

**1X800 MW Dr. NTPS VIJAYWADA STAGE-V**

**TECHNICAL SPECIFICATION  
FOR  
OXYGEN DOSING SYSTEM**

**SPECIFICATION NO: PE -TS-419-154-12000-A001**



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

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA</b>                          | SECTION I                                  |
|                                                                                   | <b>STAGE-V</b>                                              | SECTION - I A                              |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | REV.NO. 0 DATE : 03/01/2017                |

| SECTION       | DESCRIPTION                                                    | PAGE NO. |
|---------------|----------------------------------------------------------------|----------|
|               | PROJECT INFORMATION                                            | 3        |
| SECTION – I   | SPECIFIC TECHNICAL REQUIREMENTS                                | 8        |
| SECTION – IA  | SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)                   | 9        |
|               | ANNEXURE I : QUALITY PLAN                                      | 17       |
|               | ANNEXURE II :SUB VENDORS LIST                                  | 20       |
|               | ANNEXURE III :DRAWING DOCUMENTS DISTRIBUTION<br>PROCEDURE      | 27       |
|               | ANNEXURE IV :PAINTING SPECIFICATION                            | 29       |
|               | ANNEXURE V :MANDATORY SPARES LIST                              | 42       |
|               | ANNEXURE VI :DRAWING/DOCUMENTS SUBMISSION<br>SCHEDULE          | 44       |
|               | ANNEXURE VII :FORMAT FOR OPERATION AND MAINTENANCE<br>MANUAL   | 47       |
|               | P&ID                                                           | 51       |
|               | DATA SHEET-A                                                   | 54       |
| SECTION – IB  | SPECIFIC TECHNICAL REQUIREMENTS (CONTROL &<br>INSTRUMENTATION) | 56       |
| SECTION – II  | GENERAL TECHNICAL REQUIREMENT                                  | 59       |
| SECTION – IIA | GENERAL TECHNICAL REQUIREMENT (MECHANICAL)                     | 60       |
| SECTION – IIB | GENERAL TECHNICAL REQUIREMENT (CONTROL AND<br>INSTRUMENTATION) | 66       |
| SECTION - III | SCHEDULE OF PRE BID CLARIFICATIONS                             | 82       |
|               | COMPLIANCE CUM CONFIRMATION SCHEDULE                           | 83       |
|               | SCHEDULE OF DECLARATION                                        | 84       |
|               | SCHEDULE OF DEVIATION WITH COST OF WITHDRAWAL                  | 85       |

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTTPS VIJAYWADA<br/>STAGE-V</b>             | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

## PROJECT INFORMATION

## **VOLUME : IIA**

### **SECTION-II**

## **PROJECT SYNOPSIS AND GENERAL INFORMATION**

## CONTENT

| CLAUSE NO. | DESCRIPTION         |
|------------|---------------------|
| 1.00.00    | INTRODUCTION        |
| 2.00.00    | APPROACH TO SITE    |
| 3.00.00    | LAND                |
| 4.00.00    | SOURCE OF COAL      |
| 5.00.00    | SOURCE OF WATER     |
| 6.00.00    | ASH DISPOSAL AREA   |
| 7.00.00    | SALIENT DESIGN DATA |

**VOLUME : IIA**

**SECTION-II**

**PROJECT SYNOPSIS AND GENERAL INFORMATION**

**1.00.00 INTRODUCTION**

The proposed 1x800 MW Dr. Narla Tata Rao Thermal Power Station (VTPS), Stage-V, Unit-8 would be set up by Andhra Pradesh Power Generation Corporation Ltd. (APGENCO) at Ibrahimpattanam, Krishna District, Andhra Pradesh near Vijaywada. The proposed Power Plant will be installed adjacent to the existing 1x500 MW Unit-7 of Dr. Narla Tata Rao Thermal Power Station.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

**2.00.00 APPROACH TO SITE**

Site is located in the existing premises of Dr. Narla Tata Rao Thermal Power Station which is on the left side of river Krishna at a distance of 2 km between Ibrahimpattanam and Kondapalli village in Krishna district. It is 16 km on the north side of Vijaywada city and 285 km from Hyderabad. The nearest railway station is Kondapalli, 3 km away.

**3.00.00 LAND**

85 acres of land is available within the plant boundary for Main plant and auxiliaries and green belt.

230 acres of land required for Ash Dyke will be acquired near the existing ash pond. Land is available for staff colony.

**4.00.00 SOURCE OF COAL**

100% imported coal with a GCV range of 5000 to 6000 kcal/kg and upto 25% moisture will be used for this project.

**5.00.00 SOURCE OF WATER**

Source of water is the existing stage-III CW canal to plant (total quantity of water is about 2192 m<sup>3</sup>/hr).



|                                                                                   |                                                             |                                                                     |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------------------|
|  | TITLE:<br><b>1X800 MW Dr. NTTPS VIJAYWADA<br/>STAGE-V</b>   | SPECIFICATION NO. PE-TS-419-154-12000-<br>A001                      |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION I<br>SECTION - I A<br>REV.NO.      0      DATE : 03/01/2017 |

## SECTION 1

### SPECIFIC TECHNICAL REQUIREMENTS

#### SECTION I A: SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

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

|                                                                                   |                                    |                                            |
|-----------------------------------------------------------------------------------|------------------------------------|--------------------------------------------|
|  | TITLE:                             | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA</b> | SECTION I                                  |
|                                                                                   | <b>STAGE-V</b>                     | SECTION - I A                              |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR</b> | REV.NO. 0 DATE : 03/01/2017                |
|                                                                                   | <b>OXYGEN DOSING SYSTEM</b>        |                                            |

## SECTION 1 A

### SPECIFIC TECHNICAL REQUIREMENTS - MECHANICAL

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

## 1. SCOPE:

This specification is intended to cover design, engineering, manufacturing, fabrication, assembly, supply, inspection / testing at vendor's & sub-vendor's works, painting, mandatory spares, startup and commissioning spares, special tools and tackles (as applicable) , forwarding, proper packing, shipment and delivery at site, preparation and submission of drawing /documents & equipment / system guarantee etc of skid mounted **Oxygen Dosing Systems** for the **1X800 MW Dr. NTPS VIJAYWADA STAGE-V** . Two numbers skid per unit shall be provided for oxygen dosing system (one number for dosing at CPU outlet and one number for dosing at deaerator outlet).

The following drawings/ data sheets are enclosed:

- P&I diagram for Oxygen dosing system (PE-DG-419-154-12000-A001 sheet 1 of 2 & 2 of 2)
- DATA SHEET – A for Oxygen dosing system

## 2. EQUIPMENT FOR OXYGEN DOSING

Two oxygen dosing skids shall be supplied for entire station. Each skid shall be identical unless specifically mentioned otherwise. One skid out of the two skid shall be under operation at a time. Broad scope of work for bidder for this package includes all equipment and accessories. Please also refer C&I sections (section I C) for respective scopes.

- I. Entire Oxygen dosing system mounted on skid (including two bank 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. Start-up and commissioning spares as required.
- III. All flanges & counter flanges to interconnect the pipes.
- IV. Rack one (1) no. to hold 21 Nos. cylinder.
- V. Oxygen cylinders (21 Nos.).
- VI. Injector assemblies (4 nos.).
- VII. Tees (10 nos.) & Elbows (10 nos.).
- VIII. Loose tubing (200 meter).
- IX. Compression fittings (37 nos.) for loose tubing.
- X. Foundation nuts & bolts to fix each skid on the floor, as required.
- XI. Mandatory spares shall be as indicated in indicated in Annexure V.

## 3. SCOPE OF SERVICE

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

- a. Design and engineering.
- b. Fabrication of the skid mounted oxygen dosing system.
- c. Inspection and testing of the skid as per the approved quality assurance plan.
- d. Supply of the skid mounted oxygen dosing system up to the power plant site along with all accessories as defined in the technical specification.
- e. Painting shall be as specified in ANNEXURE IV of specification. Bidder to note that paint shade shall be finalized during detailed engineering as per Customer & BHEL requirement and any variation in the painting schedule as finally approved by Customer shall be taken care by bidder without any commercial and delivery implication.

## 4. TERMINAL POINTS

- i. All field instruments (pressure transmitters), solenoid valves and mass flow controller (MFC) shall be terminated at JB by the oxygen dosing vendor for further connection to DCS by BHEL. 24VDC power supply shall be provided for MFC by BHEL.

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTTPS VIJAYWADA<br/>STAGE-V</b>             | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

- ii. 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.
- iii. 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.
- iv. 24 VDC connection to **SV-3, SV-4, SV-5** for Dearator O/L & SV-3 for CPU discharge shall be directly connected by BHEL.

## 5. QUALITY PLAN AND SUB VENDOR APPROVAL

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

## 6. DRAWINGS/DOCUMENTATION REQUIREMENT ALONG WITH BID

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

- a. Deviation if any in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed)
- b. Compliance cum confirmation schedule.(Stamped & Signed)
- c. Schedule of Declaration. (Stamped & Signed)
- d. Un Price Schedule duly filled in. (Stamped & Signed).

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

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

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

For the Drawings/Documents distribution procedure, please refer **Annexure-III**.

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

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTTPS VIJAYWADA<br/>STAGE-V</b>             | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

## 8. SPARES

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

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

### 12.1 MANDATORY SPARES

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

### 12.2 START-UP AND 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.

### 12.3 MAINTENANCE TOOLS AND TACKLES

- One set of all special tools shall be furnished and shipped with each piece of equipment for dismantling, maintenance, adjustment, and calibration of the equipment. The tools shall be shipped in separate heavily constructed wooden boxes provided with hinged covers and padlock hasps.
- The Contractor shall supply under this contract all maintenance tools for each piece of equipment / system and it shall be boxed separately and the boxes shall be appropriately marked for shipment and identification of contents.

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

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

**The vendor warrants:**

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

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTTPS VIJAYWADA<br/>STAGE-V</b>             | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

and procurement policy of the BHEL and the customer prevalent at the time of such purchases and BHEL & the customer at his option may include a representative from the vendor in finalizing the purchases.

5. It is expressly understood that the final settlement between the parties in terms of relevant clauses of the tender document shall not relieve the vendor of any of his obligations under the provision of long term availability of spares and such provisions shall continue to be enforced till the expiry of 30 (thirty) years period reckoned from the scheduled date of completion of trial operation of the last equipment unless otherwise discharged expressly in writing by the BHEL or the Customer.

#### 9. PACKING:

To prevent damage to any equipment/ item of the skid during transit, wooden/ angle iron/ steel frame supports to be provided wherever required. Special attention shall be provided while packing and loading for overhead equipment. Bidder shall submit the packing details during detailed engineering for approval. Any changes required in packing details shall be complied by the bidder without any price and delivery implication.

#### 10. DESIGN REQUIREMENTS

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

- a. In addition to the requirements of Section-I & II the following shall also be complied under scope of this specification: The P&ID is enclosed herein in this section for bidder's compliance.
- b. The material of construction specified in Data Sheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subjects to customer approval during detailed engineering.
- c. All instrument-wetted parts will be suitable for requested application.
- d. All valves and instruments will be located such that they are easily accessible during normal operation and maintenance.
- e. All the terminal points shall be easily accessible and towards one side of skid.
- f. All equipment shall have name plate clearly indicating the equipment name.
- g. Tube fittings of the system shall be done using elbows and tees. Pipe bending is not acceptable.
- h. KKS codes for all drives and instruments for the project have to be followed.
- i. All JB's shall be mounted in their respective dosing skids only.
- j. MFC shall also be mounted in an enclosure. Material of construction of enclosure shall be identical to MOC of junction box. DOP of enclosure shall be IP-55 minimum. Other tech. requirements of this enclosure shall be in line with JB details indicated elsewhere in the specification.
- k. All cylinders supplied should conform to "Gas Cylinder Rules, 2004" and CCE license for the same shall be arranged by the bidder.
- l. All the equipment, instruments, valves and tubing etc. coming in contact directly with oxygen shall be oxygen cleaned and certified to be fit for use in oxygen application.

#### 16.0 MISCELLANEOUS REQUIREMENTS

- a. All special tools necessary for proper maintenance or adjustment of the equipment packaged in permanent box.
- b. Finish paints for touch-up painting of equipment after erection at site in sealed container.
- c. Document approval by Customer/BHEL under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval.

