BHEL-PEM-MAUX
PRE-QUALIFICATION CRITERIA

	PACKAGE: CHEMICAL DOSING SYSTEM	PE-PQ-STD-154-A001	
		DATE	09/06/2021
		REV NO	00

1.0	Supplier should have capabilities for design/ manufacture and having in-house/ out-sourced facility for testing of Chemical Dosing System.
2.0	The supplier has to submit either of following supporting documents meeting above mentioned pre-qualifying requirement a. Copy of minimum one (1) performance certificate in English from end user along with copy of related Purchase Order (PO) or letter of intent (LOI) or letter of award (LOA) or work order (WO) specifying that the product/ equipment is running successfully for one (1) year from date of commissioning meeting the minimum pre-qualifying requirement. OR b. Minimum two PO/ LOI /LOA/ WO placed with a minimum gap of six (6) months from same purchaser meeting the minimum pre-qualifying requirement. OR c. Minimum one PO/ LOI /LOA/ WO after commissioning of first order from same purchaser meeting the minimum pre-qualifying requirement. OR d. In case, vendor has executed contract (s) for BHEL-PEM, internal assessment by BHEL-PEM shall be followed for evaluation for satisfactory performance. For this, vendor to submit the request along-with relevant documents. OR e. Minimum three customer's/ third party's inspection reports/ test certificates/commissioning certificates meeting the minimum pre-qualifying requirement.
3.0	Minimum one (1) no. PO/ LOI/LOA/WO shall be submitted which should not be more than Ten (10) years old, for establishing continuity in business. This is over and above the requirement of PO/ LOI/LOA/WO mentioned at Sl. no. 2.0 above.
4.0	The bidder should be an OEM and will meet PQR based on its own credentials. Bid from joint venture (JV) company /Consortium bid is not acceptable.

SUGGESTED PRICE FORMAT	Doc No:	PE-PF-483-154-A001
	Rev No:	0
	Date of issue	

SUGGESTED PRICE FORMAT

NAME OF PROJECT: 2X500 MW TUTICORIN TPP (NTPL) (FGD SYSTEM PACKAGE)

NAME OF PACKAGE: CHEMICAL DOSING SYSTEM (NaOH DOSING).

TECHNICAL SPECIFICATION: **PE-TS-483-154-A001**

S. No.	DESCRIPTION	HSN NO	UNIT	QTY	AMOUNT (Ex-Works)
1.0	Total lump sum firm price inclusive of all prevailing taxes, duties and other levies for **SUPPLY PART & MANDATORY SPARES**, design (i.e. preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables (excluding chemicals), Mandatory spares, startup and commissioning spares, forwarding, proper packing, shipment and delivery at site for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.		Set	1	
2.0	**MAJOR BREAK-UP OF PRICES GIVEN IN 1.0 ABOVE.**				
2.1	Prices inclusive of all prevailing taxes, duties and other levies for SUPPLY PART comprising of design (i.e.preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables (excluding chemicals), startup and commissioning spares, forwarding, proper packing, shipment and delivery at site for project and package specified above complete with all accessories for following items for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order. (Break-up of prices as per Annexure I)	84041000	Set	1	
2.2	Total lumpsum firm price inclusive of all prevailing taxes, duties and other levies for **Mandatory spares** comprising of manufacture, fabrication, assembly, inspection / testing (as applicable) at vendor's & sub-vendor's works, painting, forwarding, proper packing, shipment, delivery at site & guarantee as per tender technical specification above, amendment & agreements till placement of order. (Price break up of Mandatory spares is to be furnished as per Annexure- II).	84041000	Lot	1	

Note:
1.) Bidder to quote the Prices in 'figures' along with corresponding 'words'.

2.) PG to consider and suitably incorporate taxes, duties and other commercial aspects.

Particulars of bidder / authorised representative

Name	Designation	Signature		Date	Company Seal

SUGGESTED PRICE FORMAT ANNEXURE-I			Doc No:	PE-PF-483-154-A001	
			Rev No:	0	
			Date of issue	26-11-2021	
NAME OF PROJECT: 2X500 MW TUTICORIN TPP (NTPL) (FGD SYSTEM PACKAGE)					
NAME OF PACKAGE: CHEMICAL DOSING SYSTEM (NaOH DOSING).					
TECHNICAL SPECIFICATION:	**PE-TS-483-154-A001**				
S. No.	**DESCRIPTION**		**UNIT**	**QTY**	**AMOUNT (Ex-Works)**
	BREAK-UP OF SUPPLY PRICES GIVEN IN 2.1 OF MAIN SHEET.				
2.1	Prices inclusive of all prevailing taxes, duties and other levies for SUPPLY PART comprising of design (i.e.preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables (excluding chemicals), startup and commissioning spares, forwarding, proper packing, shipment and delivery at site for project and package specified above complete with all accessories for following items for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.		Set	1	
2.1.1	NaOH dosing skid		No.	1	
2.1.2	Supply of **Startup and Commissioning spares** inclusive of all prevailing taxes, duties and other levies etc. (As per BHEL NIT & tender technical specification, amendment & agreements till placement of order.)		Set	1	
Particulars of bidder / authorised representative					
Name	**Designation**	**Signature**	**Date**	**Company Seal**	

