

**2X660 MW MOUDA STPP-II**

**VOLUME: II B & III**

**TECHNICAL SPECIFICATIONS  
FOR  
OXYGEN DOSING SYSTEM**

**SPECIFICATION NO.: PE-TS-385-154-12000A-A001**



**BHARAT HEAVY ELECTRICALS LIMITED**

**POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT  
NOIDA, INDIA**



**TITLE: TECHNICAL SPECIFICATION FOR  
OXYGEN DOSING SYSTEM  
2X660 MW MOUDA STPP STAGE II**

SPEC. NO. PE-TS-385-154-12000A-A001

VOLUME

SECTION

REV. NO. 0


DATE:

SHEET :

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## SECTION – A


### SCOPE OF ENQUIRY

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## 1.0 SCOPE OF ENQUIRY


This specification is intended to cover design, engineering, manufacturing, fabrication, assembly, inspection & testing at manufacturer's works, supply and dispatch to power station site of skid mounted Oxygen Dosing Systems along with start up commissioning spares and mandatory spares as specified hereinafter for the 2 X 660 MW MOUDA STTP STAGE.

- 1.2 Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.
- 1.3 It is not the intent to specify all the details of the design & manufacture. However, the equipment shall conform in all respect to high standard of design, engineering & workmanship and shall be capable of performing the required duties in a manner acceptable to BHEL / NTPC, who will interpret the meaning of drawing & the specification & shall be entitled to reject any work or material, which is not in full accordance herewith.
- 1.4 In case of any Deviation, the Bidder shall indicate the same clause by clause in the deviation schedule. In the absence of the same it will be construed that the bid conform strictly to the specification.
- 1.5 General terms & conditions, instructions to the bidder and other attachments referred to elsewhere, shall be made part of tender specification. The bidder shall be responsible for all governed by requirements stipulated hereinafter.
- 1.6 In case of any data/requirement stipulated in the drawings but not in the specification and vice-versa, such data /requirement shall be deemed to be contained in the both.
- 1.7 In the event of any conflict between the various sections of the specification, bidder shall bring the same to the attention of the BHEL during bid clarification stage before award of contract.
- 1.8 In case the bidder fails to fulfill the requirements specified in clause numbers 1.6 and 1.7, the final verdict on such cases shall rest with the BHEL/NTPC and same shall be binding on the bidder without any technical/commercial/delivery implications to the BHEL/NTPC.
- 1.9 Bidder to note that the terms "Owner", "Customer" or "End-user" used anywhere in this technical specification essentially means the end-user of the project or his assigned consultant.
- 1.10 The equipment covered under this specification shall not dispatch unless the same have been finally inspected, accepted and shipping release issue by BHEL/NTPC.

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## SECTION – B

### PROJECT INFORMATION

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## 1.0 BACKGROUND

Mouda STTP Stage-I comprising of two units of 500 MW each is presently under implementation. Now in view the huge power generation capacity requirement and future capacity addition plans, it is proposed to enhanced capacity of Mouda STTP. The Present proposal is to install additional two units of 660 MW in Stage-II this making the ultimate capacity of the project to 2320 MW.

## 2.0 LOCATION AND APPROACH

The plant site is located in Mouda Tehsil, district Nagpur of Maharashtra Stage, having latitude and longitude of 20°10'50" N and 79°23'52" E respectively. The site is bounded by villages Kumbhari on North, Lapka & Mouda on south, Koradi on East & Rahli on West and is at a distance of about 4 kms. From Mouda town and approachable form NH-6. Nearest railway station is Chacker 8 Kms away from site on Nagpur – Kolkata Broad Gauge (BG) section of south Eastern Railway (main line). The nearest commercial airport is at Nagpur Located at a distance of approximately 42 Kms form the project site.

**Vicinity Plan** is enclosed.

## 3.0 LAND

For Stage –I of Mouda project, about 1580 acres of land required for the project is acquired/under acquisition.

About 125 acres of additional land for plant and 50 acres for Township required. The same has been identified contiguous to existing plant and township areas. The township is to be located in North West of the plant area and on Mouda – Ramtek road, 6 Kms away from Mouda town. No major problem anticipated in acquisition as per site visit and discussions with State Govt. officials.

About 550 acres of land is required for ash disposal. Alternatives suggested by Mouda site visited on 09.07.09 and the land near Kirnapur & Kpra villages have been finalized. In principle land availability for Mouda Stage-II has been obtained from Office of the Collector, Nagpur vide letter ref. no. Desk-17/Resettlement/T-1/w.s. 323/09 dated 27.08.09

Bidder may visit the site and acquaint themselves with the facilities available.


## 4.0 WATER

Make up water requirement for Stage-II of this project would be about 4800 m<sup>3</sup>/hr. Water requirement for the project will be met form pondage created on river Wain Ganga/ Kanhan by construction of dam near Gosikhurd by Govt. of Maharashtra. Make-up water shall be drawn from above mentioned source and shall be pumped to the raw water reservoir located about 24 Kms from intakes well.

Maharashtra Government has approved the reservation of 100 MCM water including the evaporation losses for NTPC in Goshikhurd Project for the ultimate stage of the project (Stage-1 2x500 MW) + Stage-II (2x660 MW). Ministry of Industries, /energy and a Labour Department, Government of Maharashtra vide letter dated 10.12.2002 has given in principle consent for making available the required water for Mouda project.

## 5.0 RAILWAY SIDING

Customer intends to construct the railway siding to project site from the nearest existing

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railway line. However the same may not be available to BHEL for his use to transport equipment and material.

## 6.0 COAL AVAILABILITY AND TRANSPORTATION

### 6.1 COAL AVAILABILITY

Raw coal is proposed as fuel. The annual coal requirement would be about of 7.5 MTPA for 2x660MW of Mouda STTP Stage-II.

Likely coal source for the expansion project is similar to Mouda TPP Stage-I. The matter has been taken up with Ministry of Coal, Govt. of India for Long Term Coal Linkage.

### 6.2 COAL TRANSPORTATION

Coal is proposed to be transported through Indian Railway network.

## 7.0 CAPACITY

Stage-I	:	2x500MW	Under construction/Implementation
Stage-II	:	2x660MW	Present Proposal

## 8.0 CONSTRUCTION POWER

The requirements of the construction power supply for the project would be met from the existing 11 KV. Miscellaneous Switchgear located near 132 KV switchyard. Necessary 11KV ring main/LT sub-stations shall be provided for the required power plant area.

## 9.0 METROLOGICAL DATA

The metrological data from nearest observatory is placed in section B.




CLAUSE NO.	PROJECT INFORMATION		<div>एनटीपीसी NTPC</div>
	ANNEXURE-I		
<div></div>			
MOUDA, SUPER THERMAL POWER PROJECT STAGE-II (2X660 MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO. : CS-9575/9571/0360/0370/9586-102-2	PART-A SUB SECTION-II ANNEXURE-I	PAGE 5 OF 17



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## SECTION – C

### SPECIFIC TECHNICAL REQUIREMENT

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## SECTION – C1

### SPECIFIC TECHNICAL REQUIREMENT - MECHANICAL

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## 1. SCOPE:

The scope of this design philosophy covers the basis of design, system description, equipment selection aspects and control philosophy for Oxygen dosing system for 2X660 MOUDA STTP STAGE II. The above system shall be skid mounted. Two numbers skid per unit shall be provided for oxygen dosing system for each unit (one number for dosing at CPU outlet and one number for dosing at deaerator outlet).

### 1.1 SCOPE OF SUPPLY

Broad scope of work of this package includes all equipment and accessories. Please also refer Electrical and C&I sections (section C2 & section C3) for respective scopes.

The Oxygen dosing system, as specified in Technical data sheets, and shall consist of the followings:

- Entire Oxygen dosing system mounted on skid as per P&ID and Data Sheet-A.
- Instrumentation (minimum) as per the enclosed P&ID.
- Start-up and commissioning spares as required.
- All flanges/counter flanges to interconnect the pipes.

### 1.2 SCOPE OF SERVICE

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.

### 1.3 CIVIL SCOPE

Nil.

## 2. OXYGEN DOSING SYSTEM: (2 SKIDS PER UNIT/TOTAL= 4 SKIDS)

(Refer drg no. PE-DG-385-154-A003)

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 D1, C3 and D3.


## 3. MANDATORY SPARES

Scope of supply of mandatory spares shall be as per mandatory spares parts list as enclosed in Section C1 of this specification.

## 4. QUALITY ASSURANCE PLANS

Bidder to note that all inspection and testing shall be carried out as per approved manufacturing QAP to be submitted by bidder during detailed engineering for the project. However the same shall be in line with requirement mentioned in BHEL inspection requirement as enclosed in section D1 of this



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specification. Any changes/additional tests insisted upon by BHEL/NTPC during detailed engineering shall be accepted by bidder without any commercial / technical and delivery implication to BHEL/NTPC.

#### 5. SUB VENDORS:-

Bidder to note that sub-vendors shall be as per BHEL approved sub vendor list enclosed in section C1. Any additional Sub Vender shall subject to BHEL and NTPC approval during detailed engineering.

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

- All field instruments (pressure and flow transmitters), solenoid valves and PCV shall be terminated at JB by the oxygen dosing vendor for further connection to BOP-DCS by NTPC.
- 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.
- Dosing termination point shall be after PCV and terminated at one point by the oxygen dosing supplier for further interconnection till dosing locations by BHEL.
- Instrument air connection PCV shall be directly connected by BHEL.
- 24 VDC connection to SV-3, SV-4 and SV-5 shall be directly connected by BHEL/NTPC.
- 15 NB instrument air connections up to the PCV in each individual skid shall be supplied by BHEL.

#### 7. 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 D1 of technical specification.

#### 8. PACKING:

To prevent damage to the equipment 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

#### 9. DRAWINGS/DOCUMENTATION

##### 9.1 DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID:-


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

No other technical document is required along with bidder's offer. Any other document submitted by bidder shall not be evaluated by BHEL and shall be considered as withdrawn.

Bidder to note that any un-declared deviation mentioned in bidder offer other than specified in the scheduled of Deviations shall be considered as null and void.

##### 9.2 LIST OF DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT:-

1	PE-DC-385-154-12000A-A001	<del>Design Memorandum for Oxygen Dosing System</del>
2	PE-VO-385-154-12000A-A001	P&ID for Oxygen Dosing System
3	PE-VO-385-154-12000A-A002	Technical Data sheet for Oxygen Dosing System
4	PE-VO-385-154-12000A-A003	GA drawing and foundation detail for Oxygen Dosing System
5	PE-VO-385-154-12000A-A004	Local Control Panel drawings for Oxygen Dosing System
6	PE-VO-385-154-12000A-A005	O&M Manual for Oxygen Dosing System
7	PE-VO-385-154-12000A-A006	QAP for Oxygen Dosing System

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**Notes: -**

- a) Any drawing/document other than those mentioned above if required by BHEL/NTPC during detailed engineering shall be furnished by the bidder without any commercial/delivery implication to BHEL.
- b) For Control & Instrumentation documents please refer section C3.

**9.3 DOCUMENTS TO BE SUBMITTED AFTER DISPATCH OF SKIDS:-**

Bidder shall submit soft copy/hard copy/CD ROMs of all the finally approved drawings and O&M Manuals as required by NTPC/NTPC consultant/BHEL-site/BHEL-PEM. The exact number of hard copies/CD ROMs of these documents to be submitted shall be notified to the bidder at the time of detailed engineering and bidder shall submit the same without any commercial/delivery implications to BHEL/NTPC.


**10. COMMISSIONING SPARES**

Commissioning spares if deemed necessary by the bidder for commissioning of the 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.


**11. DESIGN REQUIREMENTS**

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


- i. All the terminal points shall be easily accessible and towards one side of skid.
- ii. All valves shall be easily accessible for the operator.
- iii. All equipments shall have name plate clearly indicating the equipment name.
- iv. Pipe fittings of the system shall be done using elbows and tees. Pipe bending is not acceptable.
- v. All LCP shall be mounted in their respective dosing skids only.

