

**2X660 MW SURATGARH STPS Stage V  
UNIT # 7 & 8**

**VOLUME: II B & III**

**TECHNICAL SPECIFICATIONS  
FOR  
OXYGEN DOSING SYSTEM**

**SPECIFICATION NO.: PE-TS-392-154-12000A-A001**



**BHARAT HEAVY ELECTRICALS LIMITED**

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



**TITLE: TECHNICAL SPECIFICATION FOR  
OXYGEN DOSING SYSTEM  
2X660 MW SURATGARH STPS STAGE V  
UNIT # 7& 8**

SPEC. NO. **PE-TS-392-154-12000A-A001**

VOLUME

SECTION

REV. NO. 0


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VOLUME-IIB & III**


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## SECTION – A

### SCOPE OF ENQUIRY


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## 1.0 SCOPE OF INQUIRY/ INTENT OF SPECIFICATION

- 1.1 The specification is intended to cover design, engineering, manufacture, inspection and testing at vendor's/ sub-vendor's works, painting, mandatory spares, erection and commissioning spares, proper packing and supply and dispatch to power station site, and handing over of **OXYGEN DOSING SYSTEM** as per details in different sections / volumes of this specification for **2 X 660 MW Suratgarh STPS Stage V unit 7&8**.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the vendor from the responsibility of providing such facilities to complete the supply of **OXYGEN DOSING SYSTEM**.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgment is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.
- 1.7 Deviations along with cost of withdrawal (positive or negative), if any, should be very clearly brought out clause by clause in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.

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- 1.8 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.9 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean BHEL and /or RRUVNL including their consultant as interpreted by BHEL in the relevant context.
- 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/Customer.
- 1.11 BHEL's/Customer's representative shall be given full access to the shop in which the equipments are being manufactured or tested and all test records shall be made available to him.

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## SECTION – B

### PROJECT INFORMATION

SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>		VOLUME II SECTION – B
	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> GENERAL PROJECT INFORMATION		SHEET 1 OF 3

1.0	Owner	Rajasthan Rajya Vidyut Utpadan Nigam Ltd., Jaipur
2.0	Consulting Engineer	TATA Consulting Engineers Ltd. 73/1, St. Marks Road, Bangalore – 560 001  Tel : 080 – 6622 6000 Fax : 080 – 22274874
3.0	Location of the plant	Prabat Nagar, Suratgarh Sriganganagar district, Rajasthan.
4.0	Latitude and longitude	Latitude : 29 deg. 10 min. N Longitude : 74 deg.01 min. E
5.0	Elevation above mean sea level	186 m (approximate)
6.0	<b>Climatic conditions</b>	
6.1	Temperatures : Monthly basis	
	Mean of daily max.	32.8 deg.C (in the month of May)
	Mean of daily min.	17.6 deg.C (in the month of Jan)
6.2	Temperatures : Annual basis	
	Mean of daily max.	32.3 deg.C
	Mean of daily min.	19.6 deg.C
	Highest temperature recorded	50 deg.C
	Lowest temperature recorded	(-) 2.8 deg.C
	Design Ambient Temperature for Electrical Equipment design	50 deg C
6.3	Relative humidity	Varies between 21% and 81%
6.4	Annual average rain fall	312 mm
6.5	Annual mean wind speed :	4 km / hr.
7.0	Wind load	

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SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>		VOLUME II SECTION – B
	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> GENERAL PROJECT INFORMATION		SHEET 2 OF 3

	Calculations for wind effect shall be in accordance with IS:875-1987(Part-3) taking into account the following:	
	a) Basic wind speed = 47 m/sec	
	b) Factor K1 = 1.07	
	c) Category of terrain = Category 2	
	d) K3 – as per IS 875	
8.0	Seismic data (As per IS: 1893 latest issue)	
	a) Zone	Zone II
	Designs & design coefficients shall be based on IS 1893:2002	
	Design condenser cooling water inlet temperature	33 Deg C
9.0	Auxiliary power supply:	
	Auxiliary electrical equipment to be supplied against this specification shall be suitable for operation on the following system:	
	a) For motors rated 160 kW and below.	415V AC, 3-phase, 3-wire effectively earthed.
	b) For motors rated above 160 kW and up to 1500 kW	6600V AC, 3-phase, 3-wire, 50 Hz, non-effectively earthed
	c) For motors rated above 1500kW	11000V AC, 3-phase, 3-wire, 50 Hz, non-effectively earthed
	d) For motor control centres	415V AC, 3-phase, 3/4-wire effectively earthed.
	e) DC motor starters, DC solenoids, DC alarm control and protection	220 V DC, 2-wire unearthed
	f) AC control & protective devices	110 V 1 phase, 50Hz, 2 wire AC supply. The single phase 110V AC supply shall be derived by VENDOR by providing 415V / 110 V Control transformers of adequate rating with MCCB / MCB on both the primary and secondary sides.
	g) Uninterrupted power supply	230 V, 1-phase, 50 Hz, 2-wire, AC

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SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME II SECTION – B
	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> GENERAL PROJECT INFORMATION	SHEET 3 OF 3

	supply (For all instrumentation and control system equipment and solenoid valves)
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- g) Lighting fixtures and space heaters 240 V, 1 phase, 2 wire, 50Hz, solidly earthed system
- h) Construction supply 415 V, 3 phase, 4 wire, 50Hz AC supply with neutral lead solidly earthed.
- i) The above voltages may vary as follows :

All devices shall be suitable for continuous operation over the entire range of voltage and frequency indicated below without any change in their performance.

AC supply

Voltage variation  $\pm 10\%$   
Frequency variation  $\pm 5\%$

DC supply

Combined voltage & frequency variation 10%

- j) For instrument and control system of steam generator and steam turbine generator. 230 V  $\pm 5\%$  AC UPS, 1-phase, 50 Hz, 2-wire. The 24 V DC required for control system shall be generated from this UPS.

10.0 All the electrical equipment shall be designed for 50° C reference ambient temperature.


## 11.0 LOCATION OF PLANT

The proposed power project shall be located in the state of Rajasthan, in Shriganganagar Distt. The proposed power project is located within 393 km from Jaipur 169 km from Bikaner and 367 Km from Delhi.

**Major road distances of the project site are as follows:-**


Between	Distance in KMs.
Project-Suratgarh	: 31 km (Neraest Railhead)
Project-Jaipur (State Capital)	: 393 km
Project- Delhi	: 367 Km
Project - Jaipur	: 393 km (Nearest Airport in Rajasthan)
- Amritsar	: 378 km (Nearest Airport)
Project - Bikaner	: 169 km

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	<b>TITLE : TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2X660 MW SURATGARH STPS STAGE V UNIT # 7&amp; 8</b>	SPEC. NO. PE-TS-392-154-12000A-A001	
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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 SURATGARH STPS STAGE V unit 7 & 8. The above system shall be skid mounted. Two numbers skid per unit shall be provided for oxygen dosing system for each unit (one skid for dosing at CPU outlet and one skid for dosing at deaerator outlet).

### 1.1 SCOPE OF SUPPLY FOR BIDDER

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

The scope of supply for Oxygen dosing system consists of the followings:

- i. Entire Oxygen dosing system mounted on skid (including two banks of cylinders (containing four cylinders in each bank) as per P&ID and Data Sheet-A Instrumentation (minimum) as per the enclosed P&ID.
- ii. Mandatory spares
- iii. Start-up and commissioning spares as required.
- iv. All flanges & counter flanges to interconnect the pipes.
- v. Racks (2 Nos.) each to hold 26 cylinders, cylinders (52 Nos.) injector assemblies, tees (20 nos.), elbows (20 nos.), loose tubing (480 meter), compression fittings (90 nos.) for loose tubing.

### 1.2 SCOPE OF SERVICE

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

- i. Design and engineering.
- ii. Fabrication of the skid mounted oxygen dosing system.
- iii. Painting as per the enclosed painting requirement. However, any variation in the painting requirement as finally approved by customer shall be taken care by the bidder without any commercial and delivery implication.
- iv. Inspection and testing of the skid as per the approved quality assurance plan.
- v. 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-392-154-12000A-A001)

Each skid of Oxygen Dosing System consists of the following:

- a) Two banks of oxygen cylinder with four cylinders in each bank for dosing at downstream of deaerator/CPU outlet.
- b) Two number of Pressure Regulator as per section D1 and data sheet - A
- c) 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.
- d) Control & instrumentation as per P&ID of oxygen dosing system, data sheet-A, Section D1, C3 and D3.

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### 3. MANDATORY SPARES

Scope of mandatory spares shall be as per mandatory spares list as enclosed in C1 of this technical specification.

### 4. 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.

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

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

### 6. PAINTING:


Bidder to note that painting shall be as per approved painting requirement to be finalized during detailed engineering. However the same shall be prepared in line with the painting requirement enclosed in section D1 of technical specification.

### 7. 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. Packing and transport instructions are enclosed in section D1.

### 8. DESIGN/CONSTRUCTION:

- In addition to the requirements of Section-C & D the following shall also be complied under scope of this specification: The P&ID is enclosed herein in this section for bidder's compliance.
- The material of construction specified in Data Sheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subjects to customer approval during detailed engineering.
- All instrument-wetted parts will be suitable for requested application.
- All high points on any, tanks, pumps, piping or instrumentation will be vented and provided with valve. All low points on any, tanks, pumps, piping or instruments will be drained and provided with valve.
- All valves and instruments will be located such that they are easily accessible during normal operation and maintenance.
- All the terminal points shall be easily accessible and towards one side of skid.
- All valves shall be easily accessible for the operator.
- All equipments shall have name plate clearly indicating the equipment name.
- Pipe fittings of the system shall be done using elbows and tees. Pipe bending is not acceptable.

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- j) All the terminal points where flange joints are involved, bidder shall terminate it along with matching counter flange, nuts, bolts, gaskets etc.
- k) KKS codes for all drives and instruments for the project have to be followed.
- l) All JB's shall be mounted in their respective dosing skids only.
- m) MFC/ Flow Meter cum Transmitter shall also be mounted in an enclosure. DOP of enclosure shall be IP-65 minimum. Other tech. requirements of this enclosure shall be in line with JB details indicated elsewhere in the specification.
- n) All cylinders supplied should conform to "Gas Cylinder Rules, 2004" and CCE license for the same shall be arranged by the bidder.
- o) All the equipments, instruments and tubing etc. coming in contact directly with oxygen shall be oxygen cleaned and certified to be fit for use in oxygen application.

## 9. QUALITY PLAN AND SUB VENDOR APPROVAL

- a. Requirement of detailed QP, inspection checklist, certificate of conformance etc. for each equipment and sub-vendor shall be finalized during detailed engineering stage; decision of BHEL/customer shall be binding on vendor in this regard. Any changes/additional tests insisted upon by Owner during approval of QAP's shall be accepted by bidder without any commercial and delivery implication to BHEL/Customer. Bidder shall submit the quality plans in BHEL format during detailed engineering stage. Bidder to note further that during detailed engineering all the QAP's/check lists etc. shall be submitted to Customer/BHEL for approval. All inspection & testing etc. shall be carried out accordingly.
- b. The sub vendor list enclosed is indicative only and is subject to approval / acceptance by customer (RRUVNL). Bidder to propose his sub vendor list with back up documents (experience list , end user certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.

## 10. DRAWINGS/DOCUMENTATION

### 10.1 DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID(PI refer electrical & C&I portion also):-

- a) Pre- bid clarifications in given format only.
- b) Deviations (if any) in given format only.


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

### 10.2 LIST OF DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT (PI refer electrical & C&I portion also):-

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

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

Bidder confirmed drawings submission schedule as follows:

- Drawing/documents submission schedule: First submission of basic drawings/ documents – (P&ID, GA drawings and foundation details and Quality plan) shall be within 3 weeks from the date of LOI.
- Every revised submission incorporating comments – within 7 days.
- BHEL shall provide observation / approval within 03 weeks from the date of document submission by bidder.

Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account.


SNO	BHEL DRG NO	DRG TITLE	No. of weeks for document submission after placing LOI/PO	Document size
1	PE-VO-392-154-12000A-A001	P&ID for Oxygen Dosing System	3	A3
2	PE-VO-392-154-12000A-A002	GA drawing and foundation detail for Oxygen Dosing System	3	A3
3	PE-VO-392-154-12000A-A003	Technical Data sheet for Oxygen Dosing System	4	A4
4	PE-VO-392-154-12000A-A004	QAP for Oxygen Dosing System	3	A3
5	PE-VO-392-154-12000A-A005	Junction Box Termination drawings for Oxygen Dosing System	5	A3
6	PE-VO-392-154-12000A-A006	Erection procedure	6	A4
7	PE-VO-392-154-12000A-A007	Engineering BOQ	10	A4
8	PE-VO-392-154-12000A-A008	O&M Manual along with catalogue for Oxygen Dosing System	20	As applicable

In addition of above following documents shall also be submitted by bidder during detail engineering:-

- Storage instructions

**NOTE:-**

- Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier
- Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of drawing beyond one month will be to customer's account.

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Bidder to note that the successful bidder, during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted as per dwg/document distribution schedule. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- Vendor's Internal proxy setting should not block DMS application's link (<http://124.124.36.198/wrenchwebaccess/login.aspx>)”
- DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website ([www.bhelpem.com](http://www.bhelpem.com)) under the Vendor session.
- For quick access bidder may refer the link <http://bhelpem.com/DMSManuals/DMSManuals.html>


## 11.0 SPARES

- a. All the spares for the equipment under the contract provided by the vendor will strictly conform to the specifications and documents and will be identical to the corresponding main equipment/components supplied under the contract.
- b. The quality plan and the inspection requirement finalised for the main equipment will also be applicable to the corresponding spares.

### The vendor warrants:

- i. That all spares supplied will be new and in accordance with the contract document and will be free from defects in design, material and workmanship and shall further guarantee as under:
- ii. In case of any failure in the original component/equipments due to faulty designs, materials and workmanship, the corresponding spare parts if any, supplied will be replaced without any extra cost to the BHEL and customer unless a joint examination and analysis by BHEL and/or customer of such spare parts prove that the defect found in the original part that failed can safely be assured not to be present in spare parts.
- iii. The long term availability of spares to the BHEL and the customer for the full life of the equipment covered under the contract and that before going out of production of spare parts of the equipment covered under the contract, vendor and his sub-vendors shall give the BHEL and the customer at least 24 (Twenty Four) months advance notice so that the latter may order his bulk requirements of spares, if he so desires. The same provision will also be applicable to the sub-vendors. Further, in case of discontinuance of manufacture of any spares by the vendors or his sub-vendors the vendors and his sub-vendors, will provide the BHEL and the customer, 2 (two) years in advance, with full manufacturing drawings, material specifications and technical information required by the BHEL and the customer for the purpose of manufacture of such items and also the right to manufacture such spares for their own requirements.
- iv. Further in case of discontinuance of supply of spares by the vendors or his sub-vendors, the vendor will provide the BHEL and the customer with full information for replacement of such spares with other equivalent makes, if so required by the BHEL and the customer.
- v. Notwithstanding the above, the vendor shall be responsible for supply of spares for the lifetime of the package at reasonable prices. The prices of all future requirements of spares shall be




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derived from the corresponding ex-works price at which the orders for such spares have been placed by the BHEL and the customer as a part of the mandatory or long term or any other kind of spares. The base indices for calculating ex-works price shall be commissioning of last equipment under main contract.

- c. The vendor will indicate the delivery period of the spares, which the BHEL and the customer may procure in accordance with this clause.
- d. In case of emergency requirements of spares, the vendor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.
- e. In case the vendor fails to supply the mandatory or long term or any other kind of spares on the terms stipulated above, the BHEL and the customer shall be entitled to purchase the same from the alternate sources at the risk and the cost of the vendor and recover from the vendor, the excess amount paid by the BHEL and the customer over the rates as per the contract. In the event of such risk purchase by the BHEL or the customer, the purchases will be as per the works and procurement policy of the BHEL and the customer prevalent at the time of such purchases and BHEL & the customer at his option may include a representative from the vendor in finalizing the purchases.
- f. It is expressly understood that the final settlement between the parties in terms of relevant clauses of the tender document shall not relieve the vendor of any of his obligations under the provision of long term availability of spares and such provisions shall continue to be enforced till the expiry of 30 (thirty) years period reckoned from the scheduled date of completion of trial operation of the last equipment unless otherwise discharged expressly in writing by the BHEL or the customer.


## 12.0 MISCELLENEOUS REQUIREMENTS

- a) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- b) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- c) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of drawing beyond one month will be to customer's account.
- d) Engineering for this project is being carried out in 3D environment at BHEL end. Name of engineering platform on which BHEL is doing the project IS Smart Plant Suite. This is being done to have automated interface checking and thereby minimising rework at site. Hence bidder, in their own interest, is requested to prepare all layout drawings using 3D Modelling software. These drawings will also be made available to BHEL in soft for checking interface with other agencies in consolidated layout drawings. Bidder's inability to prepare drawing using 3D Modelling software will not be criterion for evaluation of their bid.
- e) Vendor to attend regular engineering meeting with BHEL and customer fortnightly in BHEL or customer office as decided during detail engineering. Vendor will depute his entire concerned engineering

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representatives along with the project manager for discussion and approval. Meeting can be held at site also.