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

- d. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to Customer and BHEL for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- e. In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at Customer/BHEL end, delay in review/ approval of drawing beyond one month will be to Customer/BHEL account.
- f. Bidder to submit BBU during detailed engineering after approval of Basic documents. BBU shall be equal to BOQ for the package and there shall be no price and delivery implication is applicable to BHEL / CUSTOMER for the same. None of the items supplied for the project as non-billable. Incomplete BBU shall not be review by BHEL.
- g. Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.
- h. Relevant requirements as per GTR, GCC, ECC & SCC. Any statutory requirement / clearance required for the packages from government / local body shall be in bidder's scope.
- i. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- j. Vendor to attend regular engineering meeting with BHEL and Customer fortnightly in BHEL or Customer office as decided during detail engineering. Vendor will depute his entire concerned engineering representatives along with the project manager for discussion and approval. Meeting can be held at site also.
- k. Latest version of all codes and standards to be followed.
- l. For detailed dispatch instructions, Bidder to refer special condition of contract (SCC) of the project.

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

## ANNEXURES

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

|                                                                                   |                                    |                                            |
|-----------------------------------------------------------------------------------|------------------------------------|--------------------------------------------|
|  | TITLE:                             | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA</b> | SECTION I                                  |
|                                                                                   | <b>STAGE-V</b>                     | SECTION - I A                              |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR</b> | REV.NO. 0 DATE : 03/01/2017                |
|                                                                                   | <b>OXYGEN DOSING SYSTEM</b>        |                                            |

# **ANNEXURE I:** **QUALITY PLAN**

|                                                                                                                                                                                                                   |                                                           |                                                                                                                                                                                |          |                                                                                                                     |                    |                                               |                                                               |                                                                    |    |                                                                                                                   |   |             |         |                     |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------------------------------|---------------------------------------------------------------|--------------------------------------------------------------------|----|-------------------------------------------------------------------------------------------------------------------|---|-------------|---------|---------------------|--|
|                                                                                                                                                                                                                   |                                                           | MANUFACTURER'S<br>NAME & ADDRESS :                                                                                                                                             |          | MANUFACTURING QUALITY PLAN                                                                                          |                    |                                               |                                                               | PROJECT<br>PACKAGE<br>CONTRACT NO.<br>MAIN SUPPLIER<br>BHEL QP. NO |    | :1X800 MW Dr. NTPS VIJAYWADA STAGE-V<br>: OXYGEN DOSING SYSTEM<br>: BHEL/PEM/NOIDA<br>: PE-V0-419-154-12000A-A004 |   |             |         |                     |  |
|                                                                                                                                                                                                                   |                                                           |                                                                                                                                                                                |          | ITEM:<br>OXYGEN DOSING SYSTEM<br>SUB - SYSTEM :<br>DEAERATOR & CEP DISCHARGE DOSING<br>SYSTEM                       |                    | QP. NO :<br>REV. :<br>DATE :<br>PAGE :        |                                                               |                                                                    |    |                                                                                                                   |   |             |         | 1<br><br><br>1 OF 2 |  |
|                                                                                                                                                                                                                   |                                                           |                                                                                                                                                                                |          |                                                                                                                     |                    |                                               |                                                               |                                                                    |    |                                                                                                                   |   |             |         |                     |  |
| S.NO.                                                                                                                                                                                                             | COMPONENTS/ OPERATION                                     | CHARACTERISTICS CHECKED                                                                                                                                                        | CATEGORY | TYPE/ METHOD CHECK                                                                                                  | EXTENT OF<br>CHECK | REFERENCE DOCUMENT                            | ACCEPTANCE NORMS                                              | FORMAT OF RECORDS                                                  | D* | AGENCY**                                                                                                          |   |             | REMARKS |                     |  |
|                                                                                                                                                                                                                   |                                                           |                                                                                                                                                                                |          |                                                                                                                     |                    |                                               |                                                               |                                                                    |    | M                                                                                                                 | C | N           |         |                     |  |
| 1                                                                                                                                                                                                                 | 2                                                         | 3                                                                                                                                                                              | 4        | 5                                                                                                                   | 6                  | 7                                             | 8                                                             | 9                                                                  |    | 10                                                                                                                |   |             | 11      |                     |  |
| 1.0                                                                                                                                                                                                               | WELDER'S QUALIFICATION                                    |                                                                                                                                                                                |          |                                                                                                                     |                    |                                               |                                                               |                                                                    |    |                                                                                                                   |   |             |         |                     |  |
| 1.1                                                                                                                                                                                                               | WELDING PROCEDURE<br>SPECIFICATION (WPS)                  | CORRECTNESS                                                                                                                                                                    | MA       | SCRUTINY                                                                                                            | 100%               | ASME IX                                       | ASME IX                                                       | QW 482                                                             |    | P                                                                                                                 | V | V           |         |                     |  |
| 1.2                                                                                                                                                                                                               | WELDER PERFORMANCE &<br>PROCEDURE QUALIFICATION<br>RECORD | WELD SOUNDNESS & WELDING<br>PERFORMANCE                                                                                                                                        | MA       | PHYSICAL TEST                                                                                                       | 100%               | ASME IX                                       | ASME IX                                                       | QW 483 & QW 484                                                    |    | P                                                                                                                 | V | V           |         |                     |  |
| 2                                                                                                                                                                                                                 | EMPTY OXYGEN CYLINDER                                     | MTC, HYDRO TEST & RELEVANT<br>TESTS AS PER IS 7285                                                                                                                             | MA       | IS 7285                                                                                                             | 100%               | APPROVED DATASHEET                            | AS PER APPROVED<br>DATASHEET                                  | MFRS<br>CERTIFICATE                                                |    | P                                                                                                                 | V | V           |         |                     |  |
| 3                                                                                                                                                                                                                 | VALVES (BODY & BONNET)                                    | MATERIAL                                                                                                                                                                       | MA       | --                                                                                                                  | 100%               | APPROVED DATASHEET                            | AS PER MODEL<br>DECODIFICATION MENTIONED<br>IN MFRS CATALOGUE | MANUFACTURERS COC                                                  |    | P                                                                                                                 | V | V           |         |                     |  |
| 4                                                                                                                                                                                                                 | INSTRUMENTS                                               |                                                                                                                                                                                |          |                                                                                                                     |                    |                                               |                                                               |                                                                    |    |                                                                                                                   |   |             |         |                     |  |
| 4.A                                                                                                                                                                                                               | PRESSURE GAUGE                                            | MOC FOR WETTED PARTS,<br>CALIBRATION & BOURDON OVER<br>PRESSURE PROTECTION & TYPE<br>TEST CERTIFICATE                                                                          | MA       | MEASUREMENT                                                                                                         | 1/TYPE             | APPROVED DATASHEET                            | AS PER APPROVED<br>DATASHEET                                  | MFRS<br>CERTIFICATE                                                |    | P                                                                                                                 | V | V           |         |                     |  |
| 4.B                                                                                                                                                                                                               | PRESSURE TRANSMITTER                                      | CALIBRATION, OVER LOAD<br>PROTECTION & TYPE TEST<br>CERTIFICATE                                                                                                                | MA       | MEASUREMENT                                                                                                         | 100%               | APPROVED DATASHEET                            | AS PER APPROVED<br>DATASHEET                                  | MANUFACTURERS COC                                                  |    | P                                                                                                                 | V | V           |         |                     |  |
| 5                                                                                                                                                                                                                 | SOLENOID VALVES                                           | MATERIAL                                                                                                                                                                       | MA       | VISUAL                                                                                                              | 100%               | APPROVED DATASHEET                            | AS PER MODEL<br>DECODIFICATION MENTIONED<br>IN MFRS CATALOGUE | MANUFACTURERS COC                                                  |    | P                                                                                                                 | V | V           |         |                     |  |
| 6                                                                                                                                                                                                                 | CYLINDER PRESSURE<br>REGULATOR                            | MATERIAL                                                                                                                                                                       | MA       | VISUAL                                                                                                              | 100%               | APPROVED DATASHEET                            | AS PER MANUFACTURERS<br>CATALOGUE                             | MANUFACTURERS COC                                                  |    | P                                                                                                                 | V | V           |         |                     |  |
| 7                                                                                                                                                                                                                 | TERMINATION BOX                                           | COUNTUNITY,IR-HV-IR & DEGREE<br>OF PROTECTION                                                                                                                                  | MA       | ELECTRICAL                                                                                                          | 100%               | APPROVED DATASHEET                            | AS PER APPROVED<br>DATASHEET                                  | MFRS COC &<br>INSPECTION REPORT                                    |    | P                                                                                                                 | V | V           |         |                     |  |
| 8                                                                                                                                                                                                                 | TUBING                                                    | CHEMICAL & PHYSICAL                                                                                                                                                            | MA       | CHEMICAL & PHYSICAL<br>TEST                                                                                         | 100%               | APPROVED DRAWING<br>DATASHEET                 | APPROVED DRAWING<br>DATASHEET                                 | LAB REPORT                                                         |    | P                                                                                                                 | V | V           |         |                     |  |
| 9                                                                                                                                                                                                                 | MASS FLOW CONTROLLER                                      | CALIBRATION REPORT                                                                                                                                                             | MA       | ELECTRICAL                                                                                                          | 100%               | APPROVED DRAWING &<br>DATASHEET               | APPROVED DRAWING &<br>DATASHEET                               | CALIBRATION REPORT                                                 |    | P                                                                                                                 | V | V           |         |                     |  |
| 10                                                                                                                                                                                                                | FITTING                                                   | MATERIAL                                                                                                                                                                       | MA       | VISUAL                                                                                                              | 100%               | APPROVED DRAWING                              | AS PER MODEL<br>DECODIFICATION MENTIONED<br>IN MFRS CATALOGUE | MANUFACTURERS COC                                                  |    | P                                                                                                                 | V | V           |         |                     |  |
| 11                                                                                                                                                                                                                | FINAL ASSAMBLY                                            | DIMENSION, ORIENTATION &<br>COMPLETENESS.                                                                                                                                      | MA       | MEASUREMENT                                                                                                         | 100%               | APPROVED DRAWING                              | APPROVED DRAWING                                              | INSPECTION                                                         |    | P                                                                                                                 | W | W           |         |                     |  |
|                                                                                                                                                                                                                   | FAT                                                       | LEAKAGE                                                                                                                                                                        |          | N2 FILL FOR 2HR                                                                                                     | 100%               | APPROVED DRAWING /<br>FACTORY ACCEPTANCE TEST | NO LEAKAGE                                                    | INSPECTION                                                         |    | P                                                                                                                 | W | W           |         |                     |  |
|                                                                                                                                                                                                                   |                                                           |                                                                                                                                                                                |          |                                                                                                                     |                    |                                               |                                                               | REPORT                                                             |    |                                                                                                                   |   |             |         |                     |  |
| 12                                                                                                                                                                                                                | POWDER COATING STAMPING                                   | DFT MEASUREMENT                                                                                                                                                                | MI       | VISUAL                                                                                                              | 100%               | APPROVED PAINTING SCHEME                      |                                                               |                                                                    |    | P                                                                                                                 | W | V           |         |                     |  |
| NOTES: ALL INSTRUMENTS/VALVES ETC. SHALL BE OXYGEN CLEANED AND SUITABLE FOR OXYGEN SERVICE. MANUFACTURERS COC CERTIFYING THE SAME REGARDING OXYGEN CLEANED SHALL BE SUBMITTED FOR REVIEW DURING FINAL INSPECTION. |                                                           |                                                                                                                                                                                |          |                                                                                                                     |                    |                                               |                                                               |                                                                    |    |                                                                                                                   |   |             |         |                     |  |
|                                                                                                                                                                                                                   |                                                           | LEGEND :<br>* RECORDS IDENTIFIED WITH "TICKS" SHALL BE ESSENTIALLY<br>INCLUDED BY CONTACTION IN QA DOCUMENTATION.<br>** M : MANUFACTURER/SUB-CONTRACTOR<br>C : BHEL, N:TSGENCO |          |                                                                                                                     |                    |                                               |                                                               | DOC NO.                                                            |    | REV :                                                                                                             |   | CAT :       |         |                     |  |
| MANUFACTURER/<br>SUB SUPPLIER                                                                                                                                                                                     |                                                           | MAIN SUPPLIER                                                                                                                                                                  |          | INDICATE "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION AS APPROPRIATE,<br>"CHP" SHALL BE IDENTIFIED IN COLUMN "N". |                    |                                               |                                                               | FOR CUSTOMER USE                                                   |    |                                                                                                                   |   |             |         |                     |  |
| SIGNATURE                                                                                                                                                                                                         |                                                           |                                                                                                                                                                                |          |                                                                                                                     |                    |                                               |                                                               |                                                                    |    | REVIEWED BY                                                                                                       |   | APPROVED BY |         | APPROVAL SEAL       |  |

