IB THERMAL POWER STATION,BANHARPALI
2X660 MW UNIT # 3 & 4

VOLUME: II B & III

TECHNICAL SPECIFICATIONS
FOR
OXYGEN DOSING SYSTEM

SPECIFICATION NO.: PE-TS-391-154-12000A-A001

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

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VOLUME-IIB

SECTION – A

SCOPE OF ENQUIRY

1.0 SCOPE OF INQUIRY/ INTENT OF SPECIFICATION

1.1 The specification is intended to cover design, engineering, manufacture, inspection and testing at vendor's/ sub-vendor's works, painting, proper packing and supply and dispatch to power station site of skid mounted **OXYGEN DOSING SYSTEM** along with mandatory spares, erection and commissioning spares(as required), including supervision of commissioning by experience/capable engineers specified in different sections / volumes of this specification hereinafter for the **IB THERMAL POWER STATION, BANHARPALLI, 2X660 MW UNIT# 3 & 4.**

1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the vendor from the responsibility of providing such facilities to complete the supply of **OXYGEN DOSING SYSTEM** within quoted price**.**

1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgment is not in full accordance herewith.

1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.

1.5 Bidder shall be required to depute his qualified/capable personnel at any stage to supervise, Commissioning for each unit for four (4) days. This will include supervision of commissioning of Oxygen Dosing system in totality.Bidder to indicate the prices (in price format) for the same. The prices for Two (2) Visits (Comprising Eight (8) mandays), shall be inclusive of charges of Air-Fair/Rail-Fair, Boarding/Lodging, local conveyance etc.

The eight (8) days are to be considered as eight (8) working days at site. (i.e. 4 days per unit, excluding the travel time.)

1.6 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.7 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information , ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification**.** In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be

furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.8 Deviations along with cost of withdrawal (positive or negative), if any, should be very clearly brought out clause by clause in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.

1.9 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.10 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean BHEL and /or OPGCL including their consultant as interpreted by BHEL in the relevant context.

1.11 The equipment covered under this specification shall not dispatch unless the same have been finally inspected, accepted and shipping release issue by BHEL/OPGCL.

1.12 BHEL's/OPGCL's representative shall be given full access to the shop in which the equipments are being manufactured or tested and all test records shall be made available to him.

SECTION – B

PROJECT INFORMATION

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed Thermal Power Station comprising of 2 x 660 MW base unit size, Super-Critical Units would be set up by Orissa Power Generation Corporation Limited (OPGCL) in the Jharsuguda district of Orissa, India. OPGCL had already installed two units of 210 MW each adjacent to the proposed units under Phase-I of the project at IB Thermal Power Station and the units have been working for the last fifteen years.

The Bidder shall acquaint himself by a visit to the site, 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 Buyer. All relevant site data /information as may be necessary shall have to be obtained/ collected by the Bidder.

2.00.00 APPROACH TO SITE

The project site is located at Banaharpalli in the Jharsuguda district of Orissa on the bank of Hirakud Reservoir and about 20 km south of Belpahar railway station and 40 km south west of Jharsuguda. The main Howrah-Mumbai railway line passes 20 km north of the plant (at Belpahar). NH-200 (Chandikhole to Raipur) and SH-10 (Sambalpur to Sundergarh) pass through Jharsuguda town.

OPGCL has a private railway siding connecting the plant to the Indian Railways network at Lajkura Railway station.

Nearest Airport – Bhubaneswar.

Nearest Seaport – Paradeep/ Haldia.

3.00.00 LAND

The total land proposed to be required (around 40 Ha) taking into account the locations of various facilities and plant auxiliaries for units 3 & 4 under IB Thermal Power Station 2 x 660 MW units 3 & 4 and also future 2 x 660 MW will be as per the Plot Plan enclosed in Volume II-L. Land for the proposed units have already been acquired and Power block area is fairly flat land sloping towards South to South -West with contour variation from RL 204.00 M to RL 199.00 M. The Bidder shall accommodate equipment offered under this specification generally within the spaces allocated for such equipment in the Plot Plan. Specific approval from Consultant shall be taken by the Bidder prior to any revision or relocation.

4.00.0 **SOURCE OF COAL**

Coal will be the primary fuel for the proposed project. OPGC has been allotted with two coal blocks (Manoharpur and Dip-side of Manoharpur) in IB valley area with an estimated total reserve of 531.68 Million Metric Tons for captive use of the projects. Manoharpur coal block has been explored fully and has net geological reserves of 181.68 Million Metric Tons and Dip side of Manoharpur (Regionally explored) has geological reserves of 350 Million Metric Tons approximately.

Manoharpur Coal Block is about 45 Km away from Sundargarh Town along Sundargarh – Hemgiri road which passes near the block. It is also connected by black top road with two important towns of Orissa viz. Rourkela (145 Km) and Jharshuguda (75 Km). The nearest Railway station is Hemgiri, lying on the Mumbai – Howrah main line and is about 20 Km away from Manoharpur Block. Coal from the mine to the power plant will be transported by dedicated merry-go-round rail system.

5.00.00 **SOURCE OF WATER**

Water is drawn from the Hirakud reservoir through a 5.45 Km intake channel. The reservoir has a catchment area of 83.395 sq.km. with a current gross storage capacity of 7189 lakhs m^3. The project too will meet its water requirements from the Hirakud reservoir through the existing intake structure, which is sufficient to cater to the proposed project. The project had taken approval from the Water Resources Department of Orissa to draw 5400 m^3/hr of water from the reservoir, which will cater the requirement of Phase-I (existing 2 x 210 MW) and the proposed units of 2x660 MW.

The Power station will operate on semi open recirculating condenser cooling system using cooling towers. In addition all water conservation and recycling measures will be adopted to minimize requirement of make up water. The proposed project will adopt zero effluent discharge philosophy.

6.00.00 **ASH DISPOSAL AREA**

Not Used.

7.00.00 **METEOROLOGICAL DATA**

7.01.00 For the purpose of equipment design, the following Ambient Conditions / Meteorological data of site (Jharsuguda) shall be taken into consideration:-

Site elevation above MSL	:	199.5 M
Highest temp recorded	:	48.0 °C.
Lowest temp recorded	:	4.0 °C.
Monthly max. dry bulb temp	:	38.9 °C/28.0 °C/33.4 °C (Summer/winter/monsoon)

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Monthly min. dry bulb temp	:	25.4 °C/16.7 °C/26.8 °C (Summer/winter/monsoon)
Monthly max. wet bulb temp	:	23.9 °C/17.8 °C/25.5 °C (Summer/winter/monsoon)
Monthly min. wet bulb temp	:	17.6 °C/13.4 °C/25.0 °C (Summer/winter/monsoon)
Maximum Relative Humidity	:	46% / 67% / 87% (Summer/winter/monsoon)
Minimum Relative Humidity	:	21% / 33% / 87% (Summer/winter/monsoon)
Average relative Humidity	:	65%
Average Annual Rainfall	:	1460 mm.
Normal period of rain fall	:	June – September.
Heaviest rainfall in 24 hours	:	257.8 mm
Wind direction	:	South West – North East.
Basic Wind Speed at 10 m Height	:	44 m/sec as per IS:875 Part-3 (1987).
Seismic Zone	:	Zone III as per IS:1893 Part-1 (2002).
Geographical location	:	At Latitude 21° 48' North and Longitude 83° 52' East.

SECTION – C1

SPECIFIC TECHNICAL REQUIREMENT - MECHANICAL

1. SCOPE:

The scope of this specification covers the basis of design, system description, equipment selection aspects and control philosophy for Oxygen dosing system for IB THERMAL POWER STATION, BANHARPALI, 2X660 MW UNIT 3 & 4 .The above system shall be skid mounted. Two numbers skid per unit shall be provided for oxygen dosing system for each unit (one skid for dosing at CPU outlet and one skid for dosing at deaerator outlet).

1.1 SCOPE OF SUPPLY FOR BIDDER

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

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

i. Entire Oxygen dosing system mounted on skid (including one bank of cylinders (containing two cylinders) as per P&ID and Data Sheet-A Instrumentation (minimum) as per the enclosed P&ID.
ii. Mandatory spares.
iii. Start-up and commissioning spares as required.
iv. All flanges & counter flanges to interconnect the pipes.
v. Racks (2 Nos.) each to hold 34 cylinders.
vi. Oxygen cylinders (68 Nos.).
vii. Injector assemblies (8 nos.).
viii. Tees (20 nos.) & Elbows (20 nos.).
ix. Loose tubing (400 meter).
x. Compression fittings (74 nos.) for loose tubing.
xi. Foundation nuts & bolts to fix each skid on the floor, as required.

1.2 SCOPE OF SERVICE

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

i. Supervision of Commissioning.

1.3 CIVIL SCOPE

Nil.

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

(Refer drg no. PE-DG-391-154-12000A-A501)

Each skid of Oxygen Dosing System consists of the following:

a) One bank of oxygen cylinder with two cylinders in bank for dosing at downstream of deaerator/CPU outlet.
b) Two number of Pressure Regulator as per section D1 and data sheet - A
c) Associated Piping, valves, fitting as indicated in the P&ID of oxygen dosing system and data sheet-A enclosed and as required to make the system complete.
d) Control & instrumentation as per P&ID of oxygen dosing system, data sheet-A, Section D1, C3 and D3.

3. MANDATORY SPARES

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

4. COMMISSIONING SPARES

Commissioning spares if deemed necessary by the bidder for commissioning of the skids shall be supplied by the bidder as a part of base offer. List of commissioning spares quoted for and individual price break up of the same shall be submitted separately.

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

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.
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 and Mass flow controller shall be directly connected by BHEL.

6. PAINTING:

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

7. PACKING:

To prevent damage to the equipment of the skid during transit, wooden / angle iron / steel frame supports to be provided wherever required. Special attention shall be provided while packing and loading for overhead equipment. Packing and transport instructions are enclosed in section D1.

8. DESIGN/CONSTRUCTION:

a) In addition to the requirements of Section-C & D the following shall also be complied under scope of this specification: The P&ID is enclosed herein in this section for bidder's compliance.

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 high points on any, piping or instrumentation will be vented and provided with valve. All low points on any, tanks, pumps, piping or instruments will be drained and provided with valve.

e) All valves and instruments will be located such that they are easily accessible during normal operation and maintenance.

f) All the terminal points shall be easily accessible and towards one side of skid.

g) All equipments shall have name plate clearly indicating the equipment name.

h) Pipe fittings of the system shall be done using elbows and tees. Pipe bending is not acceptable.

i) All the terminal points where flange joints are involved, bidder shall terminate it along with matching counter flange, nuts, bolts, gaskets etc.

j) KKS codes for all drives and instruments for the project have to be followed.

k) All JBs shall be mounted in their respective dosing skids only.

l) 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.

m) All cylinders supplied should conform to "Gas Cylinder Rules, 2004" and CCE license for the same shall be arranged by the bidder.

n) All the equipments, 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.

9. QUALITY PLAN AND SUB VENDOR APPROVAL

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

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

10. DRAWINGS/DOCUMENTATION

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

a) Deviations (if any) in given format only.
b) Un Price Schedule duly filled.
c) Compliance cum confirmation schedule.

Bidder to note that if bidder has taken any deviation from the technical specification requirements, the same shall be clearly mentioned in the bid in the BHEL prescribed format of Schedule of Deviations attached as Volume - III of this technical specification.
No other technical document is required along with bidder's offer. Any other document submitted by bidder shall not be evaluated by BHEL and shall be considered as withdrawn.

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

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

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

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

Bidder confirmed drawings submission schedule as follows:

a) Drawing/documents submission schedule: First submission of basic drawings/ documents – (P&ID, GA drawings and foundation details and Quality plan) shall be within 3 weeks from the date of LOI.

b) Every revised submission incorporating comments – within 7 days.

c) BHEL shall provide observation / approval within 03 weeks from the date of document submission by bidder.

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

ANNEXURE-I

SNO	BHEL DRG NO	DRG TITLE	No. of weeks for document submission after placing LOI/PO	Document size
1	PE-VO-391-154-12000A-A001	P&ID for Oxygen Dosing System	3	A3
2	PE-VO-391-154-12000A-A002	GA drawing and foundation detail for Oxygen Dosing System	3	A3
3	PE-VO-391-154-12000A-A003	Technical Data sheet for Oxygen Dosing System	4	A4
4	PE-VO-391-154-12000A-A004	QAP for Oxygen Dosing System along with sub vendor list	3	A4
5	PE-VO-391-154-12000A-A005	Junction Box Termination drawings for Oxygen Dosing System	5	A3
6	PE-VO-391-154-12000A-A006	Erection procedure	6	A4
7	PE-VO-391-154-12000A-A007	Engineering BOQ	10	A4
8	PE-VO-391-154-12000A-A008	O&M Manual along with catalogue for Oxygen Dosing System	20	As applicable

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

a) Storage instructions

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

a. Internet explorer version – Minimum Internet Explorer 7

b. Internet speed – 2 mbps (Minimum preferred)

c. Pop ups from our external DMS IP (124.124.36.198) should not be blocked

d. Vendor's Internal proxy setting should not block DMS application's link *(http://124.124.36.198/wrenchwebaccess/login.aspx)"*

e. DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.

f. For quick access bidder may refer the link ***http://bhelpem.com/DMSManuals/DMSManuals.html***

NOTE:-

a) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier

b) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

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

11.0 SPARES

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

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

c. All spares supplied will be new and in accordance with the contract document and will be free from defects in design, material and workmanship.

d. In case of any failure in the original component/equipments due to faulty designs, materials and workmanship, the corresponding spare parts if any, supplied will be replaced without any extra cost to the BHEL and customer unless a joint examination and analysis by BHEL and/or customer of such spare parts prove that the defect found in the original part that failed can safely be assured not to be present in spare parts.

e. 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.

f. 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.

g. 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.

h. The vendor will indicate the delivery period of the spares, which the BHEL and the customer may procure in accordance with this clause.

i. In case of emergency requirements of spares, the vendor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.

j. In case the vendor fails to supply the mandatory or long term or any other kind of spares on the terms stipulated above, the BHEL and the customer shall be entitled to purchase the same from the alternate sources at the risk and the cost of the vendor and recover from the vendor, the excess amount paid by the BHEL and the customer over the rates as per the contract. In the event of such risk purchase by the BHEL or the customer, the purchases will be as per the works and procurement policy of the BHEL and the customer prevalent at the time of such purchases and BHEL & the customer at his option may include a representative from the vendor in finalizing the purchases.