- f) In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- g) Latest version of all codes and standards to be followed.
- h) Bidder to follow KKS numbering for this project.
- i) Billing break up (BBU) of Oxygen Dosing System should be equal to Bill of Quantity (BOQ) of the same

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## ANNEXURE I


### DRAWING DOCUMENTS SUBMISSION PROCEDURE

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

### DRAWINGS/DOCUMENTS DISTRIBUTION LIST (as applicable)

All documents & drawings shall be in English and in metric units


S. No	LIST	TCE	RRVUNL-EC	RRVUNL-SITE/ TCE SITE	BHEL SITE	PMG BHEL	REMARKS
1	Master list of drawings / doc (duly indicating sch of submission)	Soft copy	Soft copy	Soft Copy	-	Soft copy	
2	Drawings / doc for Approval/Information (First Submission)	Soft copy	Soft copy + 1 print	Soft copy + 1 print	-	Soft copy	
3	Return with comments/approval	S	Soft copy	Soft copy	-	Soft copy	
4	Drawings / Documents for approval (second & subsequent submissions till approval)	Soft copy	Soft copy + 1 print	Soft copy + 1 print	-	Soft copy	

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5	Drawings / documents for distribution (Approved by RRVUNL, in cat. A or G)	Soft copy	1 print + Soft copy	2 print + Soft copy	5 prints + Soft copy	Soft copy	
6	Erection Drawings / documents	-	1 print	3 prints	6 prints	-	
7	FINAL Erection / Installation Manual for distribution	-	1 prints+ Soft copy	2 prints+ Soft copy	3 prints+ Soft copy	Soft copy	
8	As built Drawings / documents	-	1 print+ Soft copy	3 prints+ Soft copy	2 prints+ Soft copy	Soft copy	
9	Operation & Maintenance Manual	-	1 prints + Soft copy	3 prints+ Soft copy	2 prints+ Soft copy	Soft copy	
10	Performance & functional Guarantee test reports	-	1 prints + Soft copy	3 prints + Soft copy	2 prints + Soft copy	Soft copy	
11	Type Test Certificate	Soft copy	1 prints+ Soft copy	3 prints+ Soft copy	2 prints+ Soft copy	Soft copy	
12	Commissioning & Performance Procedure Manual	-	1 prints+ Soft copy	3 prints+ Soft copy	2 prints+ Soft copy	Soft copy	
13	Project Completion Report	-	1 prints+ Soft copy	3 prints+ Soft copy	2 prints+ Soft copy	Soft copy	

**NOTES:**


- The above schedule of submission does not include Docs/Drgs. of quality assurance/inspection and delivery/dispatches.

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## DATA SHEET-A

	<b>TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2X660 MW SURATGARH STPS STAGE V UNIT # 7&amp; 8</b>	SPEC. NO. PE-TS-392-154-12000A-A001	
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Sl. No	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	Eight per skid
2.2	Loose supply of filled Oxygen cylinders	26 loose on a rack for each unit (total 52 for both units)
2.3	Design Standard of empty oxygen cylinder	IS-7285 Part I
2.4	MOC of cylinder	Chrome Moly Steel
2.5	Water Capacity	50 liters
2.6	Gas Capacity	10 m3
2.7	Max Working pressure at 15°C	204 Kg/cm2
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 26 cylinders.
3.0	<b>All Tubing</b>	
3.1	Material	SS 316
3.2	Diameter	1/2" OD, 18 BWG
4.0	<b>Ball valves</b>	
4.1	Body, Bonnet, stem	SS-316
4.2	Trim Material	SS 316
4.3	Design standard	MSS-99-2010 / equivalent
4.4	Test standard	MSS-99-2010 / equivalent
4.5	Size	1/2"
4.6	End Connections	FERRULED
4.7	Rating	2000 PSI
4.8	Valve operation	Manual
5.0	<b>Check valves/ NRV</b>	
5.1	Body, cover, disc/piston & seat	SS-316
5.2	Design standard	MSS-99-2010 / equivalent
5.3	Test standard	MSS-99-2010 / equivalent
5.4	Size	1/2"
5.5	End Connections	FERRULED
5.6	Rating	2000 PSI
5.7	Valve operation	Manual
6.0	<b>Needle valve</b>	
6.1	Body, cover, disc/piston & seat	SS-316
6.2	Size	1/2"
6.3	End Connections	FERRULED
6.4	Rating	2000 PSI
6.5	Valve operation	Manual
7.0	<b>Pressure Safety valve</b>	
7.1	Type	Spring loaded, angle type
7.2	Body, bonnet, disc & nozzle	SS-316
7.3	Valve discharges to	Atmosphere (vent)
7.4	Back pressure	Constant
7.5	Set pressure	55 Kg/cm2 (g) for skid 1 and 22 Kg/cm2 (g) for skid 2
7.6	Inlet Connections	FERRULED
7.7	Outlet Connections	FERRULED
8.0	<b>Fittings</b>	SS-316
9.0	<b>Pressure Regulator</b>	
9.1	Type	Non Venting, Clean for O2 service as per ASTM G93
9.2	Quantity	Two per skid (total 8), each mounted to an oxygen cylinder
9.3	MOC	
a	Body & trim	Brass/monel
b	O-ring	Viton
c	seat	CTFE / PTFE
9.4	Inlet connection	1/2 "
9.5	Outlet connection	1/2 "
9.6	Operating pressure	204 Kg/cm2(g)

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9.7	Set outlet Pressure	50 Kg/cm2(g) for skid dosing at CPU outlet and 20 Kg/cm2(g) for skid dosing at deaerator outlet
<b>10.0</b>	<b>Mass Flow Controller (MFC)</b>	
10.1	Expected flow of oxygen in process	50-400 GM/hr (for skid dosing at deaerator outlet) & 40-300 GM/hr. (for skid dosing at CPU outlet)
10.2	MOC-Wetted part	SS 316, ANSI B 16.5 CL 400
10.3	Operating Pressure	Pressure reducing valve set pressure (refer revised PID)
10.4	Mass flow accuracy at max flow	±1%
10.5	Transmitter	Field mounted HART protocol compatible transmitter compatible with sensor
<b>11</b>	<b>Structural steel</b>	IS 2062
<b>12</b>	<b>Nuts &amp; bolts</b>	SS 304
<b>13.0</b>	<b>Compression fittings</b>	
13.1	Quantity	90 Nos.
13.2	MOC	SS-316

**Note:-**

1. All the equipments, instruments, hoses, valves, fittings and tubing coming in contact directly with oxygen shall be oxygen cleaned and certified to be fit for use in oxygen application.
2. All cylinders supplied should conform to "Gas Cylinder Rules, 2004" and CCE license for the same shall be arranged by the bidder.

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### **LIST OF MANDATORY SPARES**

SL. NO.	ITEM DESCRIPTION	TOTAL QUANTITY
1	Complete valves (except solenoid valve) (for each type, range and size)	5 % or minimum 1 No. whichever is higher.
2	Pressure reducing cum regulating valve (for each type, range and size)	5 % or minimum 1 No. whichever is higher.
3	Pressure regulator (for each type, range and size)	5 % or minimum 1 No. whichever is higher.
4	Solenoid valve (for each type, range and size)	10 % or minimum 1 No. whichever is higher for each 660 MW unit.
5	Pressure Gauge (for each type, range and size)	10 % or minimum 1 No. whichever is higher for each 660 MW unit.
6	Pressure Transmitter (for each type, range and size)	10 % or minimum 1 No. whichever is higher for each 660 MW unit.
7	Mass flow controller (for each type, range and size)	10 % or minimum 1 No. whichever is higher for each 660 MW unit.
8	Junction box	10 % or minimum 1 No. whichever is higher for each 660 MW unit.

#### **NOTE:-**


1. Whenever % is indicated for the mandatory spares, the quantity shall be calculated for % of supply of supply for total quantity for 2 units of 2 x 660 MW, unless otherwise specified. The quantity to be reckoned for % indicated shall be rounded off to the next higher whole number. For example if the % arrived is 0.2 the quantity to be supplied shall be 1 and if the % arrived is 5.1 the quantity to be supplied shall be 6.
2. Identification: Each spare shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.



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### **Indicative list of sub vendors**

S. No.	ITEM	APPROVED SUPPLIERS	REMARKS
1.	EMPTY OXYGEN CYLINDER	KANTO EVEREST / MARUTI KOATSU CYLINDERS	
2.	CHECK VALVE	SWAGELOK / HAMLET / PARKER	
3.	BALL VALVE	SWAGELOK / HAMLET / PARKER	
4.	3 WAY VALVE MANIFOLD	EXCEL HYDRO / BY ORIGINAL MANUFACTURER	
5.	TUBING	SWAGELOK / HAMLET / PARKER / SANDVIK	
6.	FITTINGS	SWAGELOK / HAMLET / PARKER / SANDVIK	
7.	SOLENOID VALVE	ROTEX / HERION / ASCO	
8.	PRESSURE REDUCING cum REGULATING VALVE/PRESSURE REGULATOR	TESCOM, SWAGELOK	
9.	NEEDLE VALVE	SWAGELOK / HAMLET / PARKER	
10.	PRESSURE GAUGE	WIKA / GIC / WAREE / H GURU	
11.	PRESSURE SAFETY VALVE	SWAGELOK / HAMLET / PARKER	
12.	PRESSURE TRANSMITTER	HONYWELL / EMERSON / YOKOGAWA	
13.	MASS FLOW CONTROLLER	BROOK'S (EMERSON)	
14.	CYLINDER REGULATOR	TESCOM, SWAGELOK	
15.	STRUCTURAL SKID	SELF-MAKE OF MAIN VENDOR	AS APPLICABLE
16.	ENCLOSURE FOR JB	RITTAL	
17.	LUGS	DOWELL / 3D / CHETNA	
18.	CABLES	TORRENT / ICL / UCL / POLYCAB	
19.	PAINT	BERGER PAINTS / ASIAN PAINTS / SHALIMAR PAINTS / JENSON & NICOLSON / GUNJAN PAINT	
20.	FILLING OF OXYGEN CLINDER	FILLING OF EMPTY CYLINDERS MAY BE DONE FROM ANY CCE LICENSED OXYGEN GAS FILLER	AS APPLICABLE
21.	FLOW METER CUM TRANSMITTER	EMERSON PROCESS MANGEMENT (I) LTD	MICRO MOTION LFM SERIES
		GE RHEONIK	
22.	CONTROL VALVE WITH ACTUATOR	IL / DRESSER MASONILAN / CCI / NIPPON FISHER / FISHER CONTROLS (EMERSON) / COPES VULCAN / MIL CONTROLS / DRESSER VALVES INDIA PVT LTD	
23.	JUNCTION BOX	AJMERA INDUSTRIAL & ENGIN / BALIGA LIGHTING EQUIPMENT / DEVI POLYMERS / ELECTROMAC INDUSTRIES / KS INSTRUMENTS PVT LTD / MANISHA ENTERPRISE / SHRENIK & COMPANY / SUCHITRA INDUSTRIES	

	<b>TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2X660 MW SURATGARH STPS STAGE V UNIT # 7&amp; 8</b>	SPEC. NO. PE-TS-392-154-12000A-A001	
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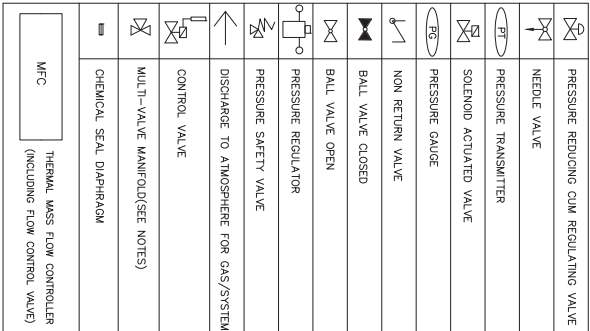
**Notes:-**

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

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## P&ID OF OXYGEN DOSING SYSTEM

## LEGEND



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RAJASTHAN RAJA VIDYUT UTPADAN NIGAM LTD.				
2 X 660 MW SURATGARH STPP, STAGE V				
BHARAT HEAVY ELECTRICALS LTD				
POWER SECTOR				
PROJECT ENGINEERING MANAGEMENT				
NEW DELHI				
DEPT CODE		NAME		
DRN		RG		
DESN		RG		
A		CHD		
APPD		SB		
DRAWING NO.				
PF-DG-392-154-12000A-A001				
SHEET 01		OF 02		REV 00

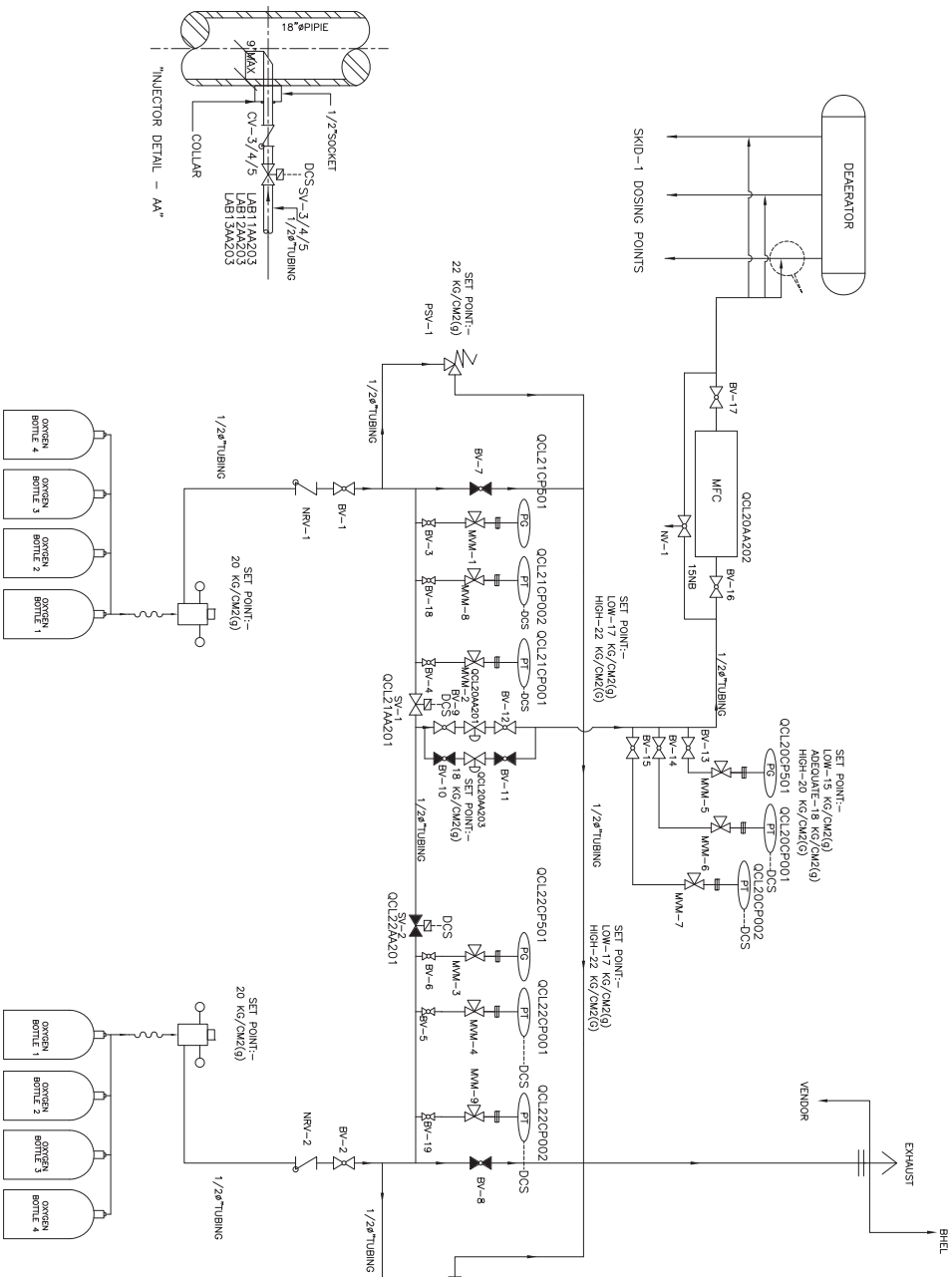
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FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

DRAWING No.

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it must not be used directly or indirectly in any way detrimental to the interest of the company.



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 DEARATOR OUTLET (TOTAL = 2 NOS.)
- 3 THREE NUMBERS INJECTION ASSEMBLY PER UNIT SHALL BE SUPPLIED LOOSE (TOTAL = 6 NOS.)
- 4 ALL TUBING SHALL BE OF SS 316, 1/2" , 18 BWG
- 5 120 M OF TUBING PER UNIT (TOTAL 240M) OF SAME SPECIFICATION SHALL BE LOOSE WITH THE SKID.
- 6 ALL THE MULTI VALVE MANIFOLD SHALL BE 3-WAY VALVE MANIFOLDS.
- 7 THE FOLLOWING SHALL BE THE TERMINAL POINT DETAILS:-  
TP 1:- ALL FIELD INSTRUMENTS(PRESSURE AND FLOW TRANSMITTERS) AND SOLENOID VALVES (SV1 & SV2 ONLY) SHALL BE TERMINATED AT THE JB BY OXYGEN DOSING VENDOR FOR FURTHER CONNECTION TO DCS BY BHEL.
- TP 2:- ALL VENT CONNECTIONS SHALL BE TERMINATED AT ONE POINT BY OXYGEN DOSING VENDOR FOR FURTHER CONNECTION TO ATMOSPHERE, IF REQUIRED, BY BHEL.
- TP 3:- DOSING TERMINAL POINT SHALL BE AFTER MFC AND TERMINATED BY THE OXYGEN DOSING SUPPLIER FOR FURTHER INTERCONNECTION TILL DOSING LOCATIONS BY BHEL.
- TP 4:- 24 VDC CONNECTION TO SV-3, SV-4, SV-5 AND MFC SHALL BE DIRECTLY CONNECTED BY BHEL.