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTTPS VIJAYWADA<br/>STAGE-V</b>             | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

| <b>TEST PROCEDURE FOR OXYGEN DOSING SYSTEM</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                              |                                    |                        |            |             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------|------------------------|------------|-------------|
| JOB NO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                              | EQUIPMENT                          | : OXYGEN DOSING SYSTEM |            |             |
| PROJECT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1X800 MW APPDCL<br>KRISHNAPATNAM<br>STAGE-II | PAGE                               | : 02 of 02             |            |             |
| <p style="text-align: center;"><b><u>TEST PROCEDURE FOR OXYGEN DOSING SYSTEM</u></b></p> <ul style="list-style-type: none"> <li>A Factory Acceptance Testing will be conducted at vendor's Factory. This will be for verification of the functional performance of critical equipment/instruments and hardware design when run at design pressure, temperature and flow.</li> <li>FAT will be carried out using <b>only the inert gas</b> such as <b>Nitrogen</b>. Following will be the FAT protocol.</li> <li>Checking the completeness of the system. This will include visual inspection of equipment and instruments as per the P &amp; ID s &amp; GA along with skid after assembling on skid.</li> <li>Soap joint leak test of tubing/fittings/valves using nitrogen at 1.25 times of maximum operating pressure (<b>ANSI B31.8</b>), for 2 hours. The allowable pressure drop would be up to 0.5 bar over 2 hours.</li> <li>Functional testing of calibrated components (equipments/ instruments) using nitrogen. The test controller will be connected to Mass flow controller. The set point will be given from test controller &amp; this will be monitored.</li> <li>Testing of Assembly of skid , instruments , termination box will be done by BHEL as per approved Quality Assurance Plan.</li> <li>Inert test run using nitrogen to demonstrate flow.</li> <li>Final Assembly &amp; Factory Acceptance Test will be witnessed by BHEL &amp; CUSTOMER</li> </ul> |                                              |                                    |                        |            |             |
| SUBMITTED TO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                              | : BHEL/PEM/NOIDA                   |                        |            |             |
| SUPPLIED BY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                              | :                                  |                        |            |             |
| CLIENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                              | : BHARAT HEAVY ELECTRICALS LIMITED |                        |            |             |
| 00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                              | Items for approval                 |                        |            |             |
| REV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | DATE                                         | DESCRIPTION                        | PREPARED BY            | CHECKED BY | APPROVED BY |

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTTPS VIJAYWADA<br/>STAGE-V</b>             | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0      DATE : 03/01/2017           |

## ANNEXURE II :

### SUB VENDORS LIST

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTTPS VIJAYWADA<br/>STAGE-V</b>             | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0      DATE : 03/01/2017           |

## SUB VENDOR LIST - MECHANICAL

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA</b>                          | SECTION I                                  |
|                                                                                   | <b>STAGE-V</b>                                              | SECTION - I A                              |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | REV.NO. 0 DATE : 03/01/2017                |

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

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

|     |                      |                            |  |  |
|-----|----------------------|----------------------------|--|--|
|     |                      | BERGER PAINTS INDIA LTD    |  |  |
|     |                      | GOODLASS NEROLAC           |  |  |
|     |                      | JENSON & NICHOLSON (I) LTD |  |  |
|     |                      | CDC CARBOLINE (I) LTD.     |  |  |
|     |                      | SHALIMAR PAINTS LTD.       |  |  |
|     |                      | ADDISON PAINTS LTD         |  |  |
|     |                      | GRAND POLYCOAT             |  |  |
|     |                      | BOMBAY PAINTS              |  |  |
|     |                      | HEMPLE PAINTS (SINGAPORE)  |  |  |
|     |                      | JOTUN PAINTS               |  |  |
|     |                      | SAIL                       |  |  |
| 11. | STRUCTURE STEEL      | TISCO                      |  |  |
|     |                      | JINDAL                     |  |  |
|     |                      | BHUSWAL                    |  |  |
|     |                      |                            |  |  |
| 12  | MASS FLOW CONTROLLER | BROOK'S (EMERSON)          |  |  |

**NOTE:**

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.
2. DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.
3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0      DATE : 03/01/2017           |

## SUB VENDOR LIST C&I

| C&I VENDOR LIST                        |                                         |                                                                                                                                                                                                                                                                                                    |
|----------------------------------------|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package Name                           | Supplier Name                           | Supplier Works Address                                                                                                                                                                                                                                                                             |
| PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE | BOSE PANDA INSTRUMENTS PVT.LTD.         | Works-1->Mr. Partha Bose 44, Saheed Hemanta Kumar Bose,Sarani, -Kolkata-WEST BENGAL India Phone- +91 33 2548 7220 FAX : +91 33 2548 0429, Pincode : 700074 Email : <a href="mailto:parthahosebni@gmail.com">parthahosebni@gmail.com</a> <a href="mailto:hosenanda@vsnl.net">hosenanda@vsnl.net</a> |
| PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE | A.N. INSTRUMENTS PVT. LTD.              | Works-1->Mr. Gautam Mukherjee Kusumba,Sonarpur Station Road,P.O. - Narendrapur, -Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email : <a href="mailto:gkm_ani@hotmail.com">gkm_ani@hotmail.com</a>                                                              |
| PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE | PRECISION MASS PRODUCTS PVT. LTD.       | Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : <a href="mailto:hitesh.parmar@ashcroftindia.com">hitesh.parmar@ashcroftindia.com</a>                                        |
| PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE | Baumer Technologies India Pvt. Ltd.     | Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : <a href="mailto:nhaiaj@haumer.com">nhaiaj@haumer.com</a>                                                                      |
| PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE | H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD | Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb,Yeshwanthpur -BANGALORE-KARNATAKA INDIA Phone- 080-23370300 FAX : 080-23379890 Pincode : 560022 Email : <a href="mailto:shikhahazra@hgurusouth.com">shikhahazra@hgurusouth.com</a>                                                      |
| PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE | FORBES MARSHALL (HYD) LTD.              | Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2,I.DA. NACHARAM , -HYDERABAD-TELANGANA INDIA Phone- 09866550762 FAX : 040 27152193 Pincode : 560076 Email : <a href="mailto:gshrinivasan@forbesmarshall.com">gshrinivasan@forbesmarshall.com</a>                                    |
| PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE | H.GURU INDUSTRIES                       | Works-1->NA NA -- Phone- FAX : Pincode : Email :                                                                                                                                                                                                                                                   |
| PRESSURE GAUGE/<br>DIFF.PRESSURE GAUGE | GAUGE BOURDON INDIA PVT. LTD.           | Works-1->Gauge Bourdon India Pvt. Ltd., Plot No 4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA India Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : <a href="mailto:info@general-gauges.com">info@general-gauges.com</a>                 |
| TRANSMITTERS                           | Moore Industries International Inc.     | Works-1->Matt Moren/Gina Cruz 16650 Schoenborn St., North Hills -CALIFORNIA- USA Phone- +1 818 894 7111, ext FAX : +1 818 830 5588 Pincode : 91343 Email : <a href="mailto:gcruz@miinet.com">gcruz@miinet.com</a>                                                                                  |
| TRANSMITTERS                           | TOSHNIWAL INDUSTRIES PVT. LTD.,         | Works-1-> Khasra No.: 218-230& 235, Industrial Estate,Makhupura, -Ajmer-RAJASTHAN India Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : <a href="mailto:rajeev.gupta@tipl.com">rajeev.gupta@tipl.com</a>                                                                          |
| TRANSMITTERS                           | Endress + Hauser (India) Pvt. Ltd.,     | Works-1-> M-171 to 173, MIDC, Waluj, -Aurangabad-MAHARASHTRA India Phone- 9881000474, FAX : 0240-2555179, Pincode : 431136, Email : <a href="mailto:Narendra.Kulkarni@wetzler_endress.com">Narendra.Kulkarni@wetzler_endress.com</a>                                                               |

**THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-419-154-12000-A001**

|              |                                             |                                                                                                                                                                                                                                                                   |
|--------------|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TRANSMITTERS | PANAM ENGINEERS                             | Works-1->Mr. Santosh Shukla Others R-628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai- MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : <a href="mailto:sales@panamengineers.com">sales@panamengineers.com</a>                |
| TRANSMITTERS | V. AUTOMAT & INSTRUMENTS (P) LTD.           | Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : <a href="mailto:production@vautomat.com">production@vautomat.com</a>                  |
| TRANSMITTERS | ABB LIMITED                                 |                                                                                                                                                                                                                                                                   |
| TRANSMITTERS | Pune Techtrol Pvt. Ltd.                     |                                                                                                                                                                                                                                                                   |
| TRANSMITTERS | YOKOGAWA INDIA LIMITED,                     | Works-1-> PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, -BANGALORE- KARNATAKA INDIA Phone- 080-41586000, FAX : 080-28521442, Pincode : Email : <a href="mailto:udav.shankar@in.yokogawa.com">udav.shankar@in.yokogawa.com</a>                                 |
| TRANSMITTERS | SBEM PVT. LTD.                              | Works-1->MR. MOHAN PADWAL 691/A/2,BIBWEWADI INDL ESTATE -PUNE- MAHARASHTRA INDIA Phone- 918600042374 FAX : 912024215670 Pincode : 411037 Email : <a href="mailto:wm@sbem.co.in">wm@sbem.co.in</a>                                                                 |
| TRANSMITTERS | Honeywell Automation India Limited          | Works-1->Mr.Kedar Tillu 53, 54, 56 & 57,Hadapsar Industrial Estate -PUNE- MAHARASHTRA INDIA Phone- 9665034625 FAX : 020 66039905 Pincode : 411013 Email : <a href="mailto:kedartillu@honeywell.com">kedartillu@honeywell.com</a>                                  |
| TRANSMITTERS | SIEMENS LIMITED                             | Works-1->Ankit Varshney Kalwa Works, Thane- Belapur Road, Thane, -MUMBAI-MAHARASHTRA INDIA Phone- FAX : Pincode : 400708 Email :                                                                                                                                  |
| TRANSMITTERS | EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD. | Works-1->Kalpesh Chandan/Hrishikesh Aghor Plot No. A 145/4 TTC IND AREA,MIDC, PAWANE, - NAVI MUMBAI-MAHARASHTRA INDIA Phone- 9619688001 FAX : 022-66736000 Pincode : 400 705 Email : <a href="mailto:Kalpesh.chandan@emerson.com">Kalpesh.chandan@emerson.com</a> |
| TRANSMITTERS | NIVO CONTROLS PVT. LTD.                     | Works-1->Mr. Praveen Toshniwal 104-115, Electronic Complex, -Indore-MADHYA PRADESH India Phone- 0731-4081305 FAX : 0731-255075 Pincode : 452010 Email : <a href="mailto:sales@nivocontrols.com">sales@nivocontrols.com</a>                                        |
| TRANSMITTERS | SMART INSTRUMENTS LTD, BRAZIL               |                                                                                                                                                                                                                                                                   |

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0      DATE : 03/01/2017           |

### ANNEXURE III:

### DRAWING DOCUMENTS DISTRIBUTION PROCEDURE

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

## DRAWING DOCUMENTS DISTRIBUTION SCHEDULE

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

### Note:

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

|                                                                                   |                                    |                                            |
|-----------------------------------------------------------------------------------|------------------------------------|--------------------------------------------|
|  | TITLE:                             | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA</b> | SECTION I                                  |
|                                                                                   | <b>STAGE-V</b>                     | SECTION - I A                              |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR</b> | REV.NO. 0 DATE : 03/01/2017                |
|                                                                                   | <b>OXYGEN DOSING SYSTEM</b>        |                                            |

## ANNEXURE IV :

### PAINTING SPECIFICATION

**SECTION-XIII**  
**TECHNICAL SPECIFICATION**  
**FOR**  
**PROTECTIVE LINING AND PAINTING**

**1.00.00 INTENT OF SPECIFICATION**

1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Package.

1.02.00 The Bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

**2.00.00 CODES & STANDARDS**

2.01.00 The Bidder shall follow relevant Indian and International Standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).