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

12.0 MISCELLENEOUS REQUIREMENTS

a) 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.

b) In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

c) Latest version of all codes and standards to be followed.

d) Bidder to follow KKS numbering for this project.

e) Skid El 0.0 should be equal to 0.1 m plus TG hall FFL. This should be taken care in GA drawing.

f) Billing break up (BBU) of Oxygen Dosing System should be equal to Bill of Quantity (BOQ) of the same.

g) For detailed dispatch instructions, Bidder to refer special condition of contract (SCC) of the project.

ANNEXURE II

DRAWING DOCUMENTS SUBMISSION PROCEDURE

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

DRAWINGS/DOCUMENTS DISTRIBUTION LIST (as applicable)

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

S.N.	Drawings and documents	Soft and Hard Prints
1.0	DRAWING FOR APPROVAL	
1.1	For approval	Soft+2 Hard Print
1.2	For customer approval	Soft+2 Hard Print
1.3	For final distribution	Soft+2 CD +5 Hard Print
2.0	DRAWING FOR REFERENCE	
2.1	For reference	Soft+2 Hard Print
2.2	For final distribution	Soft+2 CD+5 Hard Print
3.0	CERTIFICATE, REPORTS ETC.	Soft+2 Hard Print
4.0	AS BUILT DRAWINGS (IF REQUIRED)	Soft+2 CD+8 Hard Print
5.0	O&M MANUAL	
5.1	Draft for approval	Soft +3 CD+ 5 Hard Print
5.2	For final distribution	Soft +3 CD + 8 Hard Print
6.0	QUALITY PLAN / Field quality plan / PG test	Soft + 2 Hard Print

NOTES:

- The above schedule of submission does not include Docs/Drgs. of quality assurance/inspection and delivery/dispatches.
- Quantity of prints may change during detailed engineering stage based on BHEL / Customer requirement. However the same will be adhered by the bidder without any delivery/commercial implication to BHEL.

DATA SHEET-A

Sl. No	Description	Parameter
Mechanical Items		
1.0	No. of skid(s)for project	FOUR (Two per units)
2.0	**Cylinders:**	
2.1	Quantity mounted on skid	Two per skid (Total eight)
2.2	Loose supply of filled Oxygen cylinders	34 loose on a rack for entire station
2.3	Design Standard of empty oxygen cylinder	IS-7285
2.4	MOC of cylinder	Chrome Moly Steel
2.5	Water Capacity	50 liters
2.6	Gas Capacity	10 m3
2.7	Max Working pressure at $15^{O}C$	204 Kgf/cm2
2.8	Painting of oxygen cylinder	As per IS 4379
2.9	Accessories	Two numbers (one per unit) Cylinder storing rack (MS), each with capacity to hold 34 cylinders.
3.0	**All Tubing:**	
3.1	Material	ASTM A213/269 GR TP 316 SCH 40 (seamless)
3.2	Diameter	15 NB (1/2" OD)
4.0	**Ball valves**	
4.1	Body, Bonnet, stem	ASTM A182 Gr. TP 316
4.2	Trim Material	SS 316
4.3	Design standard	MSS-99-2010 / equivalent
4.4	Test standard	MSS-99-2010 / equivalent
4.5	Size	15 NB
4.6	End Connections	FERRULED ANSI B 16.11
4.7	Rating	----Class ASA 800 ----
4.8	Valve operation	Manual
5.0	**Check valves/ NRV**	
5.1	Body, cover, disc/piston & seat	ASTM A182 Gr. TP 316
5.2	Design standard	MSS-99-2010 / equivalent
5.3	Test standard	MSS-99-2010 / equivalent
5.4	Size	15 NB
5.5	End Connections	FERRULED ANSI B 16.11
5.6	Rating	----Class ASA class ASA 800----
5.7	Valve operation	Manual
6.0	**Pressure relief valve**	
6.1	Type	Spring loaded, angle type
6.2	Body, bonnet, disc & nozzle	SS 316
6.3	Valve discharges to	Atmosphere (vent)
6.4	Back pressure	Constant
6.5	Set pressure	60 Kg/cm2 (g) for skid 1 and 35 Kg/cm2 (g) for skid 2
6.6	Inlet Connections	15 NB, Flanged/threaded, ANSI B16.5, 400# for skid at CPU outlet and 300# for skid at de aerator outlet
6.7	Outlet Connections	15 NB, Flanged/threaded, ANSI B16.5, 150#
7.0	**Fittings**	Stainless steel to A276 or A479 F316, Dimension to ANSI B 16.11 FERRULED ends.
8.0	**Pressure Regulator**	
8.1	Quantity	Two per skid (total 8), each mounted to an oxygen cylinder
8.2	Body & trim	SS 316/Brass
8.3	Inlet connection	1/2 "
8.4	Outlet connection	1/2 "
8.5	Operating pressure	204 Kg/cm2(g)
8.6	Set outlet Pressure	55 Kg/cm2(g) for skid dosing at CPU outlet and 30 Kg/cm2(g) for skid dosing at deaerator outlet
9.0	**Flanges**	SS 316, ANSI B 16.5 400# for skid at CPU outlet and 300# for skid at de aerator outlet
10.0	**Structural steel**	IS 2062
11.0	**Nuts & bolts**	SS 304
12.0	**Mass Flow Controller (MFC)-REF. NOTE-3**	
12.1	Expected flow of oxygen in process	50-450 GM/hr (for skid dosing at deaerator outlet) & 40-350 GM/hr. (for skid dosing at CPU outlet)
12.2	MOC-Wetted part	SS 316, ANSI B 16.5 CL 400
12.3	Operating Pressure	Pressure reducing valve set pressure (refer PID)

13.0	**Compression fittings**	
13.1	Quantity	74 Nos.
13.2	MOC	SS-316

Note:-

1. All the equipments, instruments, hoses, valves, fittings and tubing coming in contact directly with oxygen shall be oxygen cleaned and certified to be fit for use in oxygen application.
2. All cylinders supplied should conform to “Gas Cylinder Rules, 2004” and CCE license for the same shall be arranged by the bidder.
3. Separate mass flow transmitter & flow control valve instead of ,a single mass flow controller can also be offered.

LIST OF MANDATORY SPARES

Item S.No.	DESCRIPTION OF EQUIPMENT / ITEM	QTY. FR TWO UNITS
(1)	(2)	(3)
1.0	**Mandatory Spares as per the following details:- (As Applicable)**	
1.0	Electronic Transmitters (Differential Pressure,Level,Speed etc.) all types	2 (Two) nos. complete set for each type and model/range used in the system.
2.0	Pressure Transmitters	2 (Two) nos.
3.0	**Solenoid Valve**	
3.1	Complete Solenoid Valve Assembly	4 Nos. for each type and rating used in the system
3.2	Coil (single or double coil type)	10% of total nos. used in the system or minimum 10(Ten) Nos. whichever is more for each type and rating.
4.0	Gauge (Differential Pressure, Temperature, Level)	10% of total nos. used in the system or minimum 2(Two) nos. whichever is more for each type and range.
5.0	Pressure Gauge with needle valve	2 (Two) nos.

LIST OF SUB VENDORS (INDICATIVE)

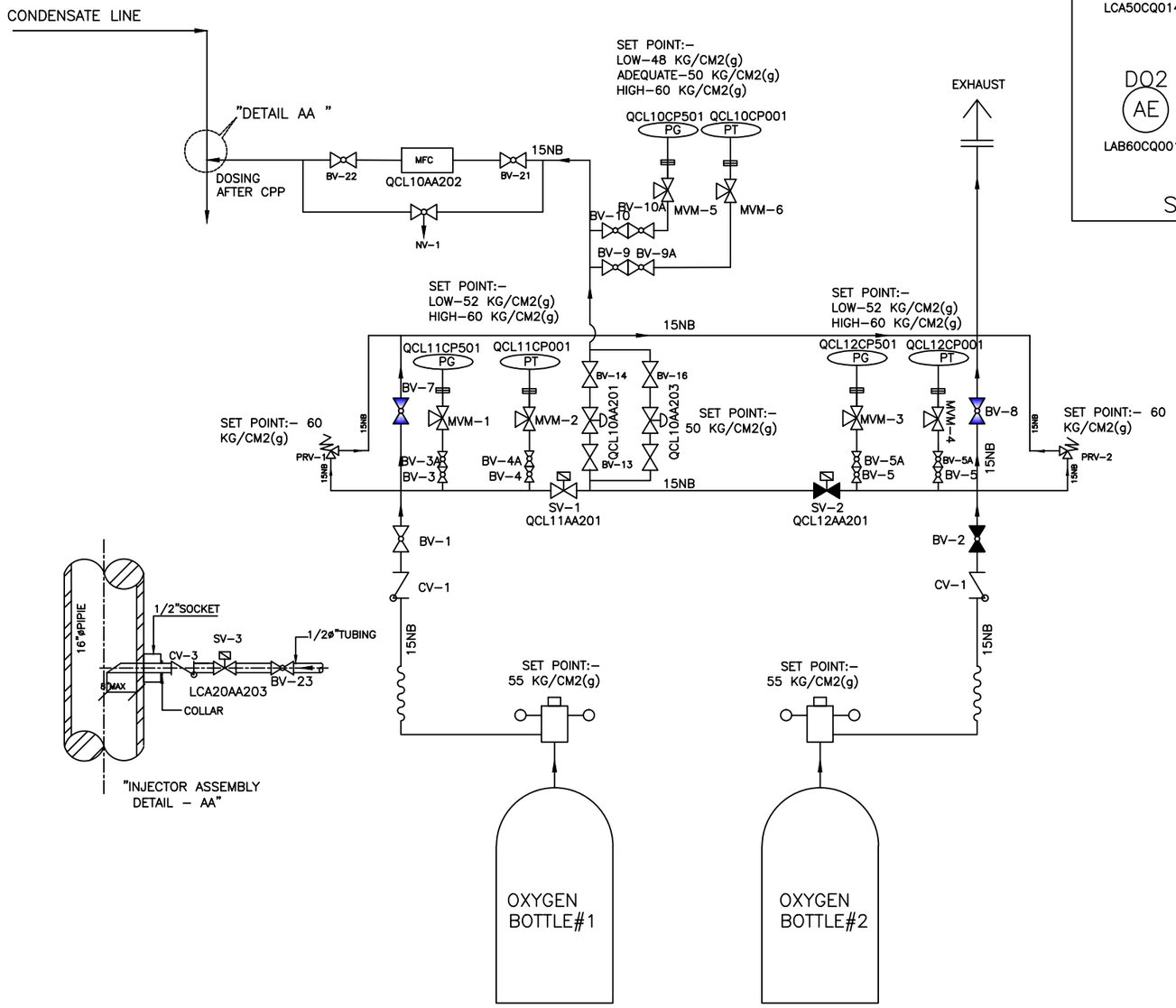
S. No.	ITEM	APPROVED SUPPLIERS		REMARKS
1.	EMPTY OXYGEN CYLINDER	KANTO EVEREST / MARUTI KOATSU CYLINDERS		
2.	CHECK VALVE	SWAGELOK / HAMLET / PARKER		
3.	BALL VALVE	SWAGELOK / HAMLET / PARKER		
4.	3 WAY VALVE MANIFOLD	EXCEL HYDRO / BY ORIGINAL MANUFACTURER		
5.	TUBING	SWAGELOK / HAMLET / PARKER / SANDVIK		
6.	FITTINGS	SWAGELOK / HAMLET / PARKER / SANDVIK		
7.	SOLENOID VALVE	ROTEX / HERION / ASCO		
8.	PRESSURE REDUCING cum REGULATING VALVE/PRESSURE REGULATOR	TESCOM, SWAGELOK		
9.	NEEDLE VALVE	SWAGELOK / HAMLET / PARKER		
10.	PRESSURE GAUGE	A N INSTRUMENTS PVT LTD,	KOLKOTTA,	
		GENERAL INSTRUMENTS CONSORTIUM,	GOA/MUMBAI	
		GOA THERMOSTATIC INSTRUMENTS,	GOA	
		FORBES MARSHALL LTD,	HYDERABAD	
		PRECISION INDUSTRIES,	AHMADABAD	
		WAAREE INDUSTRIES,	MUMBAI	
		WALCHAND INDUSTRIES LTD.,	DHARWAD	
		H.GURU INSTRUMENS (SOUTH INDIA),	B'LORE	
		ODIN	, AHMADABAD / CHENNAI	
		GLUCK,	MUMBAI	
		WIKA	, INDIA	
		ASHCROFT INDIA (earlier PRECISION INDUSTRIES,	AHMADABAD)	
		MANOMETER,	MUMBAI	
11.	PRESSURE SAFETY VALVE	SWAGELOK / HAMLET / PARKER		
12.	PRESSURE TRANSMITTER	EMERSON PROCESS (formerly FISHER ROSEMOUNT),	USA / DAMAN	
		ABB, GERMANY/	FARIDABAD	
		FUJI,	JAPAN	
		HONEYWELL,	USA/ PUNE	
		YOKOGAWA, JAPAN(YOKOGAWA INDIA LTD,	BANGALORE	

		DRESSER MASONIELAN,	FRANCE.	
		ECKARDT,	GERMANY	
		ENDRESS & HAUSER GMBH & CO,	GERMANY	
		YAMATAKE	,JAPAN	
		MIL CONTROLS LIMITED	,KERALA	
		LEVCON INSTRUMENTS (P) LTD,	KOLKATA	
		KROHNE MARSHALL LTD ,	PUNE	
13.	MASS FLOW CONTROLLER	BROOK'S (EMERSON)		
14.	CYLINDER REGULATOR	TESCOM, SWAGELOK		
15.	STRUCTURAL SKID	SELF-MAKE OF MAIN VENDOR		AS APPLICABLE
16.	ENCLOSURE FOR JB	RITTAL		
17.	LUGS	DOWELL / 3D / CHETNA		
18.	CABLES	TORENT / ICL / UCL / POLYCAB		
19.	PAINT	BERGER PAINTS / ASIAN PAINTS / SHALIMAR PAINTS / JENSON & NICOLSON / GUNJAN PAINT		
20.	FILLING OF OXYGEN CLINDER	FILLING OF EMPTY CYLINDERS MAY BE DONE FROM ANY CCE LICENSED OXYGEN GAS FILLER		AS APPLICABLE
21.		GE RHEONIK		
22.	CONTROL VALVE WITH ACTUATOR	IL / DRESSER MASONILAN / CCI / NIPPON FISHER / FISHER CONTROLS (EMERSON) / COPES VULCAN / MIL CONTROLS / DRESSER VALVES INDIA PVT LTD		
23.	JUNCTION BOX	AJMERA INDUSTRIAL & ENGIN / BALIGA LIGHTING EQUIPMENT / DEVI POLYMERS / ELECTROMAC INDUSTRIES / KS INSTRUMENTS PVT LTD / MANISHA ENTERPRISE / SHRENIK & COMPANY / SUCHITRA INDUSTRIES		

Notes:-

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

P&ID OF
OXYGEN DOSING SYSTEM



CC
AE
LCA50CQ014

AT THE OUTLET OF CONDENSATE POLISHING UNIT (PLEASE REFER P&ID OF CONDENSATE SYSTEM (PE-DG-391-100-N106 ZONE E14).

