materials, equipment, tools, instruments, bulkheads, blanking plates and all personnel required for completing these tests.
- c) Personnel performing the tests shall be qualified and experienced. Tests shall be performed as many times as necessary to assure Proper quality of materials and workmanship. If any test reveals Unsatisfactory materials or workmanship, such materials shall be Repaired or replaced to the satisfaction of the Owner.
- d) Hydrostatic and pneumatic tests shall be performed on all pipes, Tubings and systems supplied by the Bidder and shall conform To ANSI B31.1 – Code for Pressure Piping.

ii) Hydrostatic Testing

All instrument piping, which connects to process piping, shall be Hydrostatically tested.

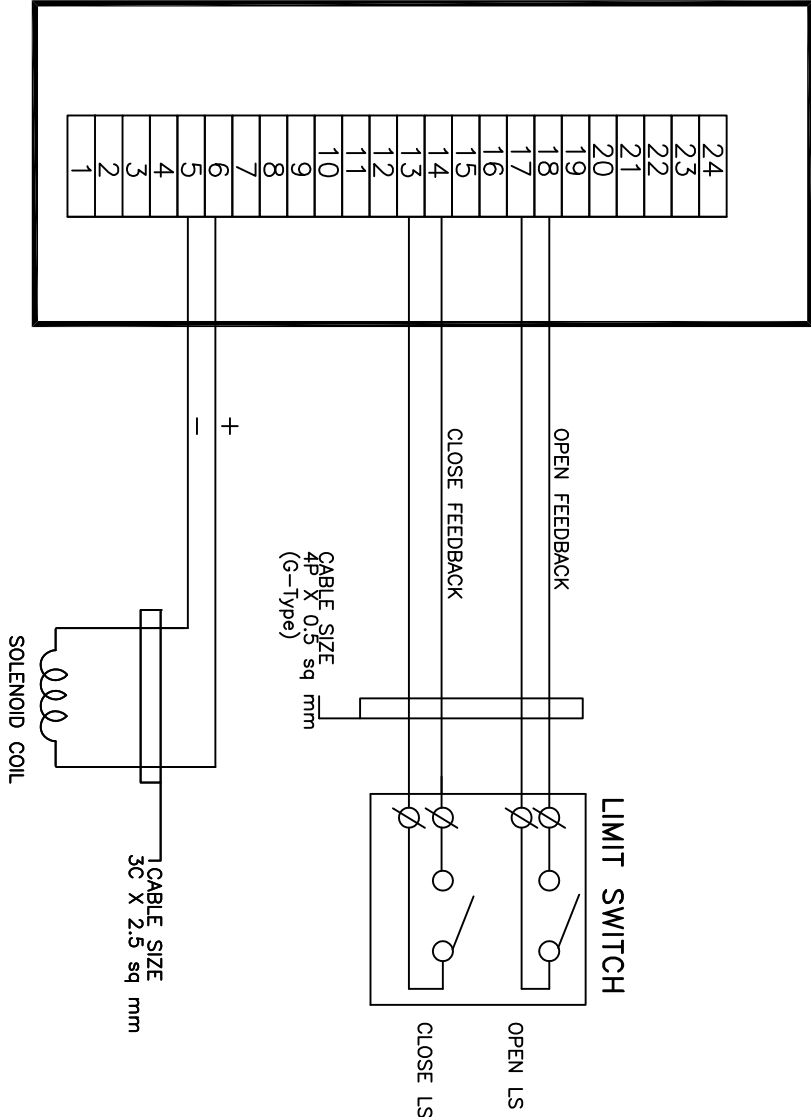


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JUNCTION BOX TERMINATION DETAILS

INTERFACE FOR SOLENOID VALVE (24VDC)

JUNCTION BOX
(TYPICAL)



		PROJECT: 2X660 MW ENNORE SEZ STPP		DRG.NO.	
TITLE		TYPICAL HOOK-UP DIAGRAM		DATE	
SOLENOID VALVE (24VDC)				REV.NO.	
SHT	1	OF	1		

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**APPLICABLE
CODES
&
STANDARDS**

1.08.00 CODES AND STANDARDS

1.08.01 All equipments, system and service covered under this specification shall comply with the requirements of the latest statutes regulations and safety codes as applicable in the locality where the equipments/systems will be installed. The Bidder shall fully acquaint himself with these requirements and shall ensure compliance with them.