- a) SSPC SP 10 / NACE 2 / : Near White Blast Cleaning
- b) SSPC PA 2 : Measurement of dry film Coating Thickness with magnetic gauges.
- c) ASTM D 4541 : Method for pull off strength using portable Adhesion Tester.
- d) NACE RP 0274 – 2004 : High-Voltage Electrical Inspection of Pipeline Coatings
- e) NACE SP 0188 – 2006 : Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

- f) NACE RP 0169 – 2002 : Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- g) AWWA C 210 – 2007 : Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
- h) IS 3589:2001 Annexure B : Steel Pipes for Water and Sewage Specification.
- i) AWWA C222-2000 : Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings.
- j) IS 13213 : 2000 : Polyurethane Full Gloss Enamel (Two pack)

### **3.00.00 GENERAL REQUIREMENTS**

- 3.01.00** The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.
- 3.02.00** The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.
- 3.03.00** The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.
- 3.04.00** The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.
- 3.05.00** Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

- 3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.
- 3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.
- 3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.
- 3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.
- 3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.
- 3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.
- 3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti corrosive painting.
- 3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.
- 3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.
- 3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).
- 3.16.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.

3.17.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.

3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.

3.19.00 All insulated piping shall have aluminium sheet jacketing.

#### **4.00.00 EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER**

**4.01.00** After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.

All factory finished paints shall be touched up at site as required.

All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.

#### **4.02.00 Surface Preparation**

4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting to Sa 2-1/2 Swiss Standard before applying the primer.

4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.

4.02.03 The minimum degree of surface preparations for all equipment, piping, fittings, valves, structures etc. shall be "Near White" according to Steel Structure, Painting Council-SSPC-SP-10 before application of any primer/paint.

#### **4.03.00 Painting**

- 4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc. to be installed indoor shall be as follows :
- a) Surface preparation shall be done either manually or by any other approved method.
  - b) Primer Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based zinc phosphate.
  - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based paint pigmented with Titanium Dioxide.
  - d) Top Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber paint of approved shade and colour with glossy finish.
  - e) Total DFT of paint system shall not be less than 150 microns.
- 4.03.02 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc to be installed **outdoor** shall be as follows :
- a) Surface preparation shall be done by means of sand blasting, which shall conform to Sa 2-1/2 Swiss Standard.
  - b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.
  - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.
  - d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.
  - e) Total DFT of paint system shall not be less than 300 microns.
- 4.03.03 Specification for application of paints for external surfaces protection of steel pipes and fittings which are **buried underground / laid inside a huge pipe & or submerged Under Water and laid under Pipe Trenches** (in road/rail/pipe or trench crossings) shall be as follows :

External surface of the pipe, fittings, specialties etc. handling raw water/clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 2000 micron including primer coat.

- 4.03.04 Specification for application of paints for **internal surface protection of large diameter pipes** (sizes above 600 mm NB and above) if any, shall be as follows :
- a) All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.
  - b) Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.
  - c) The minimum dry film thickness (DFT) of internal lining shall be 600 micron.
- 4.03.05 Specification for application of paints for protection of **internal surfaces of DM Water Storage Tank(s)** shall be as follows :
- a) Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.
  - b) Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.
  - c) Total thickness of primer and paint should not be less than 500 microns.
- 4.03.06 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.
- 4.03.07 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.
- 4.03.08 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

4.03.09 All machined surfaces shall have two (2) coats of water repellant grease after thorough cleaning.

## **5.00.00 COATING PROCEDURE AND APPLICATION**

5.01.00 Surface Preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 / NACE 2 / Sa2½ of ISO 8501 (near white metal)

- a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.
- b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 Application of Epoxy Coating

- a) Coating shall be applied when
  - i) When the pipe surface temperature shall be atleast 3°C above dew point temperature.
  - ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater than 50°C.
- b) Material preparation shall be in accordance with manufacturer's recommendations.
- c) Application of epoxy coating system :

The epoxy coating system shall be applied as per recommendation of the manufacturer and shall be applied by airless spray / plural component spray machine. For more than one coat, the second shall be applied with the time limits as recommended by the manufacturer.

5.03.00 Application of PU Coating

- a) PU coating shall be applied when the pipe surface temperature atleast 3°C above dew point temperature (when R.H is more than 85%).
- b) Material preparation and application shall be done as per manufacturer recommendation.

**6.00.00 TEST REQUIREMENTS :**

**6.01.00 Measurement of dry film thickness**

Measurement of dry film thickness of coating : Coating thickness shall be in the range of  $\pm 20\%$  and as per SSPC PA 2.

**6.01.01 Apparatus / Instrument:-**

The instrument used for dry film thickness may be Type 1 pull of gauges or Type 2 electronic gauges.

**6.01.02 Procedures:-**

- a) Number of measurements:  
For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).
- b) If the structure is less than 300 square feet, each 100 square feet should be measured.
- c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.
- d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet
- e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness.  
Area measurement must be within specified range.

**6.02.00 Electrical Inspection (Holiday) Test**

- 6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.
- 6.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.
- 6.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.
- The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)
- Testing Voltage  $V = 7900 \sqrt{T} \pm 10$  percent where T is the average coating thickness in mm.
- 6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.
- 6.03.00 Adhesion Pull off Test :**
- After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.
- 6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:
- A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling "Jaw" at the bottom and also dollies.
- 6.03.02 Prepare the test surface :
- Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.
- 6.03.03 Prepare Dolly (Test Pull Stub) :

The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.

6.03.04 Select an adhesive:

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

6.03.05 Attach the dolly to the surface.

- a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.
- b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.
- c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.
- d) Push the dolly inward against the surface, then apply tape across the head of the dolly.

6.03.06 Adhesion Test Procedure

- a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.
- b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.
- c) Slide the dragging indicator pin on the black column to zero by pushing it downward.
- d) Firmly hold the base of the instrument in one hand and rotate the handwheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm<sup>2</sup> required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm<sup>2</sup> of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.

e) Read the scale and record the adhesion value.

#### **6.04.00 Coating Repair**

Defective Coating shall be repaired in accordance with the following subsections.

##### **6.04.01 Surface Preparation:**

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

6.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

##### **6.04.03 Coating Application :**

The coating system shall be applied to the prepared areas in accordance with procedure.

##### **6.04.04 Repair Inspection :**

Repaired portion shall be electrically inspected using a holiday detector.

#### **6.05.00 Welded Field Joints**

##### **6.05.01 Preparation :**

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid Epoxy / PU coating shall be feathered by abrading the coating surface for a distance of 25 mm.

##### **6.05.02 Electrical Inspection :**

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.

**7.00.00 INFORMATION/DATA REQUIRED**

The Bidder shall submit complete list of paints and primers proposed, giving detail information, such as, chemical composition, drying time etc. and also unit rates for application of each type of paint along with supply shall be furnished.

|                                                                                   |                                    |                                            |
|-----------------------------------------------------------------------------------|------------------------------------|--------------------------------------------|
|  | TITLE:                             | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA</b> | SECTION I                                  |
|                                                                                   | <b>STAGE-V</b>                     | SECTION - I A                              |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR</b> | REV.NO. 0 DATE : 03/01/2017                |
|                                                                                   | <b>OXYGEN DOSING SYSTEM</b>        |                                            |

**ANNEXURE V :**

**MANDATORY SPARES LIST**

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTTPS VIJAYWADA<br/>STAGE-V</b>             | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

| S.No. | Equipment/Package Name | Quantity                                                                                                 |
|-------|------------------------|----------------------------------------------------------------------------------------------------------|
| 1.0   | Complete Set of Valves | 10% of the total quantity used for each unit for each type and Size or Minimum 2 No. whichever is higher |

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTTPS VIJAYWADA<br/>STAGE-V</b>             | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

## ANNEXURE VI

### DRAWING / DOCUMENTS SUBMISSION SCHEDULE

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

#### DRAWING/DOCUMENTS SUBMISSION SCHEDULE

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

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

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

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

| S.No | Drawing/Document No.      | Drawing/Document Title                                     | No. of weeks for drawing/document submission after placing LOI/PO |
|------|---------------------------|------------------------------------------------------------|-------------------------------------------------------------------|
| 1.   | PE-V2-419-154-12000A-A001 | P&ID for Oxygen Dosing System                              | 3                                                                 |
| 2.   | PE-V2-419-154-12000A-A002 | GA drawing and foundation detail for Oxygen Dosing System  | 3                                                                 |
| 3.   | PE-V2-419-154-12000A-A003 | Technical Data sheet for Oxygen Dosing System              | 5                                                                 |
| 4.   | PE-V2-419-154-12000A-A004 | QAP for Oxygen Dosing System along with sub vendor list    | 3                                                                 |
| 5.   | PE-V2-419-154-12000A-A005 | Junction Box Termination drawings for Oxygen Dosing System | 5                                                                 |
| 6.   | PE-V2-419-154-12000A-A008 | O&M Manual along with catalogue for Oxygen Dosing System   | 8                                                                 |
| 7.   | PE-V2-419-154-12000A-A009 | PACKING & FORWARDING DETAILS                               | 8                                                                 |

#### NOTE:-

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

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

- In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account.

(a) Bidder to note that drawings/documents submission shall be through web based Document Management System. Bidder would be provided access to the DMS for drawings/documents approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

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

|                                                                                   |                                    |                                            |
|-----------------------------------------------------------------------------------|------------------------------------|--------------------------------------------|
|  | TITLE:                             | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA</b> | SECTION I                                  |
|                                                                                   | <b>STAGE-V</b>                     | SECTION - I A                              |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR</b> | REV.NO. 0 DATE : 03/01/2017                |
|                                                                                   | <b>OXYGEN DOSING SYSTEM</b>        |                                            |

# **ANNEXURE VII :** **FORMAT FOR OPERATION AND MAINTENANCE** **MANUAL**

**FORMAT FOR OPERATION AND MAINTENANCE MANUAL**

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

**Check List for Operation & Maintenance Manual**

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

| Sl.no. & Sections | Description                                                                                                                                                                                                    | Tick (√) if included in Manual |    |                | Remarks |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|----|----------------|---------|
|                   |                                                                                                                                                                                                                | Yes                            | No | Not Applicable |         |
| 1.                | Cover page                                                                                                                                                                                                     |                                |    |                |         |
| 1.1               | Project Name                                                                                                                                                                                                   |                                |    |                |         |
| 1.2               | Customer/consultant Name                                                                                                                                                                                       |                                |    |                |         |
| 1.3               | Name of Package                                                                                                                                                                                                |                                |    |                |         |
| 1.4               | Supplier details with phone, FAX ,email address, Emergency Contact number                                                                                                                                      |                                |    |                |         |
| 1.5               | Name and sign of prepared by, checked by & approved by                                                                                                                                                         |                                |    |                |         |
| 1.6               | Revision history with approval Details                                                                                                                                                                         |                                |    |                |         |
| 2.0               | Index                                                                                                                                                                                                          |                                |    |                |         |
| 2.1               | Showing the sections & related page nos.<br>All the pages should be numbered section wise                                                                                                                      |                                |    |                |         |
| 3.0               | Description of Plant/ System                                                                                                                                                                                   |                                |    |                |         |
| 3.1               | Description/ write up of operating principle of system equipment/ associated sub-systems & accessories/controls system, operating conditions, performance parameters under normal , start up and special cases |                                |    |                |         |
| 3.2               | Equipment list and basic parameter with Tag numbers                                                                                                                                                            |                                |    |                |         |
| 3.3               | Data sheets approved by Customer/ for information and catalogues provided by original manufacturer                                                                                                             |                                |    |                |         |
| 3.4               | Associated other packages and Interface/ terminal points                                                                                                                                                       |                                |    |                |         |
| 3.5               | P&ID & Process Diagrams                                                                                                                                                                                        |                                |    |                |         |
| 3.6               | GA Layout drawings, As-built drawings, Actual photograph of items/ system (Drawings of A2 & bigger sizes are to be attached in the last)                                                                       |                                |    |                |         |
| 3.7               | Single line/ wiring diagrams                                                                                                                                                                                   |                                |    |                |         |
| 3.8               | Control philosophy/ control write-ups                                                                                                                                                                          |                                |    |                |         |
| 4.0               | Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)                                                                                                      |                                |    |                |         |
| 4.1               | Pre-Commissioning Checks                                                                                                                                                                                       |                                |    |                |         |
| 4.2               | Handling of items at site                                                                                                                                                                                      |                                |    |                |         |