DQ2
AE
LAB60CQ001

AT THE OUTLET OF ECONOMIZER INLET (PLEASE REFER P&ID OF FEED WATER SYSTEM (PE-DG-391-100-N105 ZONE 11L).

SWAS PANEL SCOPE

LEGEND

	PRESSURE REDUCING CUM REGULATING VALVE
	NEEDLE VALVE
PT	PRESSURE TRANSMITTER
	SOLENOID ACTUATED VALVE
PG	PRESSURE GAUGE
	NON RETURN VALVE/CHECK VALVE
	MASS FLOW CONTROLLER
	BALL VALVE
	PRESSURE REGULATOR
	PRESSURE SAFETY VALVE
	DISCHARGE TO ATMOSPHERE
	MULTI-VALVE MANIFOLD(SEE NOTES)
	CHEMICAL SEAL DIAPHRAGM

NOTES: -

1 THE ENTIRE SYSTEM INCLUDING THE JUNCTION BOX SHALL BE SKID MOUNTED.
2 ONE NUMBER SKID FOR ENTIRE STATION SHALL BE PROVIDED FOR DOSING AT CPU OUTLET.
3 ONE NUMBER INJECTION ASSEMBLY FOR ENTIRE STATION SHALL BE SUPPLIED LOOSE.
4 ALL THE VALVES SHALL BE OF SS 316, 800 CLASS SW.
5 ALL TUBING SHALL BE OF SS 316, 15 NB AND SCH 80.
6 30 M OF TUBING FOR ENTIRE STATION OF SAME SPECIFICATION SHALL BE LOOSE WITH THE SKID,
7 ALL THE MULTI VALVE MANIFOLD SHALL BE 3-WAY VALVE MANIFOLDS.
8 ALL FIELD INSTRUMENTS(PRESSURE AND FLOW TRANSMITTERS), AND SOLENOID VALVES(SV1 & 2 ONLY) SHALL BE TERMINATED AT THE JB.

P&ID FOR OXYGEN DOSING SYSTEM
(FOR DOSING AT CPU OUTLET)

PROJECT: IB THERMAL POWER STATION, BANHARPALI
2 x 660 MW UNITS 3&4

OWNER: ODISHA POWER GENERATION CORPORATION LIMITED

OWNER'S CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI CHENNAI NEW DELHI

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

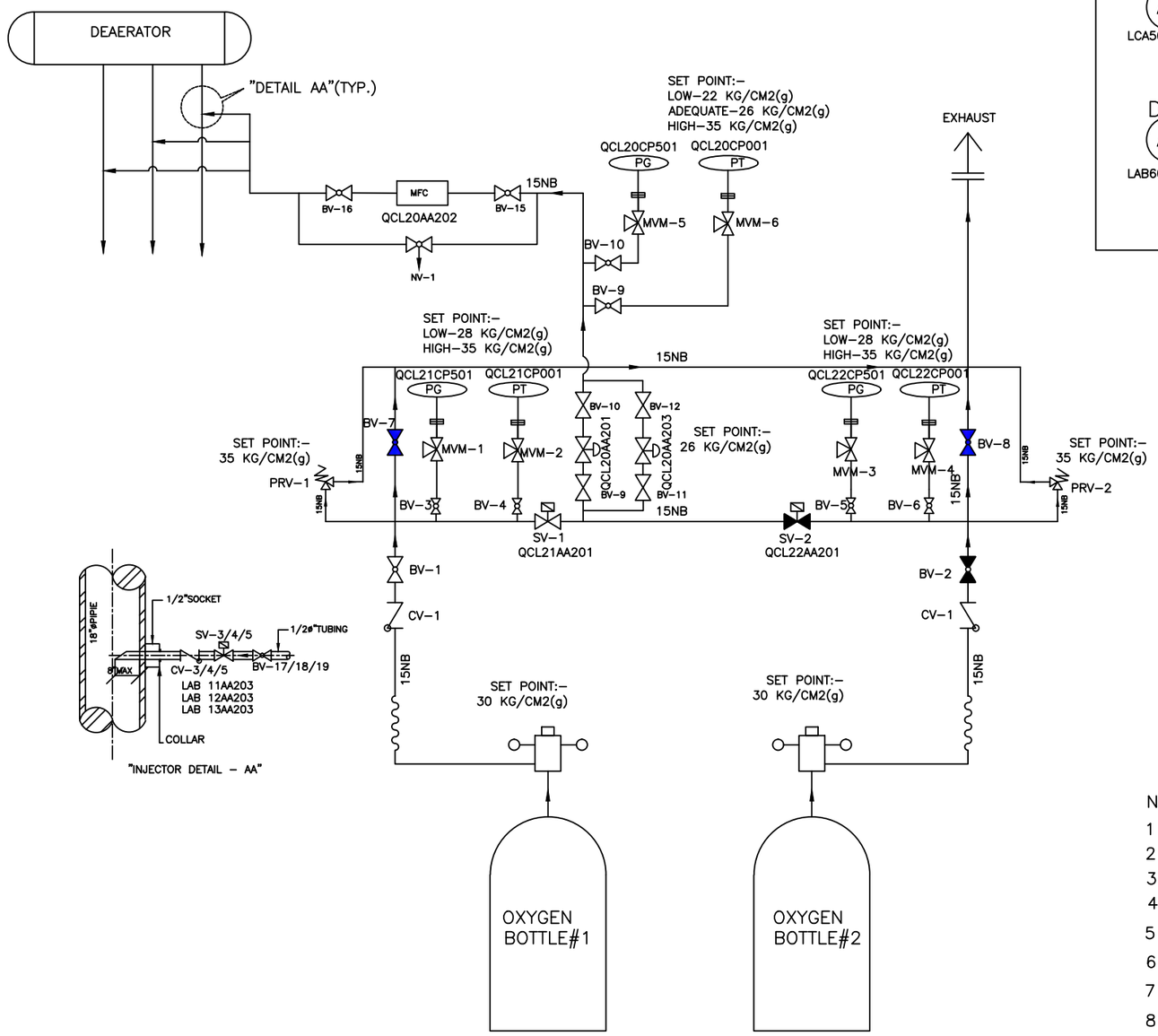
JOB NO.	391
STATUS	CONTRACT
DISTRIBUTION	

REV.	DATE	ALTD	CHD	APPD

DEPT CODE		NAME	SIGN	DATE
M	DRN	VK		
	DESN	VK		
	CHD	FS		
	APPD	SB		

TITLE: P & ID FOR OXYGEN DOSING SYSTEM (FOR CPU OUTLET)

DEPT. | SCALE | DRAWING NO. PE-DG-391-154-A501
SIGN | SHEET 01 OF 02 | REV. 00
SIZE-A0



CC
AE
LCA50CQ014

AT THE OUTLET OF CONDENSATE POLISHING UNIT (PLEASE REFER P&ID OF CONDENSATE SYSTEM (PE-DG-391-100-N106 ZONE E14).

DO2
AE
LAB60CQ001

AT THE ECONOMIZER INLET (PLEASE REFER P&ID OF FEED WATER SYSTEM (PE-DG-391-100-N105 ZONE 11L).

SWAS PANEL SCOPE

LEGEND

	PRESSURE REDUCING CUM REGULATING VALVE
	NEEDLE VALVE
PT	PRESSURE TRANSMITTER
	SOLENOID ACTUATED VALVE
PG	PRESSURE GAUGE
	NON RETURN VALVE/CHECK VALVE
	MASS FLOW CONTROLLER
	BALL VALVE
	PRESSURE REGULATOR
	PRESSURE SAFETY VALVE
	DISCHARGE TO ATMOSPHERE
	MULTI-VALVE MANIFOLD(SEE NOTES)
	CHEMICAL SEAL DIAPHRAGM

NOTES:-

1 THE ENTIRE SYSTEM INCLUDING THE JUNCTION BOX SHALL BE SKID MOUNTED.
2 ONE NUMBER SKID FOR ENTIRE STATION SHALL BE PROVIDED FOR DOSING AT DEAERATOR OUTLET.
3 THREE NUMBERS INJECTION ASSEMBLY FOR ENTIRE STATION SHALL BE SUPPLIED LOOSE.
4 ALL THE VALVES SHALL BE OF SS 316, 800 CLASS SW.
5 ALL TUBING SHALL BE OF SS 316, 15 NB AND SCH 80.
6 80 M OF TUBING FOR ENTIRE STATION OF SAME SPECIFICATION SHALL BE LOOSE WITH THE SKID,
7 ALL THE MULTI VALVE MANIFOLD SHALL BE 3-WAY VALVE MANIFOLDS.
8 ALL FIELD INSTRUMENTS(PRESSURE AND FLOW TRANSMITTERS), AND SOLENOID VALVES(SV1 & 2 ONLY) SHALL BE TERMINATED AT THE JB.

P&ID FOR OXYGEN DOSING SYSTEM
(FOR DOSING AT DEAERATOR OUTLET)

PROJECT: IB THERMAL POWER STATION, BANHARPALI
2 x 660 MW UNITS 3&4

OWNER: ODISHA POWER GENERATION CORPORATION LIMITED

OWNER'S CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI CHENNAI NEW DELHI

JOB NO. 391
STATUS CONTRACT
DISTRIBUTION

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

REV.	DATE	ALTD	CHD	APPD

DEPT CODE		NAME	SIGN	DATE
M	DRN	VK		
	DESN	VK		
	CHD	FS		
	APPD	SB		

TITLE: P & ID FOR OXYGEN DOSING SYSTEM (FOR DEARATOR OUTLET)

DEPT. | SCALE 1:100 | DRAWING NO. PE-DG-391-154-A501
SIGN | SHEET 02 OF 02 | REV. 00
SIZE-A0

SECTION – C2

SPECIFIC TECHNICAL REQUIREMENT – ELECTRICAL

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure–I to Section – C2 [Scope of Work (Electrical)].

1.2 Make of various equipment/ items in the scope of bidder shall be to approval of owner during detailed engineering stage without any commercial implications.

1.3 Bidder shall furnish all AC as well as DC loads required for the system at different voltage levels (eg. 415V AC, 240 V AC, 220 V DC etc.) of all types, such as motor feeders, supply feeders in PEM format along with the offer, as applicable.

1.4 All electrical equipment shall be suitable for the power supplies, fault levels and climatic conditions indicated in project information enclosed with the specification.

1.5 All drawings, data sheets, Quality Plan, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage as per formats enclosed. The same shall be subject to approval without any commercial implications.

1.6 Technical requirements shall be as per specifications listed in Clause 4.1, 4.2 & 4.3 below.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

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

a) A copy of this sheet “Electrical Equipment Specification for OXYGEN DOSING SYSTEM’ and sheet “Electrical Scope between BHEL and Vendor” with bidder’s signature and company stamp.
b) List of Erection and Commissioning spares.
c) List of Erection & Maintenance tools & tackles.
d) Electrical load requirement in the load data format.

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

4.0 LIST OF ENCLOSURES

4.1 Electrical scope between BHEL & vendor (Annexure-I).
4.2 Load data format (Annexure-II).

ANNEXURE – I

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PROJECT: 2 X 660MW BANHARPALLI TPP **PACKAGE: OXYGEN DOSING SYSTEM (MAUX)**
FOR SKID MOUNTED SYSTEM

REV: 0 DATE: 08/05/14

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

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ANNEXURE-II																		

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (dc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

BHEL VM	LOAD DATA (ELECTRICAL)	JOB NO.	391	ORIGINATING AGENCY	PEM (ELECTRICAL)
		PROJECT TITLE	2 X 660MW BANHARPALLI TPP	NAME	DATA FILLED UP ON
		SYSTEM	OXYGEN DOSING SYSTEM	SIGN.	DATA ENTERED ON
		DEPTT. / SECTION	ELECTRICAL	SHEET 1 OF 1 REV. 00	DE'S SIGN. & DATE

SECTION – C3

SPECIFIC TECHNICAL REQUIREMENT (CONTROL & INSTRUMENTATION)

SECTION-C

Specific Technical Requirements (C&I)

1.1 Control & Instrumentation for Oxygen Dosing system is in bidder scope of supply.

1.2 **OXYGEN DOSING SYSTEM** control shall be realized in BOP-DCS (BHEL Supply).

1.3 Bidder to supply the field instrumentation as required / shown in the P&ID.

1.4 Field Instruments shall be housed / grouped suitably.

1.5 The detailed specification of instruments, JB, control panel are given in detail as below.

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 in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

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

- GA Drawing.
- Field instruments data sheet.
- JB grouping document.
- Instrument schedule.
- Recommended Control write-up
- Any other document decided during detailed engineering.

1.8 Measuring instruments / equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment. The instrumentation vendor shall be subject to BHEL's / customer's approval. Further, all instruments shall be of proven reliability, accuracy, repeatability requiring a minimum of maintenance. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, makes / numbers as approved by BHEL / customer during detailed engineering.

1.9 Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

1.10 All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments.

1.11 BHEL shall provide 240V supply for Mass Flow Controller.

1.12 SOVs shall be suitable for 240V AC/24V DC.

1.13 20% Spare terminals shall be provided on JBs.

SECTION – D1

GENERAL TECHNICAL REQUIREMENT – MECHANICAL

1.0 **SCOPE:**

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

2.0 DESIGN BASIS:

- Design Calculation for the systems.
- P&I diagram for Oxygen dosing system (part of this document)
- DATA SHEET – A for Oxygen dosing system (part of this document)

3.0 DESIGN PHILOSOPHY:

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

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

The following philosophy of chemical feed system is considered:-

a) During normal operation:-

- pH is maintained at 8.2-8.5 by dosing aqueous ammonia solution.
- Oxygen dosing rate recommended by BHEL is 30-150 ppb. Exact dosing rate shall be decided by the operator. For sizing of oxygen dosing system, 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 each unit. However, dosing shall be done at one place at a time only.
- Dosing rate shall be controlled from DCS by regulating mass flow controller (MFC) provided on each O2 dosing skid under full load conditions based on dissolved oxygen level at economizer inlet (LAB60CQ001). Oxygen dosing rate can be adjusted in the range of 30-150 ppb from DCS. However, customer may also chose to manually feed a particular set point within this range and operate the oxygen dosing automatically based on this set point.
- The oxygen dosing shall automatically turn off by closing the mass flow controller (MFC) if cation conductivity(LCA50CQ014) at CPU Outlet in the cycle goes above 0.3 us/cm. The tapping point of the cation conductivity is at CPU outlet(refer zone 14E in the P&ID of Condensate system-PE-DG-391-100-N106)

b) Start up sequence:-

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

c) Shut down sequence:-

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

4.0 Equipment for Oxygen Dosing (Two skids per unit, Total 4 Nos. for station)

As mentioned, four oxygen dosing skids shall be supplied for entire station. Each skid shall be identical unless specifically mentioned otherwise. Since per unit only one skid of the two shall be under operation at a time, the cylinder storage for the all the skids shall be common located at the

vicinity of the oxygen dosing skids. Each skid shall consist of the following components:-

4.1 Cylinder banks

Each oxygen dosing skid shall consist of a bank of two oxygen cylinders, dosing at downstream of deaerator/CPU outlet. Oxygen cylinder bank is provided to cater daily requirement. The automatic change-over of cylinder takes place on the basis of pressure i.e. the cylinder banks dosing at Condensate Polishing Unit (CPU) outlet will switch over at 52 kg/cm2(g) and the cylinder banks dosing at deaerator outlet at 28 kg/cm2(g). Separate storage rack for 34 cylinders per unit shall be supplied to cater one month oxygen requirement.