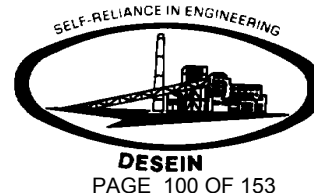
The equipments, systems and services furnished as per this specification shall conform to the codes and standards mentioned in Cl. no. 1.08.02 of this Section. However in the event of any conflict between the requirements of two standards or between the requirements of any standard and this specification, the more stringent requirements shall apply unless confirmed otherwise by the Owner in writing. The decision of the Owner shall be final and binding in all such cases.

The Bidder's scope of supply shall include some items such as thermowells, and other in-line devices for main steam, hot reheat, cold reheat, feed water system falling under the purview of Indian Boiler Regulation (IBR) Act. It shall be the responsibility of the Bidder to obtain the necessary approval of the concerned Inspecting Authority/Chief Inspector of Boilers for the design and design calculations and manufacturing and erection procedures as called for under the IBR act for all items requiring such certifications.

The requirements of statutory authorities (e.g. MOEF, Inspectors of factories, IBR, TAC, BEE, CPCB/TNPCB etc) with regards to various plants areas like Main plant, Fuel oil plant/system, Chlorination Plant, Fire Fighting system, Emission Measurement, Ambient Air Monitoring system etc. shall be complied, even if not actually spelt out.

1.08.02 Reference Codes and Standards

The design, manufacture, inspection, testing, site calibration and installation of all equipment and systems covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable ANSI,



ASME, IEEE, NEC, NEMA, ISA, DIN, VDE, NFPA, IEC, EIA, TIA and Indian Standards and their equivalents. Bidder to note that in no case, OEM/manufacturers own standards shall be accepted.

1.08.02.01 Temperature Measurement

1. Performance Test Code for temperature measurement ASME PTC 19.3 (1974 – R 1998)
2. Temperature measurement - Thermocouples ANSI-MC 96.1 – 1982, IEC 584
3. Temperature measurement by electrical resistance thermometers - IS-2806.
4. Thermometer-element-platinum resistance-IS-2848, IEC 751/DIN 43760
5. RTD Design Code – DIN EN 60751:1996, BS EN 60751 : 2008
6. Thermowell Design Code – ASME PTC 19.3 TW – 2010

1.08.02.02 Pressure Measurement

1. Performance Test Code for pressure measurement - ASME PTC 19.2 (2010)
2. Bourdon tube pressure and vacuum gauges - IS 3624, IS 3602, ASME B 40.1

1.08.02.03 Electronic measuring Instruments & Control hardware

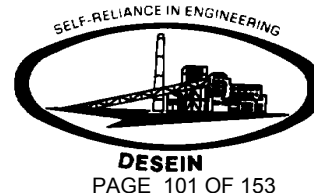
1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973), IS 9319
2. Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 - 1974.
3. Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1:ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975): ISA-S26 (1968).
5. Surge withstand capability (SWC) tests - ANSI C 37.90A (1974) IEEE Std. 472 (1974). IEC – 255.4.
6. Printed circuit boards - IPC TM-650, IEC 326 C
7. General requirements and tests for printed wiring boards - IS 7405 (Part-I) - 1973
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles ANSI C73-1973.
11. Direct acting Electrical Indicating Instruments: IS-1248-1968.