|             |                                                                                                                                                                                                                                 |  |  |  |  |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| <b>4.3</b>  | Storage at site                                                                                                                                                                                                                 |  |  |  |  |
| <b>4.4</b>  | Unpacking & Installation procedure                                                                                                                                                                                              |  |  |  |  |
| <b>5.0</b>  | Operation Guidelines for plant personal/ user/ operator                                                                                                                                                                         |  |  |  |  |
| <b>5.1</b>  | Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.                                                |  |  |  |  |
| <b>5.2</b>  | Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned. |  |  |  |  |
| <b>5.3</b>  | Do's & Don't of the equipments.                                                                                                                                                                                                 |  |  |  |  |
| <b>5.4</b>  | Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition                                                         |  |  |  |  |
| <b>5.5</b>  | Parameters to be monitored with normal values and limiting values                                                                                                                                                               |  |  |  |  |
| <b>5.6</b>  | Trouble shooting with causes and remedial measures                                                                                                                                                                              |  |  |  |  |
| <b>5.7</b>  | Routine operational checks, recommended logs & records                                                                                                                                                                          |  |  |  |  |
| <b>5.8</b>  | Changeover schedule if more than one auxiliary for the same purpose is given                                                                                                                                                    |  |  |  |  |
| <b>5.9</b>  | Painting requirement and schedule                                                                                                                                                                                               |  |  |  |  |
| <b>5.10</b> | Inspection, repair, Testing and calibration procedures                                                                                                                                                                          |  |  |  |  |
| <b>6.0</b>  | Maintenance guidelines for plant personal                                                                                                                                                                                       |  |  |  |  |
| <b>6.1</b>  | List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.                                                                                      |  |  |  |  |
| <b>6.2</b>  | Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given. |  |  |  |  |
| <b>6.3</b>  | Preventive Maintenance & Overhauling schedules linked with running hours/ calendar period along with checks to be given                                                                                                         |  |  |  |  |
| <b>6.4</b>  | Long term maintenance schedules especially for structural, foundations etc.                                                                                                                                                     |  |  |  |  |
| <b>6.5</b>  | Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.        |  |  |  |  |
| <b>6.6</b>  | List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given                                                                             |  |  |  |  |

|             |                                                                                                                                    |  |  |  |  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| <b>6.7</b>  | List of vendors & Sub-vendors with their latest addresses, service centres, Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc. |  |  |  |  |
| <b>6.8</b>  | List of mandatory and recommended spare parts list                                                                                 |  |  |  |  |
| <b>6.9</b>  | Tentative Lead time required for ordering of spares from the equipment supplier                                                    |  |  |  |  |
| <b>6.10</b> | Guarantee and warranty clauses                                                                                                     |  |  |  |  |
| <b>7.0</b>  | <b>Statutory and other specific requirements considerations.</b>                                                                   |  |  |  |  |
| <b>8.0</b>  | <b>List of reference documents</b>                                                                                                 |  |  |  |  |
| <b>9.0</b>  | <b>Binding as per requirement</b>                                                                                                  |  |  |  |  |

|                                                                                   |                                     |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------|--------------------------------------------|
|  | TITLE:                              | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPPS VIJAYWADA</b> | SECTION I                                  |
|                                                                                   | <b>STAGE-V</b>                      | SECTION - I A                              |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR</b>  | REV.NO. 0 DATE : 03/01/2017                |
|                                                                                   | <b>OXYGEN DOSING SYSTEM</b>         |                                            |

**P&ID**





|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA</b>                          | SECTION I                                  |
|                                                                                   | <b>STAGE-V</b>                                              | SECTION - I A                              |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | REV.NO. 0 DATE : 03/01/2017                |

### DATA SHEET – A

| Sl. No                  | Description                                           | Parameter                                                                                            |
|-------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| <b>Mechanical Items</b> |                                                       |                                                                                                      |
| 1.0                     | No. of skid(s)for project                             | Two                                                                                                  |
| 2.0                     | <b>Cylinders:</b>                                     |                                                                                                      |
| 2.1                     | Quantity mounted on each skid                         | Eight per skid (Total Sixteen)                                                                       |
| 2.2                     | Loose supply of filled oxygen cylinder                | 21 nos                                                                                               |
| 2.3                     | Design Standard of empty oxygen cylinder              | IS-7285 Part I                                                                                       |
| 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                     | Hydrotest                                             | 304 kg/cm2                                                                                           |
| 2.10                    | Accessories                                           | Gas Regulator                                                                                        |
| 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-SP-99-2010 / equivalent                                                                          |
| 4.4                     | Test standard                                         | MSS-SP-99-2010 / equivalent                                                                          |
| 4.5                     | Size                                                  | 1/2" OD                                                                                              |
| 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 /Bonnet, nozzle       | SS-316                                                                                               |
| 5.2                     | Design standard                                       | MSS-SP-99-2010 / equivalent                                                                          |
| 5.3                     | Test standard                                         | MSS-SP-99-2010 / equivalent                                                                          |
| 5.4                     | Size                                                  | 1/2"                                                                                                 |
| 5.5                     | End Connections                                       | FERRULED                                                                                             |
| 5.6                     | Rating                                                | 2000 PSI                                                                                             |
| 5.7                     | Valve operation                                       | "Self-actuated"                                                                                      |
| 6.0                     | <b>Pressure Safety valve</b>                          |                                                                                                      |
| 6.1                     | Type                                                  | Spring loaded, angle type                                                                            |
| 6.2                     | Body, bonnet, disc & nozzle                           | SS-316                                                                                               |
| 6.3                     | Valve discharges to                                   | Atmosphere (vent)                                                                                    |
| 6.4                     | Back pressure                                         | Constant                                                                                             |
| 6.5                     | Set pressure                                          | 47 Kg/cm2 (a) for dosing at CPU outlet and 24 Kg/cm2 (a) for dosing at deaerator outlet              |
| 6.6                     | Inlet Connections                                     | ¼ inch FERRULED                                                                                      |
| 6.7                     | Outlet Connections                                    | ¼ inch FERRULED                                                                                      |
| 7.0                     | <b>Solenoid Valve</b>                                 |                                                                                                      |
| 7.1                     | Type                                                  | 2 / 2 Way single coil.                                                                               |
| 7.2                     | Body, bonnet, disc & nozzle                           | SS 316/ SS 302/ PTFE+EPDM                                                                            |
| 7.3                     | Coil Voltage                                          | 24 V DC                                                                                              |
| 8.0                     | <b>Fittings</b>                                       | SS-316                                                                                               |
| 9.0                     | <b>Pressure Regulator cum Pressure reducing Valve</b> |                                                                                                      |
| 9.1                     | Body/Seat/O ring                                      | SS 316/Brass/PTFE                                                                                    |
| 9.2                     | Inlet connection                                      | ¼ inch with ¼ inch X ½ inch adaptor                                                                  |
| 9.3                     | Outlet connection                                     | ¼ inch with ¼ inch X ½ inch adaptor                                                                  |
| 9.4                     | Operating pressure                                    | 204 Kg/cm2(g)                                                                                        |
| 9.5                     | Set outlet Pressure                                   | As per P&ID                                                                                          |
| 10.0                    | <b>Mass Flow Controller (MFC)</b>                     |                                                                                                      |
| 10.1                    | Expected flow of oxygen in process                    | 70-550 gm/ hr. (for skid dosing at deaerator outlet); 40-350 gm/ hr. (for skid dosing at CPU outlet) |

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA</b>                          | SECTION I                                  |
|                                                                                   | <b>STAGE-V</b>                                              | SECTION - I A                              |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | REV.NO. 0 DATE : 03/01/2017                |

|           |                                |                                                   |
|-----------|--------------------------------|---------------------------------------------------|
| 10.2      | Type                           | Thermal Mass Flow Controller                      |
| 10.3      | Response time                  | < 1 second                                        |
| 10.4      | Turn down rate                 | 50:1                                              |
| 10.5      | MOC-Wetted part                | SS 316                                            |
| 10.6      | Operating Pressure             | Pressure reducing valve set pressure (refer P&ID) |
| 10.7      | Mass flow accuracy at max flow | ±1%                                               |
| 10.8      | End connection                 | ½ inch ferrule                                    |
| <b>11</b> | <b>Structural steel</b>        | IS 2062                                           |
| <b>12</b> | <b>Nuts &amp; bolts</b>        | SS 304                                            |

|                                                                                   |                                                     |                                            |
|-----------------------------------------------------------------------------------|-----------------------------------------------------|--------------------------------------------|
|  | TITLE:                                              | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | 1X800 MW Dr. NTTPS VIJAYWADA<br>STAGE-V             | SECTION I                                  |
|                                                                                   | TECHNICAL SPECIFICATION FOR<br>OXYGEN DOSING SYSTEM | SECTION - I B                              |
|                                                                                   |                                                     | REV.NO. 0      DATE : 03/01/2017           |

## SECTION – I B

### SPECIFIC TECHNICAL REQUIREMENTS (CONTROL & INSTRUMENTATION)

|                                                                                   |                                                                                                                |           |       |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------|-------|
|  | <b>TITLE: TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM<br/>1 X 800 MW APPDCL VIJAYWADA<br/>STAGE-V</b> | SPEC. NO. |       |
|                                                                                   |                                                                                                                | VOLUME    |       |
|                                                                                   |                                                                                                                | SECTION   |       |
|                                                                                   |                                                                                                                | REV. NO.  | DATE: |
|                                                                                   |                                                                                                                | SHEET     |       |

### **SPECIFIC TECHNICAL REQUIREMENTS (C&I)**

- 1.1 **Oxygen Dosing System** shall be operated from DCS through operator work station (OWS) located in common control room (CCR).
- 1.2 Bidder to supply the field instrumentation, solenoid valve (with limit switches for open close feedback) as required and is shown in the P&ID.  
All local gauges as well as transmitters, sensors and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation maintenance under the scope of specification shall be provided. The necessary root valves, impulse piping, drain cock, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting / erection of these local instruments shall be furnished even if not specifically asked for. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg /Cm<sup>2</sup>.
- 1.3 All the instruments/drives shall be terminated on JBs in field. JBs shall be in Bidder's scope. The detailed specification of instruments, JB etc. are given in detail as below. JB shall be provided with 20% additional/spare terminals.
- 1.4 Scope of all the instrument cables, control cables, fiber optic cables and any other cable & junction box shall be as follows:

| <u>DETAILS</u>                                                                      | <u>SCOPE<br/>SUPPLY</u> | <u>SCOPE<br/>E&amp;C</u> | <u>REMARKS</u>                                                                                              |
|-------------------------------------------------------------------------------------|-------------------------|--------------------------|-------------------------------------------------------------------------------------------------------------|
| Power cables, ordinary control cables and screened control cables                   | Vendor                  | Vendor*                  | Within the skid.                                                                                            |
| Power cables, ordinary control cables and screened control cables                   | BHEL                    | BHEL                     | For cables from JB to DCS, BHEL will provide screened control cable including supply, laying & termination. |
| Junction box for control & instrumentation cable (if applicable)                    | Vendor                  | Vendor*                  |                                                                                                             |
| Any special type of cable like compensating, co-axial, prefab, MICC & fibre optical | Vendor                  | Vendor*                  | Within the skid                                                                                             |

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

- 1.5 All the sensors used for permissive and interlocks shall be dual redundant viz. 2 nos. Pressure Transmitters (PT's) each at respective inlets of the solenoid valve and MFC shall be provided (as indicated in the P&ID's).
- 1.6 The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication shall be acceptable in this regard.
- 1.7 In case of any conflict and repetition of clauses in the specification, the more stringent requirements as per BHEL's interpretation shall be complied by the bidder.

|                                                                                   |                                                                                                                |           |       |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------|-------|
|  | <b>TITLE: TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM<br/>1 X 800 MW APPDCL VIJAYWADA<br/>STAGE-V</b> | SPEC. NO. |       |
|                                                                                   |                                                                                                                | VOLUME    |       |
|                                                                                   |                                                                                                                | SECTION   |       |
|                                                                                   |                                                                                                                | REV. NO.  | DATE: |
|                                                                                   |                                                                                                                | SHEET     |       |

- 1.8 The requirements given are to be read in conjunction with detailed technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per BHEL's interpretation shall be complied by the bidder.
- 1.9 Bidder to delegate /depute their persons/experts (5 working days) as per owner/consultants' requirement without any additional cost to BHEL during commissioning. Schedule of the visit shall be intimated 7 days in advance.
- 1.10 Drawings/Documents and data to be furnished after award of the contract:
- Field instruments data sheet.
  - JB GA drawing & termination details.
  - Any other document decided during detailed engineering.