4.2 Pressure Regulator:

The line pressure regulator is used for reducing a high supply pressure (204 bars cylinder pressure) to 55 kg/cm2(g) pressure in skid dosing at CPU outlet and to 30 kg/cm2(g) pressure in skid dosing at deaerator outlet.

4.3 Valves, tubing, vents and instrumentation shall be as per the attached P&ID (PE-DG-391-154-A501) and the data sheet. The MOC and specification of the equipments shall be as per the attached data sheet.

5.0 Control and Instrumentation:-

The mode of operation of the oxygen dosing system shall be from DCS only. All the logics, controls and interlocks shall be implemented in DCS. Local manual intervention is not envisaged. Both manual/automatic controls shall be implemented in DCS. The provision to select “Auto” or “Manual” mode shall be provided in DCS OWS only.
The oxygen gas shall be at high pressure (204 Kgf/cm2) in the cylinders. The same shall be brought to a lower pressure by the Pressure Regulator (set pressure of 55 Kgf/cm2 for skid dosing at CPU outlet and set pressure of 30 Kgf/cm2 for skid dosing at deaerator outlet attached with each cylinder.

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

Two cylinders provided on skid are connected and one cylinder will serve at a time, based on the pressure at the inlet of solenoid valve. In case the pressure at the inlet of SV1(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 shall be taken in to service provided the pressure at the inlet of SV2 (QCL12AA201,QCL22AA201for 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 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) {set point –“ADEQUATE--(Set points–50 kgf/cm2 for skid dosing at CPU outlet & pressure transmitter (QCL20CP001) {set point – “ADEQUATE--(26 kgf/cm2 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 controllers (QCL10AA 202 for skid dosing at CPU outlet and QCL20AA202 for skid dosing at dearator outlet) and from pressure transmitters (QCL10CP001 for skid dosing at CPU outlet & QCL20CP001 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 mass flow controller 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 DCS.

All solenoid valves mounted in the oxygen dosing skid shall be 24 VDC powered from DCS and routed through the local skid mounted junction box. 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 DCS.

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.

Note :-

1. **24 DC to MFCs shall be provided by BHEL.**
2. **Separate mass flow transmitter & flow control valve instead of ,a single mass flow controller can also be offered.**

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
During Normal Operation:-					
Pressure transmitter	PT (QCL11CP001)	60 Kg/cm2 (g) (HIGH)	Not applicable	Yes (HIGH pressure at cylinder 1 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter	PT (QCL11CP001)	52 Kg/cm2 (g) (LOW)	Close SV-1 & Open SV-2	Yes (LOW pressure at cylinder 1 outlet)	Auto-changeover of cylinders. Manually replace cylinder 1 with filled cylinder.
Pressure transmitter	PT (QCL12CP001)	60 Kg/cm2 (g) (HIGH)	Not applicable	Yes (HIGH pressure at cylinder 2 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter	PT (QCL12CP001)	52 Kg/cm2 (g) (LOW)	Close SV-1 & Open SV-2	Yes (LOW pressure at cylinder 2 outlet)	Auto-changeover of cylinders. Manually replace cylinder 2 with filled cylinder.
Pressure transmitter	PT (QCL10CP001)	48 Kg/cm2 (g) (LOW)	Close MFC	Yes (Oxygen dosing stopped due to low pressure)	
Pressure transmitter	PT (QCL10CP001)	60 Kg/cm2 (g) (HIGH)	Not applicable	Yes (HIGH dosing pressure)	Manual checking of pressure reducing valve reqd.
Pressure transmitter	PT (QCL10CP001)	50 Kg/cm2 (g) (Adequate)	Open Permissive pressure of MFC,	Not applicable	
Cation Conductivity analyzer	(SWAS PANEL SCOPE) (LCA50CQ014)	0.3 µs/cm (at 25˚C), increasing (HIGH)	Close MFC	Yes (Oxygen dosing stopped due to high cation conductivity in feed water cycle)	Increase ammonia pH set point to raise pH to 9.2-9.5 range
Dissolved oxygen analyzer	(SWAS PANEL SCOPE) (LAB60CQOO1)	30 ppb (LOW), decreasing	Gradually open MFC to increase DO provided signal from PT-3 is "NOT LOW" (i.e < 48 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 plant chemist during commissioning within the range of 30-150 ppb.
Dissolved oxygen analyzer	(SWAS PANEL SCOPE) (LAB60CQOO1)	150 ppb, increasing (HIGH)	Close MFC to decrease DO	Yes (Oxygen dosing stopped due to high DO level in feed water cycle)	
During Start up:-					
Cation Conductivity analyzer	(SWAS PANEL SCOPE) (LCA50CQ014)	0.15 µs/cm (at 25˚C), decreasing (ADEQUATE)	Open MFC , 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
During Normal Operation:-					
Pressure transmitter	PT (QCL21CP001)	35 Kg/cm2 (g) (HIGH)	Not applicable	Yes (HIGH pressure at cylinder 1 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter	PT (QCL21CP001)	28 Kg/cm2 (g) (LOW)	Close SV-1 & Open SV-2	Yes (LOW pressure at cylinder 1 outlet)	Auto-changeover of cylinders. Manually replace cylinder 1 with filled cylinder.
Pressure transmitter	PT (QCL22CP001)	35 Kg/cm2 (g) (HIGH)	Not applicable	Yes (HIGH pressure at cylinder 2 outlet)	Manual checking of pressure regulator reqd.
Pressure transmitter	PT (QCL22CP001)	28 Kg/cm2 (g) (LOW)	Close SV-2 & Open SV-1	Yes (LOW pressure at cylinder 2 outlet)	Auto-changeover of cylinders. Manually replace cylinder 2 with filled cylinder.
Pressure transmitter	PT (QCL20CP001)	22 Kg/cm2 (g) (LOW)	Close MFC	Yes (Oxygen dosing stopped due to low pressure)	
Pressure transmitter	PT (QCL20CP001)	35 Kg/cm2 (g) (HIGH)	Not applicable	Yes (HIGH dosing pressure)	Manual checking of pressure reducing regulating valve reqd.
Pressure transmitter	PT (QCL20CP001)	26 Kg/cm2 (g) (Adequate)	Open Permissive pressure of MFC	Not applicable	
Cation Conductivity analyzer	(SWAS PANEL SCOPE) (LCA50CQ014)	0.3 µs/cm (at 25˚C), increasing (HIGH)	Close MFC	Yes (Oxygen dosing stopped due to high cation conductivity in feed water cycle)	Increase ammonia pH set point to raise pH to 9.2-9.5 range
Dissolved oxygen analyzer	(SWAS PANEL SCOPE) (LAB60CQOO1)	30 ppb (LOW), decreasing	Gradually open MFC to increase DO provided signal from PT-3 is "NOT LOW" (i.e < 22 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 plant chemist during commissioning within the range of 30-150 ppb.
Dissolved oxygen analyzer	(SWAS PANEL SCOPE) (LAB60CQOO1)	150 ppb, increasing (HIGH)	Close MFC to decrease DO	Yes (Oxygen dosing stopped due to high DO level in feed water cycle)	
During Start up:-					
Cation Conductivity analyzer	(SWAS PANEL SCOPE) (LCA50CQ014)	0.15 µs/cm (at 25˚C), decreasing (ADEQUATE)	Open FCV, provided signal from PT-3 is "NOT LOW" (i.e < 22 Kg/cm2 (g)) & signal from DO analyzer is "NOT HIGH" (i.e > 150 ppb)	Yes (Oxygen dosing started)	

DATA SHEET – A

Sl. No	Description	Parameter
Mechanical Items		
1.0	No. of skid(s)for project	FOUR (Two per units)
2.0	**Cylinders:**	
2.1	Quantity mounted on skid	Two per skid (Total eight)
2.2	Loose supply of filled Oxygen cylinders	34 loose on a rack for entire station
2.3	Design Standard of empty oxygen cylinder	IS-7285
2.4	MOC of cylinder	Chrome Moly Steel
2.5	Water Capacity	50 liters
2.6	Gas Capacity	10 m3
2.7	Max Working pressure at $15^{O}C$	204 Kgf/cm2
2.8	Painting of oxygen cylinder	As per IS 4379
2.9	Accessories	Two numbers (one per unit) Cylinder storing rack (MS), each with capacity to hold 34 cylinders.
3.0	**All Tubing:**	
3.1	Material	ASTM A213/269 GR TP 316 SCH 40 (seamless)
3.2	Diameter	15 NB (1/2" OD)
4.0	**Ball valves**	
4.1	Body, Bonnet, stem	ASTM A182 Gr. TP 316
4.2	Trim Material	SS 316
4.3	Design standard	MSS-99-2010 / equivalent
4.4	Test standard	MSS-99-2010 / equivalent
4.5	Size	15 NB
4.6	End Connections	FERRULED ANSI B 16.11
4.7	Rating	----Class ASA 800 ----
4.8	Valve operation	Manual
5.0	**Check valves/ NRV**	
5.1	Body, cover, disc/piston & seat	ASTM A182 Gr. TP 316
5.2	Design standard	MSS-99-2010 / equivalent
5.3	Test standard	MSS-99-2010 / equivalent
5.4	Size	15 NB
5.5	End Connections	FERRULED ANSI B 16.11
5.6	Rating	----Class ASA class ASA 800----
5.7	Valve operation	Manual
6.0	**Pressure relief valve**	
6.1	Type	Spring loaded, angle type
6.2	Body, bonnet, disc & nozzle	SS 316
6.3	Valve discharges to	Atmosphere (vent)
6.4	Back pressure	Constant
6.5	Set pressure	60 Kg/cm2 (g) for skid 1 and 35 Kg/cm2 (g) for skid 2
6.6	Inlet Connections	15 NB, Flanged/threaded, ANSI B16.5, 400# for skid at CPU outlet and 300# for skid at de aerator outlet
6.7	Outlet Connections	15 NB, Flanged/threaded, ANSI B16.5, 150#
7.0	**Fittings**	Stainless steel to A276 or A479 F316, Dimension to ANSI B 16.11 FERRULED ends.
8.0	**Pressure Regulator**	
8.1	Quantity	Two per skid (total 8), each mounted to an oxygen cylinder
8.2	Body & trim	SS 316/Brass
8.3	Inlet connection	1/2 "
8.4	Outlet connection	1/2 "
8.5	Operating pressure	204 Kg/cm2(g)
8.6	Set outlet Pressure	55 Kg/cm2(g) for skid dosing at CPU outlet and 30 Kg/cm2(g) for skid dosing at deaerator outlet
9.0	**Flanges**	SS 316, ANSI B 16.5 400# for skid at CPU outlet and 300# for skid at de aerator outlet
10.0	**Structural steel**	IS 2062
11.0	**Nuts & bolts**	SS 304
12.0	**Mass Flow Controller (MFC)-Ref-Note-1**	
12.1	Expected flow of oxygen in process	50-450 GM/hr (for skid dosing at deaerator outlet) & 40-350 GM/hr. (for skid dosing at CPU outlet)

12.2	MOC-Wetted part	SS 316, ANSI B 16.5 CL 400
12.3	Operating Pressure	Pressure reducing valve set pressure (refer PID)
13.0	**Compression fittings**	
13.1	Quantity	74 Nos.
13.2	MOC	SS-316

Note:-

1. Separate mass flow transmitter & flow control valve instead of ,a single mass flow controller can also be offered.

TECHNICAL SPECIFICATION FOR

PAINTING

16.00.00 **PAINTING**

16.01.00 **General**

All exposed metallic and wooden surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the acceptance of the Buyer.

All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Buyer. The quality and supplier of the paints shall require acceptance of the Buyer.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the spray painting equipment.

If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat.

Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Buyer. Spray guns shall not be used outdoors in windy weather or near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment.

Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use.

Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

The Seller shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.

Shop primer for steel and iron surfaces which will have a continuous operating temperature below 35 Deg.C shall be selected by the Seller, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35 Deg.C.

The colour scheme shall be submitted during execution of contract for acceptance by the Buyer / Consultant.

16.02.00 **Preparation**

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying.

Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed.

The priming coat shall be applied without delay.

16.03.00 **Damaged Paintwork**

Any damaged paintwork shall be made good as follows:

a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.

b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.

c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

16.04.00 **Painting Systems**

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.

a) **Surfaces Subject To Weathering**

All surfaces shall have a minimum of four coats of paint made up as follows :

Primer coat	:	30 micron DFT
Tie coat	:	30 micron DFT
Finishing coat (2 Nos.)	:	20 micron DFT per coat

The total minimum DFT shall be 100 micron.

b) **Surfaces Inside Buildings**

All surfaces shall have a minimum of three coats of paint made up as follows:

Primer coat	:	30 micron DFT
Tie coat	:	30 micron DFT
Finishing coat (2 Nos.)	:	20 micron DFT per coat

The total minimum DFT shall be 100 micron.

The type and colour of primer & finish coat shall be selected by the Seller after approval by the Buyer.

For detail painting on building & structural steel elements refer Section-IIG/1 & IIG/2 of this specification.

c) **Un-insulated components >120 ° C but less than 600 ° C (other than those coming in the gas path) like Safety & Valves, Silencers, etc) and for Drain Cooler, LP Heaters-2 & 3 and HP Heaters**

1) Surface Preparation: St3 by Power tool cleaning.