LEGEND

	PRESSURE REDUCING CUM REGULATING VALVE
	NEEDLE VALVE
	PRESSURE TRANSMITTER
	SOLENOID ACTUATED VALVE
	PRESSURE GAUGE
	NON RETURN VALVE
	BALL VALVE CLOSED
	BALL VALVE OPEN
	PRESSURE REGULATOR
	PRESSURE SAFETY VALVE
	DISCHARGE TO ATMOSPHERE FOR GAS/SYSTEM
	PNEUMATIC CONTROL VALVE
	MULTI-VALVE MANIFOLD(SEE NOTES)
	CHEMICAL SEAL DIAPHRAGM
	MFC THERMAL MASS FLOW CONTROLLER (INCLUDING FLOW CONTROL VALVE)

RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD.  
2 X 660 MW SURATGARH STPP, STAGE V



BHARAT HEAVY ELECTRICALS LTD  
POWER SECTOR  
PROJECT  
NEW DELHI

TITLE P&ID FOR OXYGEN DOSING  
AT DEARATOR OUTLET

DEPT CODE	NAME	SIGN	DATE
DRN	RG		
DESIGN	RG		
CHD	SK		
APPD	SB		

DRAWING NO  
PB-DG-392-154-12000A-A001

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TECHNICAL SPECIFICATION FOR  
OXYGEN DOSING SYSTEM  
**2X660 MW SURATGARH STPS STAGE V**  
**UNIT # 7 & 8**

SPECIFICATION NO. PE-TS-392-154-12000A-  
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SECTION – C2  
SPECIFIC TECHNICAL SPECIFICATION - ELECTRICAL



TECHNICAL SPECIFICATION FOR  
OXYGEN DOSING SYSTEM  
**2X660 MW SURATGARH STPS STAGE V**  
**UNIT # 7 & 8**

SPECIFICATION NO. PE-TS-392-154-12000A-A001  
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DATE 04.04.2014

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

**1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER**

- 1.1 Services and equipment as per "Electrical Scope between BHEL and Vendor".
- 1.2 Any item/work either supply of equipment's 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.
- 1.3 Supply of mandatory spares as specified in the technical specification.
- 1.4 Erection and commissioning spares.
- 1.5 Erection & Maintenance tools & tackles.
- 1.6 Electrical load requirement for Oxygen Dosing System.
- 1.7 All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- 1.8 Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to BHEL/Customer approval without any commercial and delivery implications to BHEL/Customer.
- 1.9 Various drawings, data sheets, 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 BHEL/Customer approval without any commercial implication to BHEL/Customer.

**2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER FOR ELECTRICAL & TERMINAL POINTS:**

Refer "Electrical Scope between BHEL and Vendor"

**3.0 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 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.

**THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-392-154-12000A-A001**

**ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR**

**PACKAGE: OXYGEN DOSING SYSTEM**

Date-04.04.14


**PROJECT : 2 X 660 MW : SURATGARH SCTPS, UNIT# 7 & 8.**

<u>S.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 mass flow controller upto JB shall be done by bidder. Connection between JB and 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. Solderless crimping type tinned copper heavy-duty lugs for power cables. 3. Solderless crimping type heavy duty copper lugs for control cables.
4	Equipment grounding	Vendor	Vendor	Within the skid
5	Below grade grounding	BHEL	BHEL	

**NOTE :-**

1. All cabling beyond the battery limit of the skid (i.e all cables between DDCMIS and JB) is excluded from bidder's scope.




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## SECTION – C3

### SPECIFIC TECHNICAL SPECIFICATION CONTROL & INSTRUMENTATION


	<b>2X660 MW SURATGARH,RAJASTHAN</b>	SECTION: D
	<b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I) OXYGENATED TREATMENT</b>	
<p><b><u>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I) WITH SCOPE OF SUPPLY:</u></b></p> <ol style="list-style-type: none"> <li>1) OXYGENATED TREATMENT shall be operated from DCS through operator work stations located in control room (BHEL Scope).</li> <li>2) Bidder to supply the field instrumentation, control and solenoid valve (with limit switches for open close feedback) as required and is shown in the P&amp;ID.</li> <li>3) The junction boxes and cables required for termination of instruments, Solenoid valve and Mass flow controller upto junction box are in bidder's scope.</li> <li>4) The cable used shall be 0.5 mm<sup>2</sup>, F type cable for analog signals. For solenoid 1.5mm<sup>2</sup>, 3-core cable shall be used.</li> <li>5) Regarding the supply scope of cables, please refer the "Standard scope of matrix of cables" in Electrical portion of the technical specification.</li> <li>6) The detailed specification of instruments and JB are given in detail in D3.</li> <li>7) The specifications for instruments mentioned in the specification are minimum requirements. The detail specifications shall be finalized during detail engineering.</li> <li>8) The solenoid valve and mass flow controller shall operate at 24V DC from DCS.</li> <li>9) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial and delivery 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.</li> <li>10) All C&amp;I items shall be procured from approved vendors only.</li> <li>11) All the wetted parts of the instruments including the accessories like root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments as well as valves shall be of SS-316 material and same shall be in bidder's scope.</li> <li>12) The standard Drive control Philosophy is included in the specification. Any change in drive control philosophy during detail engineering shall be incorporated by the bidder during detail engineering.</li> <li>13) Bidder's C&amp;I engineer should be present during Junction Box testing.</li> <li>14) The applicable list of deliverables mentioned in the specification shall be furnished accordingly.</li> </ol>		

	<b>2X660 MW SURATGARH,RAJASTHAN</b>	SECTION: D
	<b>SPECIFIC TECHNICAL REQUIREMENTS (C&amp;I) OXYGENATED TREATMENT</b>	
<p>15) The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be provided by bidder, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc. for external connection including spare contacts shall be wired out to suitably located junction boxes by bidder.</p> <p>16) The bidders shall specifically mention any deviation they would like to take on the C&amp;I specification. In absence of only deviation it will be implied they follow the specification without deviation.</p> <p>17) Sensor redundancy shall be provided as per the philosophy mentioned in the technical specification.</p> <p>18) Drawings/Documents and data to be furnished by bidder after award of the contract:</p> <ul style="list-style-type: none"> <li>• Field instruments data sheet.</li> <li>• Solenoid valve datasheet</li> <li>• Junction Box GA drawings &amp; Termination details.</li> <li>• Cable schedule and cable interconnection drawing.</li> <li>• Instrument schedule.</li> <li>• Recommended Control write-up</li> <li>• Any other document decided during detailed engineering</li> </ul>		

	<b>TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2X660 MW SURATGARH STPS STAGE V UNIT # 7&amp; 8</b>	SPEC. NO. PE-TS-392-154-12000A-A001	
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## SECTION – D

### GENERAL TECHNICAL SPECIFICATION

	<b>TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2X660 MW SURATGARH STPS STAGE V UNIT # 7&amp; 8</b>	SPEC. NO. PE-TS-392-154-12000A-A001	
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## SECTION – D1

### GENERAL TECHNICAL REQUIREMENT – MECHANICAL

	<b>TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2X660 MW SURATGARH STPS STAGE V UNIT # 7&amp; 8</b>	SPEC. NO. PE-TS-392-154-12000A-A001	
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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 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 99.5% pure oxygen has been considered.
- Dosing shall be done at CPU outlet and at deaerator outlet. For this purpose two separate skid based oxygen dosing systems shall be supplied for each unit.
- Dosing rate shall be controlled from DCS by regulating Mass flow controller (MFC) 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 DCS. However, Customer 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 mass flow controller (MFC) if cation conductivity in the cycle goes above 0.3 us/cm.

### b) Startup sequence:-

- Deaerator vent is kept open
- Ammonia is dosed at CPU outlet to achieve a pH of 9.2.
- Cation conductivity reaches below 0.15  $\mu\text{S}/\text{cm}$  (at 25°C) and the trend is downwards.
- Deaerator vents are closed.
- Oxygen feed is manually started from 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. 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 two banks (each bank consisting of four oxygen cylinders), dosing at downstream of deaerator/CPU outlet. The automatic change-over of cylinder banks takes place on the basis of pressure i.e. the cylinder banks dosing at Condensate Polishing Unit (CPU) outlet will switch over at 47 kg/cm<sup>2</sup>(g) and the cylinder banks dosing at deaerator outlet will switch over at 17 kg/cm<sup>2</sup>(g). Separate storage rack for 26 filled cylinders per unit shall be supplied to cater 30 days

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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 50 kg/cm<sup>2</sup>(g) pressure in skid dosing at CPU outlet and to 20 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 DCS only. All the logics, controls and interlocks shall be implemented in DCS. Local manual intervention is not envisaged. Both manual/automatic controls shall be implemented in DCS. The provision to select "Auto" or "Manual" mode shall be provided in DCS 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 50 Kg/cm<sup>2</sup> for skid dosing at CPU outlet and set pressure of 20 Kg/cm<sup>2</sup> for skid dosing at deaerator outlet) attached with each cylinder bank.

Each of the oxygen cylinder bank in the skid shall have a dedicated set of solenoid valve, pressure gauge and pressure transmitter. Two banks of cylinders (each bank consisting of four cylinders) provided on skid are connected and one bank 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 bank of 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 DCS.

A pressure safety valve shall be fitted at the upstream of each 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–48 kg/cm<sup>2</sup> for skid dosing at CPU outlet & 18 kg/cm<sup>2</sup> for skid dosing at deaerator outlet) downstream. The flow and pressure of oxygen can be monitored from DCS by the signal from mass flow controller and from pressure transmitter provided at the downstream of pressure reducing regulating valve. The flow of oxygen dosing will be controlled manually/automatically from DCS by mass flow controller (MFC) provided on skid based on the feedback from the dissolved oxygen analyzer located at deaerator outlet and cation conductivity at CPU outlet. The MFC shall have a position feedback transmitter that shall transmit the feedback signal to DCS.

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

At each dosing point, viz. CPU outlet and deaerator outlet, required injection assemblies containing ½ " tubing, fixing collar, solenoid valve and NRV shall be supplied loose.

The set points indicated below for operation of pressure reducing valve are tentative. Final value of the same shall be decided during detailed engineering as per the requirement of the mass flow controller.

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.

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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 DCS	Remarks
<b><u>During Normal Operation:-</u></b>					
Pressure transmitter	QCL11CP001	55 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	47 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 empty cylinder with filled one.
Pressure transmitter	QCL12CP001	55 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	47 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 empty cylinder with filled one.
Pressure transmitter	QCL10CP001/ QCL10CP002	46 Kg/cm <sup>2</sup> (g) (LOW)	Close MFC (QCL10AA202)	Yes (Oxygen dosing stopped due to low pressure)	
Pressure transmitter	QCL10CP001/ QCL10CP002	50 Kg/cm <sup>2</sup> (g) (HIGH)	Not applicable	Yes (HIGH dosing pressure)	Manual checking of pressure reducing valve reqd.
Cation Conductivity analyser*		0.3 µs/cm (at 25°C), increasing (HIGH)	Close MFC (QCL10AA202)	Yes (Oxygen dosing stopped due to high cation conductivity in feed water cycle)	Increase ammonia pH set point to raise pH to 9.2-9.5 range
Dissolved oxygen analyzer*		30 ppb (LOW), decreasing	Gradually open MFC(QCL10AA202) to increase DO provided signal from QCL10CP001 is "NOT LOW" (i.e. < 46 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
Dissolved oxygen analyzer*		150 ppb, increasing (HIGH)	Close MFC(QCL10AA202) to decrease DO	Yes (Oxygen dosing stopped due to high DO level in feed water cycle)	chemist during commissioning within the range of 30-150 ppb.
<b><u>During Start up:-</u></b>					
Cation Conductivity analyser*		0.15 µs/cm (at 25°C), decreasing	Open MFC (QCL10AA202), provided signal from	Yes (Oxygen dosing started)	




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		(ADEQUATE)	QCL10CP001 is "NOT LOW" (i.e. < 46 Kg/cm <sup>2</sup> (g)) & signal from DO analyzer is "NOT HIGH" (i.e. > 150 ppb)		
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**For Skid dosing at deaerator Outlet**


Source signal of	Tag Number	Set Point (suggested)	Interlock	Alarm in DCS	Remarks
<b><u>During Normal Operation:-</u></b>					
Pressure transmitter	QCL21CP001	22 Kg/cm <sup>2</sup> (g) (HIGH)	Not applicable	Yes (HIGH pressure at cylinder 1 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter	QCL21CP001	17 Kg/cm <sup>2</sup> (g) (LOW)	Close (QCL21AA201) & Open (QCL22AA201) SV-1 & SV-2	Yes (LOW pressure at cylinder 1 outlet)	Auto-changeover of cylinders. Manually replace empty cylinder with filled one.
Pressure transmitter	QCL22CP001	22 Kg/cm <sup>2</sup> (g) (HIGH)	Not applicable	Yes (HIGH pressure at cylinder 2 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter	QCL22CP001	17 Kg/cm <sup>2</sup> (g) (LOW)	Close (QCL22AA201) & Open (QCL21AA201) SV-2 & SV-1	Yes (LOW pressure at cylinder 2 outlet)	Auto-changeover of cylinders. Manually replace empty cylinder with filled one.
Pressure transmitter	QCL20CP001/ QCL20CP002	15 Kg/cm <sup>2</sup> (g) (LOW)	Close (QCL20AA202) MFC	Yes (Oxygen dosing stopped due to low pressure)	
Pressure transmitter	QCL20CP001/ QCL20CP002	20 Kg/cm <sup>2</sup> (g) (HIGH)	Not applicable	Yes (HIGH dosing pressure)	Manual checking of pressure reducing regulating valve reqd.
Cation Conductivity analyzer*		0.3 µs/cm (at 25°C), increasing (HIGH)	Close (QCL20AA202) MFC	Yes (Oxygen dosing stopped due to high cation conductivity in feed water cycle)	Increase ammonia pH set point to raise pH to 9.2-9.5 range
Dissolved oxygen analyzer*		30 ppb (LOW), decreasing	Gradually open MFC(QCL20AA202) to increase DO provided signal from QCL20CP001 is "NOT LOW" (i.e. < 15 Kg/cm <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 within the range of 30-150 ppb.
Dissolved oxygen analyzer*		150 ppb, increasing (HIGH)	Close MFC(QCL20AA202) to decrease DO	Yes (Oxygen dosing stopped due to high DO level in feed water cycle)	

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During Start up:-					
Cation Conductivity analyzer*		0.15 $\mu\text{s/cm}$ (at 25°C), decreasing (ADEQUATE)	Open MFC (QCL20AA202), provided signal from QCL10CP001 is "NOT LOW" (i.e. < 15 Kg/cm <sup>2</sup> (g)) & signal from DO analyzer is "NOT HIGH" (i.e. > 150 ppb)	Yes (Oxygen dosing started)	

Note:

- \* shall be part of SWAS scope (BHEL).
- Location of Dissolved oxygen analyser shall be Deaerator outlet.
- Location of Cation Conductivity analyser shall be CPU outlet.