1.08.02.04 Instrument Switches and Contacts

1. Contact rating - AC services NEMA ICS Part-2 125, A600
2. Contact rating - DC services NEMA ICS Part-2-125, N600.

1.08.02.05 DDCMIS & other Control System

1. Application of Safety Instrumented System – ANSI/ISA 84.01 1996
2. Functional Safety - Safety Instrumented System for Process Sector – IEC – 61151



1. ~~Stainless steel material of tubing and valves for sampling system - ASTM A269-82 Gr TP316.~~
2. ~~Submerged helical coil heat exchangers for sample coolers ASTM D 11-98.~~
3. ~~Water and Steam in power cycle - ASME PTC 19.11(2008).~~
4. ~~Standard methods of sampling system - ASTM D 1066-69.~~

1.08.02.12 Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA RP 18.1-1979.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE std. 472-1974

1.08.02.13 Interlocks, Protections

1. Relays and relay system associated with electric power apparatus - IEEE std.3.13.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE Std. 472 - 1974.
3. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I) 1973.
4. Turbine water damage prevention - ASME - TDP-1980.
5. Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.

1.08.02.14 Process Connection and Piping:

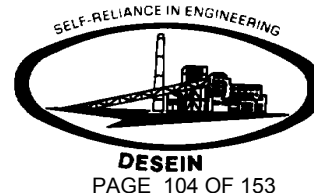
1. Codes for pressure piping power piping ANSI B31.1
2. Seamless carbon steel pipe ASTM A-106.
3. Forged and Rolled Alloy steel pipe flanges, forged fittings, valves and parts - ASTM A-182.
4. Material for socket welded fittings - ASTM A-105.
5. Seamless ferrite alloy steel pipe - ASTM A-335.
6. Pipe fittings of wrought carbon steel and alloy steel - ASTM A-234.
7. Composition bronze or metal castings - ASTM B-62.
8. Seamless copper tube, bright annealed ASTM B-168.
9. Seamless copper tube - ASTM B-75.
10. Dimensions of fittings - ANSI B-16.11
11. Valves flanged and butt welding ends - ANSI B16.34.
12. Nomenclature for Instrument tube fittings ISA-RP-42.1 - 1982.

1.08.02.15 Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A106.
2. Material for socket weld fittings - ASTM - A105.
3. Dimensions of fittings - ANSI B16.11
4. Code for pressure piping, welding, hydrostatic testing - ANSI B31.1.

1.08.02.16 Cables

1. Thermocouple extension wires/cables - ANSI C 96.1 - 1982.
2. Colour coding of single or multi-pair cables – VDE 0815



3. Guide for design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422 - 1977.
4. Requirements of vertical tray flame test - IEEE 383 - 1974.
5. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33 - 81.
6. Oxygen index and temperature index test - ASTM D-2863.
7. Smoke generation test - ASTM D-2843 and ASTM E-662.
8. Acid gas generation test - IEC-754-1.
9. Swedish chimney test - SEN - 4241475 (F3)
10. Instrumentation cables and internal wiring IS-1554 (Part-I, 1976) and IS-5831(1984).
11. Standard for Control, Thermocouple Extension and Instrumentation cable - NEMA WC57-2004 ICEA S-73-532, Rev. 2, 2004)□
12. PVC insulated (heavy duty) Electric cables for working voltages upto and including 1100V - IS:1554 (Part-I)
13. Conductors for insulated electric cables and flexible cords. - IS:8130
14. PVC insulation and sheath of electric cables - IS:5831
15. Mild steel wires, strips and tapes top armoring cables - IS:3975
16. Water Immersion Test - VDE 0815
17. Drums for electric cables - IS : 1048

1.08.02.17 Cable Trays, Conduits

1. Guide for the design and installation of cable systems in power generating station (cable trays, support systems, conduits) - IEEE Std. 422, NEMA VE-1, NFPA-70-1984.
2. Guide for the design and installation of cable systems in power generating station (Cable trays, support systems, conduits) Test Standards, NEMA VE-1 - 1979.
3. Galvanising of Carbon steel cable trays - ASTM A-386-78.