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION II                                 |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION                                    |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

## SECTION – II

### GENERAL TECHNICAL REQUIREMENT



TITLE:  
**1X800 MW Dr. NTTPS VIJAYWADA  
STAGE-V**

**TECHNICAL SPECIFICATION FOR  
OXYGEN DOSING SYSTEM**

SPECIFICATION NO. PE-TS-419-154-12000-  
A001

SECTION II

SECTION – II A

REV.NO. 0 DATE : 03/01/2017

## **SECTION – IIA**

### **GENERAL TECHNICAL REQUIREMENT (MECHANICAL)**

|                                                                                   |                                                                       |                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
|  | <b>TITLE:</b><br><b>1X800 MW Dr. NTPS VIJAYWADA</b><br><b>STAGE-V</b> | <b>SPECIFICATION NO.</b> PE-TS-419-154-12000-A001                                       |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR</b><br><b>OXYGEN DOSING SYSTEM</b>     | <b>SECTION II</b><br><b>SECTION – II A</b><br><b>REV.NO.</b> 0 <b>DATE :</b> 03/01/2017 |

## 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 aqueous ammonia and gaseous oxygen. The principles, equipment selection and control philosophy of ammonia feed system has been covered separately and is not the scope of this contract.

The following philosophy of oxygen dosing system is considered:-

### During normal operation:-

- pH is maintained at 8.2-8.5 by dosing aqueous ammonia solution.
- Oxygen dosing rate at economizer inlet, recommended by BHEL is 30-150 ppb. Exact dosing rate shall be decided by the operator based on oxygen level at economizer inlet. The set point for economizer inlet shall be maintained as 90 ppb. The dosing rate shall be varied to maintain the set point of 90 ppb. For sizing of oxygen dosing system, 200 ppb continuous dosing of 99% pure oxygen has been considered.
- Dosing shall normally be done at CPU outlet. However provision shall be given for dosing at deaerator outlet also. For this purpose two separate skid based oxygen dosing systems shall be supplied for station. However, dosing shall be done at one place at a time only.
- Dosing rate shall be controlled from Plant 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 Plant DCS. However, customer may also choose to manually feed a particular set point within this range and operate the oxygen dosing automatically based on this set point.
- The oxygen dosing shall automatically turn off by closing the mass flow controller (MFC) if cation conductivity in the cycle goes above 0.3  $\mu\text{S}/\text{cm}$ .

### Startup sequence:-

- Deaerator vent is kept open.
- LP Heater's 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 vent is closed.
- LP Heater's vent is closed.
- Oxygen feed is manually started from DCS.

### Shut down sequence:-

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

## Equipment for Oxygen Dosing System

Each skid shall consist of the following components:-

### Cylinder banks

Each oxygen dosing skid shall consist of two banks, each of four (4) 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

|                                                                                   |                                                             |                                               |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001    |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION II                                    |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION – II A<br>REV.NO. 0 DATE : 03/01/2017 |

(CPU) outlet will switch over at 42 kg/cm<sup>2</sup>(a) and the cylinder banks dosing at deaerator outlet at 19 kg/cm<sup>2</sup>(a).

#### **Pressure Regulator:**

The line pressure regulator is used for reducing a high supply pressure (204 bars cylinder pressure) to 45 kg/cm<sup>2</sup>(a) pressure in skid dosing at CPU outlet and to 22 kg/cm<sup>2</sup>(a) pressure in skid dosing at deaerator outlet.

#### **CONTROL PHILOSOPHY**

The mode of operation of the oxygen dosing system shall be from Plant DCS only. All the logics, controls and interlocks shall be implemented in Plant 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 Plant 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 45 Kg/cm<sup>2</sup> for skid dosing at CPU outlet and set pressure of 22 Kg/cm<sup>2</sup> for skid dosing at deaerator outlet attached with each cylinder.

Each of the four oxygen cylinders bank in the skid shall have a dedicated set of solenoid valve [SV-1(QCL11AA201) & SV-2(QCL12AA201)] pressure gauges (QCL11CP501 & QCL12CP501) and pressure transmitters(QCL11CP001/ QCL11CP002 & QCL12CP001/ QCL12CP002) for the CPU out let and solenoid valve [SV-1(QCL21AA201) & SV-2(QCL22AA201)] , pressure gauges(QCL21CP501 & QCL22CP501) and pressure transmitters (QCL21CP001/ QCL21CP002 & QCL22CP001/ QCL22CP002) for the Dearator out let .

Eight cylinders provided on skid are connected and four cylinders will serve at a time, based on the pressure at the inlet of solenoid valve. In case the pressure at the inlet of SV1(QCL11AA201, QCL21AA201 for the CPU outlet and dearator outlet respectively), reaches at the set point, the solenoid valve SV1(QCL11AA201,QCL21AA201 for the CPU outlet and dearator outlet respectively) will close and solenoid valve SV2 (QCL12AA201, QCL22AA201for the CPU outlet and dearator outlet respectively) will open and other cylinder bank shall be taken in to service provided the pressure at the inlet of SV2 (QCL12AA201,QCL22AA201 for the CPU outlet and dearator outlet respectively) is not low and vice versa. Alarm for pressure low at the inlet of solenoid valves shall be provided in Plant DCS.

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

The pressure of the oxygen shall be further reduced by pressure reducing valves (QCL10AA201 for skid dosing at CPU outlet and QCL20AA201 for skid dosing at dearator outlet) in the skid, based on the feedback received from pressure transmitter (QCL10CP001/ QCL10CP002) {set point –"ADEQUATE--(Set points–43 kg/cm<sup>2</sup> for skid dosing at CPU outlet & pressure transmitter (QCL20CP001/ QCL20CP002) {set point –"ADEQUATE--( 20 kg/cm<sup>2</sup> for skid dosing at deaerator outlet ) provided at the downstream of pressure reducing regulating valve. The flow and pressure of oxygen can be monitored from DCS by the signal from mass flow controller (QCL10CF001for skid dosing at CPU outlet and QCL20CF001 for skid dosing at dearator outlet) and from pressure transmitters (QCL10CP001/ QCL10CP002 for skid dosing at CPU outlet & QCL20CP001/ QCL20CP002 for skid dosing at deaerator outlet) provided at the downstream of pressure reducing regulating valve. The flow of oxygen dosing will be controlled manually/automatically from DCS by adjusting flow MFC (QCL10AA202 for skid dosing at CPU outlet & QCL20AA202 for skid dosing at deaerator outlet) provided on skid, based on the feedback from the dissolved oxygen analyzer located in the economizer inlet. The MFC shall have a position feedback transmitter that shall transmit the feedback signal to Plant DCS.

|                                                                                   |                                                             |                                                |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|------------------------------------------------|
|  | TITLE:<br><b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>    | SPECIFICATION NO. PE-TS-419-154-<br>12000-A001 |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION II                                     |
|                                                                                   |                                                             | SECTION – II A                                 |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                    |

All solenoid valves mounted in the oxygen dosing skid shall be of 24 VDC rating. All the field instruments, MFC and solenoid valves (SV 1 (QCL11AA201/QCL21AA201) & SV 2 (QCL12AA201/QCL22AA201)) shall be terminated at a junction box in the skid by BHEL's oxygen dosing vendor for further connection to Plant DCS. The cabling from JB to plant DCS shall be in BHEL scope.

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

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

**Notes:-**

- All analyzers (conductivity analyzer, dissolved oxygen analyzer) shall be in SWAS Panel (BHEL) scope.

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                    | PT (QCL11CP001/QCL11CP002) | 47 Kg/cm <sup>2</sup> (a) (HIGH) | Not applicable                                  | Yes (HIGH pressure at cylinder bank 1 outlet)   | Manual checking of pressure regulator reqd.                                          |
| Pressure transmitter                    | PT (QCL11CP001/QCL11CP002) | 42 Kg/cm <sup>2</sup> (a) (LOW)  | Close SV-1(QCL11AA201) & Open SV-2 (QCL12AA201) | Yes (LOW pressure at cylinder bank 1 outlet)    | Auto-changeover of cylinders bank. Manually replace cylinders with filled cylinders. |
| Pressure transmitter                    | PT (QCL12CP001/QCL12CP002) | 47 Kg/cm <sup>2</sup> (a) (HIGH) | Not applicable                                  | Yes (HIGH pressure at cylinder bank 2 outlet)   | Manual checking of pressure regulator reqd.                                          |
| Pressure transmitter                    | PT (QCL12CP001/QCL12CP002) | 42 Kg/cm <sup>2</sup> (a) (LOW)  | Close SV-2(QCL12AA201) & Open SV-1(QCL11AA201)  | Yes (LOW pressure at cylinder bank 2 outlet)    | Auto-changeover of cylinders bank. Manually replace cylinders with filled cylinders. |
| Pressure transmitter                    | PT (QCL10CP001/QCL10CP002) | 41 Kg/cm <sup>2</sup> (a) (LOW)  | Close MFC (QCL10AA202)                          | Yes (Oxygen dosing stopped due to low pressure) |                                                                                      |
| Pressure transmitter                    | PT (QCL10CP001/QCL10CP002) | 45 Kg/cm <sup>2</sup> (a) (HIGH) | Not applicable                                  | Yes (HIGH dosing pressure)                      | Manual checking of pressure                                                          |

|                                                                                   |                                                             |  |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--|--------------------------------------------|
|  | TITLE:<br><b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>    |  | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> |  | SECTION II                                 |
|                                                                                   |                                                             |  | SECTION – II A                             |
|                                                                                   |                                                             |  | REV.NO. 0 DATE : 03/01/2017                |

|                              |                            |                                             |                                                                                                                        |                                                                                 |                                                                                                                                 |
|------------------------------|----------------------------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
|                              |                            |                                             |                                                                                                                        |                                                                                 | reducing valve reqd.                                                                                                            |
| Pressure transmitter         | PT (QCL10CP001/QCL10CP002) | 43 Kg/cm2 (a) (Adequate)                    | Open Permissive pressure of MFC(QCL10AA202),                                                                           | Not applicable                                                                  |                                                                                                                                 |
| Cation Conductivity analyzer | (SWAS PANEL SCOPE)         | 0.3 $\mu$ S/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    | (SWAS PANEL SCOPE)         | 30 ppb (LOW), decreasing                    | Gradually open MFC (QCL10AA202) to increase DO provided signal from PT (QCL10CP001) is "NOT LOW" (i.e < 45 Kg/cm2 (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 |
| Dissolved oxygen analyzer    | (SWAS PANEL SCOPE)         | 150 ppb, increasing (HIGH)                  | Close MFC (QCL10AA202) to decrease DO                                                                                  | Yes (Oxygen dosing stopped due to high DO level in feed water cycle)            | plant chemist during commissioning within the range of 30-150 ppb.                                                              |

**During Start up:-**

|                              |                    |                                                   |                                                                                                                                              |                             |  |
|------------------------------|--------------------|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--|
| Cation Conductivity analyzer | (SWAS PANEL SCOPE) | 0.15 $\mu$ S/cm (at 25°C), decreasing (ADEQUATE ) | Open MFC (QCL10AA202) , provided signal from PT-3 is "NOT LOW" (i.e < 48 Kg/cm2 (g)) & signal from DO analyzer is "NOT HIGH" (i.e > 150 ppb) | Yes (Oxygen dosing started) |  |
|------------------------------|--------------------|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--|