2) Two coats of Heat resistant Aluminum Paint to IS 13183 Gr2 (Up to 400° C)/Gr.1 (Up to 600° C) - DFT 20 µ/coat Total DFT 40 micron

d) **Insulated parts exposed to temperature <400 °C (except those in gas path) and for Deaerator and BFPDT Oil Cooler:**

1) **Surface Preparation: St3 by Power tool cleaning.**

2) **2 coat of red-oxide zinc phosphate primer to IS 12744**

Total DFT 60 micron

e) **Heat exchanger Coils coming in the gas path. (Eco.SH &RH coils, Loose tubes, etc.) :**

Power tool cleaning followed by one coat of dip-coat paint - Red-oxide Zinc phosphate primer to BHEL Spec. DFT 30 micron/coat. Total DFT = 30 mic.

f) **Components coming in the gas path (other than Coils), including water walls, SH panels, SH Headers, Hot air ducts, etc.**

Power tool cleaning followed by 2 coats of Red-oxide Zinc phosphate primer to IS 12744 - DFT 30 micron/coat. Total DFT = 60 mic.

17.00.00 **COLOUR CO-ORDINATION & FINISH**

17.01.00 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

17.02.00 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and deliverables provided shall be colour coded for ease of identification.

17.03.00 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

17.04.00 Final colours and finishes shall be to the acceptance of the Buyer.

INSPECTION REQUIREMENT OF BHEL

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

1. Welder Qualification

a) Review of welder's qualification (WPS & PQR) shall be done by BHEL & CUSTOMER during final inspection.

2. Empty oxygen cylinder

a) Inspection report of BIS approved inspection agency for all the tests performed as per IS 7285 shall be submitted for review by BHEL & CUSTOMER during final inspection.

b) Approval certificate from CCE, Nagpur shall also be furnished if applicable as per statutory norms for review by BHEL & CUSTOMER during final inspection.

3. Valves (Ball, Check, PRV, solenoid, needle)

a) Material test Certificate/lab report for both physical & chemical test (physical test for trim material is not required) for body, bonnet, cover, trim material, ball shall be furnished for review by BHEL & CUSTOMER during final inspection.

b) Hydro test, pneumatic test, dimensions of valve assembly shall be as per BHEL approved data sheet. Manufacturer's test certificate shall be submitted for the same for review by BHEL & CUSTOMER during final inspection.

c) All valves shall be oxygen cleaned and suitable for oxygen service. Manufacturer's COC certifying the same shall be submitted for review by BHEL & CUSTOMER during final inspection.

4. Instruments (Pressure Gauge, Pressure Transmitter, Mass flow meter, pressure reducing valve)

a) Material Test certificate for wetted part as per approved data sheet shall be furnished for review by BHEL & CUSTOMER during final inspection.

b) Calibration report shall be furnished for review by BHEL & CUSTOMER during final inspection.

c) Manufacturer's COC for degree of protection of enclosure (1/similar frame size) shall be for review by BHEL & CUSTOMER during final inspection.

d) All instruments shall be oxygen cleaned and suitable for oxygen service. Manufacturer's COC certifying the same shall be submitted for review by BHEL & CUSTOMER during final inspection.

5. Control valve

a) Hydro test report for body and pneumatic test report of actuator chamber and seat shall be submitted for review by BHEL & CUSTOMER during final inspection.

b) Manufacturer's test reports shall be submitted for 100 % control valves for overall dimensional checks (as per BHEL approved GA/data sheet) and functional tests (including valve travel, opening & closing time, linearity/CAM characteristics, hysteresis) as per BHEL approved data sheets for review by BHEL & CUSTOMER during final inspection.

c) Manufacturer's test reports for CV test (including valve characteristics, PR vs discharge, PR vs opening 0 to 100% in steps of 10%) shall be submitted for 1/similar type of control valve for review by BHEL & CUSTOMER during final inspection.

6. Junction Box

a) Check of make & rating of components as per approved drawing shall be done by BHEL

b) Visual check of dimensions and orientation as per approved drawing shall be done by BHEL

c) IR-HV-IR test shall be witnessed by BHEL

d) Test certificate for degree of protection of the enclosure (1 per similar frame size) shall be submitted by bidder for review by BHEL.

7. Tubing

a) Material test Certificate/lab report and hydro test report shall be furnished for review by BHEL & CUSTOMER during final inspection.

8. Fittings

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

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

a) Measurement of skid dimensions and elevation of terminal point
b) Leak test of tubing/fitting/ valves using nitrogen at 1.25 times of maximum operating pressure for skids for two hours.
c) Visual checking of skid orientation as per BHEL/ CUSTOMER approved GA drawing
d) Visual checking of welding soundness, cleanliness at weld joints
e) Hydro test of the complete interconnected tubing
f) Pneumatic test of the complete interconnected tubing
g) Verification of painting thickness by elcometer and paint shade with respect to color shade chart
h) DP test for all socket weld joints may be witnessed by any renowned TPI at bidder's cost and review of their report shall be done by BHEL & CUSTOMER during final inspection. Alternatively, bidder may also offer DP test for BHEL & CUSTOMER witness.

Note: -

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

SECTION – D2

GENERAL TECHNICAL REQUIREMENT - ELECTRICAL

(CONSTRUCTIONAL DETAILS OF CABLE SELECTED)

1.0 CONSTRUCTIONAL DETAILS OF CABLES SELECTED

(A) LT POWER & CONTROL CABLES

S.NO.	PARTICULARS	DETAILS	
		LT POWER CABLES	LT CONTROL CABLES
1	REFERENCE STANDARD	IS: 7098 -PART -1	IS -1554 PART -1
2	SYSTEM	415 V AC , 240 V AC & 220V DC	220V DC & 240 V AC (CONTROL)
3	VOLTAGE GRADE	1.1 KV	1.1 KV
4	CONDUCTOR		
	MATERIAL	STRANDED COMPACTED PLAIN ALUMINIUM CONDUCTOR OF H 2 GRADE CLASS 2 / STRANDED HIGH CONDUCTIVITY ANNEALED PLAIN COPPER.	STRANDED, NON COMPACTED & CIRCULAR, HIGH CONDUCTIVITY ANNEALED PLAIN COPPER
	STANDARD	IS 8130	IS 8130
	SHAPE	CIRCULAR	CIRCULAR
	MINIMUM SIZE	ALUMUNIUM- 16 SQ.MM. (FOR 3 CORE), 10 SQ.MM (FOR 2 CORE) & COPPER- 2.5 SQ. MM.	2.5 SQ.MM. / 4 SQ.MM.
	MAXIMUM CONDUCTOR TEMPERATURE WHEN CARRYING CONTINUOUSLY CURRENTS	90 ^{0}C	70^{0}C
	MAXIMUM CONDUCTOR TEMPERATURE AT THE TERMINATION OF SHORT CIRCUIT CURRENT	250 ^{0}C	160 ^{0}C
5	NO. OF CORES	1C,2C,3C, 3.5C, 4C	AS PER CLAUSE 4.2.1
6	INSULATION	EXTRUDED XLPE	EXTRUDED PVC (Type-A)
	STANDARD	IS: 7098 -PART -1	IS-5831 & IS -1554 PART -1
7	INNER SHEATH	EXTRUDED PVC COMPOUND -TYPE ST2, (FOR MULTICORE CABLES ONLY) SINGLE CORE CABLES- NO INNER SHEATH	EXTRUDED PVC COMPOUND -TYPE ST1
	STANDARD	IS: 5831 & IS: 7098 -PART -1	IS: 5831 & IS -1554 PART -1
8	ARMOUR	NON-MAGNETIC HARD DRAWN ALUMINIUM SINGLE ROUND WIRE ARMOUR OF H4 GRADE FOR SINGLE CORE CABLES & GS ROUND WIRE STEEL WIRE ARMOUR FOR MUTI- CORE CABLES	GS ROUND WIRE ARMOUR
	STANDARD	IS: 3975 & IS: 7098 -PART -1	IS: 3975 & IS -1554 PART -1
9	OUTER SHEATH	EXTRUDED FRLSH PVC COMPOUND -TYPE ST2 CHARACTERISTICS : OXYGEN INDEX : MIN. 29% (AS PER ASTMD 2863). TEMPERATURE INDEX : MIN. 250^{0}C AT OXYGEN INDEX OF 21 (AS PER ASTMD 2863) ACID GAS GENERATION : MAX 20% (AS PER IEC 60754-1) SMOKE DENSITY RATING : MAX 60% (AS PER ASTMD 2843)	EXTRUDED FRLSH PVC COMPOUND -TYPE ST1 CHARACTERISTICS : OXYGEN INDEX : MIN. 29% (AS PER ASTMD 2863). TEMPERATURE INDEX : MIN. 250^{0}C AT OXYGEN INDEX OF 21 (AS PER ASTMD 2863) ACID GAS GENERATION : MAX 20% (AS PER IEC 60754-1) SMOKE DENSITY RATING : MAX 60% (AS PER ASTMD 2843)
	STANDARD	IS: 5831 & IS: 7098 -PART -1	IS: 5831 & IS -1554 PART -1

(B) CONSTRUCTIONAL DETAILS OF SCREENED CONTROL CABLES SELECTED

S.NO.	PARTICULARS	INSTRUMENTATION & SCREEN CONTROL CABLE DETAILS			
1	VOLTAGE GRADE	225V(PEAK VALUE)			
2	TYPE OF CABLES	TYPE F (INDIVIDUAL & OVERALL SCREENED) & TYPE G (OVERALL SCREENED)			
3(i)	CONDUCTOR				
(a)	MINIMUM CROSS SECTION AREA	0.5 sq.mm / 1.5 sq.mm			
(b)	CONDUCTOR MATERIAL	STRANDED, TINNED ANNEALED HIGH CONDUCTIVITY COPPER			
(c)	CONDUCTOR GRADE	ELECTROLYTIC			
(d)	NO. & DIA OF STRANDS	7 X 0.3 mm			
(e)	NO. OF PAIRS	0.5 sq.mm. - 2P, 4P,8P,12P,16P,20P 1.5 sq.mm. -2P			
(f)	STANDARD	VDE 0815			
(ii)	INSULATION				
(a)	MATERIAL	EXTRUDED PVC, compound Y I3			
(b)	THICKNESS IN mm	0.3 (NOMINAL)			
(c)	VOLUME RESISTIVITY (MIN) IN ohm-cm	1x 10^{14} at 20 deg .C & 1x 10^{11} at 70 deg .C			
(d)	VOLTAGE RATING	225 V PEAK OPERATING VOLTAGE			
(e)	STANDARD	VDE 0207 Part 4			
(iii)	PAIRING & TWISTING				
(a)	MAX. LAY OF PAIRS (mm)	50			
(b)	CONDUCTOR /PAIR IDENTIFICATION	AS FER ATTACHED ANNEXURE- D			
4	SHIELDING				
(a)	TYPE OF SHIELDING	AL-MYLAR TAPE			
(b)	INDIVIDUAL PAIR SHIELDING	APPLICABLE FOR TYPE-F CABLE ONLY			
(c)	OVERALL SHIELDING	APPLICABLE FOR BOTH TYPE-F & TYPE-G CABLES			
(d)	MINIMUM THICKNESS OF INDIVIDUAL PAIR SHIELDING	28 MICRON			
(e)	MINIMUM THICKNESS OF OVERALL CABLE ASSEMBLY SHIELDING	55 MICRON			
(f)	SHIELDING COVERAGE	100% WITH AT LEAST 20% OVERLAP			
(g)	DRAIN WIRE FOR INDIVIDUAL & OVERALL SHIELD FOR F-TYPE AND OVERALL SHIELD FOR G-TYPE	ANNEALED TINNED COPPER SIZE (NO. OF STRANDS/ SIZE:- 7/0.51sq.mm.) AS PER VDE 0815			
5	FILLERS				
(a)	TYPE	NON -HYGROSCOPIC FLAME RETARTDANT (AS REQUIRED FOR MAINTAINING CABLE CIRCULARITY)			
6	INNER SHEATH	EXTRUDED PVC (compound YM1)			
	COLOUR	BLACK			
7	ARMOUR	GS ROUND WIRE ARMOUR			
	STANDARD	VDE 0207 Part-5			
8	OUTER SHEATH				
(a)	MATERIAL	EXTRUDED FRLS PVC (compound YM1)			
(b)	THICKNESS	As per VDE 0816 and shall not be less than 1.8 mm			
(c)	COLOUR	GRAY			
(d)	STANDARD	VDE 0207 Part-5			
9	ELECTRICAL PROPERTIES	0.5 sqmm (IS & OS) Type F	0.5 sqmm (OS) Type G	1.5 sqmm (IS & OS) Type F	1.5 sqmm (OS) Type G
(a)	MUTUAL CAPACITANCE (MAX.)AT 0.8 KHz, nf / km	120	100	120	100
(b)	CONDUCTOR LOOP RESISTANCE(MAX.) AT 20 °C, OHM / km	73.4	73.4	24.6	24.6
(c)	INSULATION RESISTANCE(MIN.), Mohm / km	100	100	100	100
(d)	CROSS TALK ATTENUATION (Min.) AT 0.8KHz,	60	60	60	60
(e)	CHARACTERISTICS IMPEDANCE (Max.) AT 1KHz	320	340	230	230
(f)	ATTENUATION (max.) AT 1KHz	1.2	1.2	0.8	0.8

ANNEXURE-D

CORE IDENTIFICATION

1.0 PAIRED CABLES

1.1 FORMATION: 2cores shall be twisted to form a pair and 4 pairs shall be twisted to form a unit (or bundle). Units shall be covered with foil and stranded together to form a cable.

1.2 IDENTIFICATION SCHEME:
PAIRS : Pairs and their cores within a unit shall be identified with colour of insulation of each core as below:

PAIR NO	1	2	3	4
Core- a	Blue	Grey	Green	White
Core- b	Red	Yellow	Brown	black

In case of higher number of pairs, the above colour scheme shall be repeated, and to distinguish between two pairs giving same colour code in a cable, suitable colour bands shall be used for each unit and group cable. For example all eight cores of the first unit shall have a band of pink colour. The complete scheme is given below and the order of colour bands shall be pink, orange, violet, pink etc.

UNIT NO.	COLOUR OF BANDS	BAND MARKS
1.	PINK	=|===|==
2.		=||===||==
3.		=|||===|||===
4.		=||||===||||===
1.	ORANGE	=|===|==
2.		=||===||==
3.		=|||===|||===
4.		=||||===||||===
1.	VIOLET	=|====|==
2.		=||===||==
3.		=|||===|||===
4.		=||||===||||===
		I<-L->I

The dimension 'L' shall be limited between 60mm and 80mm. The bands shall be neat cover at least ninety percent (90%) of the periphery of the core.

(JUNCTION BOXES & CABLE LUGS)

5.04.00 **Junction Boxes**

5.04.01 Junction boxes shall be of 16 SWG sheet steel hot-dip galvanised, out-door type, dust vermin and damp proof, generally conforming to IP 55. Junction boxes for accommodating cables upto 3Cx16 sq.mm to be FRP instead of sheet steel for indoor and outdoor.