1.08.02.18 Flow measurement

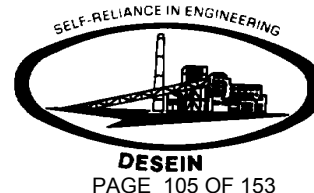
1. ASME Performance Test Code PTC-19.5 (2004), ISA RP3.2
2. BS 1042
3. ISO 5167

1.08.02.19 Surge Protection System

1. Surge withstand capability tests - ANSI C37.90a-1974. IEEE Std. 472 - 1974
2. IEC 61643-1:1998-02 and E DIN VDE 0675 part 6:1996-03/A2: 1996-10
3. IEC 61643-21:2000-09 and E VDE 0845 part 3-1:1999-07

1.08.02.20 Digital Video Recording & Management System (DVRMS)

1. ISO 9001 (2000)
2. ISO/IEC15504 Level3 or higher (SPICE 2.0 Software Process Improvement and Capability Determination)



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**SPECIFICATION
FOR
QUALITY ASSURANCE
&
TESTING**

CHAPTER-14**QUALITY ASSURANCE AND TESTING AND GUARANTEES****14.01.00 GENERAL REQUIREMENT**

- 14.01.01** All equipment furnished under this specification shall be subject to test by authorized quality assurance personnel of the Bidder, representatives of the Owner during manufacture, erection and on completion. Bidder" quality assurance personnel for these shop and site tests shall be identified in advance and shall be acceptable to the Owner. The approval of the Owner or passing of such inspection of tests will not, however, prejudice the right of the owner to reject the equipment if it does not comply with the specifications when erected or fails to give complete satisfaction in service.
- 14.01.02** The Bidder shall furnish details of shop and site tests proposed to be conducted by him at various stages to meet the specification requirements for each type of instrument/system along with his proposal. Bidder shall also furnish details of his proposed shop and site quality assurance organization for this contract
- 14.01.03** Bidder shall prepare a detailed shop and site 'Quality Assurance Programme' to meet the requirements of these specifications for Owner's approval. This document shall also contain the formats for reports and maintenance of test records specification of test equipment to be used for site tests.
- 14.01.04** All equipment and systems furnished under this specification shall be subjected to shop & site tests in accordance with the Quality Assurance Program approved by the Owner and shall be adequate to ensure full compliance with these specification, all applicable codes & standards and detailed engineering drawings and documents approved by the Owner.
- 14.01.05** The Bidder shall provide all required test equipment and simulation devices for performing all shop and site tests. All tests equipment shall be of reputed make, required accuracy class and shall be recently calibrated. The record of calibration of test equipment shall be made available to the Owner on demand.
- 14.01.06** The cost of all tests as per the requirements of this specification and approved quality assurance programme shall be included in Bidder's lump sum price for this package and no extra price shall be payable by the Owner for conducting any test as per the intent and requirements of this specification.

14.01.07 All approval/Inspection are to be carried out by the Owner only.

14.02.00 SHOP TESTS**14.02.01 General Requirement**

- 14.02.01.00 Shop tests shall include all tests to be carried out at Bidder's works at of this sub-bidder and at works where raw materials used for manufacture of equipment is produced.



14.02.01.01 Individual components, instruments and devices furnished in accordance with specification sheets, and I&C device list enclosed with these specifications shall be shop tested by manufacturer prior to shipment. The manufacturer shall conduct these tests for certifying compliance with published specifications for the equipment and provide test results to the Owner in writing. These tests and test certificates shall be in accordance with the agreed 'QA' programme for major systems/equipments. However, manufacturer's standard methods shall be followed if details of tests for any equipment are not covered under this agreed 'QA Programme'.

14.02.01.02 Whenever tested quality material is specified and wherever called upon by Indian Boilers Regulations or by the design code, the test pieces are to be prepared and tested to Owner's satisfaction.