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## PAINTING REQUIREMENT

SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME II SECTION – C 13
	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> <b>PAINTING REQUIREMENTS</b>	SHEET 1 OF 14
<p><b>PAINTING</b></p> <p>13.0</p> <p>13.0.1 This section defines the technical requirements for surface preparation selection and application of paints on equipment, vessels, machinery, piping, ducts etc. However, manufacturers shall follow their standard procedures for painting their equipment. The Bidder shall submit a detailed painting procedure for approval of OWNER / OWNER'S representative after the award of contract.</p> <p>13.0.2 The following surface and material shall require painting:</p> <ol style="list-style-type: none"> <li>All un-insulated carbon steel and alloy steel equipment like columns, vessels, drums, storage tanks, heat exchangers etc.</li> <li>All un-insulated carbon steel and low alloy piping, fitting and valves (including painting of identification marks)</li> <li>All pipe structural steel supports, walkways, platforms, hand rails, ladders etc.</li> </ol> <p>13.0.3 The following surfaces and material shall not require painting:</p> <ol style="list-style-type: none"> <li>Non-ferrous materials</li> <li>Austenitic stainless steel</li> <li>Plastic and / or plastic coated materials</li> <li>Insulated surface of equipment and pipes except colour coating wherever required</li> <li>Painted equipment like blowers, pumps, valves, etc., with finishing coats in good condition and with matching colour-code</li> </ol> <p>13.1.0 <b>Codes and Standards</b></p> <p>13.1.0.1 Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.</p> <p>13.1.0.2 The following Indian Standards may be referred to carrying out the painting job.</p> <p>IS : 5 : Colours for ready mixed paints and enamels</p> <p>IS : 1303 : Glossary of terms relating to paints</p> <p>IS : 2379 : Colour code for identification of pipelines.</p> <p>IS : 1477 : Code of practice for painting of ferrous</p>		
		ISSUE R0

SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME II SECTION – C 13
	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> PAINTING REQUIREMENTS	SHEET 2 OF 14
<p>metals in buildings (Parts I &amp; II)</p> <p>IS: 2524 : Code of practice for painting of non-ferrous metals in buildings (Parts I &amp; II)</p> <p>IS : 2395 : Code of practice for finishing of concrete, masonry and plaster surfaces (Parts I and II)</p> <p>IS : 2338 : Code of practice for finishing of wood and wood based materials (Parts I &amp; II)</p> <p>IS : 158 : Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting</p> <p>IS : 2074 : Ready mixed paint, air drying, red oxide zinc chrome, and priming.</p> <p>IS : 104 : Ready mixed paint, brushing, zinc chrome, priming</p> <p>IS : 2932 : Enamel, synthetic, exterior</p> <p>(a) undercoating (b) Finishing.</p> <p>SIS : 55900 : Swedish standard for blasting</p> <p>IS: 14506 : Epoxy Red oxide Zinc Phosphate Weldable Primer, Two Component Specification</p> <p>IS: 14209 : Epoxy Enamel, Two Component, Glossy Specification</p> <p>IS: 14589 : Zinc priming paint, Epoxy based, Two-pack-specification</p> <p>13.2.0 <b>SURFACE PREPARATION</b></p> <p>The surface shall be prepared in a manner suitable for coatings. Chemical de-rusters or rust converters shall not be applied. Acid cleaning is subject to approval of PURCHASER / PURCHASER'S representative.</p> <p>13.2.1 <b>Blasting</b></p>		
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SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME II SECTION – C 13
	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> PAINTING REQUIREMENTS	SHEET 3 OF 14
<p>The surface of the part / component shall be blasted before the coating material is applied. Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting: Primer paint shall be zinc silicate of approved brand. Dry film thickness of each primer coat shall be 15 – 25 µm</p>		
13.2.2	<b>Manual Rust Removal</b>	
	Manual rust removal shall be allowed for welded zones and for touching up installed components.	
13.2.3	<b>Cleaning</b>	
	Removal of impurity	
	Impurity	Removal
(a)	Dust, loose deposits	Vacuum-cleaning, brushing
(b)	Adhesive deposits	Power brushing
(c)	Oils, greasy impurities	Wet blasting, use of detergent additives by agreement
(d)	Salt deposits	Rinsing
(e)	Markings (e.g., felt tip pen)	Organic solvents to manufacturer's specifications e.g., Trichloro- trifluoro -ethane and solvents containing acetone (renew solvent and rag frequently).
13.3.0	<b>PROCESSING</b>	
13.3.1	<b>General</b>	
13.3.1.1	<b>Application Conditions</b>	
	<p>The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature shall be +5°C and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3 °C above dew point.</p>	
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SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME II SECTION – C 13
	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> PAINTING REQUIREMENTS	SHEET 4 OF 14
13.3.1.2	<p><b>Application Procedure</b> The primer shall be applied by means of brush or by spray. The top coats shall be applied by means of brush, roller or by spray. At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed</p>	
13.3.1.3	<p><b>Touching Up</b> Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning, according coating MANUFACTURER'S specifications. The final top coat shall be reapplied completely, if required.</p>	
13.3.1.4	<p><b>Uncoated Surfaces</b>  Moving parts of machines (e.g., stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating up to a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.</p>	
13.3.1.5	<p><b>Bond Strength</b>  The pull-off stress determined using the pull-off test method for adhesion shall be not less than 1.5 N/mm<sup>2</sup>, according to ISO 4624.</p>	
13.3.1.6	<p><b>Surface Conditions of Coating Surfaces</b>  The coating surface shall have a uniform film thickness, shade and gloss and shall be free from inclusions, sags and wrinkles.</p>	
13.3.1.7	<p><b>Coating Systems</b></p>	
13.3.1.7.1	<p><b>General Requirements for Coating Systems</b>  Coating materials according to SSPC, BS 5493 or DIN 55 928 shall be used. Intermediate coats are to be pigmented with micaceous iron oxide. The materials shall be matched with each other so that they are compatible. Coatings deviating from this specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years. The colour and gloss of top coats shall be in accordance with sub-clause suggested colour codes for painting (Sub-clause 13.10).</p>	
13.3.1.7.2	<p><b>Standard Coating System (External Coatings)</b></p>	
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	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> <b>PAINTING REQUIREMENTS</b>	SHEET 5 OF 14
<p>a) <b>Steel Structures</b></p> <ol style="list-style-type: none"> <li>i. All steel structures shall receive two primer coats and two finish coats of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two finish coats shall also be applied after erection.</li> <li>ii. Steel surface which is to painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted to Sa-2½ finish as per SIS05-5900. Primer paint shall be zinc silicate of approved brand. Dry film thickness of each primer coat shall be 40 microns.</li> <li>iii. Finish paint shall be 2 coats of High built epoxy finish of approved brand. Dry film thickness of each finish coat shall be 90 microns. The undercoat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 300 microns. All paints shall be of approved brand and shade as per the OWNER'S requirement.</li> <li>iv. Joints to be site welded shall have no paint applied within 100 mm of welding zone. Similarly where Friction grip fasteners are to be used no painting shall be provided. On completion of the joint the surfaces shall receive the paint as specified.</li> <li>v. Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams supporting gratings or chequered plate shall receive one additional coat of finish paint over and above number of coats specified before erection. Portion of steel member embedded / to be encased in concrete shall not be painted.</li> </ol> <p>b) <b>Galvanised iron and steel requiring paint finish at site</b> At site</p> <p><u>Surface Treatment</u> Mechanical cleaning from contaminants by means of washing or steam jetting and sweep blasting with fine sand or etching (T-Wash).</p> <p><u>Touch-up mechanical damages:</u> De rusting St 3 and application of high build epoxy primer DFT 80 µm.</p> <p><u>Finish coating:</u> Analogous to standard painting scheme</p>		
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	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> PAINTING REQUIREMENTS	SHEET 6 OF 14
13.3.1.7.2.1	<p><b>Painting of indoor components such as valves, pumps, motors, electrical parts, tanks etc.</b></p> <p>a) At works</p> <p><u>Surface preparation:</u> Blasting according to SIS 055900: grade SA 2 ½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer dry film thickness 15 – 25 µm, may be used.</p> <p><u>Prime coat:</u> Two (2) layers of zinc phosphate epoxy, total dry film thickness 75 µm.</p> <p>b) At site</p> <p>Thorough cleaning to remove oil, grease, dirt and any other contaminants. De-rusting of all mechanical damages according to SIS 055900 Grade ST3. Touch up with dry film thickness 50 µm.</p> <p><u>Finish coat:</u> Application of two finishing coats of Chlorinated rubber paint in approved shades at 30-40 microns DFT each coat in approved shades.</p>	
13.3.1.7.2.2	<p><u>Remarks:</u> Equipment coated with a standard application system can be accepted if the quality of this application system is corresponding with the quality of the above mentioned system.</p>	
13.3.1.7.2.3	<p><b>Painting of Outdoors equipment (external surfaces) such as piping, valves, pumps, motors, electrical parts, tanks etc.</b></p> <p>Weather exposure, weather resistance, temperature up to 120°C as per 13.7.1 and 13.7.3.</p> <p><u>Surface Preparation:</u> Blasting according to SIS 055900: grade Sa 2 ½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer dry film thickness 15-25 µm, may be used.</p> <p><u>Prime Coat:</u> Two (2) layers of zinc phosphate epoxy, total dry film thickness 75 µm.</p> <p><u>Intermediate Coat:</u> One (1) layer 2 pack high build epoxy polyamide Mio, dry film thickness 100 µm.</p>	
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	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> PAINTING REQUIREMENTS	SHEET 7 OF 14
<p><u>Finish Coat:</u> Application of two finishing coats of Chlorinated rubber paint in approved shades at 50 microns DFT each coat in approved shades.</p> <p>13.3.1.7.2.4 <b>Special Coating System (External Coatings)</b></p> <p><b>Parts exposed to temperatures above 120°C, up to 200°C, not insulated</b></p> <p>a) At works</p> <p><u>Surface Preparation:</u> Blasting according standard SIS 55900 Grade Sa 2<sup>1</sup>/<sub>2</sub> and ISO 8501-1: 1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer, dry film thickness 15-25 µm, may be used</p> <p><u>Prime coat</u> Inorganic ethyl zinc silicate, dry film thickness 75 µm.</p> <p>b) At site</p> <p><u>Pre-treatment:</u></p> <p>De-rusting of all mechanical damages, according to ISO 8501-1: 1989, grade St 3 Touch-up with 1 pack inorganic ethyl zinc silicate, dry film thickness 50 µm. Removal of all decontaminants from prime coat.</p> <p><u>Intermediate Coat:</u> 1 pack silicon acrylic, dry film thickness 35 µm.</p> <p><u>Final coat</u> 1 pack silicon acrylic, dry film thickness as 35 µm.</p> <p>Total system dry film thickness 145 µm. Final coat according to colour code.</p> <p><b>Parts exposed to temperatures above 200°C, up to 400°C, not insulated</b></p> <p>At works</p> <p><u>Surface Preparation:</u></p> <p>Blasting according to ISO 8501-1: 1988 grade Sa 2<sup>1</sup>/<sub>2</sub>. Depending on</p>		
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	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> <b>PAINTING REQUIREMENTS</b>	SHEET 8 OF 14
<p>production flow, a weldable, inorganic ethyl zinc silicate shop primer, dry film 15-25 µm, shall be used.</p> <p><u>Prime coat:</u></p> <p>Inorganic ethyl zinc silicate, dry film of thickness 75 µm.</p> <p>At site</p> <p><u>Pre-treatment:</u> De-rusting of all mechanical damages, according standard Sa 2 1/2 to ISO 8501-1: 1988. Touch-up with coating system according to MANUFACTURER'S recommendations.</p> <p><b>Insulated Parts, continuously exposed to condensing water or parts exposed to temperatures</b></p> <p>For parts that are provided with insulation on site.</p> <p>a) Insulated parts, exposed to condensing water</p> <p>At works</p> <p><u>Surface Preparations:</u></p> <p>Blasting according standard Sa 2 1/2 to ISO 8501-1: 1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer, dry film thickness 15-25 µm shall be used.</p> <p><u>Prime coat:</u></p> <p>Inorganic ethyl zinc silicate, dry film thickness 75µm.</p> <p>b) Insulated parts exposed to temperatures Parts, exposed to temperatures up to &lt;400°C at works</p> <p><u>Surface Preparation:</u></p> <p>Blasting according to standard Sa 2 1/2 to ISO 8501-1: 1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer, dry film thickness 15-25 µm shall be used.</p> <p>Parts, exposed to temperatures above 400°C at works (Steam pipes, pressure tubes and parts for the HRSG, such as heating surfaces, heaters and super heaters reheaters, etc.)</p> <p><u>Surface preparation:</u></p>		
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	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> <b>PAINTING REQUIREMENTS</b>	SHEET 9 OF 14
<p>Blasting according standard Sa 21/2 to ISO 8501-1: 1988.</p> <p><u>Temporary primer:</u></p> <p>Varnish.</p> <p>c) Intermittent exposure due to condensing water / chemicals (Indoors) At works</p> <p><u>Surface Preparation:</u> Blasting according to standard Sa 21/2 to ISO 8501-1: 1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer, dry film thickness 15-25 µm may be used.</p> <p><u>Prime Coat:</u> Two layers of zinc phosphate epoxy primer total dry film thickness greater than or equal to 75 µm.</p> <p>At site <u>Pre-treatment:</u></p> <p>De-rusting of all mechanical damages, according standard Sa 3 to ISO 8501-1: 1988, touch-up with 2 pack high build epoxy with volume solid content of more than 85%, 75 µm.</p> <p><u>Intermediate Coat:</u> 2 pack high build epoxy, dry film thickness 80 µm.</p> <p><u>Finish coat:</u></p> <p>2 pack epoxy according to colour appearance, dry film thickness of 50 µm.</p> <p>Total system dry film thickness 205 µm.</p> <p>When exposed to weathering, weather resistance finish coat shall be applied.</p> <p>d) Water exposure</p> <p>Surfaces permanently or predominantly in contact with water.</p> <p>At site / works</p> <p><u>Pre-treatment:</u></p>		
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	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> <b>PAINTING REQUIREMENTS</b>	SHEET 10 OF 14
<p>Removal of all welding pearls. Blasting according standard Sa 3 to ISO 8501-1: 1988.</p> <p><u>Coat:</u></p> <p>4 coats 2 pack coal-tar-epoxy, dry film thickness 125 µm each. Total system dry film thickness 500 µm. Touch-up after erection as required.</p> <p>13.3.1.7.2.5 <b>Buried / underground piping system (except for sea water piping)</b> Where pipelines are buried, underground protection shall be provided for the piping system as indicated in any one of the methods given below: Coal tar primer, coal tar enamel, inner wrap of fibre glass, final outer wrap of enamel impregnated fibre glass. Total thickness of coating shall not be less than 4.0 mm. With anti-corrosive tape of minimum 4 mm thick conforming to IS-10221 and AWWA C 203-93.</p> <p>Pipe surfaces shall be cleaned by shot or sand blasting before application.</p> <p>Tests to be carried out after application Bond / Adhesion test Holiday test</p> <p>13.3.1.7.3 <b>INTERNAL COATINGS</b></p> <p>13.3.1.7.3.1 <b>Tanks (Internal Surfaces) as specified in relevant sections of specification</b> Industrial, deionised, demineralised and potable water up to 60°C pH range: 4.5 – 9.5. Blasting according to ISO 8501-1: 1988, grade Sa 2<sup>1</sup>/<sub>2</sub>.</p> <p><u>Prime coat:</u> Two layers of zinc phosphate epoxy primer total DFT greater than or equal to 75 µm.</p> <p><u>Pre-treatment:</u> De-rusting of all mechanical damages, according to standard Sa 3 to ISO 8501-1:1998, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75 µm.</p> <p><u>Intermediate coat:</u> 2 pack high build epoxy, dry film thickness 80 µm.</p>		
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	RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan PAINTING REQUIREMENTS	SHEET 11 OF 14						
<p><u>Finish coats:</u> 2 pack solvent free epoxy paint dry film thickness 150 µm per coat. In case of service or potable water tanks, the coating material selected shall not taint the water. QA / QC procedure, including pinhole inspection, for shall be submitted for approval by Owner / Owner’s Representative.</p>								
13.3.1.7.3.2	<p><b>Rubber Lining of Pipes, Valves and Tanks as specified in relevant sections.</b></p> <p>At works</p> <p><u>Pre-treatment:</u></p> <p>Blasting according standard 2<sup>1</sup>/<sub>2</sub> to ISO 8501-1: 1988.</p> <p><u>Rubber lining:</u></p> <p>Hard-rubber 5mm for DM water applications, thickness greater than or equal to 3 mm for others. In case of failure of rubber lining for both pipes and vessels, the rubber lining shall be replaced by COROCOAT</p>							
13.4.0 13.4.1	<p><b>Painting for Electrical Items</b></p> <p>All the steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and scarf by pickling, emulsion cleaning, etc. The sheet steel shall be phosphated / oven dried and then painted with two coats of zinc rich primer paint. After application of the primer, two coats of finishing synthetic enamel paint shall be applied. The colour of the finishing coats inside shall be glossy white and exterior of the treated sheet steel shall be shade 631 of IS-5 / RAL 7032 for all switchboard/MCC/ Distribution boards, control panels, etc.</p>							
13.4.2	<p>All electrical equipment shall be given tropical and fungicidal treatment and outdoor equipment shall be provided with rain hood to prevent entry of rain water into the equipment.</p>							
13.5.0 13.5.1	<p><b>Painting for I &amp; C equipment: Epoxy coating required for all I&amp;C equipment.</b></p> <p><b>Suggested Colour Codes for Painting</b></p>							
<table><tr><td>Sl. No.</td><td>Item / Service</td><td>Colour</td><td>IS-5</td><td>Colour (Band)</td><td>IS - 5</td></tr></table>			Sl. No.	Item / Service	Colour	IS-5	Colour (Band)	IS - 5
Sl. No.	Item / Service	Colour	IS-5	Colour (Band)	IS - 5			
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	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> PAINTING REQUIREMENTS				SHEET 12 OF 14
13.5.1	Structures, platforms, galleries, ladders and handrails.	Dark Admiralty Grey	632	-	-
13.5.2	Boiler casing, ducting	Nut Brown	413	-	-
13.5.3	Crane				
(a)	Crane structure	Golden Yellow	356	Black	-
(b)	Trolley and hook	Crimson	540	-	-
13.5.4	Pump motors, compressors	Light Grey	631	-	-
13.5.5	Tanks (without insulation and cladding)				
(a)	Outdoor	Aluminium	-	-	-
(b)	Indoor	Light Grey	631	-	-
13.5.6	Vessels and all other proprietary equipment (without insulation and cladding)	Light Grey	631	-	-
13.5.7	Switchgear	Light Grey	631	-	-
13.5.8	Control and relay panels	Light Grey	631/ 7078 of IS1650	-	-
13.5.9	Turbines	Light Grey	631	-	-
13.5.10	Generators and exciter	Light Grey	631	-	-
13.5.11	Transformers	Aluminium	-	-	-
13.5.12	Machinery guards	Signal red	537	-	-
13.5.13	Piping (Without insulation and cladding)				
(a)	Water System				

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	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> PAINTING REQUIREMENTS				SHEET 13 OF 14
(i)	Boiler feed	Sea Green	217	-	-
(ii)	Condensate	Sea Green	217	Light Brown	410
(iii)	DM Water	Sea Green	217	Light Orange	557
(iv)	Soft Water	Sea Green	217	French Blue	166
(v)	Bearing cooling water	Sea Green	217	French Blue	166
(vi)	Potable and filtered water	Sea Green	217	French Blue	166
(vii)	Service and clarified water	Sea Green	217	French Blue	166
(viii)	Cooling water	Sea Green	217	French Blue	166
(ix)	Raw water	Sea Green	217	White	-
(b)	Air system				
(i)	Station air	Sky Blue	101	-	-
(ii)	Control air	Sky Blue	101	White	-
(c)	Oil system				
(i)	Light oil (HSD)	Light Brown	410	French blue	166
(ii)	Lubricating oil	Light Brown	410	Light grey	631
(iii)	Transformer oil	Light Brown	410	Light Orange	557
(d)	Gas system				
(i)	Fuel gas (Re-gassified LNG)	Canary Yellow			
(ii)	Carbon dioxide	Canary Yellow	309	Light grey	631
(iii)	Hydrogen	Canary Yellow	309	Signal red	537
(e)	Fire Services	Fire red	536	-	-
(f)	Effluent pipes	Black	-	-	-
(g)	Vacuum pipes	Sky Blue	101	Black	-
(h)	Drainage	Black	-	-	-
NOTES					
1.	This colour code basically refers to IS: 2379 for piping with necessary modifications.				
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<p>2. Where band colour is specified, same shall be provided at 10 metre intervals on long uninterrupted lines and also adjacent to valves and junctions.</p> <p>Note: Bidder shall furnish his painting specification to suit corrosive atmosphere of coastal area along with the bid. The specification shall in general be in line with the above requirements.</p> <div data-bbox="1382 2018 1490 2092" style="text-align: right; border: 1px solid black; padding: 5px;"> ISSUE R0 </div>		

	<b>TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2X660 MW SURATGARH STPS STAGE V UNIT # 7&amp; 8</b>		SPEC. NO. PE-TS-392-154-12000A-A001	
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## 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.