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## DATA SHEET-A

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	Description	Parameter
<b>Mechanical Items</b>		
1.0	No. of skid(s) for project	Four (two per unit)
2.0	<b>Cylinders:</b>	
2.1	Quantity mounted on skid	Two per skid (Total eight)
2.2	Loose supply of filled Oxygen cylinders	30 loose on a rack for each unit (total 60)
2.3	Total quantity of filled Oxygen Cylinders to be supplied for project	68 Nos.
2.4	Design Standard of empty oxygen cylinder	IS-7285
2.5	Water Capacity	50 liters
2.6	Gas Capacity	10 m <sup>3</sup>
2.7	Max Working pressure at 15 <sup>o</sup> C	204 Kg/cm <sup>2</sup>
2.8	Painting of oxygen cylinder	As per IS 4379
2.9	Accessories	Two numbers (one per unit) Cylinder storing rack (MS), each with capacity to hold 30 cylinders
3.0	<b>All Tubing:</b>	
3.1	Material	ASTM A213/269 GR TP 316 SCH 80 (seamless)
3.2	Diameter	15 NB (1/2" OD)
4.0	<b>Ball valves</b>	
4.1	Body, Bonnet, stem	ASTM A182 Gr. TP 316
4.2	Trim Material	SS 316
4.3	Design standard	BS 5351 & 5159/equivalent
4.4	Test standard	EN-12266-1
4.5	Size	15 NB
4.6	End Connections	SW ANSI B 16.11
4.7	Rating	----Class ASA 800 ----
4.8	Valve operation	Manual or pneumatic as per P&ID
5.0	<b>Check valves/ NRV</b>	
5.1	Body, cover, disc/piston & seat	ASTM A182 Gr. TP 316
5.2	Design standard	ANSI B 16.34/API 602
5.3	Test standard	API 598
5.4	Size	15 NB
5.5	End Connections	SW ANSI B 16.11
5.6	Rating	----Class ASA class ASA 800----
5.7	Valve operation	Manual
6.0	<b>Pressure relief valve</b>	
6.1	Type	Spring loaded, angle type
6.2	Body, bonnet, disc & nozzle	ASTM A182 Gr. TP 316
6.3	Valve discharges to	Atmosphere (vent)
6.4	Back pressure	Constant
6.5	Set pressure	60 Kg/cm <sup>2</sup> (g) for skid 1 and 30 Kg/cm <sup>2</sup> (g) for skid 2
6.6	Inlet Connections	15 NB, Flanged/threaded, ANSI B16.5, 300#
6.7	Outlet Connections	15 NB, Flanged/threaded, ANSI B16.5, 150#
7.0	<b>Fittings</b>	Stainless steel to A276 or A479 F316, Dimension to ANSI B 16.11 socket weld ends.
8.0	<b>Pressure Regulator</b>	
8.1	Quantity	Two per skid (total 8), each mounted to an oxygen cylinder
8.2	Body & trim	SS 316/Brass
8.3	Inlet connection	1/2 "
8.4	Outlet connection	1/2 "
8.5	Operating pressure	204 Kg/cm <sup>2</sup> (g)
8.6	Set outlet Pressure	55 Kg/cm <sup>2</sup> (g) for skid dosing at CPU outlet and 25 Kg/cm <sup>2</sup> (g) for skid dosing at deaerator outlet
9.0	<b>Flanges</b>	-----SS 316, ANSI B 16.5 CL 300 -----
10.0	<b>Structural steel</b>	IS 2062
11.0	<b>Nuts &amp; bolts</b>	SS 304

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### List of BHEL approved sub vendors

SL NO.	ITEM	APPROVED SUPPLIERS	PLACE	REMARKS
	<b>MECHANICAL:</b>			
1	STRUCTURE FOR THE SKID/ RACK FOR CYLINDER STORAGE	SELF-MAKE OF MAIN VENDOR	AS APPLICABLE	
2	FILLING OF OXYGEN CYLINDER	FILLING OF EMPTY CYLINDERS MAY BE DONE FROM ANY CCE LICENSED OXYGEN GAS FILLER	AS APPLICABLE	
3	EMPTY OXYGEN CYLINDERS	BPCL	NAINI	
		EVEREST KANTO	TARAPUR/AUR ANGABAD	
		MARUTI KOATSU CYLINDER LTD	HALOL, GUJARAT	
3	CHECK VALVE	PRECISION ENGG.	MUMBAI	
		CRESENT VALVE	MUMBAI	
		BDK	HUBLI	
		LEADER	JALANDHAR	
		CHEMTECH	MUMBAI	
		FOURESS	MUMBAI	
		STEELSTRONG	MUMBAI	
4	BALL VALVE	AV VALVES LTD	AGRA	
		AKAY VALVES	MUMBAI	
		FLOW CHEM INDUSTRIES	AHMEDABAD	
		KSB PUMPS LTD	MUMBAI	
		BDK	HUBLI	
		AUDCO	CHENNAI	
5	3- WAY VALVE MANIFOLD FOR PG & PT	HI TECH	AHMEDABAD	
		CHEMTROL		
		BLISS ANAND	GURGAON	
		EXCEL HYDRO	MUMBAI	
		BY ORIGINAL INSTRUMENT MANUFACTURER	AS APPLICBALE	
6	PRESSURE REDUCING VALVE	TESCOM	USA	(PART OF EMERSON PROCESS)
7	TUBING	RATNAMANI	AHMEDABAD	
		REMI	MUMBAI	
8	FITTINGS	SWAGELOK	USA	
		PARKER	USA	
		HAMLET	ISRAEL	
9	NEEDLE VALVE	BY ORIGINAL INSTRUMENT MANUFACTURER	AS APPLICBALE	
10	PAINT	BERGER PAINTS	KOLKATA	
		ASIAN PAINTS	MUMBAI	
		SHALIMAR PAINTS	KOLKATA	
		JENSON & NICOLSON	KOLKATA	
		GUNJAN PAINT	MUMBAI	
	<b>C&amp;I:</b>			
11	PRESSURE GAUGE	A N INSTRUMENTS	KOLKATA	
		H GURU	NEW DELHI	
		MANOMETER INDIA	MUMBAI	
		GIC	MUMBAI/GOA	
		GLUCK INDIA	MUMBAI	



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		BUDENBERG GAUGE		
		DRESSER IND		
		FORBES MARSHALL		
		WAREE INSTRUMENTS		
12	PRESSURE TRANSMITTER	BLISS ANAND	GURGAON	
		BRISTOL BABCOCK		
		FISHER-ROSEMOUNT		
		SMART INST		
		EMERSON PROCESS MANGEMENT (I) LTD	MUMBAI	
		SIEMENS	MUMBAI/ BANGALORE	
		SBEM	PUNE	
		TATA HONEYWELL	PUNE	
		V AUTOMAT	NEW DELHI	
		BIRLA-KENT TAYLOR LTD. (A GROUP COMPANY OF ABB)	FARIDABAD	
		FUJI ELECTRIC	JAPAN	
		YOKOGAWA	JAPAN	
13	FLOW METER CUM TRANSMITTER	EMERSON PROCESS MANGEMENT (I) LTD	USA/MUMBAI	MICRO MOTION LFM SERIES
		GE RHEONIK	USA/INDIA	
14	CONTROL VALVE WITH ACTUATOR	IL	PALGHAT	
		DRESSER MASONILAN	FRANCE	
		CCI	USA/KOREA	
		NIPPON FISHER	JAPAN	
		FISHER CONTROLS (EMERSON)	UK/USA/FRANC E	
		COPE'S VULCAN	UK	
		MIL CONTROLS	ALWAYE	
		DRESSER VALVES INDIA PVT LTD	COIMBATORE	
		WEIR	UK	
		FISHER XOMOX	CHENNAI	
15	SOLENOID VALVE	JEFFERSON	ARGENTINA	
		HERION	GERMANY/ITAL Y	
		ROTEX AUTOMATION LTD	VV NAGAR/ BARODA	
		ASCO	USA/INDIA/UK	
16	JUNCTION BOX			
		AJMERIA INDUSTRIAL & ENGIN		
		BALIGA LIGHTING EQUIPMENT		
		DEVI POLYMERS		
		ELECTROMAC INDUSTRIES		
		KS INSTRUMENTS PVT.LTD.		
		MANISHA ENTERPRISE		
		SHRENIK & COMPANY, SUCHITRA INDUSTRIES		
17	INST CABLES (SCREENED)	RELIANCE	BANGLORE	
		DELTON	FARIDABAD NEW DELHI	
		NICCO	KOLKATA	
		CHORDS CABLE	BHIWADI	
		UNIVERSAL	SATNA	
		INCAB	PUNE	
		POLYCAB	DAMAN	

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18	PVC INSULATED LT CONTORL CABLES	DELTON CABLES	FARIDABAD	
		HVPL	FARIDABAD	
		ELKAY TELELINKS	FARIDABAD	
		GEMSCAB	BHIWADI	
		KEI	BHIWADI	
		CORDS CABLE	BHIWADI	
		UCL	SATNA	
		RADIANT CABLES	HYDERABAD	
		INCAB	PUNE	
		NICCO	KOLKATA	
		PARAMOUNT CABLES	ALWAR	
		FGI	KOLKATA	
		POLYCAB WIRES	DAMAN	
		TORRENT CABLES	NADIAD	
		ICL	RAJPURA	


**Notes:-**

1. All additionally proposed sub-vendors shall be subject to BHEL/NTPC approval during detailed engineering without any delivery and commercial implication to BHEL.
2. All the finally selected sub vendors (including those mentioned above) shall be subject to NTPC approval during detailed engineering without any delivery/commercial implications to BHEL.

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## LIST OF MANDATORY SPARES FOR OXYGEN DOSING SYSTEM (AS APPLICABLE)

1. LP dosing pump assembly	1 no.
2. Drive shaft cum worm	1 no.
3. Drive worm wheel	3 nos.
4. Connecting rod plate	1 no.
5. Cross head	1 no.
6. Cross head guide bush	3 nos.
7. Plunger	1 no.
8. Discharge NRV	1 no.
9. Diaphragm / hydra tube (as the case may be)	5 nos.

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## SECTION – C2

### SPECIFIC TECHNICAL SPECIFICATION - ELECTRICAL

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### 1. EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER :

- a. Services and equipment as per "Electrical Scope between BHEL and Vendor".
- b. Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c. Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d. Erection and Commissioning spares.
- e. Erection & Maintenance tools & tackles.
- f. Electrical load requirement for Oxygen Dosing system.
- g. All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- h. Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to NTPC/BHEL approval without any commercial and delivery implications to BHEL/NTPC.
- i. Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to NTPC/BHEL approval without any commercial implication to BHEL/NTPC.


### 2. EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer "Electrical Scope between BHEL and Vendor".

### 3. DOCUMENTS TO BE SUBMITTED ALONG WITH BID


- 3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/quality assurance requirements stipulated. In line with this two signed and stamped copies of the following shall be furnished by the bidder as technical offer:
  - a) A copy of this sheet "Electrical equipment Specification for Oxygen Dosing system" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
  - b) List of Erection and Commissioning spares.
  - c) List of Erection & Maintenance tools & tackles.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.



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## STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR FOR SKID MOUNTED SYSTEM

<u>SI.NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&amp;C</u>	<u>REMARKS</u>
1	Junction Boxes	Vendor	Vendor	JB shall be mounted on respective skid. Termination of all field instruments, solenoid valves and PCV up to JB shall be done as per BHEL termination drawing by bidder. Connection between JB and BOP-DDCMIS shall be in BHEL scope.
2	Ordinary control cables, screened control cables & special control cable	Vendor	Vendor	Within the skid, between instrument and JB.
3	Cable glands and lugs for equipment supplied by vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass glands. 2. Solder less crimping type tinned copper heavy-duty lugs for Power cables. 3. Solder less crimping type heavy duty copper lugs for control Cables.
4	Equipment grounding	Vendor	Vendor	Within the skid

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## SECTION – C3

### SPECIFIC TECHNICAL SPECIFICATION CONTROL & INSTRUMENTATION


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## 1 SCOPE OF SUPPLY

- 1.1 Oxygen Dosing System shall be operated from plant station BOP DCS (NTPC Scope of supply) through operator work stations located in control room.
- 1.2 Bidder to supply the field instrumentation as required / shown in the P&ID.
- 1.3 The detailed specification of instruments, JB, control panel are given in detail as below.
- 1.4 The make/model of various instruments/items/systems shall be subject to approval of BHEL/NTPC during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.