5.04.02 Junction boxes shall be complete with neoprene gasketed inspection cover, conduit knock out, terminal blocks and painted with one coat of red oxide primer and two finishing coats of light grey (shade 631 of IS-5) synthetic enamel paint.

5.04.03 Junction boxes for outdoor use shall be weather proof IPW-55 and those for hazardous location shall be flame-proof type. Outdoor junction boxes shall be epoxy painted.

5.04.04 Junction boxes shall be of two types viz. one suitable for control wiring and the other with terminals for power cable terminations. Junction boxes for power cable terminations shall have minimum nine (9) nos. of terminals. Size of terminals shall be suitable to accommodate cables of sizes as required.

5.04.05 **The junction boxes shall have the following indelible markings :**

- Circuit nos. on top by white-stenciled paint at site.
- Circuit nos. with ferrules (inside) as per approved drawing.
- Danger sign in case of 415 V circuit.

5.04.06 Junction boxes shall be provided with two (2) nos. earthing terminals complete with nuts and washers suitable for connection to 8 SWG G.I. wire.

5.03.00 **Cable Lugs**

All cable lugs shall be Cd plated copper. Cable lugs shall be suitable for termination of different cross-sections of H.V./L.V./Control/Instrumentation cables and shall be of following types :

i) Aluminium tubular terminal end for solderless crimping to aluminium conductors.

ii) Copper tubular terminal end for solderless crimping to copper conductors.

Solderless crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.

iii) Cable lugs for control cable termination shall be insulated. These lugs shall be pin type/flat type/ring type/U type to suit the terminals provided in the panels.

(GROUNDING OF EQUIPMENT & STRUCTURES)

2.05.00 **Grounding of Equipment And Structures**

2.05.01 All indoor and outdoor electrical equipment and associated non-current carrying metal works, supporting structures, building/ boiler columns, fence, system neutrals, lightning masts/arresters shall be connected to the plant ground system.

2.05.02 Two separate and distinct ground connections shall be provided for grounding electrical equipment frameworks in compliance with I.E. rules.

2.05.03 All Electrical equipment shall be furnished with two (2) separate ground pads with tapped holes, bolts and spring washers. The connection between these ground pads and the grounding grid shall be made by short and direct earthing conductors free from kinks and splices.

2.05.04 Miscellaneous devices such as junction boxes, pull boxes, pushbutton stations, lockout switches, cable end boxes, lighting fixtures, receptacles, switches etc. shall be effectively grounded whether specifically shown or not.

2.08.00 The sizes and materials of ground conductors used in grounding system are listed below :

	DESCRIPTION	SIZE	MATERIAL
a)	Main Grounding Grid Conductor	40 mm dia Rod	Mild Steel
b)	Riser/Pigtail From Grounding Grid/Mat	40 mm dia Rod	- Do -
c)	Electrode	40 mm dia Rod 3000 mm long.	- Do -
d)	Conductor used for connection of various equipment/structures as listed below		
	i) 11 kV/3.3kV Equipment	75 x 10 mm Flat	Galvanised Steel
ii)	Structures, Bus Duct Control Panels, Cable Trays etc.	50 x 6 mm Flat	- Do -
iii)	415V Power Control Centres, Motor Control Centres, Distribution Boards etc.	50 x 6 mm Flat	- Do -
iv)	Local Panels, Lighting Panels	35 x 6 mm Flat	- Do -
v)	Motors :		
	Above 90 kW	50 x 6 mm Flat	- Do -
	Above 30 kW Upto 90 kW	35 x 6 mm Flat	- Do -
	Above 5 kW Upto 30 kW	25 x 3 mm Flat	- Do -
	Upto 5 kW	8 SWG Wire	Galvanised Iron
vi)	Miscellaneous Items, viz. Push Button Station, Junction Boxes etc.	8 SWG Wire	- Do -

SECTION – D3

GENERAL TECHNICAL REQUIREMENT (CONTROL & INSTRUMENTATION)

TECHINICAL SPECIFICATION
(INSTRUMENTS & SYSTEMS)

TECHNICAL SPECIFICATION - INSTRUMENTS AND SYSTEMS

1.00.00 FIELD INSTRUMENTS

For TG - I&C (SAG Portion), HART based Field process transmitters shall be possible only for pressure and delta pressure transmitters

1.01.00 PRESSURE, DIFFERENTIAL PRESSURE, FLOW AND LEVEL TRANSMITTER

01.	Working Principle	:	Smart
02.	Type	:	2-Wire
03.	Output signal	:	Simultaneous transmission of digital and 4-20 mA DC signal. HART protocol.
04.	Signal Processing Unit	:	Silicon solid-state electronic circuitry
05.	Measuring element	:	Capsule/Diaphragm
06.	Element material	:	AISI-316 (Stainless Steel) or better
07.	Over Pressure	:	150% of maximum pressure
08.	Turn-down ratio	:	10:1 for vacuum / very low pressure application. 30:1 for other application
09.	Span and Zero	:	Continuous non-interacting tamper proof, remote as well as manual adjustable from instrument with zero suppression and elevation facility.
10.	Enclosure	:	Epoxy coated Die cast aluminium. IP-65 (Explosion proof for NEC Class-1, Division 1 area) with ½" NPT (F) cable entry.
11.	Output Indicator	:	LCD type
12.	Body	:	Forged Carbon Steel (SS for DM Water)
13.	Operating Voltage	:	24 V DC ± 10%
14.	Load	:	600 Ohms (min.) at 24 Volts DC

15. Performance :-

a)	Accuracy	:	±0.1 % of span or better
b)	Repeatability	:	± 0.05 % of span or better
c)	Response time	:	250 msec or better
d)	Zero & Span drift	:	0.015% per Deg.C at max span 0.11% per Deg.C at min span
e)	Stability	:	0.1% of calibrated span for six months for ranges upto and including 70 Kg/ sq.cm. 0.25% of calibrated span for six months for ranges more than 70 Kg/ sq.cm (g).

16. Process connection : ½" NPT (F)

17. Sealing / Isolation : Extended diaphragm with 5 meters SS armoured capillary for corrosive, viscous and dirty fluid applications. Material for separator diaphragm, depending on application.

18. Nameplate : Tag number and Service engraved in stainless steel tag plate

19. Accessories :
    a) Installation accessories such as mounting bracket, high tensile carbon steel U-bolts suitable for pipe mounting.
    b) ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock for pressure transmitter.
    c) ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock for DP transmitter. 3 valve manifold for DP application in flue gas and air.
    d) Companion flange with nuts, bolts and gaskets.
    e) ½" NPT cable gland

1.03.00 **MASS FLOW METER**

1.03.01 **Sensor**

01.	Measuring Principle	:	Coriolis Mass flow.
02.	Primary Element	:	Flow Tube of 316SS or better
03.	Heating Arrangement	:	Integral with Flow Element.
04.	Temperature Control For Heating	:	To be provided for heavy fuel oil application.
05.	Process Connection	:	Flanged and rating as per process requirement.
06.	Drain	:	Self-draining facility
07.	Enclosure	:	Stainless steel
08.	Accessories	:	Counter flanges, Mounting nuts, bolts, gaskets, prefab cable etc.

1.03.02 **Transmitter**

01.	Measured quantities	:	Mass Flow rate, Total Mass Flow, Density, Temperature as minimum.
02.	Input Signal Processing	:	Digital Processing.
03.	Display	:	Digital Display (LCD).
04.	Output	:	2 Nos. isolated output of 4-20mA DC & HART selectable from four measured quantities.
05.	Load	:	< 750 ohms.
06.	Power supply	:	240V AC ±10%, 50 Hz.
07.	Turn Down	:	100:1
08.	Accuracy	:	± 0.2% of measured value
09.	Housing	:	Epoxy coated Die cast aluminium. IP-65 (Explosion proof for NEC Class-1, Division-1 area) with ½" NPT (F) cable entry.
10.	Hazardous duty Version	:	FM Standards.

11.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
12.	Accessories	:	a) As required for field mounting b) Mounting U-bolts, nuts, bolts, etc. c) ½"NPT cable gland

1.09.00 **PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE**

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

b) Stainless steel Diaphragm seals for corrosive, viscous and solid-bearing or slurry type process fluids.

c) Gauge saver wherever required

d) 3-Way stainless steel Gauge valve for pressure gauges. Process connection ½" NPT.

e) 5-valve SS316 manifold constructed from barstock for differential pressure gauge. Process connection ½" NPT.

f) Union, nut & tail piece and other Installation accessories as required.

16. Applicable standard : IS-3624 / 1996

17. Electrical Contact rating : Not applicable

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

1.26.00 **SOLENOID VALVE**

01.	Operating Principle	:	Electromagnetic (noiseless)
02.	Coil voltage rating	:	24V DC (in general) other 220V DC /240V AC /110V AC as per manufacturer recommendation.
03.	Ways	:	3 ways in general other depending on requirement
04.	Port size	:	1/4" NPT all ports
05.	Body	:	SS Bar Stock
06.	Trim	:	AISI SS-316
07.	Manual Operator	:	In built
08.	Duty	:	Suitable for continuous energization
09.	Sealing	:	Airtight and leak proof
10.	Fluid Temperature	:	0-150 ^{o} C (approx.)
11.	Coil Enclosure	:	Stainless Steel
12.	Insulation	:	Class-H
13.	Coil Casing	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
14.	Mounting	:	On pipe or on panel
15.	Cable Connection	:	½" NPT cable gland
16.	Accessories	:	Mounting brackets, nuts and bolts as required.
17.	Special feature	:	a) LED indication b) Double coil type.

10.01.02 Electrical Junction Box

01.	Type of enclosure	:	Dust tight & weatherproof conforming to IP 65
02.	No. of ways	:	As required plus 20% spare terminals
03.	Material	:	4 mm thick fiberglass reinforced polyester. UV stabilized.
04.	Type of cover	:	Screwed at all four corners for door.
05.	Gasket	:	Neoprene
06.	Mounting	:	Surface
07.	Cable entry	:	Cable glands
08.	Grounding	:	Brass earth lug with green screw head.
09.	Number of Drain Holes	:	At bottom capped.
10.	Identification	:	Label for JB and Tags for cable
11.	Colour	:	Outer Colour= RAL 7032, Siemens Grey Inner Colour= Brilliant White
12.	Accessories	:	a) Rail mounted cage clamp type screw less terminals suitable for conductor size up to 2.5sq.mm with markers. b) Aluminum back panel c) Cable gland d) Ferrules & lugs e) Mounting brackets, bolts and nuts made of brass.

10.01.03 Cable Gland

01.	Type	:	Double compression
02.	Entry Thread	:	NPT
03.	Material	:	Brass
04.	Finish	:	Cadmium Plated.
05.	Protection	:	IP 54 or better
06.	Accessories	:	Neoprene gasket, locknuts, reducers etc.