### 8. Fittings

- a) Material test Certificate/lab report, certificate for heat treatment and dimensions of fittings (as per BHEL

	<b>TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2X660 MW SURATGARH STPS STAGE V UNIT # 7&amp; 8</b>	SPEC. NO. PE-TS-392-154-12000A-A001	
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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) Leak test of tubing/fitting/ valves using nitrogen at 1.25 times of maximum operating pressure for skids for two hours.
- c) Visual checking of skid orientation as per BHEL/ CUSTOMER approved GA drawing
- d) Visual checking of welding soundness, cleanliness at weld joints
- e) Hydro test of the complete interconnected tubing
- f) Pneumatic test of the complete interconnected tubing
- g) Verification of painting thickness by elcometer and paint shade with respect to color shade chart
- h) 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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## PACKING AND TRANSPORT INSTRUCTIONS

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	<b>PACKING, MARKING AND TRANSPORT INSTRUCTIONS FOR EQUIPMENT</b>	SHEET 1 OF 5
1.0	<b><u>PACKING</u></b>	
1.1	All equipment and material shall be protected for ocean shipment, inland transport, and storage at the site, according to applicable Indian Standards (IS) and to the instructions given in this specification.	
1.2	The PURCHASER/CONSULTANT may require inspecting and approving the packing before the items are despatched. However, the VENDOR/CONTRACTOR shall be entirely responsible for ensuring that the packing is suitable for the mode of shipment and such inspection will not exonerate the VENDOR/CONTRACTOR from any loss or damage due to faulty packing.	
1.3	The VENDOR/CONTRACTOR shall be responsible for any damage to the equipment and materials during transit due to improper and inadequate packing.	
1.4	Any material found short upon opening the intact packing cases shall be supplied by the VENDOR/CONTRACTOR at no extra cost to the PURCHASER.	
1.5	Only packages constructed out of sound material and of dimensions proportional to the size and weight of contents shall be used.	
1.6	All packing cover and packing material shall become the property of the PURCHASER.	
1.7	In the case of large and bulky equipment, the VENDOR/CONTRACTOR shall be responsible for ascertaining transport limitations and supply the equipment in the minimum number of components or sub-assemblies, within the framework of transport limitations.	
1.8	For ocean transport, containers shall be used as far as possible. Dimensions of packages and kind of packaging must be chosen to fully utilise the size of containers.	
1.9	All equipment shall be protected for the entire period of despatch, storage and erection, against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and storage in open including possible delays in transit. Material and equipment shipped across the sea shall be packed to withstand without damage, the effects of saline atmosphere. All machined and plated parts shall be protected with anti-rust grease. Precautions shall be taken to protect shafts and journals where they rest on wooden or other supports likely to contain moisture. At such points, wrappings impregnated with anti-rust composition or vapour phase inhibitors shall be used. These shall have sufficient strength to resist chafing and indentation due to the movement, which is likely to occur in transit. The protective wrappings and impregnation shall last for a minimum period of three months or transport time whichever is more.	
1.10	All openings in the equipment shall be tightly covered, plugged or capped to prevent foreign material from entering into the equipment.	
1.11	The contents of the packages shall be sealed in thick polythene sheets. The inside walls of the packages shall be lined with waterproof material to protect	
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<p>the equipment from damage due to dust and moisture.</p> <p>1.12 Adequate provision of skids or pallets shall be made to keep the packages above the ground drain water. Crates and other large containers should have drain holes in the bottom to prevent collection of water within the packing. This is especially important where the cargo itself is subjected to condensation (cargo sweat).</p> <p>1.13 Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.</p> <p>1.14 All cases shall be provided with suitable cut-outs, closed by bolted wooden planks to facilitate inspection by custom authorities. Waterproof transparent papers shall be provided at the cut-out locations to prevent water ingress into the casing through the cut-out.</p> <p>1.15 The contents of the package shall be punched on non-corrosive metal plate and nailed to the package on a prominently visible place. If the number of items in the package is too many, a typed list in transparent waterproof bag shall be kept inside a galvanised sheet steel pocket nailed on to the outside of package at prominently visible location.</p> <p>Copies of the packing list, in triplicate, shall be forwarded to the PURCHASER prior to despatch. All items of material shall be clearly marked for easy identification against the packing list.</p> <p>1.16 Fragile materials shall be securely braced within the package or otherwise amply fastened and packed to prevent shifting or rattling. Soft non-hygroscopic packaging materials shall be placed between the hard packing materials and the fragile equipment. Articles, which do not completely fill the selected package/ container, must be cushioned, braced, fastened or blocked to prevent damage to the article itself or destruction of the package. Inner bracing or blocking must be such that the content's weight is distributed over interior surfaces rather than concentrated at one or two points.</p> <p>1.17 Components containing glass shall be carefully covered with shock absorbing protective material such as expanded polystyrene ('Thermo Cole').</p> <p>1.18 All flanges, etc., which are prone to scratching shall be provided with either metal or wooden or plastic blanks bolted in place. Metal blanks should have a minimum thickness of 3 mm and wooden blanks should be made from two layers of wood, each of 10 mm thickness, nailed together with the grain of each layer located at right angles to one another.</p> <p>1.19 Loose material, e.g. bolts, nuts, etc. shall be packed and sealed in polythene bags with proper tagging and packed in cases.</p> <p>1.20 All spare parts shall be packed and treated for long storage conditions at site.</p> <p>2.0 <b><u>MARKING</u></b></p>		
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<p>2.1 All packages shall be clearly, legibly and durably marked with uniform block letters (preferably with waterproof paint) on at least three sides with:</p> <ul style="list-style-type: none"> <li>(a) Purchaser's Name and destination address</li> <li>(b) Purchase Order/Contract Number and Date</li> <li>(c) Vendor's/Contractor's or Sub-Vendor's/Sub-Contractor's Name</li> <li>(d) Consignment Serial Number</li> <li>(e) Overall Dimensions</li> <li>(f) Net and gross weights</li> <li>(g) Sign showing 'side up'</li> <li>(h) Sign showing 'fragile' marks in case of delicate equipment</li> <li>(i) Sign showing slinging and sling position</li> <li>(j) Any handling and unpacking instructions, if considered necessary</li> <li>(k) Identification markings relating to the appropriate shipping documents</li> <li>(l) In case of spare parts, each spare part shall be clearly marked and labelled on the outside of its packing with its description and catalogue/ part number and item number of main equipment to which it relates.</li> </ul> <p>2.2 <b><u>ERECTION MARKS</u></b></p> <p>All equipment comprising multi part assemblies, e.g. steel frameworks, piping, etc., shall be marked with identifying numbers and/or letters corresponding to those of the approved drawings or material lists. These erection marks shall be clearly readable.</p> <p>Colour banding to an approved code shall be employed to identify members of similar shape or type but of different strengths or grades.</p> <p>3.0 <b><u>TRANSPORT</u></b></p> <p>3.1 No equipment or material shall be despatched without prior consent (acceptance certificate) of the PURCHASER/CONSULTANT or his representative. On receipt of the acceptance certificate, the equipment shall be packed up and made ready for despatch either on Free On Board (FOB), (Free Alongside Ship (FAS), Free On Road (FOR), Free On Truck, (FOT), Free Alongside Road (FAR), or free alongside Truck (FAT) basis as per the PURCHASE ORDER/CONTRACT. If it is on FOB basis, the VENDOR/ CONTRACTOR is responsible for loading the equipment on the board of ship. On FAS basis, another agency takes over from the VENDOR/CONTRACTOR</p>		
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<p>for loading. The same applies to FOR, FOT and FAR, FAT.</p> <p>3.2 Depending upon the equipment and the mode of transport the VENDOR/ CONTRACTOR may propose to deliver the equipment in container or as Break Bulk i.e. in components or sub-assembly form.</p> <p>3.3 In the event of VENDOR/CONTRACTOR proposing to deliver the equipment in Break Bulk form, he shall furnish full particulars of the quantity and approximate size of each item. All sub-assemblies shall be match-marked to facilitate assembly at site.</p> <p>3.4 In case of ocean shipment, the VENDOR/CONTRACTOR shall send an advance 'Advice of Shipment' to the PURCHASER and site separately, so as to reach at least seven (7) days in advance for foreign supply and three (3) days in advance for domestic supply. This advice shall state the Cost including Freight and Insurance (CIF) value of the consignment, the details of the transport and the probable date of its departure and arrival. Copies of packing list shall also be sent along with the advance intimation.</p> <p>3.5 The VENDOR/CONTRACTOR shall ship the equipment on behalf of the PURCHASER by the first available vessel belonging to a recognised shipping line. He shall ensure that the freight rates charged are not higher than the conference rates applicable to the shipping route at the time of shipment and all rebates and refunds available for such consignments are duly taken into account. The VENDOR/CONTRACTOR shall be responsible for the correct appraisal of freight rates (structural or machinery as the case may be), weights and volumes. In no case, the PURCHASER will pay any warehouse or wharf charges.</p> <p>3.6 Immediately after the shipment has been effected, the shipping documents, comprising Bill of Lading, Freight Invoice, FOB/FAS/FOR/FOT/FAT/FAR Invoice, Packing List, Certificate of Origin, Letter to Insurers and Certificates of Inspection shall be issued by the VENDOR/CONTRACTOR in accordance with the instructions of the PURCHASER/CONSULTANT. These documents shall reach the PURCHASER before the arrival of ship. Responsibility for delays, loss or damages of shipping documents shall rest with the VENDOR/ CONTRACTOR.</p> <p>3.7 In case of inland despatch by rail or truck, similar equivalent procedures as applicable to rail or truck transportation shall be adopted.</p> <p>3.8 All Equipment manufactured by the VENDOR/CONTRACTOR shall be under his charge. The PURCHASER shall arrange for insurance coverage during shipment and till delivered at site, if necessary.</p> <p>4.0 <b><u>TRANSPORT OF ELECTRICAL EQUIPMENT AND INSTRUMENTATION ITEMS</u></b></p> <p>4.1 Transformers rated 2000 kVA and less shall be shipped filled with oil. Transformers rated above 2000 kVA shall be shipped without oil but with the</p>		
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<p>tank filled with nitrogen or equivalent inert gas. A gas cylinder with suitable reducer connection and pressure gauge shall be supplied. These accessories shall become the property of the PURCHASER. The required quantity of oil shall be supplied separately in non-returnable drums.</p> <p>4.2 Switchgear cubicles and instrument control panels shall be packed and shipped in separate and convenient sections. All withdrawable equipment like circuit breakers and circuit breaker arc-chutes shall be packed and shipped separately. All relays and panel-mounted instruments shall be packed and shipped separately with their operating mechanisms temporarily arrested from movement during transport.</p> <p>4.3 Batteries shall be shipped to site in dry, uncharged condition. Appropriate quantity of acid of the correct specific gravity shall be shipped separately in non-returnable porcelain jars packed in steel wire baskets.</p> <p>4.4 Cables shall be shipped on non-returnable drums, adequately braced, and with cable ends adequately sealed to prevent ingress of moisture.</p>		
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	<b>TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2X660 MW SURATGARH STPS STAGE V UNIT # 7&amp; 8</b>	SPEC. NO. PE-TS-392-154-12000A-A001	
		VOLUME II-B	
		SECTION : D2	
		REV. NO. 00	DATE:
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## SECTION – D2