## 2 Drawings/Documents and data to be furnished after award of the contract:

- Field instruments data sheet.
- JB grouping document.
- Cable schedule and cable interconnection drawing.
- Instrument schedule.
- Drive List and Analog / Binary Input / output List
- Recommended Control write-up
- Any other document decided during detailed engineering.

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## SECTION – D


### GENERAL TECHNICAL SPECIFICATION

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## SECTION – D1

### GENERAL TECHNICAL REQUIREMENT – MECHANICAL



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## 1.0 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 BOP DCS (NTPC scope) by regulating pneumatic flow control valve (PCV) provided on each O<sub>2</sub> 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 BOP DCS (NTPC scope). However, NTPC may also chose 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 pneumatic control valve (PCV) if cation conductivity in the cycle goes above 0.3 us/cm.

### b) Start up 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  $\mu$ s/cm (at 25°C) and the trend is downwards.
- Deaerator vents are closed.
- Oxygen feed is manually started from BOP DCS.

### c) Shut down sequence:-


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

## 2.0 Equipment for Oxygen Dosing (2 skids per unit/Total= 4 skids)

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 shall consist of the following components:-

### 2.1 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 takes place on the basis of pressure i.e.

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the cylinder banks dosing at Condensate Polishing Unit (CPU) outlet will switch over at 55 kg/cm<sup>2</sup>(g) and the cylinder banks dosing at deaerator outlet at 25 kg/cm<sup>2</sup>(g). Separate storage rack for 30 filled cylinders per unit shall be supplied to cater 30 days oxygen requirement.

## 2.2 Pressure Regulator:

The line pressure regulator is used for reducing a high supply pressure (204 Kg/cm<sup>2</sup> cylinder pressure) to 55 kg/cm<sup>2</sup>(g) pressure in skid dosing at CPU outlet and to 25 kg/cm<sup>2</sup>(g) pressure in skid dosing at deaerator outlet.

## 2.3 Valves, tubing, vents and instrumentation shall be as per the attached P&ID and the data sheet. The MOC and specification of the equipments shall be as per the attached data sheet.

## 3.0 Control and Instrumentation:-

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

The oxygen gas shall be at high pressure (204 Kg/cm<sup>2</sup>) in the cylinders. The same shall be brought to a lower pressure by the Pressure Regulator (set pressure of 55 Kg/cm<sup>2</sup> for skid dosing at CPU outlet and set pressure of 25 Kg/cm<sup>2</sup> 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 BOP DCS (NTPC Scope).

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

The pressure of the oxygen shall be further reduced by pressure reducing valve in the skid based on the feedback received from pressure transmitter {set point –"ADEQUATE--(Set points–50 kg/cm<sup>2</sup> for skid dosing at CPU outlet & 20 kg/cm<sup>2</sup> for skid dosing at deaerator outlet) downstream. The flow and pressure of oxygen can be monitored from BOP DCS (NTPC Scope) by the signal from flow meter cum transmitter and from pressure transmitter provided at the downstream of pressure reducing regulating valve. The flow of oxygen dosing will be controlled manually/automatically from BOP DCS (NTPC Scope) by adjusting pneumatic flow control valve (PCV) (air to open type) provided on skid based on the feedback from the dissolved oxygen analyzer located in the economizer inlet. The PCV shall have a position feedback transmitter that shall transmit the feedback signal to BOP DCS (NTPC Scope).

All solenoid valves mounted in the oxygen dosing skid shall be 24 V DC powered from BOP DCS (NTPC Scope) and routed through the local skid mounted junction box. All the field instruments, pneumatically controlled PCV and solenoid valves (SV 1 & SV 2) shall be terminated at a junction box in the skid by BHEL's oxygen dosing vendor for further connection to BOP DCS (NTPC Scope).

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.

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


Bidder to further note in case the manufacturer of flow meter cum transmitter recommends gas fillers for proper functioning of the instrument, the same shall be deemed included in bidder's scope.

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

- Following interlocks/alarm annunciation facility shall be provided.

**For Skid dosing at CPU Outlet**

Source of signal	Tag Number	Set Point (suggested)	Interlock	Alarm in BOP DCS (NTPC Scope)	Remarks
<b><u>During Normal Operation:-</u></b>					
Pressure transmitter	QCL11CP001	60 Kg/cm <sup>2</sup> (g) (HIGH)	Not applicable	Yes (HIGH pressure at cylinder 1 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter	QCL11CP001	52 Kg/cm <sup>2</sup> (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	60 Kg/cm <sup>2</sup> (g) (HIGH)	Not applicable	Yes (HIGH pressure at cylinder 2 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter	QCL12CP001	52 Kg/cm <sup>2</sup> (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	48 Kg/cm <sup>2</sup> (g) (LOW)	Close PCV (QCL10AA202)	Yes (Oxygen dosing stopped due to low pressure)	
Pressure transmitter	QCL10CP001	60 Kg/cm <sup>2</sup> (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 PCV (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 PCV(QCL10AA202) to increase DO provided signal from QCL10CP001 is "NOT LOW" (i.e < 48 Kg/cm <sup>2</sup> (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
Dissolved oxygen		150 ppb, increasing	Close PCV(QCL10AA202)	Yes (Oxygen dosing stopped due to high	

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analyzer		(HIGH)	2) to decrease DO	DO level in feed water cycle)	within the range of 30-150 ppb.
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**During Start up:-**

Cation Conductivity analyzer		0.15 $\mu\text{S}/\text{cm}$ (at 25°C), decreasing (ADEQUATE)	Open PCV (QCL10AA202), provided signal from QCL10CP001 is "NOT LOW" (i.e < 48 Kg/cm <sup>2</sup> (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 BOP DCS (NTPC Scope)	Remarks
<b>During Normal Operation:-</b>							
Pressure transmitter		QCL21CP001	30 Kg/cm <sup>2</sup> (HIGH)	(g)	Not applicable	Yes (HIGH pressure at cylinder 1 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter		QCL21CP001	22 Kg/cm <sup>2</sup> (LOW)	(g)	Close SV-1 (QCL21AA201) & Open SV-2 (QCL22AA201)	Yes (LOW pressure at cylinder 1 outlet)	Auto-changeover of cylinders. Manually replace cylinder 1 with filled cylinder.
Pressure transmitter		QCL22CP001	30 Kg/cm <sup>2</sup> (HIGH)	(g)	Not applicable	Yes (HIGH pressure at cylinder 2 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter		QCL22CP001	22 Kg/cm <sup>2</sup> (LOW)	(g)	Close SV-2 (QCL22AA201) & Open SV-1 (QCL21AA201)	Yes (LOW pressure at cylinder 2 outlet)	Auto-changeover of cylinders. Manually replace cylinder 2 with filled cylinder.
Pressure transmitter		QCL20CP001	18 Kg/cm <sup>2</sup> (LOW)	(g)	Close PCV (QCL20AA202)	Yes (Oxygen dosing stopped due to low pressure)	
Pressure transmitter		QCL20CP001	30 Kg/cm <sup>2</sup> (HIGH)	(g)	Not applicable	Yes (HIGH dosing pressure)	Manual checking of pressure reducing regulating valve reqd.
Cation Conductivity analyzer			0.3 $\mu\text{S}/\text{cm}$ (at 25°C), increasing (HIGH)		Close PCV (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 PCV(QCL20AA202) to increase DO provided signal from QCL20CP001 is "NOT LOW" (i.e < 22 Kg/cm <sup>2</sup> (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



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Dissolved oxygen analyzer		150 ppb, increasing (HIGH)	Close PCV(QCL20AA202) to decrease DO	Yes (Oxygen dosing stopped due to high DO level in feed water cycle)	for operation by operator's plant chemist during commissioning within the range of 30-150 ppb.
<b>During Start up:-</b>					
Cation Conductivity analyzer		0.15 $\mu\text{S}/\text{cm}$ (at 25°C), decreasing (ADEQUATE)	Open PCV (QCL20AA202), provided signal from QCL10CP001 is "NOT LOW" (i.e < 22 Kg/cm <sup>2</sup> (g)) & signal from DO analyzer is "NOT HIGH" (i.e > 150 ppb)	Yes (Oxygen dosing started)	

## THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-385-154-12000A-A001


CLAUSE NO.	TECHNICAL REQUIREMENTS	
14.06.00	<b>APPLICATION OF PRIMER/PAINT</b>	
14.06.01	The paint/primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The Dry film thickness (DFT) of primer/paint shall be as specified herein.	
14.06.02	Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.	
14.06.03	Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.	
14.06.04	Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured.	
14.06.05	<p>Following are the Primer/painting schemes envisaged herein:</p> <p>PS3            -        Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104.</p> <p>PS3*          -        Zinc Chrome primer (Alkyd base) by dip coat.</p> <p>PS4            -        Synthetic Enamel (long oil alkyd) to IS2932.</p> <p>PS5            -        Red oxide zinc phosphate to IS-12744.</p> <p>PS9            -        Aluminum paint to IS 2339.</p> <p>PS9*          -        Heat resistant Aluminum paint to IS-13183 Gr.-I (for temperature 400 °C - 600 °C) , IS-13183 Gr.-II (for temperature 200°C - 400°C) and IS-13183 Gr.-III (for temperature upto 200 °C)</p> <p>PS13          -        Rust preventive fluid by spray, dip or brush.</p> <p>PS14          -        weldable primer-Deoxaluminat or equivalent.</p> <p>PS16          -        High Build Epoxy CDC mastic `15' .</p> <p>PS17          -        Aliphatic Acrylic Polyurethane CDE134 ,%V=40.0(min.)</p> <p>PS18          -        Epoxy based TiO2 pigmented coat</p> <p>PS19          -        Epoxy based Zinc phosphate primer (92% zinc in dry film (min.), %VS=35.0(min.).</p> <p>PS20          -        Epoxy based finish paint.</p>	
14.06.06	All weld edge preparation for site welding shall be applied with one coat of weldable primer.	
14.06.07	For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.	
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2
PART-B SUB-SECTION-II:M3 POWER CYCLE PIPING SYSTEM & LPP		Page 26 of 54

CLAUSE NO.		TECHNICAL REQUIREMENTS										
14.07.00		Primer/Painting Schedule										
Sl. No	Description	Surface Preparation	Primer Coat	Intermediate Coat		Finish Coats	Min. DFT/Coat (Microns)		Total Min. Painting DFT (Microns)	Colour Shade		
			System	Coat	Min. DFT/Coat (Microns)	System	Coat	Min. DFT/Coat (Microns)				
1.	All insulated Piping, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.	SP3/SP4	PS 9*	1	20	-	-	PS9*	1	20	40	As per NTPC Colour shade/ coding scheme
2.	All uninsulated Piping, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.	Design temperature <60 °C	PS 5	1	20	-	-	PS 4	3	35 \$	155 \$	
		Design temperature 60 °C- 200 °C	PS 9*	1	20	-	-	PS 9*	1	20	40	
		Design temperature > 200 °C	PS 9*	1	20	-	-	PS9*	1	20	40	
3	Constant Load Hanger (CLH), Variable Load Hanger (VLH) and other supports	SP4*	PS19	1	40	-	-	PS17	1	30	70	
4.	Valves											
	Cast /Forged	SP1/SP2/ SP3	PS9	1	20	PS9	1	PS 9	1	20	40	
	Design temperature <60°C											
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE												
TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2								PART-B SUB-SECTION-II:M3 PCP & LPP			Page 27 of 54	