14.02.01.03 In the event of Owner being furnished with certified particulars of tests, which have been carried out by the suppliers of material, the Owner may, at his discretion, dispense with these tests.

14.02.02 Material Tests

14.02.02.01 Whenever tested quality material specified and whenever called upon by Indian Boilers Regulations or by design code, the test pieces, are to be prepared and tested to Owner's satisfaction.

14.02.02.02 In the event of Owner being furnished with certified particulars of tests, which have been carried out by the suppliers of material, the Owner may, at his discretion, dispense with these tests.

14.02.03 Test at Manufacturer's Works

14.02.03.01 Works tests are to include electrical, mechanical performance and hydraulic tests in accordance with relevant IS, IBR or any other approved standard or any other tests called for by the Owner under these specifications to ensure that the equipment being supplied fulfills the requirements of these specifications. For equipments not covered by any IS or other approved standards, the tests to be carried out shall be in accordance with Bidders' quality assurance programme approved by the Owner.

14.02.03.02 Control systems, monitoring systems, control panels, instrument enclosures, and power supply systems shall be shop tested according to unique requirements specified in the applicable section of these specifications for each item and quality assurance program approved by the owner.

14.02.03.03 All shop tests shall be performed prior to shipment and the Owner shall be given the opportunity to witness these tests. The Bidder shall notify the Owner regarding readiness for shop test at least 10 days before the scheduled date if the tests to be conducted within Indian and at least 60 days before the schedule date if the test is to be conducted abroad.

14.02.04 Factory Tests



i TESTS TO BE PERFORMED FOR FIELD INSTRUMENTS

1.	Pressure Gauges
	Calibration Hydro test (1.5 times max. pr.)
2.	Pressure switches
	Calibration test / Hydro test / Contact rating test / Accuracy test / Repeatability
3.	Differential Pressure Gauges
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
4.	Differential Pressure Switches
	Calibration test / Hydro test / Contact rating test / Leak test / Accuracy test / Repeatability test.
5.	Thermometers
	Calibration / Material test / Accuracy test / Bore concentricity : $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)
6.	Temperature switch
	Calibration / Material test / Accuracy test / Bore concentricity : 1.5% of wall thickness / Hydrostatic test for TW (1.5 times max. pr.) / Contact rating test.
7.	Resistance temperature detector assembly.
	Calibration / Material test / Bore concentricity test / Insulation test ($\leq 500 \text{ M}\Omega$ at 500V DC) as per ISA, Hydro test for TW. Bore concentricity: $\pm 5\%$ of wall thickness, Accuracy test.
8.	Thermocouple assembly
	Calibration / Material test, Insulation test ($\geq 500 \Omega$ at 500 V, DC) as per ISA, Hydro static test (1.5 times max. pr.), Bore concentricity : $\pm 5\%$ of wall thickness.
9.	Thermowells
	Material test / Bore concentricity : $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)



10.	Level Guages
	Hydrostatic test / Material test / Seat leakage test / Ball check test.
11.	Level switches (Magnetic)
	Material test / Contact rating test / Hydro test / Calibration test.
12.	Flow Switch
	Material test / Hydro static test (1.5 times max. pr.) / function test.
13.	Flow glasses
	Material test / Hydrostatic test (1.5 times max. pr.) / function test.
14.	Variable area flow meters
	Calibration test / Material test / Hydrostatic test (1.5 times max. pr.)
15.	Flow element
	100% Radiography test / Hydro test / Calibration test, IBR Certificate.
	Calibration test for flow element shall be witnessed by Owner.
16.	Control valves/Pneumatic block valve/Pressure regulating valve – Refer chapter 11.
17.	Position transmitters
	Calibration / hysteresis and Accuracy test
18.	Electro Pneumatic Convertors
	Calibration test / Accuracy test
19.	Solenoid valves
	Hydrotest / Seat leakage test / CV test / Coil insulation test
20.	Air filter regulators
	Calibration test / Accuracy test
21.	Junction Boxes
	Test for degree of protection / Material test
22.	Tests for terminal blocks
	Test for moulding for flame resistant, Non-hygroscopic and Decarbonised / Insulation test between terminals / Insulation between terminal block and frame.
23.	Thermocouple extension cable
	Thermo-emf characteristic / Continuity test / Measurement on capacitance, inductance and loop resistance / Insulation resistance / High voltage test as per latest IS / Tensile and elongation test / Oxygen index test / Any other test applicable.
24.	Mass flow meter
	Performance test / Calibration test / Hydrostatic test.
25.	Boiler Level Gauge
	Hydrostatic test / Material test / Seat leakage test / IBR Certificate
26.	pH/Conductivity measurement / Silica / Dissolved oxygen analysers:
	Calibration test, Accuracy test
27.	Sample cooler :