### GENERAL TECHNICAL SPECIFICATION-ELECTRICAL

# **CABLES AND CABLE CARRIER SYSTEM**

SPEC. NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME IV SECTION: D16
PART B	<b>RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 &amp; 8, at Suratgarh, Rajasthan</b>  <b>CABLE &amp; CABLE CARRIER SYSTEM</b>	SHEET 1 OF 9
<p><b>1.0 CABLES</b></p> <p><b>1.1 H T POWER CABLES</b></p> <p>System cables shall be 11kV (UE) and 6.6 kV (UE) grade suitable for use in medium resistance earthed system, stranded &amp; compacted aluminium conductor, extruded semi conducting screen over conductor, XLPE insulated, semi-conducting followed by copper tape screened, extruded PVC Type ST – 2 inner sheathed, aluminium/GS wire armoured, overall FRLS PVC outer sheathed, conforming to IS 7098 (Part II), IEC-502 for constructional details and tests.</p> <p><b>1.2 L T POWER CABLES</b></p> <p>LV Power Cables shall be 1100 V grade, single / multi core, stranded aluminium conductor, XLPE insulated, with PVC inner sheath, armoured and outer sheath made of FRLS PVC compound, generally conforming to IS 7098 (for XLPE). The cables used for DC system shall be of single core type. Minimum conductor cross section of power cables shall be 6-sq. mm for aluminium cables.</p> <p><b>1.3 CONTROL CABLES</b></p> <p>Control cables shall be 1100 V grade, multi core, minimum 1.5 sq. mm cross section, stranded copper conductor having minimum 7 strands, PVC insulated, PVC inner sheathed / galvanised steel wire armoured, overall FRLS PVC outer sheathed generally conforming to IS 1554 Part-I. In situations where accuracy of measurement or voltage drop in control circuit warrants, higher cross sections as required shall be used.</p> <p><b>1.4 INSTRUMENTATION CABLES</b></p> <p>The instrumentation cables shall be Annealed, tinned stranded copper conductor, 0.5 sq mm , twisted into pairs, overall screened (I1 type) for digital signals, individual and overall screened ( for I2 type) for low level analog signals, individual triplet and overall screened (type I3), PVC insulated , inner PVC sheathed, GS wire armoured and overall sheathed with FRLS PVC. The insulation shall be strippable manually as well as by mechanical stripping devices without damage to the conductor.</p> <p><b>1.5 TRAILING POWER AND CONTROL CABLES FOR MOBILE EQUIPMENT.</b></p> <p>11 kV(UE) and 6.6 kV (UE) and 1100V-(E) grade power &amp; control flexible trailing, annealed tinned copper conductor, EPR insulated, EPR inner sheathed, CSP outer sheathed and shall have conductor screen of rubber. Cables shall conform to IS requirements and any other applicable standards.</p> <p><b>1.6 FIRE SURVIVAL CABLES</b></p> <p>1.6.1 Power and control, single/multi, stranded copper conductor fire survival cables complying with IEC-60331 shall be provided for following systems as per CEA guidelines.</p>		
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<p>(a) DC emergency lube oil pumps</p> <p>(b) DC seal oil pumps</p> <p>(c) DC emergency lighting cables for main building</p> <p>(d) Batteries to chargers and DC distribution boards</p> <p>(e) Turbine lube oil pumps</p> <p>(f) Jacking oil pumps</p> <p>(g) Emergency turbine trip by pushbutton in control room</p> <p>(h) Boiler Turbine: Generator inter trip which includes the interconnecting cables between:</p> <ul style="list-style-type: none"> <li>– Boiler master fuel trip and turbine trip relays</li> <li>– Generator trip relays and turbine trip relays</li> <li>– Generator trip relays and 400kV breakers</li> <li>– Generator trip relays and generator field breakers</li> <li>– Generator trip relays and ST and UT breakers</li> </ul> <p>1.6.2 FS cables shall have following properties:</p> <p>(a) Excellent fire resistance characteristics</p> <p>(b) Cables shall have features of nontoxic and low smoke generation</p> <p>(c) Flame non-propagation property</p> <p>(d) Ability to withstand burning &amp; continue to function during and after fire</p> <p>(e) Low smoke emission &amp; low halogen property to maintain circuit integrity to essential services under severe fire condition.</p> <p>1.6.3 Construction of FS cables</p> <p>(a) Conductor- Copper stranded</p> <p>(b) Fire proof layer- heat barrier based</p> <p>(c) Insulation- elastomer rubber</p> <p>(d) Fire proof layer- same as 2 above but optional – natural or synthetic, fibre or elastomer</p> <p>(e) Filler- suitable filler optional</p> <p>(f) Binder tape – two layers of glass fibre tape</p> <p>(g) Inner sheath- HOFR FRLS elastomer (heat &amp; oil flame retardant)</p> <p>(h) Armouring/screening – suitable wire</p> <p>(i) Over all sheath – HOFR FRLS</p>		
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<p><b>1.7</b> Cables for the fire detection and alarm system and communication system shall be as described else where.</p> <p><b>2.0 <u>CABLE PROPERTIES</u></b></p> <p><b>2.1</b> All single core power cables shall have wire / strip armouring of aluminium, whereas multi core power cable shall have galvanised steel wire / strip armouring.</p> <p><b>2.2</b> The sheath shall be resistant to water, UV radiation, fungus, termite and rodent attack.</p> <p><b>2.3</b> The outer sheath of FRLS PVC compound shall meet the following performance requirements:</p> <p>(a) The critical oxygen index value shall be minimum 29 when tested at <math>27 \pm 2^{\circ}\text{C}</math> as per ASTM-D-2863-77 and the temperature index shall be minimum <math>250^{\circ}\text{C}</math> at oxygen index value of 21 when tested as per ASTM-D-2863.</p> <p>(b) The maximum acid gas generation as determined by titration method shall be less than 20% by weight when tested as per IEC-60754-1 (1994). Halogen acid content in outer sheath in FS cables shall not be more than 2%.</p> <p>(c) Flammability</p> <p>(i) Cables shall pass tests under fire condition as per IS-10810-Part-53.</p> <p>(ii) Cables shall also pass tests as per IS-10810 Part-61 &amp; Part-62. Category group shall be considered as Category 'A'.</p> <p>(iii) Fire survival cables in addition to tests (i) and (ii) above shall pass tests as per IEC-331.</p> <p>(d) The smoke generation under fire shall have maximum smoke density rating of 60% when tested as per ASTM-D-2843-77 (1977). Smoke density in FS cables shall not exceed 20%.</p> <p>(e) The cables shall pass the ultraviolet tests as per DIN 53387.</p> <p>(f) The cables shall pass the tests for Water absorption tests as per IS 10810.</p> <p><b>2.4</b> The finished cable shall pass the flammability test as per IEC-322-1 (1993) and IEEE-383. In addition, it shall also pass flammability test as per Class F3 of Swedish Standard SS-424-1475 (1977).</p> <p><b>2.5</b> In addition, cables for devices mounted on or near hot surfaces of Steam Generators, Turbine Generators, Main steam etc shall have heat resistance type outer sheath.</p> <p><b>2.6</b> All LT cable shall have embossing at interval of 1 meter for owner name, size/ core type and length.</p>		
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<p>2.7 All cables shall be embossed with the name of RVUNL in addition to what is specified in the standards.</p> <p>3.0 <b><u>DESIGN CRITERIA FOR CABLE SIZING</u></b></p> <p>3.1 <b>POWER CABLES</b></p> <p>Power cable sizes shall be selected on the following basis:</p> <p>3.1.1 Power cables shall carry the full load current of the circuit continuously under site conditions considering the condition listed below:-</p> <ul style="list-style-type: none"> <li>(a) Ambient design temperature 50 deg. C.</li> <li>(b) Maximum allowable temperature under normal full load condition and under short circuit condition based on material selected (XLPE).</li> <li>(c) Maximum short circuit fault current.</li> <li>(d) Ambient temperature for underground cables, 50 deg. C.</li> <li>(e) De-rating factors as per IS/IEC and manufacturer's standard catalogues.</li> </ul> <p>3.1.2 Power cables shall withstand the fault current of the circuit for the duration not less than the maximum time taken by the primary protective system to isolate the fault. Fault clearing times for ties between two 6.6 kV switchgears shall be considered as 1 sec. Fault clearing times for ties between two 415V switchgears shall be considered as 0.5 sec.</p> <p>3.1.3 For the cables to 415 V motors and feeders protected by fuses, the cross section shall be chosen according to the cut-off current of the fuse and its fusing time.</p> <p>3.1.4 Voltage drop from transformer secondary to motor terminals during starting of motors will be limited to the following values:</p> <ul style="list-style-type: none"> <li>(a) For HV motors (except MDBFP motor) – 15% of the rated voltage</li> <li>(b) For MDBFP motors – 20% of the rated voltage</li> <li>(c) For LV motors – 15% of the rated voltage.</li> </ul> <p>3.1.5 Voltage drop in feeder cables shall be limited to 3% during full load running condition. Voltage drop from transformer secondary to motor terminals during full load running of motors shall be limited to 5 % of rated voltage.</p> <p>3.1.6 For power supply to valve actuator motors, actuators of various isolating and regulating dampers and exhaust fans, 3 core 2.5 sq. mm stranded copper conductor cable may be used in view of ease of termination. These cables shall be in other respects similar to cables described in Clause 1.2 above.</p> <p>3.1.7 Design Calculation for arriving at cable size shall be submitted for purchaser's approval.</p> <p>3.1.8 DC System Cables:-</p>		
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<p>3.1.8.1 1100 V grade, single core cables as specified in LT power cables shall be used from batteries/ battery chargers to main DCDB, between main Distribution Board, from main Distribution Board to sub distribution board, main DC supply to various system cabinets/panels, Switchgears etc and for critical auxiliaries. Flexible cables with PVC insulation shall be used where termination of XLPE/PVC insulated cables is difficult.</p> <p>3.1.8.2 Voltage drop in cables between battery to DCDB and battery charger to DCDB shall be limited to 2%. Voltage drop in cables between DCDB and loads shall be limited to 3%.</p> <p>3.1.8.3 Design Calculation for arriving at cable size shall be submitted for purchaser's approval.</p> <p>3.2 <b><u>CONTROL CABLES</u></b></p> <p>3.2.1 Current transformer leads shall be checked for the lead burden vis-a-vis the current transformer VA capacity. In case 2.5 sq. mm conductor impose unacceptably high burden on CTs, 4.0-sq. mm conductor shall be used. The conductor material shall be copper.</p> <p>3.2.2 Voltage transformer leads shall be checked for voltage drop which shall be limited to within 1% for all cases other than tariff metering. For tariff metering the voltage drop shall be limited to 0.2%. In case the voltage drop with 2.5 sq. mm conductors exceed this value, higher conductor sizes shall be used.</p> <p>3.3 <b><u>INSTRUMENTATION CABLE</u></b></p> <p>3.3.1 Element identification : As per IEC-60189-2</p> <p>3.3.2 Core wrapping : By non-hygroscopic material by taping or by extrusion</p> <p>3.3.3 Element screening : By copper tape of minimum 0.04mm thickness or by copper laminated plastic tape</p> <p>3.3.4 Rip cord : Non-metallic rip cord under the core wrapping</p> <p>3.3.5 Drain wire : A tinned copper drain wire of minimum 0.05 mm<sup>2</sup> cross section in contact with each screen of cabling element.</p> <p>Cabling elements shall be any one of the following:</p> <p>A 'Pair' of two insulated conductors twisted together designated by alphabet 'p' printed on a binding tape at 200 mm intervals.</p> <p>A 'Triple' of three insulated conductors twisted together designated by alphabet 't', printed on a binding tape at 200 mm intervals.</p> <p>Maximum length of lay in the finished cable shall be 120 mm.</p> <p>3.3.6 <b><u>Units</u></b></p> <p>Cables shall be bunched together in units of twenty cabling elements or sub units of five or ten elements, stranded in concentric layers. The units or sub</p>		
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<p>units shall be designated by p1, p2, p3,. t1, t2, t3...,q1, q2, q3, .., or Q1, Q2, Q3 ..., etc. depending on the combination.</p> <p>3.3.7 <u>Overall screening and armouring</u></p> <p>Cables shall have an overall screen made up of copper/aluminium tape of 0.04 mm thickness or copper/aluminium of 0.008 mm thickness laminated with plastic tape with a minimum overlap of 15%.A drain wire of tinned copper with minimum 0.5 mm<sup>2</sup> cross section shall be provided in continuous contact with the screen.</p> <p>3.3.8 <u>Inner and Outer Sheath</u></p> <p>The inner and outer sheaths shall consist of black PVC compound.</p> <p>3.3.9 <u>Insulation Resistance</u></p> <p>Minimum insulation resistance per km shall be 500 mega Ohm.</p> <p>3.3.10 <u>Mutual Capacitance</u></p> <p>Mutual capacitance of any pair of conductors shall not exceed 120 nF/km.</p> <p>3.3.11 <u>Capacitance Unbalance</u></p> <p>The capacitance unbalance between any two pairs shall not exceed 400 pF for 500 metre length of cable.The construction, performance and testing of cables except as mentioned above shall generally comply with the following standards :</p> <p>IEC-60189 - Part-1 : Low frequency cables and wires with PVC insulation and sheath. General test and measuring methods</p> <p>IEC-60189 - Part-2: (-do- Cables in pairs and triples).</p> <p>4.0 <b><u>CABLE TERMINATIONS</u></b></p> <p>4.1 Cables shall be laid in trays /trenches/ conduits by the Bidder. Also joint markers shall be provided at each joint.</p> <p>4.2 All 1100V termination for XLPE/PVC power cables and control cables shall be by Double compression weather proof type cable glands. Heavy duty, tinned, long barrel copper lugs shall be used for termination.</p> <p>5.0 <b><u>CABLE JOINTS</u></b></p> <p>Cable joints shall be avoided to the extent possible. If joints are unavoidable due to circuit length, in excess of permissible maximum drum length, they shall be heat shrinkable types having a short circuit with stand capacity value as specified in clause 3.1.2 above. Lugs shall be heavy duty, tinned copper, long barrel type. All cable glands shall be double compression, weather proof.</p> <p>6.0 <b><u>POWER RECEPTACLES</u></b></p>		
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<p>3 phase, 5 pin, 63A power receptacles with switch shall be provided . The receptacle shall be industrial heavy duty type and shall have suitable interlock facility for safety. The receptacle shall conform to IS 1293 and the switch to IS 4064.</p> <p><b>7.0 <u>CABLE CARRIER SYSTEM</u></b></p> <p>7.1 The cable carrier system shall be designed considering the following :</p> <ul style="list-style-type: none"> <li>(a) Facility for easy laying of cables.</li> <li>(b) Access to maintenance.</li> <li>(c) Neat and aesthetic appearance.</li> <li>(d) Safety of equipment &amp; personnel.</li> <li>(e) Ground water seepage.</li> <li>(f) Drainage system for oil and water.</li> </ul> <p>7.2 Cables shall be laid in prefabricated ladder (for power and control) / perforated (instrumentation) type trays and in conduits. Also joint markers shall be provided at each joint. The cable trays shall be laid vertical in boiler and ESP area, coal handling and ash handling area.</p> <p>7.3 Cable trays and supporting structures in chemically corrosive area like battery room and water treatment plant shall be mild steel painted trays finished with chlorinated rubber based paint/epoxy paint.</p> <p>7.4 Cable trenches will be avoided to the extent possible inside Fuel oil pump house, water treatment plan where possibility of oil and water collection exists and Boiler &amp; ESP areas.</p> <p>7.5 No direct underground burial cables shall be laid except lighting tower, street lighting. For some exceptional case like isolated individual equipments it shall be allowed after approval by the owner /consultant.</p> <p><b>8.0 <u>CABLE INSTALLATION AND ACCESSORIES</u></b></p> <p>8.1 All material and accessories required for cable installation like cable trays, tray covers, support steel, etc., shall be hot dip galvanized. Conduits/pipes shall also be hot dip galvanized steel. The racks/trays, conduits/pipes, trenches required to route the cables to individual equipment shall be supplied and installed by the BIDDER.</p> <p>8.2 Separate trays shall be provided for LV Power (AC&amp;DC)/Control &amp; Instrumentation cables.</p> <p>8.3 After laying all the cables, BIDDER shall dress all cables by clamping at every metre, so that the cables are securely held and aesthetically good.</p> <p>8.4 Cable trays shall be avoided very close to the pipes carrying high temperature steam. When they are inevitable, it shall be laid after OWNER approval and</p>		
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SPEC. NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME IV SECTION: D16
PART B	<b>RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 &amp; 8, at Suratgarh, Rajasthan</b>  <b>CABLE &amp; CABLE CARRIER SYSTEM</b>	SHEET 8 OF 9
<p>suitable insulation material shall be provided between the cable trays and pipes.</p> <p>8.5 1100 V cables up to 120-sq. mm. can be laid in two layers. Control and Instrumentation cables can be laid in three layers.</p> <p>8.6 One spare conduit shall be provided for cable of center / outer drive in clarifier.</p> <p>8.7 Power and control cables for critical / emergency drives / equipment like DC EOP / JOP shall be kept away and routed in separate cable trays</p> <p>8.8 All cable entries to the buildings to be sealed by fire proof &amp; water proof cement after cable installation.</p> <p>8.9 One drum (500m) spare LT power/control of each size of cable shall be included.</p> <p><b>9.0 CABLE TRAYS AND COVERS</b></p> <p>9.1 All outdoor cable trays are to be provided with covers. All vertical cable tray race ways are to be provided with covers all round. Cable trays shall be of ladder / perforated type complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories. Cable trays of ladder and perforated types and the associated accessories such as coupler plates, tees, elbows, etc., shall be fabricated from 12 gauge (2.5 mm thick) mild steel sheets. Cable tray covers shall be provided for all cable trays and raceways. The cable tray accessories like trays, elbows, bends, etc., shall be fabricated and galvanized before bringing to site. Cable tray covers shall be fabricated from 16 gauge (1.7 mm thick) MS sheets. All the sheet steel shall be hot dip galvanized.</p> <p>9.2 1100 V rated cables of sizes 120-sq. mm and above shall be laid in single layer. Single core cables used for 3-phase AC power circuits shall be laid in Trefoil form with suitable PVC aluminum clamps to hold the cables.</p> <p>9.3 The sizing of cable trays from TG building to other areas shall consider para 9.2 above an additionally to avoid crowding and criss crossing of cables, especially in boiler area where vertical risers are to be provided for various power, control and instrumentation cables to higher elevations of boiler.</p> <p>9.4 Slotted angles shall not be used for cabling. In all locations smaller size cable trays of 50 mm / 100 mm wide shall be used for one or two cables.</p> <p><b>10.0 FIRE-PROOF SEALING OF CABLE PENETRATION</b></p> <p>Cables / cable tray openings in walls and floors or through pipe sleeves from one area to another or one elevation to another, between the units and within the same unit, shall be sealed by a fire-proof sealing system. The fireproof sealing system (FPSS) shall effectively prevent the spread of fire from the flaming to the non-flaming side, in the event of a fire. The FPSS shall conform to the following requirements:</p>		
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SPEC. NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME IV SECTION: D16
PART B	<b>RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 &amp; 8, at Suratgarh, Rajasthan</b>  <b>CABLE &amp; CABLE CARRIER SYSTEM</b>	SHEET 9 OF 9
<p>(a) FPSS shall have a fire rating of two hours.</p> <p>(b) The FPSS shall be subjected to fire endurance test, hose stream test, temperature measurement of non-flaming side as per ASTM-E119. 'Standard method of fire tests of building construction and materials'.</p> <p>(c) The FPSS will also conform to the in-combustibility test carried out in accordance with IS: 3144-1992.</p> <p>(d) Under fire condition, the FPSS material shall not emit excessive smoke or any corrosive or toxic fumes.</p> <p>(e) FPSS shall have minimum life of 25 years.</p> <p><b>11.0 FIRE BREAK</b></p> <p>11.1 Fire break shall be provided by applying a suitable fire-resistant coating on cables for the required length to meet the fire rating of 30 minutes.</p> <p>11.2 Fire break shall be provided at an interval of 15 metres in the straight portion of each of the cable tray above ground, at intervals of 30 metres in cable trenches and at 5M for all vertical trays. All cable inter section and tee offs shall be provided with firebreaks.</p> <p>11.3 When pipe sleeves are provided for cables from outdoor areas to indoor areas, the pipe opening at the outdoor side shall be sealed by fire proof sealing material, which is also continuously waterproof. The indoor side of the pipe opening shall also be sealed by continuous fire proof sealing materials. The duct banks in outdoor areas also need to be sealed by water proof seals. It is necessary to explore possibility of applying waterproof coating on fireproof sealing.</p> <p><b>12.0 TESTS</b></p> <p>All routine tests and FRLS tests as per relevant standard shall be performed on each size of cable. If same size is supplied in different lots, inspection shall be done for each lot. If same cable is supplied by different agencies, test shall be carried out on cables supplied by each agency. These tests shall be carried out as per relevant standards as applicable.</p> <p>Routine and acceptance test shall be carried out on FPSS.</p> <p>Type test certificates for type tests conducted on identical design and size of the Cables shall be submitted for review. If type tests have not been done or the certificates are found to be not in order by purchaser then these type tests shall be conducted on Cables to be supplied for this project at no extra cost to Purchaser.</p> <p>13.0 For technical particulars refer datasheet-A.</p>		
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SPEC. NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>		VOLUME IV SECTION: D16
PART B	<b>RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 &amp; 8, at Suratgarh, Rajasthan</b>  <b>DATA SHEET-A</b> <b>CABLE &amp; CABLE CARRIER SYSTEM</b>		SHEET 1 OF 2

Sr. No.	Description	unit	Client specification
1.0	Name of manufacturer		*
2.0	Make of cable		
3.0	Conductor No. core x Size Form- circular/segmented Effective cross sectional area sq. mm		*
4.0	Whether cores identification numbers for cables with 5 cores and above to be provided		Yes
5.0	Whether incremental running lengths are marked on cable		Yes
6.0	Finished cable a) Diameter under armour in mm b) Diameter over armour in mm c) Overall diameter in mm		*
7.0	Cable drums a) Whether cable drums confirm to IS : 10417 b) Length of cables in drum & tolerance c) Weight of cable drum without cables d) Weight of cable drum with cables e) Type of end sealing		*
8.0	FRLS cables a) Critical oxygen index value at 250 deg C when tested for temperature index test as per ASTM-		Ref. Clause 2.3


REV. NO.	R0	R1	JOB NO. TCE - 5750A	CLIENT : RRVUNL  PROJECT : 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan
PPD. BY :	UM	SK		
CKD. BY :	MSVM	MSVM		
DATE	NOV'2009	JUN'2012		

SPEC. NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME IV SECTION: D16
PART B	<b>RRVUNL, 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 &amp; 8, at Suratgarh, Rajasthan</b>  DATA SHEET-A CABLE & CABLE CARRIER SYSTEM	SHEET 2 OF 2

Sr. No.	Description	unit	Client specification
	<p>D-2863</p> <p>b) Total acid gas generation by weight when tested as per IEC – 754-1 in %</p> <p>c) Percentage of light transmission under fire for assessment of smoke generation when tested as per ASTM – D – 2843-77</p> <p>d) Will the cables offered against this specification pass the flammability tests as per</p> <p>1) Class – F3 – Swedish standard S5-424- 1475</p> <p>2) IEC 60332 – 1C</p> <p>3) IEC 60331 – 1</p>		
9.0	Maximum dielectric loss of cable per KM at normal voltage and frequency	Watt/km	*
10.0	Short circuit capability for 1 Sec (HT & LT Power Cable)	kA rms	Minimum 40kA and 50 kA for HT and LT respectively and shall be in line with requirements of the switchgear and protection.
11.0	Maximum dielectric stress at core screen	KV/cm	*
12.0	Max. overall diameter of cables	mm	*

‘\*’ indicated above shall be filled by BIDDER.