**For Skid dosing at deaerator Outlet**

| Source of signal                 | Tag Number                 | Set Point (suggested) | Interlock                                       | Alarm in DCS                                  | Remarks                                                                              |
|----------------------------------|----------------------------|-----------------------|-------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------------------|
| <b>During Normal Operation:-</b> |                            |                       |                                                 |                                               |                                                                                      |
| Pressure transmitter             | PT (QCL21CP001/QCL21CP002) | 24 Kg/cm2 (a) (HIGH)  | Not applicable                                  | Yes (HIGH pressure at cylinder bank 1 outlet) | Manual checking of pressure regulator reqd.                                          |
| Pressure transmitter             | PT (QCL21CP001/QCL21CP002) | 19 Kg/cm2 (a) (LOW)   | Close SV-1(QCL21AA201) & Open SV-2 (QCL22AA201) | Yes (LOW pressure at cylinder bank 1 outlet)  | Auto-changeover of cylinders bank. Manually replace cylinders with filled cylinders. |
| Pressure                         | PT                         | 24 Kg/cm2 (a)         | Not applicable                                  | Yes (HIGH)                                    | Manual                                                                               |

|                                                                                   |                                                             |                                               |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001    |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION II                                    |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION – II A<br>REV.NO. 0 DATE : 03/01/2017 |

|                                    |                                   |                                                           |                                                                                                                                                                        |                                                                                                   |                                                                                                                                                                                                                                           |
|------------------------------------|-----------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| transmitter                        | (QCL22CP001/<br>QCL22CP002)       | (HIGH)                                                    |                                                                                                                                                                        | pressure at<br>cylinder bank<br>2 outlet)                                                         | checking of<br>pressure<br>regulator reqd.                                                                                                                                                                                                |
| Pressure<br>transmitter            | PT<br>(QCL22CP001/<br>QCL22CP002) | 19 Kg/cm2 (a)<br>(LOW)                                    | Close SV-2<br>(QCL22AA201)<br>& Open SV-1<br>(QCL21AA201)                                                                                                              | Yes (LOW<br>pressure at<br>cylinder bank<br>2 outlet)                                             | Auto-<br>changeover of<br>cylinders bank.<br>Manually<br>replace<br>cylinders with<br>filled cylinders.                                                                                                                                   |
| Pressure<br>transmitter            | PT<br>(QCL20CP001/<br>QCL20CP002) | 18 Kg/cm2 (a)<br>(LOW)                                    | Close FCV<br>(QCL20AA202)                                                                                                                                              | Yes (Oxygen<br>dosing<br>stopped due<br>to low<br>pressure)                                       |                                                                                                                                                                                                                                           |
| Pressure<br>transmitter            | PT<br>(QCL20CP001/<br>QCL20CP002) | 22 Kg/cm2 (a)<br>(HIGH)                                   | Not applicable                                                                                                                                                         | Yes (HIGH<br>dosing<br>pressure)                                                                  | Manual<br>checking of<br>pressure<br>reducing<br>regulating valve<br>reqd.                                                                                                                                                                |
| Pressure<br>transmitter            | PT<br>(QCL20CP001/<br>QCL20CP002) | 20 Kg/cm2 (a)<br>(Adequate)                               | Open Permissive<br>pressure of MFC<br>(QCL20AA202).                                                                                                                    | Not<br>applicable                                                                                 |                                                                                                                                                                                                                                           |
| Cation<br>Conductivity<br>analyzer | (SWAS PANEL<br>SCOPE)             | 0.3 $\mu$ s/cm (at<br>25°C),<br>increasing<br>(HIGH)      | Close MFC<br>(QCL20AA202)                                                                                                                                              | Yes (Oxygen<br>dosing<br>stopped due<br>to high cation<br>conductivity in<br>feed water<br>cycle) | Increase<br>ammonia pH set<br>point to raise pH<br>to 9.2-9.5 range                                                                                                                                                                       |
| Dissolved<br>oxygen<br>analyzer    | (SWAS PANEL<br>SCOPE)             | 30 ppb (LOW),<br>decreasing                               | Gradually open<br>MFC<br>(QCL20AA202)<br>to increase DO<br>provided signal<br>from<br>PT(QCL20CP001)<br>is "NOT LOW" (i.e<br>< 18 Kg/cm2 (g))                          | Yes (Low DO<br>level in feed<br>water cycle)                                                      | Initial set point<br>may be chosen<br>as 90 ppb.<br>However,<br>provision may<br>be kept to<br>choose exact<br>set point for<br>operation by<br>operator's plant<br>chemist during<br>commissioning<br>within the range<br>of 30-150 ppb. |
| Dissolved<br>oxygen<br>analyzer    | (SWAS PANEL<br>SCOPE)             | 150 ppb,<br>increasing<br>(HIGH)                          | Close MFC<br>(QCL20AA202)<br>to decrease DO                                                                                                                            | Yes (Oxygen<br>dosing<br>stopped due<br>to high DO<br>level in feed<br>water cycle)               |                                                                                                                                                                                                                                           |
| <b><u>During Start up:-</u></b>    |                                   |                                                           |                                                                                                                                                                        |                                                                                                   |                                                                                                                                                                                                                                           |
| Cation<br>Conductivity<br>analyzer | (SWAS PANEL<br>SCOPE)             | 0.15 $\mu$ s/cm (at<br>25°C),<br>decreasing<br>(ADEQUATE) | Open MFC<br>(QCL20AA202),<br>provided signal<br>from PT-3 is<br>"NOT LOW" (i.e <<br>22 Kg/cm2 (g)) &<br>signal from DO<br>analyzer is "NOT<br>HIGH" (i.e > 150<br>ppb) | Yes (Oxygen<br>dosing<br>started)                                                                 |                                                                                                                                                                                                                                           |

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION II                                 |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION – II B                             |
|                                                                                   |                                                             | REV.NO. 0      DATE : 03/01/2017           |

## SECTION – IIB

### GENERAL TECHNICAL REQUIREMENT (CONTROL AND INSTRUMENTATION)

1.00.00 SPECIFICATION FOR ELECTRONIC TRANSMITTERS

1.01.00 PRESSURE TRANSMITTER

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

- ii. Repeatability  $\pm 0.05\%$  of Span or better
- 17. Sealing/Isolation : Extended diaphragm (Silicon oil/Fluorolub filled ) with 5 meters SS armoured capillary
- 18. Accessories :
  - a. Universal mounting bracket suitable for 2" pipe mounting
  - b. High tensile carbon steel U-bolts
  - d. ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock
  - e. Companion flange with nuts, bolts and gaskets
  - f. ½" NPT cable gland
- 19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system

~~1.02.00 DIFFERENTIAL PRESSURE TRANSMITTER / FLOW TRANSMITTER~~

4.01.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

1. Type : Bourdon/Bellows/Diaphragm
2. Sensing & Socket : SS-316
3. Movement Material : SS-316
4. Case Material : Stainless steel. IP-65 (Explosion proof for NEC Class-1, Division 1 area)
5. Dial Size : Generally 150 mm
6. Scale : Black lettering on white in 270 O arc.
7. Window : Shatterproof glass
8. Range Selection : Normal process pressure: 50~70 % of range
9. Over-range Protection : 125% of maximum range by internal stop. External stop at zero  
For Zero adjustment (Micrometer screw external)
10. Adjustment : For Range adjustment (Micrometer screw internal).
11. Element Connection : Argon welding
12. Process Connection : 1/2" NPT (M) Bottom for local, back for panel mounting
13. Performance : Accuracy of  $\pm 1.0$  % of span or better
14. Operating ambient : 0 - 50 °C
15. Safety Feature : Blow out disc /diaphragm at the back
16. Accessories :
  - a) Snubbers for pulsating fluid application. discharge  
Stainless steel Diaphragm seals
  - c) 3-Way SS316 Gauge cock for

pressure gauges

~~5 valve SS316 manifold from~~

17. Nameplate : Tag number, service engraved in stainless steel tag plate

4.02.00 LEVEL INDICATOR (FLOAT & BOARD TYPE)

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

4.03.00 GAUGE GLASS

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

10.00.00 **SOLENOID VALVES**

- |     |                     |   |                                      |
|-----|---------------------|---|--------------------------------------|
| 1.  | Operating Principle | : | Electromagnetic (noiseless)          |
| 2.  | Coil voltage rating | : | 24 V DC                              |
| 3.  | Ways                | : | 2/3/4 way                            |
| 4.  | Port size           | : | 1/4" NPT all ports                   |
| 5.  | Body                | : | SS bar stock                         |
|     | Trim                | : | SS-316                               |
| 6.  | Duty                | : | Suitable for continuous energization |
| 7.  | Sealing             | : | Airtight and leak proof              |
| 8.  | Ambient Temperature | : | 0 - 50 ° C                           |
| 9.  | Fluid Temperature   | : | 0-150 ° C (approx.)                  |
| 10. | Coil Enclosure      | : | Stainless Steel                      |
| 11. | Insulation          | : | Class-H                              |
| 12. | Coil Casing         | : | IP-65                                |
| 13. | Mounting            | : | On pipe or on panel                  |
| 14. | Cable Connection    | : | ½" NPT                               |
| 15. | Accessories         | : | Cable glands, SS Tag plate           |

suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

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

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

#### 4.04.00 JUNCTION BOX

1. Type of Enclosure : Dust tight & weatherproof conforming to IP 65
2. Material : 3 mm sheet steel / fiberglass reinforced polyester(UV stabilized)
3. Type of Cover : Solid unhinged with retention chain / Screwed at all four corners
4. Paint : RAL 7032-Siemens Grey
5. Mounting : Surface / Two (2) inch Pipe stanchion  
(At a dry compartment at one side of the enclosure / rack with front opening type door)
6. Cable Entry : 3 mm (min) Bottom / side Gland plate
7. Gasket : Neoprene
8. Grounding : Brass earth lug with green screw head  
External-2 nos , Internal-1no. (M6)
9. Number of Drain Holes : Two at bottom capped
10. Identification : Label for JB and Tags for cable
11. Accessories : a) Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals  
b) Cable gland (Brass) & raceways

- c) Ferrules & lugs (Brass)
- d) Aluminum back panel
- e) Canopy at top
- f) Mounting brackets
- g) bolts and nuts made of brass etc.



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

### CHECK LIST FOR TRANSMITTER (APPLICABLE FOR PRESSURE TRANSMITTER)

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

#### Legend :

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

#### Note :

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



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

### CHECK LIST FOR SOLENOID VALVES

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

#### Legend :

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

#### Note :

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



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

### CHECK LIST FOR PRESSURE & DP GAUGE

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

#### Legend :

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

#### Note :

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

## DATA SHEET FOR MASS FLOW CONTROLLER FOR OXYGEN DOSING

SPECIFICATION NO.:

VOLUME

SECTION

REV. NO.

DATE :

SHEET

1

OF

1

**DATA SHEET – A & B**

DATA SHEET – A FOR MASS FLOW CONTROLLER  
(TO BE FILLED BY PURCHASER)

DATA SHEET – B  
(TO BE FILLED UP  
BY BIDDER)

## GENERAL

PROJECT  
MAKE/MODEL NUMBER  
TYPE  
SERVICE

VIJAYWADA TPS (1X800 MW)  
BIDDER TO SPECIFY  
BIDDER TO SPECIFY  
99% PURE OXYGEN

TECHNICAL

- PRINCIPLE
- MATERIAL OF CONSTRUCTION
  - a) BODY
  - b) WETTED PARTS
- POWER SUPPLY
- INPUT SIGNAL
- OUTPUT SIGNAL
  
- ACCURACY (on FSD)
- LINEARITY
- HYSTERESIS
- REPEATABILITY
- TURN DOWN RATIO
- RESPONSE TIME
- PROCESS CONNECTION
- MOUNTING/ INSTALLATION DETAIL
- ENCLOSURE
- REVERSE POLARITY PROTECTION
- MEASURED SIGNAL (AS MINIMUM)
  
- TAG PLATE MATERIAL
- ACCESSORIES
- CABLE ENTRY DETAILS/QTY

☐ CORJOLIS ☐ THERMAL MASS FLOW ☐ OTHER

☐ DIE CAST AL (MINIMUM) ☐ \_\_\_\_\_

■ SS 316 ☐ \_\_\_\_\_

■ 24V DC ☐ 230V AC

4-20 mA

4-20 mA for Mass Flow Rate (HART compatible)

(Selectable for other measured quantities)

■  $\pm 1\%$  ☐ \_\_\_\_\_

■  $\pm 1\%$  ☐ \_\_\_\_\_

■  $\pm 1\%$  ☐ \_\_\_\_\_

■  $\pm 0.2\%$  ☐ \_\_\_\_\_

■ 50:1 ☐ \_\_\_\_\_

■ 100 mSec ☐ \_\_\_\_\_

■  $\frac{1}{2}$ " NPT (M) ☐  $\frac{1}{2}$ " FLANGED

BIDDER TO SPECIFY

■ JP-65 ☐ \_\_\_\_\_

☐ PROVIDED ☐ \_\_\_\_\_

■ MASS FLOW RATE ☐ TOTAL MASS FLOW

☐ TEMPERATURE ☐ DENSITY

■ STAINLESS STEEL ☐ \_\_\_\_\_

BIDDER TO SPECIFY

BIDDER TO SPECIFY

### SERVICE CONDITION

SL.  
No.