TECHNICAL REQUIREMENTS												
CLAUSE NO.												
	Design temperature 60 °C-200 °C	SP1/SP2/SP3	PS9*	1	20	-	-	PS9*	1	20	40	
	Design temperature > 200 °C	SP1/SP2/SP3	PS9*	1	20			PS9*	1	20	40	
5.	All Structural Steel components	Outside TG building and in SG envelope	SP4*	1	75	PS18	1	75	2	35	250	
			Inorganic Ethyl Zinc Silicate					a) Epoxy coat PS17	1	30		
								b) Final coat of paint PS17	1	30		
6.	Weld Edges	SP6 (Hand cleaning by wire brushing)	SP4*	1	35	PS18	1	35	2	25	150	
			-do-					a) Epoxy coat PS17	2	25		
								b) Final coat of paint PS17	1	30		
			PS13 (Weldable primer)	1	25	-	-	-	-	-	-	
\$ The first 2 finished coats (total min.DFT of 70 microns) shall be done at shop and the 3 <sup>rd</sup> finish coat (min.DFT 35 Microns) shall be applied at site.												
<b>15.00.00 Testing Requirements:</b> The detailed testing requirements for power cycle piping and its components are given in the subsection for Quality Assurance(QA) .The requirements pertaining to testing given in this subsection if in variance with that given in QA subsection, then the more stringent of the two shall be followed.												
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) / STEAM GENERATOR PACKAGE			TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 9586-102-2				PART-B SUB-SECTION-II-M3 PCP & LPP			Page 28 of 54		




## THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-385-154-12000A-A001

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
1.00.00	<b>SCOPE OF SUPPLY AND SERVICES</b>			
1.01.00	The scope of work for the equipment and accessories to be furnished in accordance with this specification shall include design, manufacture, engineering, inspection and testing at suppliers works, packing, forwarding to site, unloading, erection, supervision, pre-commissioning, testing and commissioning and performance testing of the equipment/system and works indicated in this Sub-section of the technical specification. Any item or works though not specifically mentioned in this specification but needed to complete the equipment & systems to meet the intent of the Specification shall also be furnished, unless specifically mentioned under "Exclusion" in Sub-Section-IV of Part-A, Section-VI of the Technical Specifications.			
1.02.00	The scope of work is detailed out in this Part-A of the technical specification, Section-VI and is elaborated below :  <b>Sub-Section</b> III A                      Mechanical equipments and systems  III B                      Electrical Systems  III C                      Control & Instrumentation System  III D                      Civil Works			
1.03.00	Scope of supply of the Contractor also includes mandatory spares, start-up and commissioning spares. The general requirements in respect of various types of spares is given in Sub-Section-VII, Part-A of Technical Specification.			
1.04.00	<b>Tests</b>  The scope of the Contractor includes all shop tests, type tests, site tests, routine tests, etc., fulfilment of complete quality assurance & inspection requirements and related activities for all the equipment & systems covered under the scope of work of bidder as per the stipulations of Technical Specifications.			
1.05.00	<b>Paints and Painting</b>  The Contractor's scope of works includes supply of paints and painting of all equipments and structures as per the Employer's standard colour coding scheme which shall be furnished to the Contractor during detail engineering stage. The painting of various components shall comply with the requirements stipulated in different part of this specification. However, for components where no specific requirement is stipulated, the painting conforming to the requirements stipulated below shall be provided.  (a)      The surfaces which have surface temperature 95°C or less and which are insulated, shall be painted with at least two coats of zinc phosphate primer as per IS 12744 & two coats of enamel paint with total DFT not less than 80 microns.  (b)      All surfaces having temperature above 95°C and which are insulated shall be applied with at least two coats of high temperature special primer/ paint with total DFT not less than 40 microns.  (c)      SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.			
MOUDA SUPER THERMAL POWER PROJECT STAGE-II (2X660 MW) STEAM GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-9575/9571/0370/ 0360/9586-102(R)-2	PART-A SUB SECTION-III SCOPE OF SUPPLY AND SERVICES	PAGE 1 OF 4


## THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-385-154-12000A-A001

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	
	(d) Painting specification for all other exposed steel surfaces not covered above shall be same as that given in Civil Sub-section, Part-B, Section VI for corrosion protection of steel structures.	
1.06.00	<b>Pre-commissioning and Commissioning Activities</b>	
1.06.01	Contractor's Scope shall include all pre-commissioning and commissioning activities, required for successful performance of all equipments and systems under this package and shall include, but will not be limited to, activities detailed in Sub section VI of Part-B of Technical Specification. Contractor's scope shall also include supply of all materials and services including the following for successful conductance of pre-commissioning and commissioning activities:	
1.06.02	Complete pre-commissioning work including tests of facilities such as line flushing, hydraulic testing of pressure parts, air and gas tightness tests of steam generator enclosure and duct work, chemical cleaning of pressure parts, steam blow off etc. and all other tests as mutually agreed in the Contractor's quality assurance program as well as those identified in the specification.	
1.06.03	Commissioning and initial operation of the facilities.	
1.06.04	Supply of all consumables (except coal and fuel oil for firing) like chemicals for chemical cleaning, passivation, inhibition etc., oil for line flushing, nitrogen for blanketing, consumables for air/ gas tightness tests and any other consumable as may be required for above pre-commissioning/ commissioning activities.	
1.06.05	Supply of all temporary equipments such as tanks, piping, including supports, valves, nitrogen blanketing equipments including nitrogen cylinders, pumps and all necessary instrumentation for successful conductance of pre-commissioning and commissioning activities. All temporary equipments, pumps, valves etc. brought to sites, by the Contractor for pre-commissioning/commissioning purpose shall be in good working condition to ensure its safe and reliable operation at site. All such temporary equipments/components shall be brought to site atleast three (3) months prior to commencement of relevant pre-commissioning/commissioning activities. On receipt of the temporary equipments/components at site, the same shall be inspected by the Employer to ensure its safe and reliable operation and if in the opinion of the Employer the temporary equipments/components are not in satisfactory conditions to ensure its safe and reliable operation the same shall be immediately replaced by the Contractor.	
1.06.06	The temporary equipments specifically brought by the Contractor solely for the pre-commissioning and commissioning work shall on completion of these activities, remain the property of the Contractor. However, the nitrogen blanketing equipment including nitrogen cylinders shall get included in the Contractor's permanent scope of supply and become property of the Employer.	
1.06.07	The selection of material of all the temporary equipments/ instruments shall be compatible with the service conditions expected during pre-commissioning/ commissioning activities.	
1.06.08	All temporary equipments and instruments shall be clearly listed out in the bid.	
1.06.09	Supply of all labour, skilled/ semi skilled supervisors, engineers and any other manpower.	
1.07.00	<b>First Fill of Consumables, Oils &amp; Lubricants</b>  Contractor scope of supply of the first fill requirements of all consumable such as greases, oil, lubricants, servo fluids, essential chemicals etc. which are required to put the equipments	
MOUDA SUPER THERMAL POWER PROJECT STAGE-II (2X660 MW) STEAM GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-9575/9571/0370/ 0360/9586-102(R)-2
PART-A SUB SECTION-III SCOPE OF SUPPLY AND SERVICES		PAGE 2 OF 4


## THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-385-154-12000A-A001


CLAUSE NO.	TECHNICAL REQUIREMENTS	
4.09.00	<p><b>Acceptance Criteria</b></p> <p>Stiffness values shall be checked. The permissible deviations shall be as per DIN 2096.</p> <p>Following acceptance criteria shall be followed:</p> <ol style="list-style-type: none"> <li>General workmanship is being good and as recommended by the manufacturer and approved by the Engineer.</li> <li>Tolerances are within the specified limit.</li> <li>Material test certificate (MTC) is in compliance with the applicable codes/standards.</li> <li>Bought out material is from the approved manufacturer / vendor.</li> <li>Bought out material is matching with the approved sample.</li> </ol>	
5.00.00	<b>MISCELLANEOUS REQUIREMENTS</b>	
5.01.00	<b>Corrosion Protection</b>	
5.01.01	<p><b>General</b></p> <ol style="list-style-type: none"> <li>All equipments, pipes, etc. shall be painted as per the requirements specified in the relevant section of the specification.</li> <li>All Steel structures (except those embedded in Concrete) shall be provided with Painting as given below which is designed for a minimum maintenance free life of Ten (10) years (expected life, long range Ten (10) to Twenty (20) years, as per BS : 5493.</li> <li>All Paints shall be of high build constitution.</li> <li>All Painting shall be done as per approved Painting scheme of the Vendors / Manufacturers, which shall be submitted by the Bidder and as approved by the Employer. Painting scheme shall also include Item codification / Description of all Coats of Paints for manufacturer's, from whom the Paint is intended to be procured.</li> </ol>	
5.01.02	<p><b>Painting of Steel Surfaces embedded in Concrete.</b></p> <ol style="list-style-type: none"> <li>For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT).</li> <li>All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents.</li> </ol>	
5.01.03	<p><b>Painting of Steel Surfaces (other than those embedded in Concrete)</b></p> <ol style="list-style-type: none"> <li>All Steel surfaces shall be provided with self curing Inorganic Zinc Silicate Primer Coat (Solid by Volume Minimum 60%) of Minimum 75 Micron Dry Film Thickness (DFT) applied over blast cleaned surface to near white metal conforming to Sa 2 ½ finish of Swedish standard SIS-05-5900. The Primer Coat shall be applied in Shop immediately after blast cleaning by Airless spray technique.</li> </ol>	
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2
		PART-B SUB-SECTION-V CIVIL WORKS
		PAGE 17 OF 22

## THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-385-154-12000A-A001

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<p>(b.) Primer Coat shall be followed with the application of Intermediate Coat of Polyamide Cured pigmented Titanium Dioxide (TiO<sub>2</sub>) or Micaceous Iron Oxide (MIO) Epoxy based Paint (Solid by Volume Minimum 60%) of Minimum 75 Micron DFT. This Coat shall be applied in Shop after an interval of Minimum overnight (from the application of Primer Coat) by Airless spray technique.</p> <p>(c) Intermediate Coat shall be followed with the application of Finish Coat of Polyamide Cured colour pigmented Epoxy based Paint (Solid by Volume Minimum 60%) of Minimum 75 Micron DFT. This Coat shall be applied after an interval of Minimum overnight and maximum indefinite (from the application of Intermediate Coat) either before Erection by Airless spray technique or after Erection by brush and / or spray. Colour and shade of the Coat shall be as approved by the Employer. The Finish Coat thickness of 75 Micron can be built up either in Single application at Shop or in two applications one at Shop and the other at Site.</p> <p>(d) Finish Coat shall be followed with the application of Final Finish Coat of Polyurethane based colour pigmented Paint (Solid by Volume Minimum 40%) of Minimum 25 Micron DFT. This Coat shall be applied within Seven (7) days (from the completion of Finish Coat), after Erection by brush and / or spray. Colour and shade of the Coat shall be as approved by the Employer.</p>	
5.01.04	<p><b>Touch-up Painting on damaged areas</b></p> <p>(a) <b>For Coatings damaged up to metal surface</b></p> <p>Surface preparation shall be carried out by Manual Cleaning. Minimum 6 inches adjoining area with existing Coating shall be roughened by Wire brushing, emery paper rubbing etc., for best adhesion of patch Primer.</p> <p>Primer Coat of self-priming Epoxy Touch-up Primer applied by brush immediately after the surface preparation. (Minimum DFT 100 Microns).</p> <p>Over this Primer Coat, Intermediate Coat, Finish Coat and Final Finish Coat shall be applied as covered above by brush with Intermediate Coat applied within maximum seven (7) days of application of touch up Primer.</p> <p>(b) <b>For Coatings damaged upto Intermediate Coatings (i.e. where Primer Coat is intact).</b></p> <p>Damaged area including Minimum 6 inches adjoining area with existing Coating should be roughened by wire brushing, emery paper rubbing etc., for best adhesion of patch Primer without damaging the Primer Coat.</p> <p>Touch-up Primer, Intermediate, Finish and Final Finish Coats shall be applied as specified above for Coatings damaged up to metal surface.</p>	
5.01.05	<p>Painting of Welded areas / Painting of areas exposed after removal of temporary supports / Touch-up Painting on damaged areas of Employer's Structures, where inter-connection, Welding / modification etc. has been carried out by the Contractor.</p> <p>(a) Clean the surface to remove flux spatters and loose rust, loose Coatings in the adjoining areas of Weld seams by wire brush and emery paper.</p> <p>(b) Painting procedure to be followed as mentioned above for Touch-up Painting on damaged areas.</p>	
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2	PART-B SUB-SECTION-V CIVIL WORKS  PAGE 18 OF 22

## THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-385-154-12000A-A001


CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
7.00.00	<p>5) The contractor shall furnish the complete and final feeder list for LT system and HT system for all loads and drives under the scope of supply of contractor to employer in advance and as per mutually agreed schedule. Contractor shall indicate the location of his equipments in feeder load list.</p> <p>6) Contractor shall furnish the cable list as per mutually agreed format for all the cables under his scope of supply under electrical and C&amp;I section, to the employer to facilitate preparation of cable schedule.</p> <p>7) Interconnection diagram for cables between contractor's equipments shall be prepared by the contractor.</p> <p>8) Contractor shall provide cable glands and lugs for all equipments in his scope.</p> <p>9) Contractor shall provide all accessories such as rigid/ flexible conduits, fittings, junction boxes, tying materials, cable tags, markers etc. for the cables under his scope.</p>		
	<p><b>PAINTING FOR ELETRICAL EQUIPEMENT</b></p> <p>The painting for electrical equipment shall be epoxy based with suitable additives. The thickness of finish coat shall be minimum 50 microns. However in case electro static process of painting is offered for any electrical equipment, minimum paint thickness of 50 microns shall be acceptable for finish coat. The contractor shall furnish the complete painting details during detailed engineering.</p>		
MOUDA SUPER THERMAL POWER PROJECT STAGE-II (2X660 MW) STEAM GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO. : CS-9575/9571/0360/0370/9586-102-2	PART-A SUB SECTION-III B ELECTRICAL SYSTEMS  PAGE 2 OF 2

<div><div>बी एच डी एल</div><div></div></div>	<div>TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2x660 MW MOUDA STTP STAGE II</div>	SPEC. NO. PE-TS-385-154-12000A-A001	
		VOLUME II-B	
		SECTION : D1	
		REV. NO. 00	DATE:
		SHEET 40	

## INSPECTION REQUIREMENT OF BHEL

The inspection of oxygen dosing system shall be done as per the manufacturing Quality Plan which shall be subject to approval by BHEL & CUSTOMER during detailed engineering. Any changes insisted upon by BHEL shall be taken care of by bidder. However the minimum inspection requirement of BHEL shall be as given below.

1. **Welder Qualification**
  - a) Review of welder's qualification (WPS & PQR) shall be done by BHEL & CUSTOMER during final inspection.
2. **Empty oxygen cylinder**
  - a) Inspection report of BIS approved inspection agency for all the tests performed as per IS 7285 shall be submitted for review by BHEL & CUSTOMER during final inspection.
  - b) Approval certificate from CCE, Nagpur shall also be furnished if applicable as per statutory norms for review by BHEL & CUSTOMER during final inspection.
3. **Valves (Ball, Check, PRV, solenoid, needle)**
  - a) Material test Certificate/lab report for both physical & chemical test (physical test for trim material is not required) for body, bonnet, cover, trim material, ball shall be furnished for review by BHEL & CUSTOMER during final inspection.
  - b) Hydro test, pneumatic test, dimensions of valve assembly shall be as per BHEL approved data sheet. Manufacturer's test certificate shall be submitted for the same for review by BHEL & CUSTOMER during final inspection.
  - c) All valves shall be oxygen cleaned and suitable for oxygen service. Manufacturer's COC certifying the same shall be submitted for review by BHEL & CUSTOMER during final inspection.
4. **Instruments (Pressure Gauge, Pressure Transmitter, Mass flow meter, pressure reducing valve)**
  - a) Material Test certificate for wetted part as per approved data sheet shall be furnished for review by BHEL & CUSTOMER during final inspection.
  - b) Calibration report shall be furnished for review by BHEL & CUSTOMER during final inspection.
  - c) Manufacturer's COC for degree of protection of enclosure (1/similar frame size) shall be for review by BHEL & CUSTOMER during final inspection.
  - d) All instruments shall be oxygen cleaned and suitable for oxygen service. Manufacturer's COC certifying the same shall be submitted for review by BHEL & CUSTOMER during final inspection.
5. **Control valve**
  - a) Hydro test report for body and pneumatic test report of actuator chamber and seat shall be submitted for review by BHEL & CUSTOMER during final inspection.
  - b) Manufacturer's test reports shall be submitted for 100 % control valves for overall dimensional checks (as per BHEL approved GA/data sheet) and functional tests (including valve travel, opening & closing time, linearity/CAM characteristics, hysteresis) as per BHEL approved data sheets for review by BHEL & CUSTOMER during final inspection.
  - c) Manufacturer's test reports for CV test (including valve characteristics, PR vs discharge, PR vs opening 0 to 100% in steps of 10%) shall be submitted for 1/similar type of control valve for review by BHEL & CUSTOMER during final inspection.
6. **Junction Box**
  - a) Check of make & rating of components as per approved drawing shall be done by BHEL
  - b) Visual check of dimensions and orientation as per approved drawing shall be done by BHEL
  - c) IR-HV-IR test shall be witnessed by BHEL
  - d) Test certificate for degree of protection of the enclosure (1 per similar frame size) shall be submitted by bidder for review by BHEL.
7. **Tubing**
  - a) Material test Certificate/lab report and hydro test report shall be furnished for review by BHEL & CUSTOMER during final inspection.

<div><div>बी एच डी रल</div><div></div></div>	TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2x660 MW MOUDA STTP STAGE II	SPEC. NO. PE-TS-385-154-12000A-A001	
		VOLUME II-B	
		SECTION : D1	
		REV. NO. 00	DATE:
		SHEET	५१

**8. Fittings**

- a) Material test Certificate/lab report, certificate for heat treatment and dimensions of fittings (as per BHEL approved data sheet) shall be submitted for review by BHEL & CUSTOMER during final inspection.

**9. Final skid assembly (Inspection witness by BHEL & CUSTOMER except point g)**

- a) Measurement of skid dimensions and elevation of terminal point  
b) Visual checking of skid orientation as per BHEL/ CUSTOMER approved GA drawing  
c) Visual checking of welding soundness, cleanliness at weld joints  
d) Hydro test of the complete interconnected tubing  
e) Pneumatic test of the complete interconnected tubing  
f) Verification of painting thickness by elcometer and paint shade with respect to color shade chart  
g) DP test for all socket weld joints may be witnessed by any renowned TPI at bidder's cost and review of their report shall be done by BHEL & CUSTOMER during final inspection. Alternatively, bidder may also offer DP test for BHEL & CUSTOMER witness.

**Note: -**

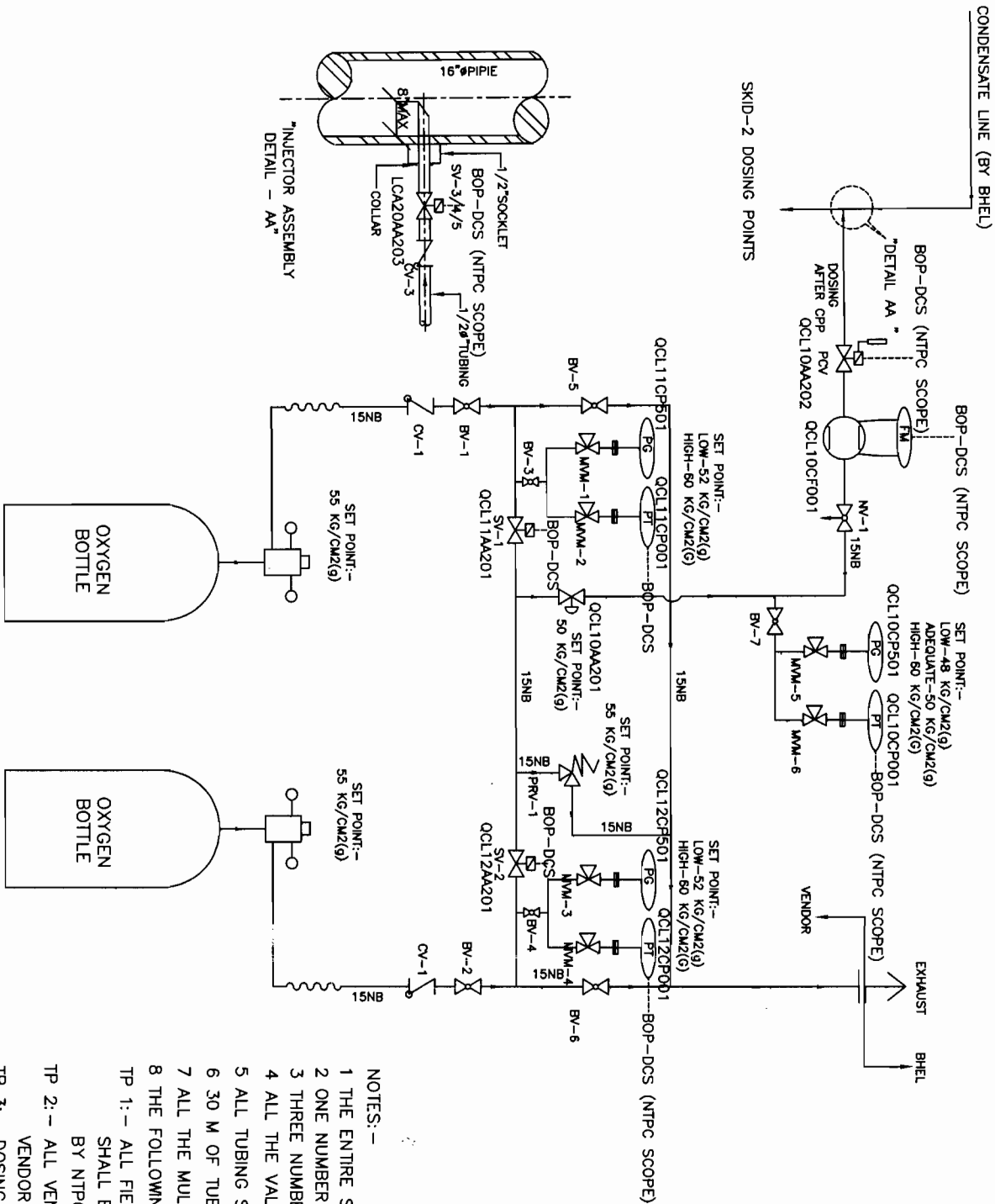
- i. For pressure transmitters and for imported components (imported either by bidder or by equipment manufacturer's authorized dealer/distributor), manufacturer's COC is also applicable in place of test certificate. However, the COC should contain all the desired relevant information.  
ii. For type test reports such as degree of protection for enclosures and for CV test, reports generated on an equipment of similar frame size/design/model within 5 years preceding the date of final inspection is acceptable to BHEL.

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ON DRAWING

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



LEGEND	
	PRESSURE REDUCING CUM REGULATING 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

- 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 CEP DISCHARGE(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, 800 CLASS SW.
  - 5 ALL TUBING SHALL BE OF SS 316, 15 NB AND SCH 80.
  - 6 30 M OF TUBING PER UNIT (TOTAL 60M) OF SAME SPECIFICATION SHALL BE LOOSE WITH THE SKID.
  - 7 ALL THE MULTI VALVE MANIFOLD SHALL BE 3-WAY VALVE MANIFOLDS.
  - 8 THE FOLLOWING SHALL BE THE TERMINAL POINT DETAILS:-
  - TP 1:- ALL FIELD INSTRUMENTS(PRESSURE AND FLOW TRANSMITTERS), AND SOLENOID VALVES(SV & 2 ONLY) SHALL BE TERMINATED AT THE JB BY OXYGEN DOSING VENDOR FOR FURTHER CONNECTION TO DCS BY NTPC.
  - 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 PCV AND TERMINATED BY THE OXYGEN DOSING SUPPLIER FOR FURTHER INTERCONNECTION TILL DOSING LOCATIONS BY BHEL.
  - TP 4:- INSTRUMENT AIR CONNECTION TO PCV SHALL BE DIRECTLY CONNECTED BY BHEL.
  - TP 5:- 24 VDC CONNECTION TO SV-3 SHALL BE DIRECTLY CONNECTED BY NTPC.
  9. BHEL SHALL TERMINATE ALL INSTRUMENTS/DEVICES AS PER NTPC PROVIDED TERMINATION DRAWINGS & WILL PROVIDE JBS AND CABLES ACCORDINGLY.