REV. NO.	R0	R1	JOB NO.	CLIENT : RRVUNL
PPD. BY :	UM	SK	TCE -	
CKD. BY :	MSVM	MSVM	5750A	
DATE	NOV'2009	JUN'2012		PROJECT : 2 x 660 MW Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan

	<b>TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2X660 MW SURATGARH STPS STAGE V UNIT # 7&amp; 8</b>	SPEC. NO. PE-TS-392-154-12000A-A001	
		VOLUME II-B	
		SECTION : D3	
		REV. NO. 00	DATE:
		SHEET	

## SECTION – D3


### GENERAL TECHNICAL SPECIFICATION CONTROL & INSTRUMENTATION

SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME V SECTION : D5.4
Package: EPC	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> <b>INSTRUMENTATION AND CONTROL EQUIPMENT</b> SPECIFICATION FOR INSTRUMENTATION & CONTROL EQUIPMENT	SHEET 1 OF 42
<p><b>1.0 SPECIFICATIONS FOR INSTRUMENTS TO BE SUPPLIED ARE AS FOLLOWS.</b></p> <p><b>1.1 Pressure Indicators/DP indicators</b></p> <p>Direct reading, pipe mounted Pressure gauges of die-cast aluminium body, with 6 inch(150mm) phenolic dial (white dial with black numerals), 316 SS/304 SS Bourdon tube for high pressure application and 316SS Diaphragm/bellow for low pressure applications, AISI 304 movements and micrometer type adjustable aluminium pointer an accuracy of +/-1.0% of span including accessories like siphons for steam services, snubbers for pump discharge applications and chemical diaphragm for corrosive and oil services and name plate, etc. Material of accessories shall be SS. IP65 or equivalent degree of protection for enclosure. Over range protection shall be 50% above maximum pressure. Armoured capillary of 10 M shall be provided as required. Process connection shall be 1/2"NPT (F).</p> <p><b>1.2 Pressure Switches/DP Switches</b></p> <p><del>Non indicating type, field mounted Pressure Switches of aluminium casing (epoxy coated), and 316 SS element and repeatability of +/-1% of span, including accessories like siphons for steam services, snubbers for pump discharge applications and chemical diaphragm for corrosive and oil services, name plate &amp; mounting brackets. Material of accessories shall be SS. Auto reset micro switch with internal adjustment for set values with 2 SPDT contacts rated for 0.2 A at 220 V DC. IP 65 or equivalent degree of protection for enclosure. Over range protection 50% above maximum pressure. Scale for setting shall be provided. Piston actuated for high pressure applications and diaphragm/bellows for low pressure/vacuum. Process connection 1/2" NPT (F).</del></p> <p><b>1.3 Pressure Transmitters/DP Transmitters/Flow transmitters(DP type/Level transmitters/DP type (SMART))</b></p> <p>Micro-processor based 2 wire indicating type (LCD display), rack mounted with accuracy of +/-0.075% of span, external zero and span adjustment, self diagnostics, temperature sensor for compensation. Power supply 24 V DC; output signal of 4-20 mA DC. IP 65 or equivalent degree of protection. Aluminum housing with epoxy coating, Accessories like snubbers for pump discharge applications and chemical diaphragm. 10 m PVC covered SS armoured capillary for corrosive and oil services, three way manifold, nameplate etc. Material for accessories shall be SS. Turn down ration 30:1. Load impedance 700 ohm (min).Process connection-1/2"NPT (F). 2 valve manifold for absolute pressure, 3 valve manifold for gauge/vacuum and 5 valve manifold for DP/level/flow measurements. For HFO, LFO applications, SS capillary with ANSI RF flanged ends shall be provided.</p>		
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SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME V SECTION : D5.4
Package: EPC	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> <b>INSTRUMENTATION AND CONTROL EQUIPMENT</b> SPECIFICATION FOR INSTRUMENTATION & CONTROL EQUIPMENT	SHEET 7 OF 42
<p><del>coloured LCD or fluorescent tube with user selectable span; programmability (selection of input &amp; scan/storage rate) shall be through Front panel keyboard; the recorder shall have the capability of being drawn out from the front side of the housing for maintenance and shall have electrical connection of plug-in type; material of casing shall be die-cast aluminium with epoxy coating and with a non-glare shatter proof Glass; enclosure shall be IP32 The quantity of Hybrid recorders shall be 4 nos.</del></p> <p>1.21 Pressure and Differential Pressure Transmitter Racks</p> <p>Open type transmitter racks to mount all pressure, differential pressure and flow transmitters with vibration dampener: air supply lines and header shall be provided with bulk head fittings to receive impulse lines; Also provided with blow down/drain header. The material of accessories shall be SS. Drains shall be connected upto suitable Owner / Project Manager's drain header. The quantity shall be as required for the specified Pressure and Diff. Pressure transmitter.</p> <p>1.22 Junction Boxes (JB)</p> <p>All JB's shall be Galvanised. Wall/column mounted junction boxes having 32 (2x16) terminals and cable entry only at the bottom and sealed with fireproof compound; Screwed terminal type; IP 65 or equivalent degree of protection for enclosure. Separate terminal blocks shall be used for analog and digital signal and also for signals with different voltages. Removable gland plate shall be supplied. JB shall have single lockable door with gasket, able to open side ways, with common keys. Painting inside shall be glossy white &amp; outside - IS-5 shade 631. Shield bus for screw connection shall be provided. Terminal size shall be suitable for 0.5 sq.mm to 2.5 sq.mm wire. Terminal blocks shall be vertical. JB shall have provision to add 10% additional terminals. Accessories like metal tag (SS), clamps, fixtures, bolts (SS), nuts (SS), gaskets (neoprene), lock &amp; key, fireproof compound for sealing, etc. shall be supplied. The grouping of instruments in JB's is subject to Owner / Project Manager's approval. All the field Junction boxes shall have single doors and provision for locking. The doors shall not have screwed type of locking, but turnable hinge based. The JB's are subject to approval prior to manufacturing All JB's shall be provided with individual canopies to avoid ingress of water. All the TB's used shall be 6.6polymide to withstand corrosion and the metallic portion shall be coated against rust / corrosion.</p> <p>1.23 <del>Programmable Logic controller (PLC)-Refer Cl.no. 9.0 &amp; Table-15</del></p> <p>1.24 Interposing Relays (IPR)</p> <p><del>Electro magnetic type IPRs with plug-in type connections, suitable for channel/rail mounting in cabinets; coil rating 24V D.C; 2 set of silver plated Change over contacts rated for 0.2A 220 V DC. Freewheeling diode across relay coil (copper) and self reset type status indicator flag (electronic) shall be provided. All relays</del></p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME V SECTION : D5.4
Package: EPC	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> <b>INSTRUMENTATION AND CONTROL EQUIPMENT</b> SPECIFICATION FOR INSTRUMENTATION & CONTROL EQUIPMENT	SHEET 13 OF 42
1.37	<p><b>Air Filter Regulator (AFR)</b></p> <p>Constant bleed type AFR with an accuracy of <math>\pm 0.1\%</math>, inlet pressure range of 5-8 kg /sq.cm and suitable spring ranges (AFR) for use with positioners in control valves, control damper, E/P converters and shut off valves, transmitter purging lines etc; Filtering particles above five microns having phosphor bronze filter element. Material of accessories shall be SS. Built in blow down valve shall be provided. AFR shall have automatic drain feature. All accessories shall be supplied. Degree of protection shall be IP65.</p>	
1.38	<p><b>Position Transmitters</b></p> <p>24VDC operated Non contact LVDT type with 4-20 mA DC 2 wire system with an accuracy of <math>\pm 1\%</math>; range adjustment and zero adjustment to be provided; IP65 degree of protection for casing. The output shall be linear. All accessories shall be SS.</p>	
1.39	<p><b>Solenoid Valves</b></p> <p>Direct operated solenoid valves, pilot operated for higher sizes with shut off class (leakage) VI, body material of bronze, plunger material of 316 SS rated for continuous duty. IP 65 class for enclosure. Insulation class of 'F' for the solenoid. Body ratings shall suit the pressure and temperature conditions.</p>	
1.40	<p><b>Void</b></p>	
1.41	<p><b>Bunker level monitoring system:</b></p> <p>Radar type shall be provided. 230V UPS shall be utilised for the instruments. The system shall provide 4-20mA for connecting to DCS and CHS PLC.</p>	
1.42	<p><b>Furnace Temperature Probe</b></p> <p>Duplex k-type thermocouple with mineral insulation &amp; SS sheath located in furnace below SH panels; minimum of 2 nos. Probe housing shall be weather proof &amp; corrosion resistant. Accuracy shall be <math>\pm 0.5\%</math> of span. The junction shall be ungrounded with response time of 2 to 5 seconds. Starter box shall be provided with IP65 enclosure &amp; 3 mm thick sheet. Electric motor with chain drive shall be provided for the lance. The traverse of the probes from opposite sidewalls shall cover the full cross section of the furnace. Automatically controlled cooling system shall be provided for the lance. Loss of cooling water shall be detected &amp; provided as a contact. Accessories like limit/torque switches position transmitters, etc. shall be provided. All the field mounted accessories (limit switches etc.) shall comply to NEMA-4</p>	
		ISSUE R1

	DOCUMENT TITLE		DOCUMENT NUMBER	
	DRIVE CONTROL & MEASUREMENT PHILOSOPHY (STANDARD)		PE-SD-999-145-I002	
	PROJECT: -----		REVISION NUMBER 02	DATE 28-08-2009
			SHEET 3	OF 15

d. Necessary electrical protections for the drives shall be realised at MCC, whereas process interlocks and protections shall be realised in DCS.

e. Following signal exchange shall take place between MCC & DCS

- i. Drive Start & Stop commands.
- ii. Drive ON & OFF feedback.
- iii. MCC disturbed (Thermal O/L, Control supply fail, EPB operated, MCC isolated).

f. Current measurement shall be provided in DCS for monitoring on OWS for all drives  $\geq 30$  KW and for important drives  $< 30$  KW also. Current transducers shall be provided in MCC.

*The above signal exchanges are diagrammatically represented in sheet no. 9.*

### 3 Solenoid Operated Drives

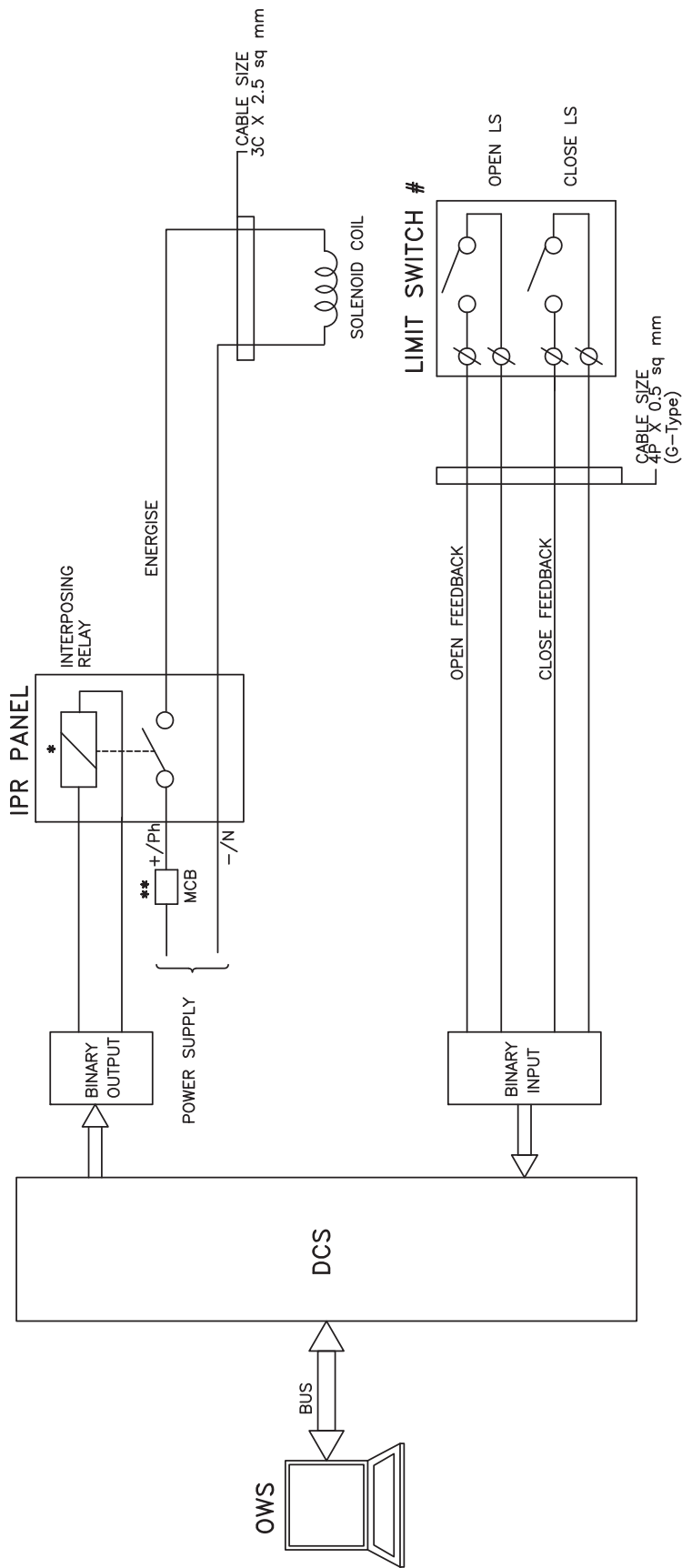
- a. Solenoid operated drives shall be operable from remote i.e. CCR only.
- b. Remote manual operation of all drives shall be done from OWS.
- c. Remote control commands i.e. open/close shall be generated from DCS and shall be issued to the respective solenoid through interposing relays located in Interposing Relay panels.
- d. Necessary process interlocks shall be realized in DCS.
- e. Following signal exchange shall take place between solenoid operated drive & DCS
  - i. Valve open & close command.
  - ii. Valve status feedback by means of limit switches (open/close), wherever available or from relay contact of interposing relays if Limit Switches are not provided.

*The above signal exchanges are diagrammatically represented in sh. no. 10.*


### 4 HT Unidirectional Drives (Breaker operated).


- a. Remote manual operation of Breaker operated drives shall be normally from remote i.e. Station DCS in main Control Room through OWS.
- b. Remote/Switchgear selection shall be realized from SWGR mounted R/S selector switch.