DOSING  
LOCATION

OPERATING  
PRESSURE

DESIGN  
PRESSURE

OPERATING  
TEMP

DESIGN  
TEMP

FLOW  
RANGE

FLOW  
RATE

MAX  
OPERATING  
TEMP

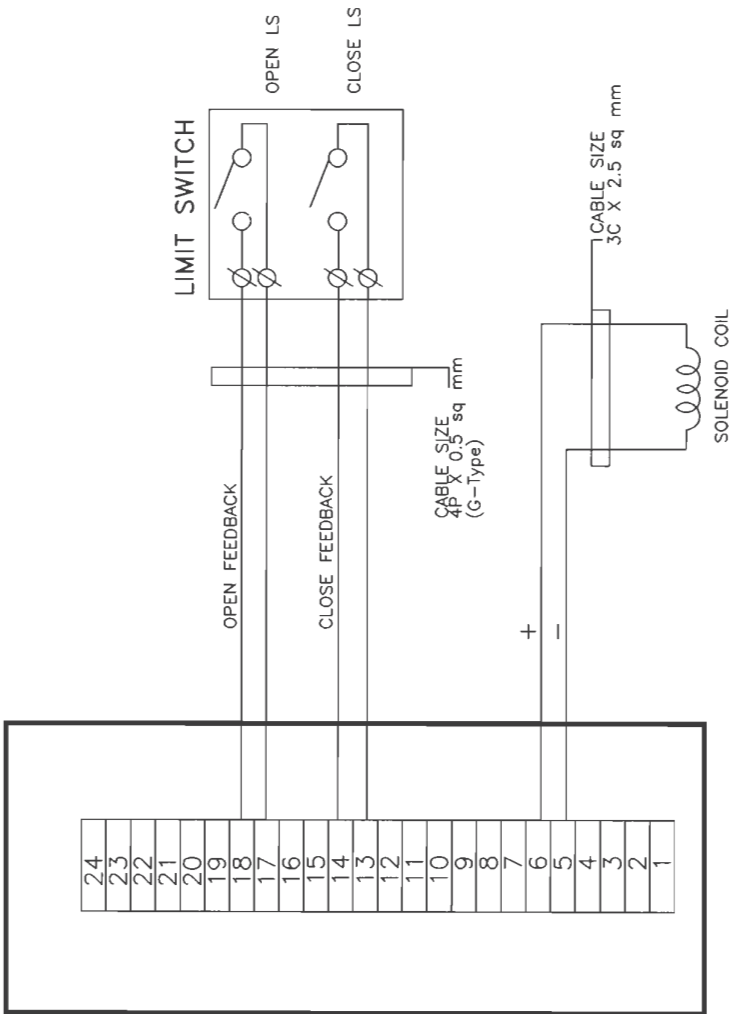
1.

AT DEA O/L  
AT CPU O/L

VENDOR TO SELECT AS PER PROCESS CONDITIONS

INTERFACE FOR SOLENOID VALVE (24VDC)

JUNCTION BOX  
(TYPICAL)



PROJECT: 1X800 MW VIJAYWADA TPS

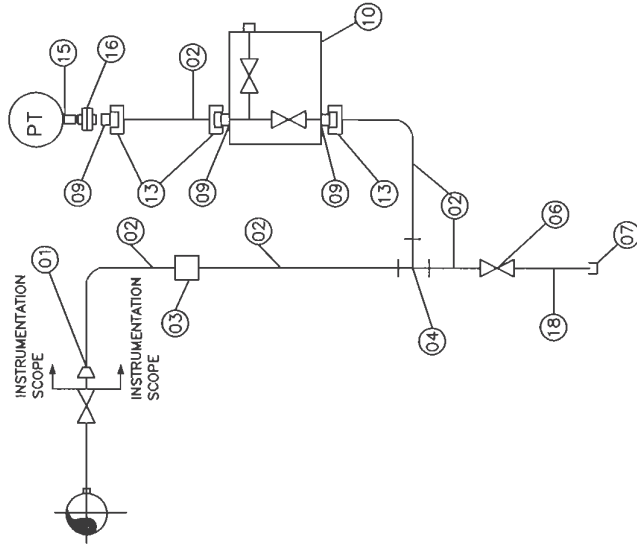
TITLE  
TYPICAL HOOK-UP DIAGRAM  
SOLENOID VALVE (24VDC)

DRG.NO.

DATE

REV.NO.

SHT 1 OF 1



WITH CHEMICAL SEAL

| ITEM NO | ITEM/DESCRIPTION                                   | MATERIAL          | SIZE                                 | QTY   |       |           |          |
|---------|----------------------------------------------------|-------------------|--------------------------------------|-------|-------|-----------|----------|
|         |                                                    |                   |                                      | WATER | STEAM | PULSATING | CHEMICAL |
| 01      | REDUCER (IF APPLICABLE)                            | SAME AS MAIN PIPE | 1" X 1/2" SW                         | 01    | 01    | 01        | 01       |
| 02      | SEAMLESS PIPE                                      | SAME AS MAIN PIPE | 1/2"                                 | A/R   | A/R   | A/R       | A/R      |
| 03      | FORGED COUPLING                                    | SAME AS MAIN PIPE | 1/2" SW                              | A/R   | A/R   | A/R       | A/R      |
| 04      | FORGED TEE                                         | SAME AS MAIN PIPE | 1/2" SW                              | 01    | 01    | 01        | 01       |
| 06      | FORGED GLOBE VALVE                                 | SAME AS MAIN PIPE | 1/2" SW                              | 01    | 01    | 01        | 01       |
| 07      | CAP                                                | SAME AS MAIN PIPE | 1/2" NPTF                            | 01    | 01    | 01        | 01       |
| 09      | ADAPTOR - M TO M                                   | SS316             | M20X1.5M X 1/2" NPTM                 | 03    | 03    | 03        | 03       |
| 10      | TWO VALVE 3 WAY MANIFOLD WITH VENT PLUG            | SS316             | 1/2" NPTF                            | 01    | 01    | 01        | 01       |
| 11      | SYPHON                                             | CS                | 1/2" SW                              | 00    | 01    | 00        | 00       |
| 12      | SNUBBER                                            | SS316             | M20X1.5M X M20X1.5F                  | 00    | 00    | 01        | 00       |
| 15      | CONNECTOR - M TO M                                 | SS316             | 1/2" NPTM X 1/2" NPTM                | 00    | 00    | 00        | 01       |
| 16      | CHEMICAL SEAL                                      | SS316             | 1/2" NPTF X 1/2" NPTF                | 00    | 00    | 00        | 01       |
| 13      | NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER | SS316             | NUT SIZE : M20 X 1.5 WITH 100MM TAIL | 03    | 03    | 03        | 03       |
| 18      | NIPPLE                                             | SAME AS MAIN PIPE | 1/2" NPTM X 1/2" SW                  | 01    | 01    | 01        | 01       |



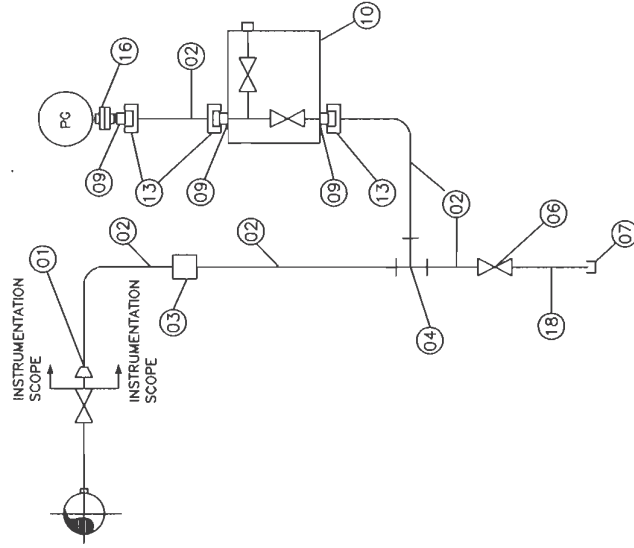
TITLE :-

# INSTRUMENT INSTALLATION DIAGRAM PRESSURE TRANSMITTERS

DRG. NO. PE-DG-999-145-XXXX

REV. NO. 00 DATE 05.11.13

SHT 6 OF 9



WITH CHEMICAL SEAL

| ITEM NO | ITEM/DESCRIPTION                                   | MATERIAL          | SIZE                                 | QTY   |       |           |          |
|---------|----------------------------------------------------|-------------------|--------------------------------------|-------|-------|-----------|----------|
|         |                                                    |                   |                                      | WATER | STEAM | PULSATING | CHEMICAL |
| 01      | REDUCER (IF APPLICABLE)                            | SAME AS MAIN PIPE | 1" X 1/2" SW                         | 01    | 01    | 00        | 01       |
| 02      | SEAMLESS PIPE                                      | SAME AS MAIN PIPE | 1/2"                                 | A/R   | A/R   | A/R       | A/R      |
| 03      | FORGED COUPLING                                    | SAME AS MAIN PIPE | 1/2" SW                              | A/R   | A/R   | A/R       | A/R      |
| 04      | FORGED TEE                                         | SAME AS MAIN PIPE | 1/2" SW                              | 01    | 01    | 01        | 01       |
| 06      | FORGED GLOBE VALVE                                 | SAME AS MAIN PIPE | 1/2" SW                              | 01    | 01    | 01        | 01       |
| 07      | CAP                                                | SAME AS MAIN PIPE | 1/2" NPTF                            | 01    | 01    | 01        | 01       |
| 09      | ADAPTER - M TO M                                   | SS316             | M20X1.5M X 1/2" NPTM                 | 02    | 02    | 02        | 03       |
| 10      | TWO VALVE 3 WAY MANIFOLD WITH VENT PLUG            | SS316             | 1/2" NPTF                            | 01    | 01    | 01        | 01       |
| 11      | SYPHON                                             | SS316             | 1/2" SW                              | 00    | 01    | 00        | 00       |
| 12      | SNUBBER                                            | SS316             | M20X1.5M X M20X1.5F                  | 00    | 00    | 01        | 00       |
| 13      | NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER | SS316             | NUT SIZE : M20 X 1.5 WITH 100MM TAIL | 03    | 03    | 03        | 03       |
| 16      | CHEMICAL SEAL                                      | SS316             | 1/2" NPTF X 1/2" NPTF                | 00    | 00    | 00        | 01       |
| 18      | NIPPLE                                             | SAME AS MAIN PIPE | 1/2" NPTM X 1/2" SW                  | 01    | 01    | 01        | 01       |
| 19      | ADAPTER - M TO F                                   | SS316             | M20X1.5M X 1/2" NPTF                 | 01    | 01    | 01        | 00       |



TITLE :-

# INSTRUMENT INSTALLATION DIAGRAM PRESSURE GAUGES

|          |                    |      |          |
|----------|--------------------|------|----------|
| DRG. NO. | PE-DC-999-145-IXXX |      |          |
| REV. NO. | 00                 | DATE | 05.11.13 |
| SHT      | 4                  | OF   | 9        |

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION I                                  |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

## SECTION-III

|                                                                                   |                                                             |                                            |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------|
|  | TITLE:<br><b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>    | SPECIFICATION NO. PE-TS-419-154-12000-A001 |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION I                                  |
|                                                                                   |                                                             | SECTION - I A                              |
|                                                                                   |                                                             | REV.NO. 0 DATE : 03/01/2017                |

#### SCHEDULE OF PRE-BID CLARIFICATION

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

| VOLUME | SECTION | CLAUSE NO. | PAGE NO. | SPECIFICATION REQUIREMENT | CLARIFICATION | REASONS FOR CLARIFICATION |
|--------|---------|------------|----------|---------------------------|---------------|---------------------------|
|        |         |            |          |                           |               |                           |
|        |         |            |          |                           |               |                           |
|        |         |            |          |                           |               |                           |
|        |         |            |          |                           |               |                           |
|        |         |            |          |                           |               |                           |
|        |         |            |          |                           |               |                           |
|        |         |            |          |                           |               |                           |

|                                                                                   |                                                             |                                              |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|----------------------------------------------|
|  | TITLE:                                                      | SPECIFICATION NO. PE-TS-419-154-12000-A001   |
|                                                                                   | <b>1X800 MW Dr. NTPS VIJAYWADA<br/>STAGE-V</b>              | SECTION I                                    |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR<br/>OXYGEN DOSING SYSTEM</b> | SECTION - I A<br>REV.NO. 0 DATE : 03/01/2017 |

## COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

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

|                                                                                   |                                                                       |                                                                                                                                              |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
|  | <b>TITLE:</b><br><b>1X800 MW Dr. NTPS VIJAYWADA</b><br><b>STAGE-V</b> | SPECIFICATION NO. PE-TS-419-154-12000-A001<br><hr/> SECTION I<br><hr/> SECTION - I A<br><hr/> REV.NO.      0      DATE : 03/01/2017<br><hr/> |
|                                                                                   | <b>TECHNICAL SPECIFICATION FOR</b><br><b>OXYGEN DOSING SYSTEM</b>     |                                                                                                                                              |

### DECLARATIONS

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

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

Bidders Company Name .....

Authorized representative's  
Signature .....

Name .....

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

**DEVIATION SHEET (COST OF WITHDRAWAL)**

**1X800 MW Dr. NTPS VIJAYWADA**  
**STAGE-V**  
**TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM**

**TECH SPC NO: PE-TS-419-154-12000-A001**

**TENDER ENQUIRY REFERENCE:-**

**NAME OF BIDDER:-**

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

**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.