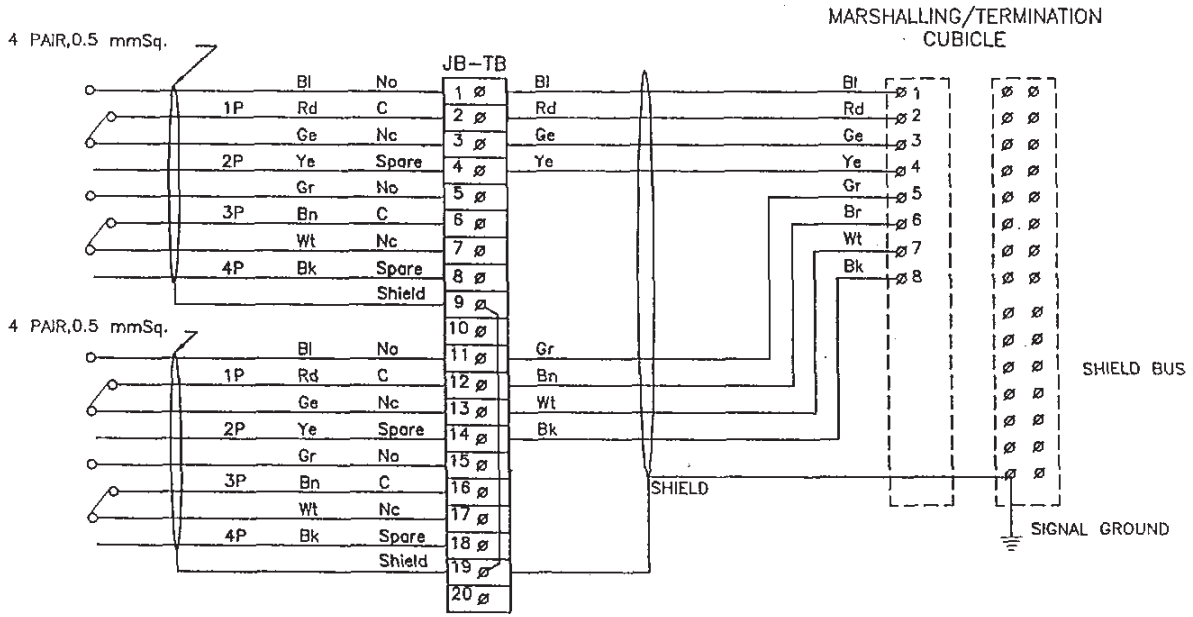
JUNCTION BOX TERMINATION DETAILS

BHARAT HEAVY ELECTRICALS LTD

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA



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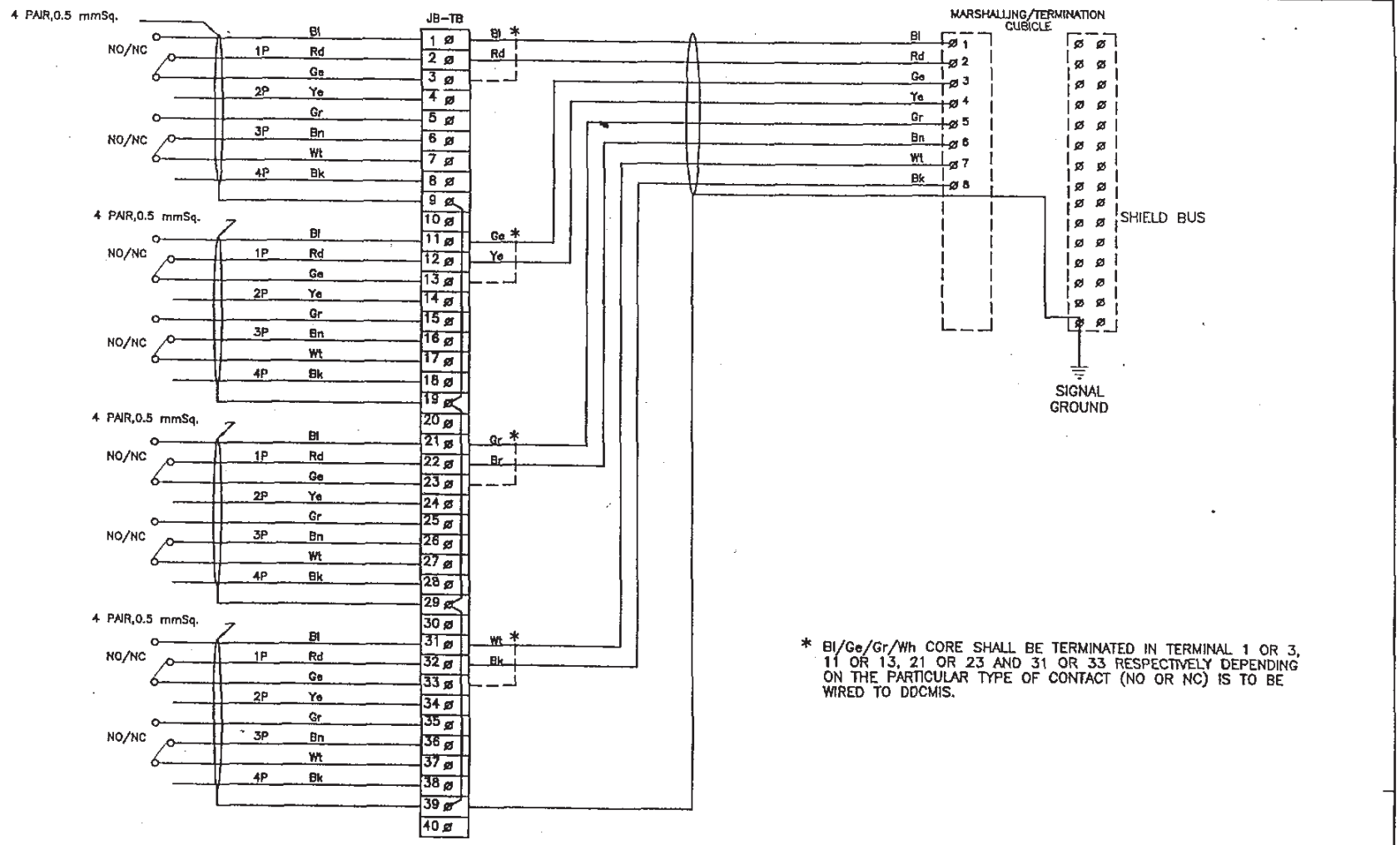
INTERFACING OF FIELD INSTRUMENTS/
SWGR SWITCH (COC) TERMINATION DETAILS



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SWITCH TERMINATION DETAILS
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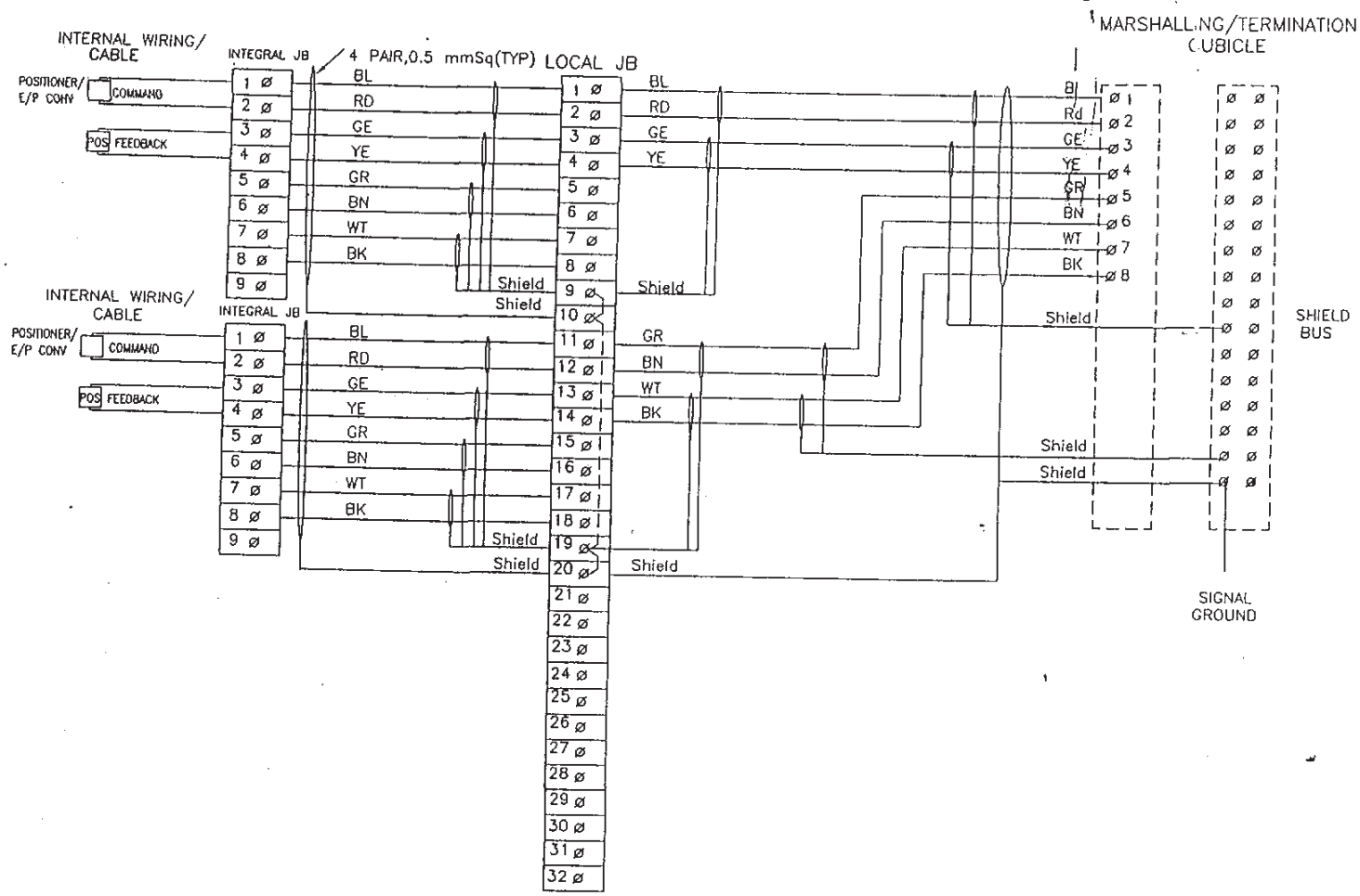
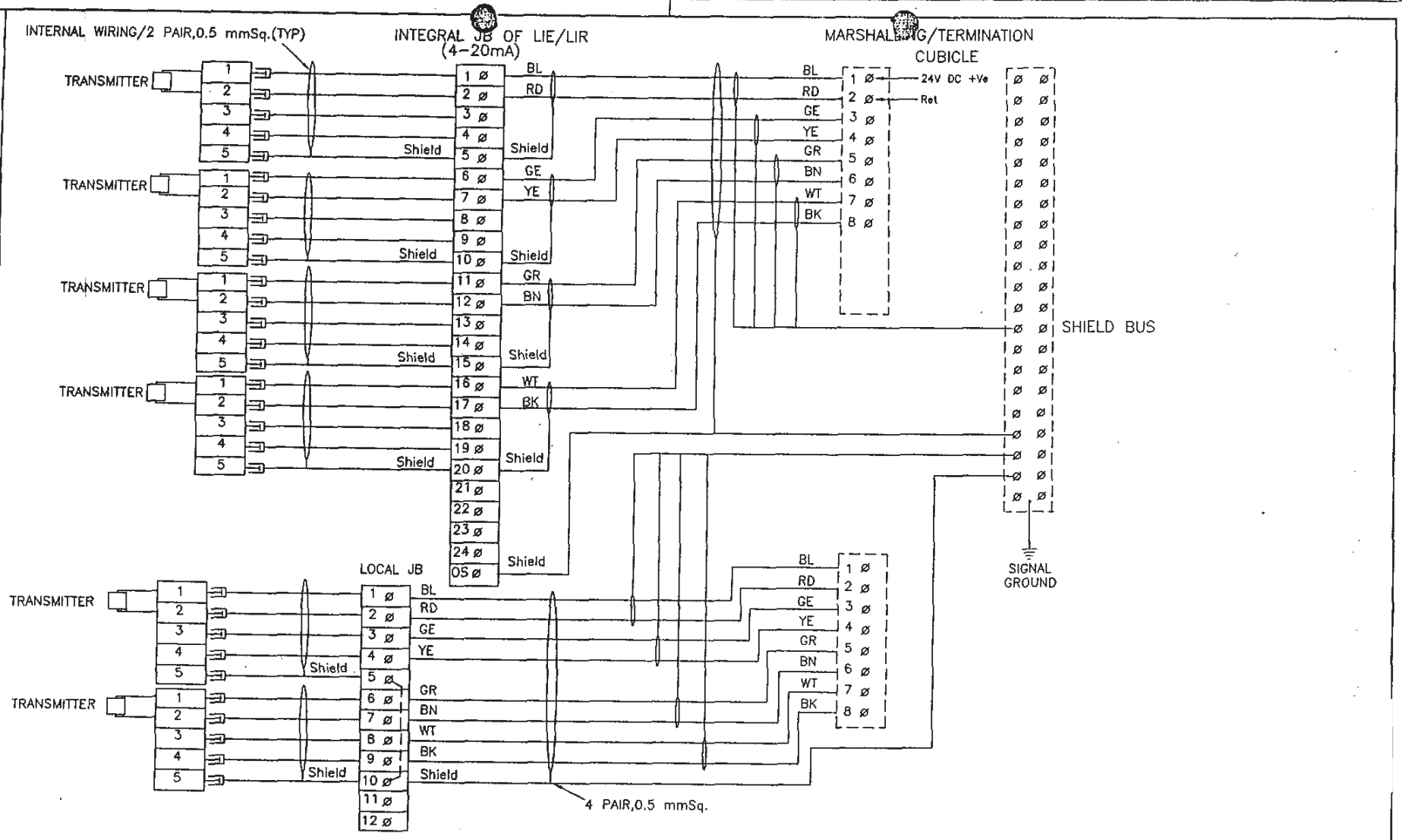
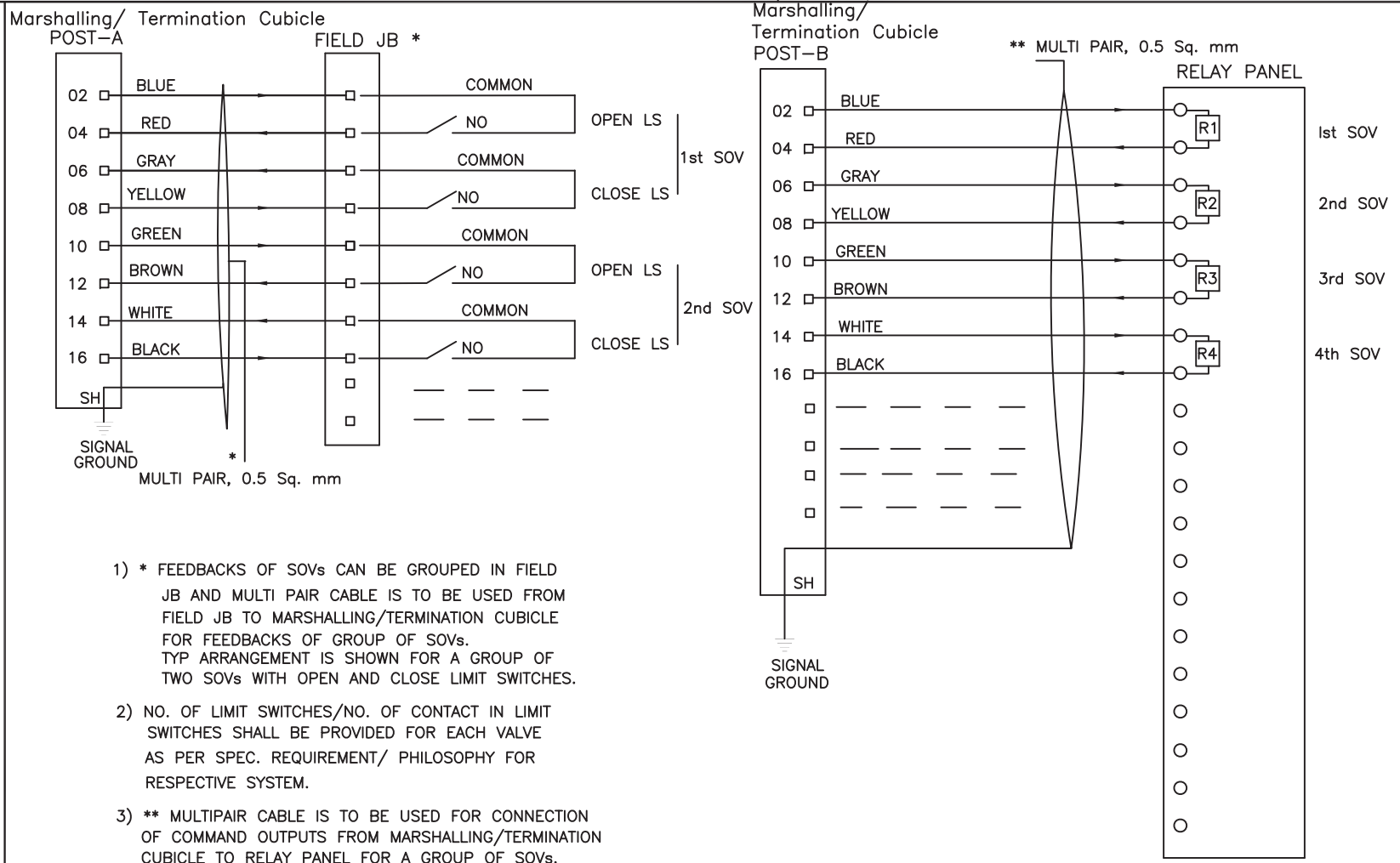


TITLE

INTERFACING OF FIELD INSTRUMENTS
CONTROL VALVE


INTERNAL WIRING/2 PAIR,0.5 mmSq.(TYP)
INTEGRAL JB OF LIE/LIR
(4-20mA)
MARSHALLING/TERMINATION
CUBICLE
TRANSMITTER
TRANSMITTER
TRANSMITTER
TRANSMITTER
Shield
BL
RD
GE
YE
GR
BN
WT
BK
24V DC +Ve
Ret
SHIELD BUS
SIGNAL
GROUND
LOCAL JB
TRANSMITTER
TRANSMITTER
4 PAIR,0.5 mmSq.
TITLE
INTERFACING OF FIELD INSTRUMENTS
4-20mA



1) * FEEDBACKS OF SOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF SOVs. TYP ARRANGEMENT IS SHOWN FOR A GROUP OF TWO SOVs WITH OPEN AND CLOSE LIMIT SWITCHES.