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



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


	PROJECT:		DRG.NO.	PE-SD-999-145-1002
	DDCMIS INTERFACE FOR SOLENOID DRIVE		DATE	23.09.2006
			REV.NO.	00
			SHT	10 OF 15

	<b>TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2X660 MW SURATGARH STPS STAGE V UNIT # 7&amp; 8</b>	SPEC. NO. PE-TS-392-154-12000A-A001	
		VOLUME II-B	
		SECTION : D3	
		REV. NO. 00	DATE:
		SHEET	

## QUALITY PLAN AND CHECK LIST

THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-392-154-12000A-A001

FORM NO. PEM-6666-0

	<b>CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (Mechanical Auxiliary Packages)</b>	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 2 OF 2	
Data Sheet No.: <b>PE-CL-999-145-1026-0</b>			


SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGEN CY			REMARKS
				P	W	V	
1.0	CHECK FOR		APPROVED TECHINCAL REQUIREMENT/ DATA SHEET				MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
	1.1 DIAL SIZE	100%		M	C	C	
	1.2 MODEL NO/TAG NO	100%		M	C	C	
	1.3 RANGE/SCALE	100%		M	C	C	
	1.4 END CONNECTION	100%		M	C	C	
	1.5 SWITCH CONTACT RATING & NOS	100%		M	C	C	
2.0	CALIBRATION						
	2.1 ACCURACY	100%		M	C	B	
	2.2 REPEATABILITY (FOR SWITCH)	100%		M	C	B	
	2.3 SET POINT ADJUSTMENT FOR SWITCH	100%		M	C	C	
3.0	OVER PRESSURE & LEAK TEST	100%		M	C	C	
4.0	OPERATION OF PR. RELEIF DEVICE	ONE PER TYPE		M	C	C	
5.0	REVIEW OF T.C. FOR MATERIAL OF--						
	5.1 SENSOR	FOR LOT		-	-	B	
	5.2 MOVEMENT			-	-	B	
	5.3 PROCESS CONNECTION			-	-	B	
	5.4 HOUSING			-	-	B	
6.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST		-	-	B	
7.0	REVIEW OF T.C. FOR CONTACT RATING OF SWITCH	ONE PER TYPE		-	-	B	
8.0	ACCESSORIES AS APPLICABLE	100%		M	C	C	

LEGEND:

M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

		<b>CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (Mechanical Auxiliary Packages)</b>		SPECIFICATION NO.: VOLUME SECTION REV. NO.      DATE: SHEET      1      OF      1			
				Data Sheet No.: PE-CL-999-145-1026-0			
SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS
				M	C	B	
1.0	CHECKS FOR VISULA, MODEL TAG NO.	SEE NOTE-1 BELOW	APPROVED TECHINCAL REQUIREMENT/ DATA SHEET	P	W	V	MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATERIAL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
2.0	PROCESS CONNECTION	-do-		P	W	V	
3.0	ACCURACY	-do-		P	W	V	
4.0	REPEATEABILITY	-do-		P	W	V	
5.0	HYSTERISIS	-do-		P	W	V	
6.0	EFFECT OF TEMP VARIATION ON ACCURACY	-do-		P	W	V	
7.0	SPAN /ZERO ADJUSTMENT	ONE/TYPE		P	W	V	
8.0	EFFECT OF SUPPLY VOLTAGE VARIATION	ONE/TYPE		P	W	V	
9.0	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
10.0	BURN IN TEST	ONE/TYPE		P	W	V	
11.0	DEGREE OF PROTECTION	ONE/TYPE		P	W	V	
<b>LEGEND:</b> M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.							
<b>NOTE:</b> <ol style="list-style-type: none"> <li>QUANTUM OF CHECK SHALL BE AS BELOW 100 % - BY MANUFACTURER RANDOM FOR EACH TYPE - BY BHEL &amp; CUSTOMER</li> <li>MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.</li> <li>IN CASE OF IMPORTED ITEMS CONTRACTORS SHALL REVIEW TC's AND NOT INSPECT.</li> </ol>							
CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.							

## **SENSOR REDUNDANCY- PHILOSOPHY**




SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME V SECTION : D5.3
Package: EPC	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> <b>INSTRUMENTATION AND CONTROL EQUIPMENT</b> DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SHEET 12 OF 55
<p>7.5 The Contractor shall submit a brief write up on CLCS function for all SG, TG and balance of plant controls along with the bid.</p> <p><b>8.0 OPEN LOOP CONTROL SYSTEM FOR SG &amp; TG AND ITS AUXILIARIES</b></p> <p>8.1 The open loop controls shall be provided as per system requirement.</p> <p>8.2 The open loop control system shall be provided as per the guidelines given under clause 4.0 of this section.</p> <p>8.3 The Contractor shall submit a brief write up on OLCS function for all SG, TG and balance of plant controls along with the bid.</p> <p><b>9.0 REDUNDANCY AND AVAILABILITY REQUIREMENTS</b></p> <p>9.1 Measurement system (MS), Closed Loop Control System (CLCS) and Open Loop Control System (OLCS) shall all be configured with redundancy at processor modules, communication modules, data bus and power supply modules.</p> <p>9.2 Both CLCS &amp; OLCS shall be configured with Redundant I/O channels for each sensor/signals. Where redundant sensors are provided redundant I/O channels shall be provided for each sensors/signals. (For eg. If two sensors are provided for a particular service, then totally 4 input channels are required.). All the outputs from the CLCS and OLCS shall be dual redundant.</p> <p>9.3 Boiler protection system &amp; Turbine Protection system shall be with SIL3 certification for each unit.</p> <p>9.4 Redundant sensors shall be provided for all control applications.</p> <p>9.5 For all important and critical controls (CLCS) triple redundant sensors shall be provided. This will include sensors provided for compensation also. Similarly for critical protection logic requirements triple redundant sensors for 2 out of 3 logic shall be provided to avoid spurious tripping. For all other control application dual redundant sensors shall be provided. Critical closed loop controls are detailed in Clause 12.0 of this section.</p> <p><b>10.0 SENSOR REDUNDANCY- PHILOSOPHY</b></p> <p>10.1 Two out of three measurements philosophy shall be adopted for the control of all critical closed and open loop variables for reliability of operation. The control system shall select the median value for the normal control purpose.</p> <p>10.2 In case of deviation of one transmitter output from the other two, the same shall be automatically isolated and average output of the remaining transmitters shall be fed to the control and measurement system and the control loop in this case shall be</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME V SECTION : D5.3
Package: EPC	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> <b>INSTRUMENTATION AND CONTROL EQUIPMENT</b> DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SHEET 13 OF 55
<p>maintained on auto, with an alarm on the operator's monitor as well as maintenance engineer's monitor. In case of failure of the two remaining transmitters in circuit, deviation of one transmitter output is more than the preset limit compared to the other transmitter, there shall be automatic bump less transfer and changeovers shall have suitable alarms.</p> <p>10.3 For all other control parameters the number of sensors / transmitters shall be two. One out of two selection logic and selection of average value of the two signals shall be followed.</p> <p>10.4 In the event of excessive deviation between two signals control system shall trip to manual and it shall be annunciated to bring operators attention and operator has facility to select any of the transmitters through VDU operation.</p> <p>10.5 In the event of failure of one of the two transmitters, it shall automatically select a healthy transmitter but control system shall remain in auto mode.</p> <p>10.6 Separate transmitters shall be used for measurement avoiding signal tapping from control loop/ control transmitter.</p> <p>10.7 For signal compensations, separate signals from separate transmitters shall be used for measurement and control.</p> <p>10.8 Sensor Redundancy For OLCS</p> <p>10.8.1 All sensors for the following causes of trips shall be triple.</p> <p>(a) Unit trips,</p> <p>(b) Boiler trips,</p> <p>(c) Turbine trips</p> <p>(d) Trip of any auxiliary which will lead to substantial (50%) loss of unit availability.</p> <p>10.8.2 All sensors for the following causes of trips shall be dual (requirement specified at Clause 10.8.1 will have priority of application).</p> <p>(a) All HT equipment trips.</p> <p>(b) All LT equipment trips.</p> <p>10.8.3 Single sensors shall be provided for the following:</p> <p>(a) Alarm</p>		
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SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME V SECTION : D5.3
Package: EPC	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> <b>INSTRUMENTATION AND CONTROL EQUIPMENT</b> DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SHEET 14 OF 55
<p>(b) Permissive</p> <p>(c) Measurement</p> <p>10.9 Sensor Redundancy For CLCS</p> <p><b>11.0 CONTROLS INCLUDED IN DCS</b></p> <p>11.1 Steam Generators (SG) soot blowing controls, Fans, blowers (if applicable) controls for boiler and auxiliaries. All SG closed loop controls like combustion control (fuel flow / air flow), temperature &amp; pressure, air flow, SA/PA pressure, SH/ RH steam temperature, furnace draft, drum level (if applicable) etc..</p> <p>11.2 All turbine analog controls including EHTC for TD BFP(except turbine integral system analog controls)</p> <p>11.3 Co-ordinated Master Control</p> <p>11.4 Regenerative cycle controls like heater drain, deaerator level, deaerator pressure, hotwell level, CEP controls, BFP controls, Hotwell makeup, Vacuum Bkr.vlv gland seal water pressure control.</p> <p>11.5 Balance of plant controls like auxiliary steam, CW &amp; Circulating cooling water system, Emergency cooling water system (if applicable), etc.</p> <p><b>12.0 CRITICAL CONTROL LOOPS</b></p> <p>Following CLCS loops are considered critical, for which triple redundant sensors shall be provided for all involved parameters involved in the loop. Parameters involved will also include parameters used for compensation. For the balance control loops, only dual redundant sensors shall be provided.</p> <p>(a) Furnace draft</p> <p>(b) PA Flow Control,</p> <p>(c) SA Pressure control</p> <p>(d) SA Flow control</p> <p>(e) O2 correction control</p> <p>(f) Steam Temperature Control</p> <p>(g) Turbine Governor control</p>		
		ISSUE R1

SPEC.NO. TCE.5750A-H-500-001	<b>TATA CONSULTING ENGINEERS LIMITED</b>	VOLUME V SECTION : D5.3
Package: EPC	<b>RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 &amp; 8 at Suratgarh, Rajasthan</b> <b>INSTRUMENTATION AND CONTROL EQUIPMENT</b> DESIGN, PERFORMANCE AND FUNCTIONAL REQUIREMENTS	SHEET 53 OF 55
31.9	For all HT drives alarm and trip signals for bearing and winding temperatures shall be considered through soft LVM from temperature element signal only. No temperature transmitters are required for these signals.	
31.10	All Critical control valves shall be provided with anti-cavitation trim. Control valves / dampers shall be supplied with all accessories including non-contact type position transmitters and E/P Positioners. Combination of I/P + Pneumatic positioner is not acceptable. All inching valves shall be supplied with position transmitters integral with the valve positioner.	
31.11	All transmitters shall be SMART type with integral local LCD indication and HART protocol.	
31.12	All Temperature sensors shall be Duplex type and field mounted temperature transmitter shall be provided for all temperature measurement applications. Direct wiring of RTD or T/C to DCS or PLC is not preferred. (Except for Winding and bearing temperature sensors ).	
31.13	Switches (pressure, temperature, level & flow etc.) shall be provided only for critical equipment trip such as BFP/ CEP trip etc. Wherever possible, transmitters shall be provided with required redundancies for all other purposes.	
31.14	Similar make and model shall be provided for same type of I&C system equipment. This shall specifically apply for field transmitters, control valves etc.	
31.15	Smart positioners shall be provided for all control valves/ dampers.	
31.16	Where multiple functions like monitoring /control/alarm etc. are sought to be performed based on a parameter value, in minimum dual sensor shall type be provided.	
31.17	All outdoor field equipment shall be provided with epoxy painting.	
31.18	Individual continuous purging shall be provided for all Air and Flue gas transmitters. The tap points for these services shall be "Y" shaped. The purging line shall be connected near the root valve only and not at the Transmitter end.	
31.19	All local cabinets / utility plant control panels with bottom cable entry shall be provided with suitable pedestals for easy cabling. The panels shall be designed for ease of operation of operating hardware and monitoring the indicators.	
31.20	All local panel indicating lamp/indicating type Push button should be of cluster LED type only. All local panels shall be of double door type instead of double leaf type to avoid ingress of dust in dust prone areas.	
31.21	All motorised bypass valves shall be inching type and shall be provided with position transmitters of non-contact type.	
		ISSUE R1

	<b>TITLE: TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM 2X660 MW SURATGARH STPS STAGE V UNIT # 7&amp; 8</b>	SPEC. NO. PE-TS-392-154-12000A-A001	
		VOLUME III	
		SECTION :	
		REV. NO. 00	DATE:
		SHEET	

### SCHEDULE OF PRE-BID CLARIFICATION

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAU SE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

**SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL****PROJECT:-2X660 MW SURATGARH STPS STAGE V UNIT # 7 & 8****PACKAGE:- OXYGEN DOSING SYSTEM****TENDER ENQUIRY REFERENCE:-****NAME OF VENDOR:-**

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWAL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWAL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWAL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
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**TECHNICAL DEVIATIONS**



**COMMERCIAL DEVIATIONS**


**PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE**

<b>NAME</b>	<b>DESIGNATIONS</b>	<b>SIGN &amp; DATE</b>	

**NOTES:**

- For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
- For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
- All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
- Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
- Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
- Bidder shall furnish price copy of above format along with price bid.
- The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
- Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
- For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
- Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
- All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
- Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
- In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
- In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

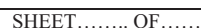
	<b>TITLE</b> <b>TECHNICAL SPECIFICATION FOR</b> <b>OXYGEN DOSING SYSTEM</b> <b>2X660 MW SURATGARH STPS STAGE V</b> <b>UNIT # 7&amp; 8</b>	SPECIFICATION NO. PE-TS-392-154-12000A-A001
		VOL III
		SHEET..... OF.....

### COMPLIANCE CERTIFICATE

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

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.
2. QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.  
QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.  
The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.
3. All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.
4. There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.
5. The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.
6. The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).
7. All sub vendors shall be subject to BHEL/CUSTOMER approval.
8. Any special tools & tackles, if required, shall be in bidder's scope.

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	





**2X660 MW SURATGARH STPS STAGE-V UNIT # 7&8**

**PACKAGE:- OXYGEN DOSING SYSTEM**

**SUGGESTIVE UN-PRICED SCHEDULE**

Sl. No.	DESCRIPTION OF EQUIPMENT / ITEM	QTY.	UNIT PRICE EX- WORKS (DULY PACKED)	TOTAL PRICE EX- WORKS (DULY PACKED)	EXCISE DUTY @ %	SALES TAX @ %	FREIGHT CHARGES	TOTAL PRICE (FOR SITE)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1.0	Total lump sum price on FOR site basis for design, engineering, manufacture, fabrication, assembly, inspection and testing at manufacturer's works, start up and commissioning spares, mandatory spares, supply and dispatch to power station site of skid mounted <b>OXYGEN DOSING SYSTEM</b> alongwith other items including freight, all prevailing taxes, duties and other levies of as required for the total scope defined as per BHEL specification no. <b>PE-TS-392-154-12000A-A001</b> and subsequent clarifications confirmation, correspondences with the bidders till date.							
	<b>NOTES:</b>							
a)	Bidder to note that total price indicated above at <b>1.0</b> shall be considered for evaluation and hence should be complete in all respect for the full scope defined and considering all terms and conditions agreed.							
b)	In case, price indicated above does not match with total of item wise break-up given at <b>2.0</b> , the higher price so calculated shall be considered for evaluation but in case of order, the same shall be placed at the lowest price.							
<b>2.0</b>	<b>MAJOR BREAK-UP OF PRICES GIVEN IN 1.0 ABOVE</b>							
<b>2.1</b>	Total lump sum price on FOR site basis for design, engineering, manufacture, assembly, inspection and testing at manufacturer's works, packing, supply and delivery at site, including freight for <b>OXYGEN DOSING SYSTEM</b> complete with all accessories for the total scope defined as per BHEL specification no. <b>PE-TS-392-154-12000A-A001</b> and subsequent clarifications confirmation, correspondences with the bidders till date.							
<b>2.1.1</b>	Oxygen dosing skid (including eight cylinders mounted on each skid)	4 nos.						
<b>2.1.2</b>	Accessories (as described below)							
<b>2.1.2.a</b>	Injector Assembly	8 nos.						
<b>2.1.2.b</b>	1/2" OD, 18 BWG, SS 316 tubing for oxygen dosing	480 m						
<b>2.1.2.c</b>	SS 316 Tube fittings --tees	20 nos						
<b>2.1.2.d</b>	SS-316 Compression fittings	90 nos						
<b>2.1.2.e</b>	SS 316 Tube fittings --90° elbows	20 nos						
<b>2.1.2.f</b>	Filled oxygen cylinders (Each of 50 lt water volume filled at 204 Kg/cm2 pressure)	52 nos.						

<b>2.1.2.g</b>	<b>Rack to hold 26 filled oxygen cylinders</b>	2 nos.							
<b>2.2</b>	Supply of <b>Commissioning spares/special tools &amp; tackles</b> inclusive of all taxes, duties etc. on "FOR" site basis (as and if deemed necessary by the bidder for commissioning of his skid) (In case quoted, bidder to furnish price break up separately.)								
	<b>Total of 2.1.1, 2.1.2.a, 2.1.2.b, 2.1.2.c, 2.1.2.d, 2.1.2.e, 2.1.2.f, 2.1.2.g and 2.2</b>								
<b>2.3</b>	<b>Mandatory spares as per following</b>								
<b>2.3.1</b>	Complete valves (except solenoid valve) (for each type, range and size)	5 % or minimum 1 No. whichever is higher.							
<b>2.3.2</b>	Pressure reducing cum regulating valve (for each type, range and size)	5 % or minimum 1 No. whichever is higher.							
<b>2.3.3</b>	Pressure regulator (for each type, range and size)	5 % or minimum 1 No. whichever is higher.							
<b>2.3.4</b>	Solenoid valve (for each type, range and size)	10 % or minimum 1 No. whichever is higher for each 660 MW unit.							
<b>2.3.5</b>	Pressure Gauge (for each type, range and size)	10 % or minimum 1 No. whichever is higher for each 660 MW unit.							
<b>2.3.6</b>	Pressure Transmitter(for each type, range and size)	10 % or minimum 1 No. whichever is higher for each 660 MW unit.							
<b>2.3.7</b>	Mass flow controller(for each type, range and size)	10 % or minimum 1 No. whichever is higher for each 660 MW unit.							
<b>2.3.8</b>	Junction box	10 % or minimum 1 No. whichever is higher for each 660 MW unit.							
	<b>Total of 2.3.1 to 2.3.8</b>								