NATIONAL THERMAL POWER CORPORATION LTD.

2 X 660 MW MOUDA STPP STAGE II



BHARAT HEAVY ELECTRICALS LTD  
POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT  
NEW DELHI

TITLE P&ID FOR OXYGEN DOSING  
SKID AT CEP DISCHARGE

DEPT	NAME	SIGN	DATE
DRN	RG		
DES	RG		
CHD	SK		
APPD	SB		

DRAWING NO. PE-DG-385-154-A003

SHEET 01 OF 02 REV 0

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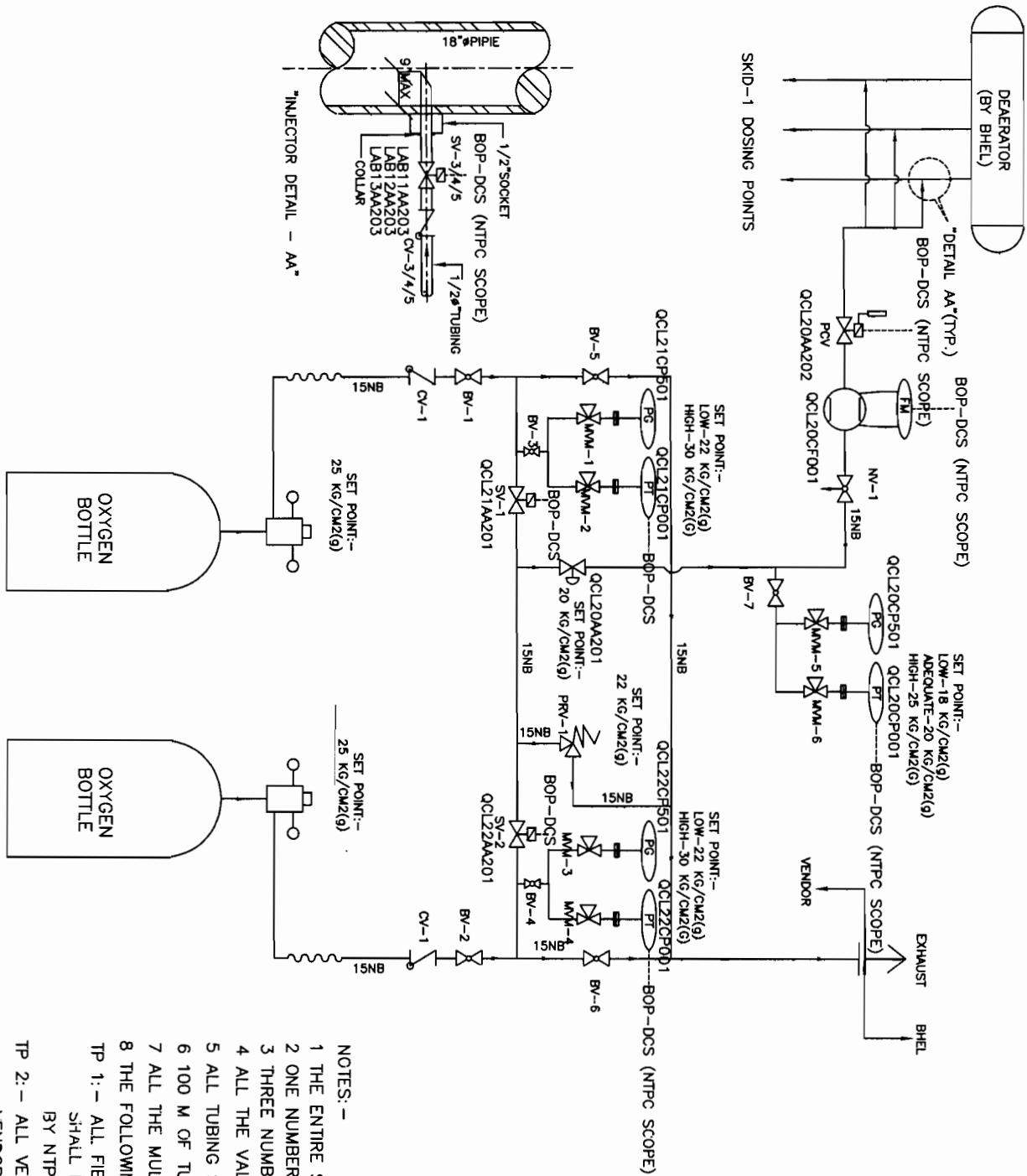


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ON DRAWING

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



LEGEND	
	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

- 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, 800 CLASS SW.
  - 5 ALL TUBING SHALL BE OF SS 316, 15 NB AND SCH 80.
  - 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.
  - 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 DCS BY NTPC.
  - 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 PCV AND TERMINATED BY THE OXYGEN DOSING SUPPLIER FOR FURTHER INTERCONNECTION TILL DOSING LOCATIONS BY BHEL.
  - TP 4:- INSTRUMENT AIR CONNECTION TO PCV SHALL BE DIRECTLY CONNECTED BY BHEL.
  - TP 5:- 24 VDC CONNECTION TO SV-3, SV-4 AND SV-5 SHALL BE DIRECTLY CONNECTED BY NTPC.
  9. BHEL SHALL TERMINATE ALL INSTRUMENTS/DEVICES AS PER NTPC PROVIDED TERMINATION DRAWINGS & WILL PROVIDE JBS AND CABLES ACCORDINGLY.

NATIONAL THERMAL POWER CORPORATION LTD.

2 X 660 MW MOUDA STPP STAGE II




BHARAT HEAVY ELECTRICALS LTD  
POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT  
NEW DELHI

TITLE P&ID FOR OXYGEN DOSING  
SKID AT DEAERATOR OUTLET

DEPT	NAME	SIGN	DATE
DRN	RG		
DES	RG		
CHK	SK		
APPD	SB		

DRAWING No. PE-DG-385-154-A003

SHEET	02	OF	02	REV	0
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	<b>TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2x660 MW MOUDA STTP STAGE II</b>	SPEC. NO. PE-TS-385-154-12000A-A001	
		VOLUME II-B	
		SECTION : D2	
		REV. NO. 00	DATE:
		SHEET	44

## SECTION – D2

### GENERAL TECHNICAL SPECIFICATION -ELECTRICAL





## **SUB-SECTION-III:E4**


### **LT CONTROL CABLES**


MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) /  
NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) /  
RAGHUNATHPUR TPP PHASE-II (2 x660MW)  
STEAM GENERATOR PACKAGE


TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2

CLAUSE NO.	TECHNICAL REQUIREMENTS	
1.00.00	<b>LT CONTROL CABLES</b>	
	<b>CODES &amp; STANDARDS</b>	
1.01.00	<p>All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes :</p> <p>IS :1554 - I      PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.</p> <p>IS : 3961          Recommended current ratings for cables</p> <p>IS : 3975          Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.</p> <p>IS : 4905          Methods for random sampling.</p> <p>IS : 5831          PVC insulation and sheath of electrical cables.</p> <p>IS : 8130          Conductors for insulated electrical cables and flexible cords.</p> <p>IS : 10418        Specification for drums for electric cables.</p> <p>IS : 10810        Methods of tests for cables.</p> <p>ASTM-D-2843      Standard test method for density of smoke from the burning or decomposition of plastics.</p> <p>IEC-754 (Part-I)          Test on gases evolved during combustion of electric cables.</p> <p>IEC -332          Tests on Electric cables under fire conditions Part-3 : Tests on bunched wires or cables (category -B)</p>	
2.00.00	<b>TECHNICAL REQUIREMENTS</b>	
2.01.00	The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.	
2.02.00	Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.	
2.03.00	Conductor of control cables shall be made of multi stranded, plain annealed copper.	
2.04.00	PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.	
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black color as per IS : 5831.	
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2
PART-B SUB SECTION-III:E4 (LT CONTROL CABLES)		PAGE 1 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS																						
2.06.00	<p>For multicore armoured cables, the armouring shall be of galvanised steel as follows:-</p> <table border="1"> <thead> <tr> <th></th><th>Calculated nominal dia of cable under armour</th><th>Size and Type of armour</th></tr> </thead> <tbody> <tr> <td>1)</td><td>Upto 13 mm</td><td>1.4mm dia GS wire</td></tr> <tr> <td>2)</td><td>Above 13 upto 25 mm</td><td>0.8 mm thick GS formed wire / 1.6 mm dia GS wire</td></tr> <tr> <td>3)</td><td>Above 25 upto 40 mm</td><td>0.8mm thick GS formed wire / 2.0mm dia GS wire</td></tr> <tr> <td>4)</td><td>Above 40 upto 55mm</td><td>1.4 mm thick GS formed wire/ 2.5mm dia GS wire</td></tr> <tr> <td>5)</td><td>Above 55 upto 70 mm</td><td>1.4mm thick GS formed wire / 3.15mm dia GS wire</td></tr> <tr> <td>6)</td><td>Above 70mm</td><td>1.4 mm thick GS formed wire / 4.0 mm dia GS wire</td></tr> </tbody> </table> <p>The gap between armour wire / formed wire shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.</p>		Calculated nominal dia of cable under armour	Size and Type of armour	1)	Upto 13 mm	1.4mm dia GS wire	2)	Above 13 upto 25 mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire	3)	Above 25 upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire	4)	Above 40 upto 55mm	1.4 mm thick GS formed wire/ 2.5mm dia GS wire	5)	Above 55 upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire	6)	Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire	
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2.07.00	<p>Outer sheath shall be of PVC(grade as applicable) and grey in colour . In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.</p> <p>(a) Oxygen index of min. 29 (As per IS:10810(Part-58))</p> <p>(b) Acid gas emission of max. 20% (As per IEC-754-I).</p> <p>(c) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM D-2843.</p>																						
2.08.00	<p>Cores of the cables of upto 5 cores shall be identified by coloring of insulation. Following color scheme shall be adopted.</p> <table border="1"> <tbody> <tr> <td>1 core</td><td>-</td><td>Red, Black, Yellow or Blue</td></tr> <tr> <td>2 core</td><td>-</td><td>Red &amp; Black</td></tr> <tr> <td>3 core</td><td>-</td><td>Red, Yellow &amp; Blue</td></tr> <tr> <td>4 core</td><td>-</td><td>Red, Yellow, Blue and Black</td></tr> <tr> <td>5 core</td><td>-</td><td>Red, Yellow, Blue, Black and Grey</td></tr> </tbody> </table>	1 core	-	Red, Black, Yellow or Blue	2 core	-	Red & Black	3 core	-	Red, Yellow & Blue	4 core	-	Red, Yellow, Blue and Black	5 core	-	Red, Yellow, Blue, Black and Grey							
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2.09.00	<p>For cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the color of insulation. The color of insulation for all the cores shall</p>																						
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE		<div> <div> TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2 </div> <div> PART-B SUB SECTION-III:E4 (LT CONTROL CABLES) </div> <div> PAGE 2 OF 6 </div> </div>																					