2) NO. OF LIMIT SWITCHES/NO. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEM.

3) ** MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF SOVs.

TITLE

INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(SINGLE COIL SOLENOID)

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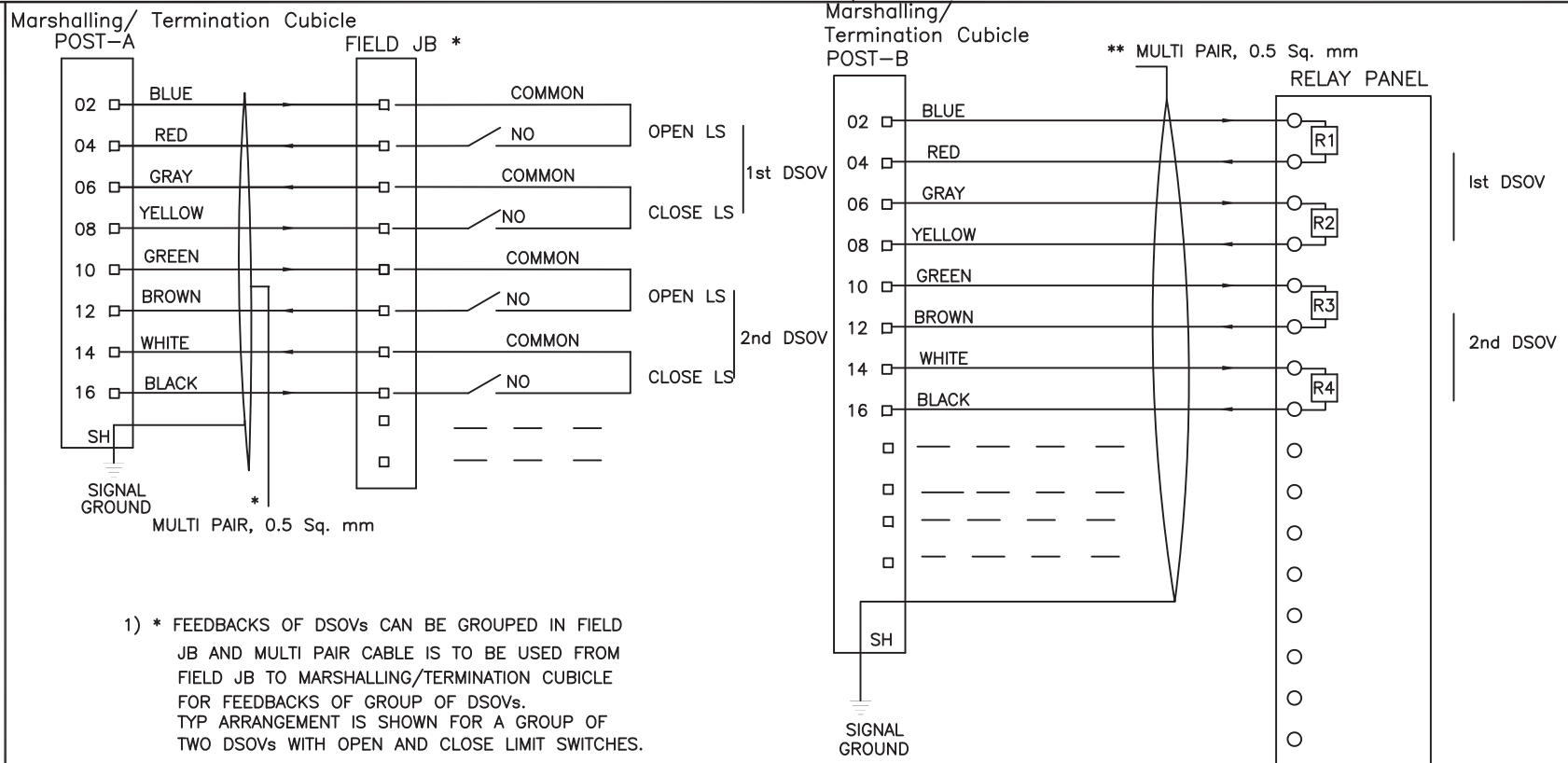


1) * FEEDBACKS OF DSOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF DSOVs. TYP ARRANGEMENT IS SHOWN FOR A GROUP OF TWO DSOVs WITH OPEN AND CLOSE LIMIT SWITCHES.

2) NO. OF LIMIT SWITCHES/NO. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEM.

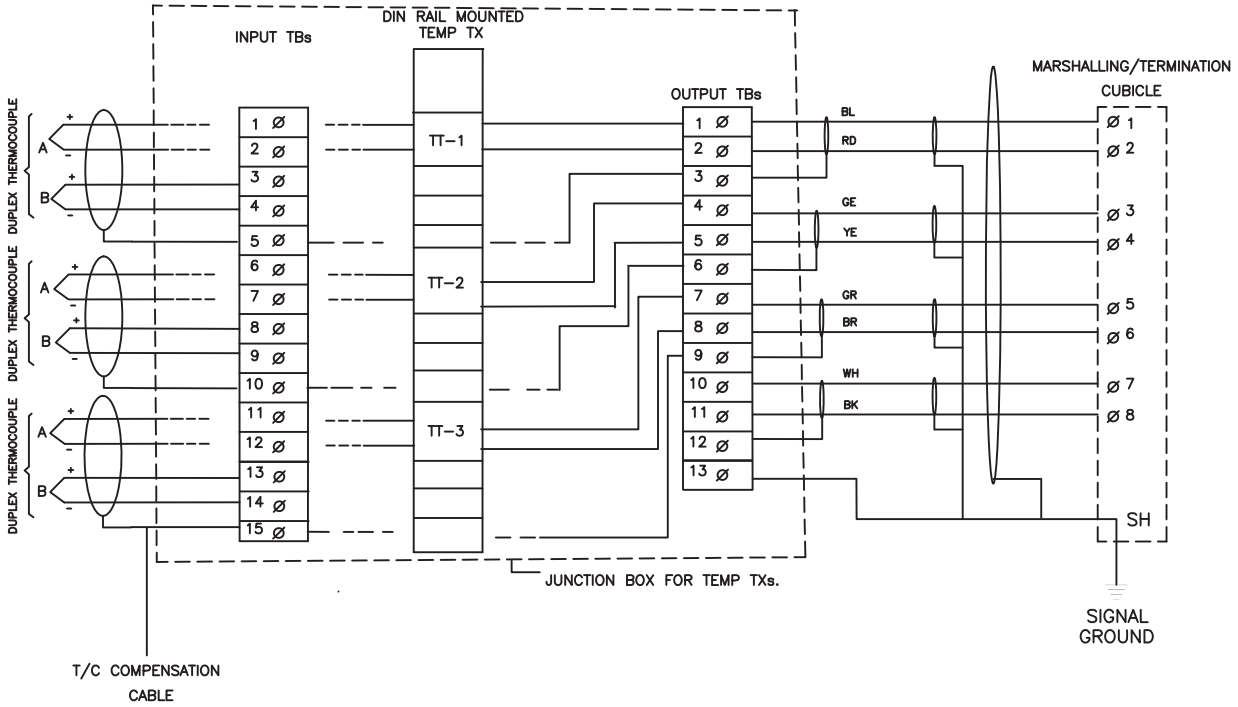
3) ** MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF DSOVs.

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: INTERFACING OF FIELD INSTRUMENTS
INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR
(DOUBLE COIL SOLENOID)

SH 09 OF 14

CAD FILE NAME: C:\PC_MS\TYPTPP_SG,TG,BOP\OCT,02\0000-999-POL-A-065SH09rD.DWG



NOTE: 1) ABOVE IS THE TYP DRG. FOR DIN RAIL MOUNTED TEMP TRANSMITTER FOR T/C APPLICATION. EXACT TYPE OF TEMP TRANSMITTERS SHALL BE AS PER PART–A OF SPECIFICATION.

2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINALISED DURING DETAILED ENGG. STAGE.

3) AFTER GLANDING OF T/C CABLES ON JB, THE CABLE PAIR OF FIRST ELEMENT WILL BE DIRECTLY CONNECTED TO TT AND FOR CABLE PAIR OF SECOND ELEMENT LOOP SHALL BE KEPT, BEFORE TERMINATION AT INPUT TBs FOR FUTURE USE.

TITLE

INTERFACING OF FIELD INSTRUMENTS
TYPICAL T/C CONNECTION WITH TEMP TXs IN JBs

QUALITY PLAN FOR INSTRUMENTS

BHARAT HEAVY ELECTRICALS LTD

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA

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

CHECK LIST FOR 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 :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. When material corelation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verifid 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	FUCTIONAL TEST			P	W	V	

Legend :

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

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Contractor to provide compliance certificate for tests/checks verifid 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 :

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

VOLUME-III

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

SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWL

PROJECT:-IB THERMAL POWER STATION , BANHARPALI
2X660 WM UNIT # 3 & 4

PACKAGE:- OXYGEN DOSING SYSTEM

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

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

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

NOTES:

1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.

2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.

3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.

4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.

5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawl of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.

6. Bidder shall furnish price copy of above format along with price bid.

7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.

8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.

9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl 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 withdrawl of deviation shall be taken as NIL.

10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.

11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.

12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.

13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.

14. In case of descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

COMPLIANCE CERTIFICATE

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

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.

2. QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.
   QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.
   The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.

3. All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.

4. There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.

5. The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.

6. The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).

7. All sub vendors shall be subject to BHEL/CUSTOMER approval.

8. Any special tools & tackles, if required, shall be in bidder's scope.

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

	TITLE *** SCHEDULE OF DECLARATIONS**	**BHEL DOCUMENTS NO.: PE-TS-391-154-12000A-A001** VOL III SHEET…….. OF……

*** Bidder shall include this schedule both in technical and Price offers**

DECLARATION

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 (except indicated in the deviation sheet (with cost of withdrawal).

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

Biders Company Name …….

Authorised representative's
Signature ……..

Name …….

Bider's Name

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

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

IB THERMAL POWER STATION, BANHARPALI
2 X 660 MW UNIT # 3 & 4
PACKAGE:- OXYGEN DOSING SYSTEM
SUGGESTIVE UN-PRICED SCHEDULE

Sl. No.	DESCRIPTION OF EQUIPMENT / ITEM	QTY.	UNIT PRICE EX-WORKS (DULY PACKED)	TOTAL PRICE EX-WORKS (DULY PACKED)	EXCISE DUTY @ %	SALES TAX @ %	FREIGHT CHARGES	TOTAL PRICE (FOR SITE)
(1)	(2)	(3)	(4)	5)	6)	7)	8)	9)
1.0	Total lump sum price on FOR site basis for design, engineering, manufacture, fabrication, assembly, inspection and testing at manufacturer's works, start up and commissioning spares, mandatory spares, supply and dispatch to power station site of skid mounted **OXYGEN DOSING SYSTEM** alongwith other items including supervision of commissioning by experience/capable engineer,freight, all prevailing taxes, duties and other levies of as required for the total scope defined as per BHEL specification no. **PE-TS-391-154-12000A-A001** and subsequent clarifications confirmation, correspondences with the bidders till date.							
	NOTES:							
a)	Bidder to note that total price indicated above at **1.0** shall be considered for evaluation and hence should be complete in all respect for the full scope defined and considering all terms and conditions agreed.							
b)	In case, price indicated above does not match with total of item wise break-up given at **2.0**, the higher price so calculated shall be considered for evaluation but in case of order, the same shall be placed at the lowest price.							
2.0	**MAJOR BREAK-UP OF PRICES GIVEN IN 1.0 ABOVE**							
2.1	Total lump sum price on FOR site basis for design, engineering, manufacture, assembly, inspection and testing at manufacturer's works, packing, supply and delivery at site, including freight for **OXYGEN DOSING SYSTEM** complete with all accessories for the total scope defined as per BHEL specification no. **PE-TS-392-154-12000A-A001** and subsequent clarifications confirmation, correspondences with the bidders till date.							
2.1.1	**Oxygen dosing skid (including two cylinders mounted on each skid)**	4 nos.						
2.1.2	**Accessories (as described below)**							
2.1.2.a	**Injector Assembly**	8 nos.						
2.1.2.b	**1/2" OD, 18 BWG, SS 316 tubing for oxygen dosing**	400 m						
2.1.2.c	**SS 316 Tube fittings --tees**	20 nos						
2.1.2.d	**SS-316 Compression fittings**	74 nos						
2.1.2.e	**SS 316 Tube fittings --90° elbows**	20 nos						
2.1.2.f	**Filled oxygen cylinders (Each of 50 lt water volume filled at 204 Kg/cm2 pressure)**	68 nos.						
2.1.2.g	**Rack to hold 34 filled oxygen cylinders**	2 nos.						
2.2	Supply of **Commissioning spares/special tools & tackles** inclusive of all taxes, duties etc. on "FOR" site basis (as and if deemed necessary by the bidder for commissioning of his skid) (in case quoted, bidder to furnish price break up separately.)							

Sl. No.	DESCRIPTION OF EQUIPMENT / ITEM	QTY.	UNIT PRICE EX-WORKS (DULY PACKED)	TOTAL PRICE EX-WORKS (DULY PACKED)	EXCISE DUTY @ %	SALES TAX @ %	FREIGHT CHARGES	TOTAL PRICE (FOR SITE)
(1)	(2)	(3)	(4)	5)	6)	7)	8)	9)
2.3	**Mandatory Spares as per the following details:-(As Applicable)**							
2.3.1	Electronic Transmitters (Differential Pressure,Level,Speed etc.) all types	2 (Two) nos. complete set for each type and model/range used in the system.						
2.3.2	Pressure Transmitters	2 (Two) nos.						
2.3.3	**Solenoid Valve**							
2.3.3.1	Complete Solenoid Valve Assembly	4 Nos. for each type and rating used in the system						
2.3.3.2	Coil (single or double coil type)	10% of total nos. used in the system or minimum 10(Ten) Nos. whichever is more for each type and rating.						
2.3.4	Gauge (Differential Pressure, Temperature, Level)	minimum 2(Two) nos. whichever is more for each type and range.						
2.3.5	Pressure Gauge with needle valve	2 (Two) nos.						
	Total of 2.3.1 to 2.3.5							
	Total of 2.1.1, 2.1.2.a, 2.1.2.b, 2.1.2.c, 2.1.2.d, 2.1.2.e, 2.1.2.f, 2.1.2.g , 2.2 and 2.3							
3.0	**Supervision of Commissioning (By Experienced/Capable Engineer):**							
3.1	Lump sum supervision charges for Two (2) Visits (Comprising eight (8) mandays),inclusive of charges of Air-Fair/Rail-Fair,Boarding/Lodging Local conveyance etc.	2 Visits						