	Hydro test, IBR Certificate
28.	Sampling racks :
	Hydro test, IBR Certificate for tubes and fittings.
29.	S02 / Nox analyser / SPM analyser:
	Calibration test, accuracy test
30.	Interposing relay
	Functional test, temperature rise test, H.V test, Insulation test
31.	Transmitter Racks :
	Hydro test, air leak test for piping / tubing and fittings. IBR certification as required for tubing / piping and fittings.
32.	Pressure Transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
33.	Differential pressure transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
34.	Temperature Transmitter
	Calibration test / Accuracy test / Ambient temperature error test
35	Pneumatic Block Valves
	 a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
36.	Pressure Regulating Valve





TITLE :
**2 x 660MW ENnore SEZ SUPERCRITICAL
THERMAL POWER PROJECT**

SPECIFICATION NO.: PE-TS-412-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION:

REV. NO. 01

DATE :27.02.2017

SECTION III



TITLE :
2 x 660MW ENnore SEZ SUPERCRITICAL
THERMAL POWER PROJECT

TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM

SPECIFICATION NO.: PE-TS-412-154-A101

SUB-SECTION:

REV. NO. 01 **DATE :27.02.2017**

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

Note: Bidder to furnish all the pre bid in the above indicated pre bid clarification format only. General Pre bid clarification will not be considered.

THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-412-154-A101

		SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL							
		PROJECT:- 2 x 660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT							
		PACKAGE:- OXYGEN DOSING SYSTEM							
		TENDER ENQUIRY REFERENCE:-							
NAME OF VENDOR:-									
SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWAL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWAL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWAL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE									
NAME		DESIGNATIONS				SIGN & DATE			
NOTES:									
1. 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.									
2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.									
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.									
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.									
5. 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.									
6. Bidder shall furnish price copy of above format along with price bid.									
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.									
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.									
9. 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.									
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.									
11. 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.									
12. Cost of withdrawal is to be given seperately 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.									
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.									
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.									

	TITLE : 2 x 660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT	SPECIFICATION NO.: PE-TS-412-154-A101	
	TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM	SUB-SECTION:	
		REV. NO. 01	DATE : 27.02.2017

COMPLIANCE CUM CONFIRMATION SCHEDULE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

- a.) 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.
- b.) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein. 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.
- c.) 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.
- d.) There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.
- e.) 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.
- f.) 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).
- g.) All sub vendors shall be subject to BHEL/CUSTOMER approval.
- h.) Any special tools & tackles, if required, shall be in bidder's scope.
- i.) Demonstration parameters shall stand valid till the satisfactory completion of demonstration test and its acceptance by BHEL/Customer.

	TITLE : 2 x 660MW ENnore SEZ SUPERCRITICAL THERMAL POWER PROJECT		SPECIFICATION NO.: PE-TS-412-154-A101	
	TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM		SUB-SECTION:	
			REV. NO. 01	DATE : 27.02.2017

DECLARATIONS

I.....certify 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