CLAUSE NO.	TECHNICAL REQUIREMENTS	
	be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm.	
2.10.00	<p>In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath :</p> <p>(a) Cable size and voltage grade - To be embossed</p> <p>(b) Word 'FRLS' at every 5 meter - To be embossed</p> <p>(c) Sequential marking of length of the cable in meters at every one meter. - To be embossed / printed.</p> <p>The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible.</p>	
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part -3.	
2.12.00	Allowable tolerances on the overall diameter of the cables shall be $\pm 2$ mm maximum over the declared value in the technical data sheets.	
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.	
2.14.00	<p><b>Cable selection &amp; sizing</b></p> <p>(a) Rated current of the equipment</p> <p>(b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage</p> <p>(c) Short circuit withstand capability</p> <p>This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.</p> <p>(d) The minimum size of conductor shall be 1.5 sq.mm.</p>	
2.14.01	<p><b>Derating Factors</b></p> <p>Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:</p> <p>a) Variation in ambient temperature for cables laid in air</p> <p>b) Grouping of cables</p> <p>c) Variation in ground temperature and soil resistivity for buried cables.</p>	
2.14.02	Cable lengths shall be considered in such a way that straight through cable joints are avoided.	
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2
		PART-B SUB SECTION-III:E4 (LT CONTROL CABLES)
		PAGE 3 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS	
2.14.03	Cables shall be armoured type if laid in switchyard area, coal handling area or directly buried.	
3.00.00	<b>CONSTRUCTIONAL FEATURES</b>	
3.01.00	<b>1.1 KV Grade Control Cables</b>	
	Control Cables shall have stranded copper conductor multicore PVC insulated, PVC inner-sheathed, armoured / unarmoured, PVC outer-sheathed conforming to IS:1554. (Part-I).	
3.02.00	<b>Cable Drums</b>	
	<p>(a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS : 10418.</p> <p>(b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.</p>	
4.00.00	<b>TESTS</b>	
4.01.00	<b>GENERAL</b>	
	<p>(a) All equipment to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.</p> <p>(b) However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.</p> <p>(c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.</p> <p>(d) The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.</p>	
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2
PART-B SUB SECTION-III:E4 (LT CONTROL CABLES)		PAGE 4 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS							
4.02.00	<b>Type Tests:</b>							
4.02.01	The Type tests reports for the following shall be submitted for one size each of LT control cable of each make :							
	S. No.	Type Test	Remarks					
	a)	For Conductor						
	1.	Resistance test						
	b)	For Armour Wires / Formed Wires						
	2.	Measurement of Dimensions						
	3.	Tensile Test						
	4.	Elongation test						
	5.	Torsion test	For round wire only					
	6.	Winding test	For Formed wires only					
	7.	Resistance test						
	8.	Zinc Coating test	For G.S. conductors only.					
	c)	For PVC insulation & PVC Sheath						
	9.	Test for thickness						
	10.	Tensile strength and elongation test before ageing and after ageing						
	11.	Ageing in air oven						
	12.	Loss of mass test	For PVC insulation and sheath only					
	13.	Hot deformation test	For PVC insulation and sheath only					
	14.	Heat shock test	For PVC insulation and sheath only					
	15.	Shrinkage test						
	16.	Thermal stability test	For PVC insulation and sheath only					
	17.	Oxygen index test	For outer sheath only					
	18.	Smoke density test	For outer sheath only					
	19.	Acid gas generation test	For outer sheath only					
<table><tr><td>MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2</td><td>PART-B SUB SECTION-II:E4 (LT CONTROL CABLES)</td><td>PAGE 5 OF 6</td></tr></table>					MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2	PART-B SUB SECTION-II:E4 (LT CONTROL CABLES)	PAGE 5 OF 6
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THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-385-154-12000A-A001

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<p>d) For completed cables</p> <p>20. Insulation resistance test (Volume resistivity method)</p> <p>21. High voltage test</p> <p>22. Flammability test as per IEC - 332 Part-3 (Category-B)</p> <p>4.03.00 <b>Acceptance Tests:</b> As per QA Table</p> <p>4.04.00 <b>Routine Tests :</b>As per QA Table</p>	
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2	PART-B SUB SECTION-III:E4 (LT CONTROL CABLES)





## **SUB-SECTION-III:E3**


### **LT POWER CABLES**

MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) /  
NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) /  
RAGHUNATHPUR TPP PHASE-II (2 x 660MW)  
STEAM GENERATOR PACKAGE

TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2


CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<b>LT POWER CABLES</b>			
<b>1.00.00</b>	<b>CODES &amp; STANDARDS</b>			
1.01.00	<p>All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:</p> <p>IS :1554 - I      PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.</p> <p>IS : 3961          Recommended current ratings for cables</p> <p>IS : 3975          Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.</p> <p>IS : 4905          Methods for random sampling.</p> <p>IS : 5831          PVC insulation and sheath of electrical cables.</p> <p>IS:7098(Part-I) Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.</p> <p>IS : 8130          Conductors for insulated electrical cables and flexible cords.</p> <p>IS : 10418        Specification for drums for electric cables.</p> <p>IS : 10810        Methods of tests for cables.</p> <p>ASTM-D-2843 Standard test method for density of smoke from the burning or decomposition of plastics.</p> <p>IEC-754(Part-I) Test on gases evolved during combustion of electric cables.</p> <p>IEC -332          Tests on Electric cables under fire conditions. Part-3 : Tests on bunched wires or cables (category -B)</p>			
<b>2.00.00</b>	<b>TECHNICAL REQUIREMENTS</b>			
2.01.00	The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.			
2.02.00	Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.			
2.03.00	Aluminum conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be multi stranded.			
2.04.00	XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg.C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg.C.			
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE		<b>TECHNICAL SPECIFICATION</b> <b>SECTION-VI</b> BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2		<b>PART-B</b> SUB SECTION-III:E3 (LT POWER CABLES)
				PAGE 1 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black color as per IS : 5831.			
2.06.00	For single core armoured cables, armouring shall be of aluminum wires/formed wires. For multicore armoured cables armouring shall be of galvanised steel as follows : -			
	Calculated nominal dia of cable under armour		Size and Type of armour	
	i) Upto 13 mm		1.4mm dia GS wire	
	ii) Above 13 & upto 25mm		0.8 mm thick GS formed wire / 1.6 mm dia GS wire	
	iii) Above 25 & upto 40 mm		0.8 mm thick GS formed wire / 2.0 mm dia GS wire	
	iv) Above 40 & upto 55mm		1.4 mm thick GS formed wire / 2.5 mm dia GS wire	
	v) Above 55 & upto 70 mm		1.4 mm thick GS formed wire / 3.15 mm dia GS wire	
	vi) Above 70mm		1.4 mm thick GS formed wire / 4.0 mm dia GS wire	
2.06.01	The aluminum used for armouring shall be of H4 grade as per IS:8130 with maximum resistivity of .028264 ohms mm <sup>2</sup> per meter at 20 deg C. Aluminum armouring shall be same as indicated above for galvanized steel.			
2.06.02	The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface, of GS wire/formed wire.			
2.07.00	Outer sheath shall be of PVC(of suitable grade) & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.			
	(a)	Oxygen index of min. 29 (As per IS:10810(Part-58))		
	(b)	Acid gas emission of max. 20% (As per IEC-754-I).		
	(c)	Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM-D-2843.		
2.08.00	Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:			
	1 core	-	Red, Black, Yellow or Blue	
	2 core	-	Red & Black	
	3 core	-	Red, Yellow & Blue	
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2		PART-B SUB SECTION-III:E3 (LT POWER CABLES)
PAGE 2 OF 6				


CLAUSE NO.	TECHNICAL REQUIREMENTS	
	4 core - Red, Yellow, Blue and Black	
2.09.00	For reduced neutral conductors the core shall be black.	
2.10.00	<p>In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath.</p> <p>(a) Cable size and voltage grade - To be embossed</p> <p>(b) Word 'FRLS' at every 5 meter - To be embossed</p> <p>(c) Sequential marking of length of the cable in meters at every one meter-To be embossed / printed.</p> <p>The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.</p>	
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part -3.	
2.12.00	Allowable tolerances on the overall diameter of the cables shall be +1-2mm maximum over the declared value in the technical data sheets.	
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.	
2.14.00	Cable selection & sizing	
2.14.01	<p>Cables shall be sized based on the following considerations:</p> <p>(a) Rated current of the equipment</p> <p>(b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage</p> <p>(c) Short circuit withstand capability</p> <p>This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the let-out energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.</p> <p>(d) The minimum conductor size shall be 6 sq.mm for Al conductor cables &amp; 2.5 sq.mm for copper conductor cables. The constructional details of copper conductor cables shall be same as indicated for copper control cables.</p>	
2.14.02	<p><b>Derating Factors</b></p> <p>Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:</p> <p>a) Variation in ambient temperature for cables laid in air</p> <p>b) Grouping of cables</p> <p>c) Variation in ground temperature and soil resistivity for buried cables.</p>	
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
2.14.03	Cable lengths shall be considered in such a way that straight through cable joints are avoided.	
2.14.04	Cables shall be armoured type if laid in switchyard area, coal handling area or directly buried.	
2.14.05	All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated and preferable sizes are 1Cx150, 1Cx300, 1Cx630, 3Cx150 & 3Cx240 sq.mm.	
3.00.00	<b>CONSTRUCTIONAL FEATURES</b>	
3.01.00	<b>1.1 KV Grade Power Cables</b>	
	<p>(a) 1.1KV grade XLPE power cables shall have compacted aluminum conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured/ unarmoured, PVC outer-sheathed conforming to IS:7098. (Part-I).</p> <p>(b) 1.1KV grade PVC power cables shall have aluminum conductor(compact type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured/ unarmoured, PVC outer-sheathed conforming to IS:1554 (Part-I).</p> <p>(c) 1.1KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250 deg.C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968</p>	
3.02.00	<b>Cable Drums</b>	
	<p>(a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS : 10418.</p> <p>(b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.</p>	
4.00.00	<b>TESTS</b>	
4.01.00	<b>GENERAL</b>	
	<p>(a) All equipment to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last <i>ten</i> years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client..</p>	
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2
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CLAUSE NO.	TECHNICAL REQUIREMENTS						
	<p>(b) However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.</p> <p>(c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.</p> <p>(d) The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.</p>						
4.02.00	<b>Type Tests :</b>						
4.02.01	The reports for the following type tests shall be submitted on one size each of PVC/XLPE LT Power cables of each make:						
	<b>S.No.</b>	<b>Type Tests</b>	<b>Remarks</b>				
	a)	For Conductor					
	1.	Resistance test					
	b)	For Armour Wires/ Formed Wires					
	2.	Measurement of Dimensions					
	3.	Tensile Test					
	4.	Elongation test					
	5.	Torsion test	For round wires only				
	6.	Winding test	For Formed wires only				
	7.	Resistance test					
	8.	a) Zinc Coating test	For G.S. Formed wires /wires only.				
		b) Wrapping test	For aluminum wires/formed wires only.				
	c)	For PVC/XLPE insulation & PVC Sheath					
	9.	Test for thickness					
	10.	Tensile strength & elongation tests before ageing and after ageing					
	11.	Ageing in air oven					
<table><tr><td>MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-4 (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2</td><td>PART-B SUB SECTION-III:E3 (LT POWER CABLES)</td><td>PAGE 5 OF 6</td></tr></table>				MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-4 (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2	PART-B SUB SECTION-III:E3 (LT POWER CABLES)	PAGE 5 OF 6
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<div> <div>12. Loss of mass test</div> <div>For PVC insulation and sheath only</div> </div> <div> <div>13. Hot deformation test</div> <div>For PVC insulation and sheath only</div> </div> <div> <div>14. Heat shock test</div> <div>For PVC insulation and sheath only</div> </div> <div> <div>15. Shrinkage test</div> <div></div> </div> <div> <div>16. Thermal stability test</div> <div>For PVC insulation and sheath only</div> </div> <div> <div>17. Hot set test</div> <div>For XLPE insulation only</div> </div> <div> <div>18. Water absorption test</div> <div>For XLPE insulation only</div> </div> <div> <div>19. Oxygen index test</div> <div>For outer sheath only</div> </div> <div> <div>20. Smoke density test</div> <div>For outer sheath only</div> </div> <div> <div>21. Acid gas generation test</div> <div>For outer sheath only</div> </div> <div> <div>d) For completed cables</div> <div></div> </div> <div> <div>22. Insulation resistance test (Volume resistivity method)</div> <div></div> </div> <div> <div>23. High voltage test</div> <div></div> </div> <div> <div>24. Flammability test as per IEC - 332 Part-3 (Category -B)</div> <div></div> </div>	
4.03.00	<b>Acceptance Tests:</b> As per QA table	
4.04.00	<b>Routine Tests :</b> As per QA table	
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102-2	PART-B SUB SECTION-III:E3 (LT POWER CABLES)  PAGE 6 OF 6

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## SECTION – D3

### GENERAL TECHNICAL REQUIREMENT CONTROL & INSTRUMENTATION

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**[A] GENERAL TECHNICAL REQUIREMENTS FOR CONTROL VALVE WITH PNEUMATIC ACTUATOR ALONGWITH ACCESSORIES ARE:**

1. The control valves' actuators to be sized for shut off differential pressure.
2. Control valves shall be sized to have an opening of 10% min. And 80% at max. Flow condition. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel.
3. All the valves shall be capable of handling at least 120% of the required maximum flow.
4. Anticavitation trims shall be provided for valves with cavitation services and hardened trims for flashing services.
5. Control valve accessories shall be fitted on the valve body. Integral pneumatic tubing shall be PVC coated copper and fittings shall be of brass. Applicable accessories shall be terminated at the junction box (mounted on the skid).
6. Type of flow action ("under the seat" or "over the seat") will be selected by the vendor, however wherever downstream side is subjected to vacuum, flow action shall be "flow to close" (over the seat). Separate indication for the same has not been provided.
7. Trim supplied shall be suitable for quick changing and trim velocity shall not exceed 30 m/sec.
8. Control valves shall undergo quality assurance program as per approved quality plan.
9. The multiple stages shall be such that the controlled pressure drop across each stage shall ensure that the valve does not cavitate in any of the stages.
10. The sizing procedure followed shall be as per latest edition of ansi/isa or equivalent standard.
11. Tolerance on end to end, center to center, center to face shall be in accordance with ANSI B16.10
12. Facility to adjust the maximum travel of the stem shall be incorporated.
13. The end connections shall be socket welded for sizes below 50NB. Flanged connection shall be provided for DM water services with suitable rubber lined interfaces.
14. Smart positioner shall be provided with advanced diagnostic software with features like stroke counter or travel counter, leakage in actuator, on line partial closure test, valve signature analysis, valve response test, valve fixation/ jamming detection etc to be provided.
15. Universal hart calibration (one per unit) shall be provided, common to all smart positioners.
16. Travel time for all the control valves shall be within 10 sec.
17. Noise abatement shall be achieved by valve body and trim design and not by use of silencer.

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## **[B] SPECIFICATIONS OF SMART POSITIONERS OF CONTROL VALVES:-**

The electronic positioner shall meet the following requirements:

### **1. Electrical**

- |                            |  |
|----------------------------|--|
| (A) Input Signal           | 4-20 mA-from Control System  |
| (B) Power Supply           | Loop Powered from the output card of control system.   |
| (C) HART Protocol          | Compatibility for remote calibration & Diagnostics (Super-imposed HART Signal on Input Signal) (4-20 mA) |
| (D) Valve Position Sensing | Position sensing (Non-contact type), 4-20 mA<br>O/P Signal for control system to be provided             |

### **2. Environment**

- |                      |                    |
|----------------------|--------------------|
| (A) Operating Temp.  | (-) 30 to 80 Deg.C |
| (B) Humidity         | 0-95%              |
| (C) Protection Class | IP-65 Minimum      |

### **3. Software for Configuration and Diagnostic**

- |   |  |
|---|--|
| (A) Software  | Windows Based Software, Software shall meet the requirement for configuration, diagnostics, calibration and testing of the actuator  |
| (B) Diagnostic/Test features  | Advanced Diagnostic Features like Stroke Counter or Travel Counter, Leakage in actuators, online partial closure test, valve signature analysis, step response test, valve friction/jamming detection etc. to be provided. |
| (C) Factory Valve Signature Tests Reports (PR VS Valve Travel and Travel VS I/P Signal) | To be Provided   |

### **4. Configuration/ Operating Modes**

- |                           |  |
|---------------------------|--|
| (A) Calibration           | Remote Calibration, Auto & Manual Calibration shall be possible      |
| (B) Operating Range       | Full Range & Split Range Signal Range                                |
| (C) Valve Action          | Direct & Reverse Valve Action  |
| (D) Flow Characterization | Possible to Fit Valve Characteristic curve linear & equal percentage |

### **5. Fail Safe/Fail Freeze**


- |   |     |
|---|-----|
| Fail Safe/Fail Freeze Features to be provided | Yes |
|---|-----|

### **6. Pneumatic**

- |                         |   |
|-------------------------|---|
| (A) Air Capacity        | Sufficient to Handle the Valves Selected/Boosters to be supplied if required. |
| (B) Air Supply Pressure | To suit the Air Supply Pressure   |
| (C) Process             | 1/2 Inch NPT Connection   |

### **7. Performance**

- |                              |                          |
|------------------------------|--------------------------|
| (A) Characteristic Deviation | <= 0.5% of SPAN          |
| (B) AMB Temp. Effect         | <=0.01% deg.C. or Better |

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### 8. EMC & CE Compliance

Required to inter- national Standard like EN (IEC) EN50081 - 2 & EN50082 Or Equivalent

### 9. Accessories

- |                               |   |
|-------------------------------|---|
| (A) In Built Operator panel   | Display with push buttons for configuration<br>Display on the positioned itself (password protected/hardware Lock)                  |
| (B) Hand Held Hart Calibrator | Universal Hart Calibrator to be provided, one per unit  |
| (C) Press Gauge block         | For Supply & output pressure, filter regulator other accessories shall be provided as on required basis for making system complete. |
| (D)Electrical Cable Entry     | ½ NPT, side or bottom entry to avoid water ingress  |
| (E) Valves Mounting Assembly  | for Sliding Stem/Rotary/Single acting/ double acting on required basis.   |

### [C] END PREPARATION


Valve body ends shall be socket welded, flanged or screwed as finalized during detailed engineering and as per Employer's approval. For valves size 50 mm and below, the welded ends wherever required shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.

### [D] VALVE ACTUATORS


All control valves shall be furnished with pneumatic actuators. The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously. Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force (at least 0.15 Kg/sq.cm. per linear mm of seating surface) shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified. The travel time of the pneumatic actuators shall not exceed 10 seconds.

## MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

- 1.0 Measuring instruments / equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment. The instrumentation vendor shall be subject to BHEL's approval. Further, all instruments shall be of proven reliability, accuracy, repeatability requiring a minimum of maintenance. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, makes / numbers as approved by BHEL during detailed engineering.
- 2.0 Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
- 3.0 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 and 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. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg / Cm<sup>2</sup>.

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SL. NO.	FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
		PR. GAUGE / D.P. GAUGE	TEMP. GAUGE	LEVEL GAUGE
1	Sensing Element and Material	Bourdon for high pressure, Diaphragm / Bellow for low pr. of 316 SS	Mercury in steel below 450 Deg.C and inert gas actuated for above 450 Deg.C of SS bulb and capillary	Tempered toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel 304 SS
3	Dial size	150 mm	150 mm	Tubular covering entire range.
4	End connection	½ inch NPT (F)	¾ inch NPT (F)	Process connection as per ASME PTC and drain / vent 15 NB +2%.
5	Accuracy	+1% of span	+1% of span	+2%
6	Scale	Linear, 270 Deg. Arc graduated in metric units.	Linear, 270 Deg. Arc graduated in Deg. C	Linear vertical
7	Range selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale
8	Over range test	Yes	Yes	Test pr. For the assembly shall be 1.5 to the max. design pr. at 38 Deg. C.
9	Housing	Weather and dust proof as per NEMA-4	Weather and dust proof as per NEMA-4	CS/304 SS leak proof
10	Zero / Span adjustment		Provided	Provided

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11	Identification	Engraved with service legend or engraved phenolic laminated tag plate	Engraved with service legend or laminated phenolic name plate	Engraved with service legend or laminated phenolic name plate
12	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel / SS as per CS / Alloy process requirement.
13	Material of Bourdon movement	316 SS / 304 SS	316 SS / 304 SS	316 SS / 304 SS

#### 4.0 PROCESS ACTUATED SWITCHES (PRESS. / DIFF. PRESS. / TEMP. / LEVEL / LIMIT)

SL. NO.	FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS			
		PR. SWITCH / D.P.	TEMP. SWITCH	LEVEL SWITCH	LIMIT SWITCH
1	Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr. / vacuum	Vapour pressure sensing liquid filled bellow type with bulb and capillary	Capacitance types for oil and dirty medium, water, condensate application.	Micro switch
2	Material	316 SS	316 SS / 304 SS	316 SS	Silver plated high conductivity non-corrosive
3	Repeatability	+0.5% for full range	+0.5% for full range	+0.5% for full range	+0.5%
4	End connection	½ Inch NPT (F)	½ Inch NPT (F)	1" NB Socket Weld	
5	Over range proof pressure	150% of max. design press.	---	150% of max. design press.	---
6	No. of contacts	2 NO + 2 NC, SPDT snap action dry contact	2 NO + 2 NC, SPDT snap action dry contact	2 NO + 2 NC, SPDT snap action dry contact	2 NO + 2 NC, SPDT
7	Rating of contacts	5A, 240V AC or 0.25A, 220V DC	5A, 240V AC or 0.25A, 220V DC	5A, 240V AC or 0.25A, 220V DC	5A, 240V AC or 0.25A, 220V DC Hermetically.

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8	Enclosure	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55
9	Set point / dead	Provided	Provided	Provided	Provided
10	Accessories	Syphon, snubber, chemical seal, pulsation dampener as required by process	Thermowell of 316 SS and packing glands	All mounting accessories	
11	Mounting	Suitable for enclosure rack mounting	Suitable for rack mounting vertically	Suitable for rack mounting or direct mounting	Direct factory mounting on valves, equipment with provision for adjusting at site.
12	Elect. Connection	Plug in socket	Plug in socket	Plug in socket	Plug in socket


## 5.0 FIELD MOUNTED LOCAL JUNCTION BOXES

- |       |                                 |   |
|-------|---------------------------------|---|
| (i)   | No. of ways                     | 12/24/36/48/64/72/96/128 with 20% spare terminals.  |
| (ii)  | Material and Thickness          | 4mm thick Fiberglass Reinforced Polyester.  |
| (iii) | Type                            | Screwed at all four corners for door. Door handle shall be self Locking with common key. Door gasket shall be of synthetic rubber.  |
| (iv)  | Mounting clamps and accessories | Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass, included in Bidders scope of supply. |
| (v)   | Type of terminal blocks         | Rail mounted maxitermi or cage-clamp type suitable for conductor size up to 2.5 mm <sup>2</sup> . A M6 earthing stud shall be provided.   |
| (vi)  | Protection Class                | IP: 55 minimum for indoor & IP-66 minimum for outdoor   |
| (vii) | Colour                          | to be decided during detailed engineering & Subject to Employer's approval.   |

## 6.0 CABINET/PANELS

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



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glanding is not possible Bidder shall indicate in his proposal his suggested procedure for cable entry and securing the cable at place. If gland plate is not provided, then a suitable plate of 2mm size shall be provided to close bottom entry of panels with proper fixing through screw at number of points for giving rigid support. Bidder shall furnish the number of cables that can be connected in each cabinet and Bidder shall provide the number of marshalling and termination cabinets required to connect all the specified input and output points as per the arrangements decided by the Employer during detail Engg. Bidder shall also provide after the final installation of the cable, a suitable fire proof sealing material on the gland plates to ensure absolute sealing of the cabinet bottom, thereby ensuring that no dust ingress takes place from the cable entry zones. The grouping, layout of all the above cabinets shall be as approved by the Employer during detail engg.

The Bidder shall furnish with the proposal, detailed drawings and photographs giving sufficient information to demonstrate to the Employer, the internal layouts of cabinets offered, constructional features of cabinets, system of packaging of control modules in racks, wiring and cabling techniques, termination method for field cables, test facilities provided, etc.

The cabinets shall be IP-55 protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.

The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables.

The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2345 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Bidder during detailed engineering.


Cabinet doors shall be hinged and shall have turned back edges and additional bracing where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.

Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish colour shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. The finish colors for exterior and interior surfaces shall conform to following shades:

Front & Rear-RAL 9002; End panels sides- RAL 5012. Internal colour shall be same as external colour.

Paint films which show sags, checks or other imperfections shall not be acceptable.


Cabinets shall be designed for a grounded installation on the building structure. Any isolation from the building ground which is required by equipment design shall be provided internal to the cabinet.

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All panels, cabinets shall be provided with a continuous bare copper ground bus, for grounding, bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels.

All alarm contacts located within cabinets as well as inputs/outputs from other related system shall be suitably terminated in the cabinets.

The Bidder may submit details of his standard wiring practice for similar application for consideration and approval of Employer.

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### SCHEDULE OF CLARIFICATION/DEVIATION

All clarification/deviation 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