SUGGESTED PRICE FORMAT ANNEXURE-II LIST OF MANDATORY SPARES		Doc No:	PE-PF-483-154-A001	
		Rev No:	0	
		Date of issue	26-11-2021	
NAME OF PROJECT:2X500 MW TUTICORIN TPP (NTPL) (FGD SYSTEM PACKAGE)				
NAME OF PACKAGE: CHEMICAL DOSING SYSTEM (NaOH DOSING).				
TECHNICAL SPECIFICATION:		PE-TS-483-154-A001		
BREAK-UP OF SUPPLY PRICES GIVEN IN 2.2 OF MAIN SHEET.				
S. N.	**DESCRIPTION**	**UNIT**	**QTY**	**AMOUNT (Ex-Works)**
A.	**Agitator**			
1.1	Impeller assembly	No.	1 Nos. for each type and size	
1.2	Bearings	No.	2 Sets for each type and size	
1.3	Shaft assembly	No.	1 Sets for each type and size	
1.4	Shaft seal	No.	1 Sets for each type and size	
1.5	Gear box, if applicable	No.	1 no. of each type and size	
1.6	Complete agitator assembly	No.	1 no. of each type and size	
B	**Valves**			
2.1	Complete valves for each type	No.	2 Sets for each type and size	
2.2	Seat, disc, spindle with nut for each type	No.	2 Sets for each type and size	
2.3	Flats of each type and size of Non return valves	No.	1 Sets for each type and size	
Particulars of bidder / authorised representative				
Name	**Designation**	**Signature & Company Seal**		**Date**

PROJECT
2X500 MW TUTICORIN TPP (NTPL)
(FGD SYSTEM PACKAGE)

CUSTOMER: NLC TAMILNADU POWER LIMITED

TECHNICAL SPECIFICATION
FOR
CHEMICAL DOSING SYSTEM (NaOH DOSING)

SPECIFICATION NO: PE-TS-483-154-A001

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

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING) PROJECT: 2X500 MW TUTICORIN TPP (NTPL) **(FGD SYSTEM PACKAGE)**	BHEL DOCUMENTS NO.: PE-TS-483-154-A001	
		VOLUME – II B	
		REV NO: 00	DATE:

CONTENT

VOLUME – II B

SECTION	DESCRIPTION	PAGE NO
SECTION – A	INTENT OF SPECIFICATION	
SECTION – B	PROJECT INFORMATION	
SECTION – C1	SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL) ➢ SUB VENDORS LIST [TABLE-1] ➢ LIST OF COMMISSIONING SPARES [TABLE-3] ➢ MANDATORY SPARES [TABLE-4]. ➢ PAINTING SPECIFICATION ➢ QUALITY PLAN ➢ DATA SHEET – A ➢ DRAWINGS • P&ID	
SECTION – C2	SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)	
SECTION – C3	SPECIFIC TECHNICAL REQUIREMENTS FOR C&I	
SECTION – D1	GENERAL TECHNICAL REQUIREMENT FOR MECHANICAL	
VOLUME-III		
	➢ SCHEDULE OF PREBID CLARIFICATION ➢ SCHEDULE OF DEVIATION WITH COST OF WITHDRAWAL ➢ COMPLIANCE CUM CONFIRMATION SCHEDULE ➢ DRAWING/DOCUMENTS SUBMISSION SCHEDULE ➢ SCHEDULE OF DECLARATION	

SECTION - A
INTENT OF SPECIFICATION

1.0 SCOPE OF INQUIRY/ INTENT OF SPECIFICATION:

This specification is intended to cover design, engineering, manufacturing, fabrication, assembly, painting, packing, inspection & testing at manufacturer's works, **mandatory spares, start up and commissioning spares,** special tools & tackles, supply and dispatch to power station site of skid mounted **NaOH DOSING SYSTEM** including supervision of commissioning by experience/capable engineer, as specified in different sections / volumes of this specification hereinafter for the **2X500 MW TUTICORIN TPP (NTPL) (FGD SYSTEM PACAKGE)** for following systems:-

- **NaOH Dosing system (1 number for entire units).**

1.1 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 them of the responsibility of providing such facilities to complete the supply of **NaOH DOSING SYSTEM.**

1.2 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.

1.3 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.

1.4 **Bidder shall be required to depute his qualified/capable personnel at any stage for one (1) visit of two (2) days to supervise in Commissioning**. This visit will include supervision of commissioning of LP Dosing system in totality including pump, stroke controllers commissioning and auto operation from remote. Bidder to indicate the prices (in price format) for the same. The prices for Visit shall be inclusive of charges of Air-Fair/Rail-Fair, Boarding/Lodging, local conveyance etc.

1.5 Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.

1.6 The general terms 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 are 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 BHEL/Customer shall prevail and shall be complied by the bidder without any commercial and delivery 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 BHEL/ Customer as and when brought to their notice either by the bidder or by BHEL/ customer themselves. However, such

requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Vol – III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.

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 Customer (NTPL: NLC TAMIL NADU POWER LIMITED) as interpreted by BHEL in the relevant context. Please refer GCC/SCC for better clarity.

1.11 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and dispatch release issued by BHEL/Customer.

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

1.13 Pre-bid meeting shall be held before bid submission. Bidder to ask all their queries in Prebid clarifications format only.

568142/2021/PS-PEM-MAX

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING) PROJECT: 2X500 MW TUTICORIN TPP (NTPL) **(FGD SYSTEM PACKAGE)**	BHEL DOCUMENTS NO.: PE-TS-483-154-A001	
		VOLUME II-B	
		SECTION –A	
		REV. NO. 00	DATE:

SECTION – B

PROJECT INFORMATION

2.0 GENERAL PROJECT INFORMATION

1	Owner / Purchaser	NLC Tamil Nadu Power Limited (NTPL) (A Joint Venture Between NLC INDIA LIMITED and Tamil Nadu Electricity Board)
2	Project Name	NTPL Tuticorin Thermal Power Project
3	Capacity and Configuration	1000 MW [2 x 500 MW]
4	Owner's Consultant	Development Consultants Private Limited
5	Geographical Location	Latitude $8^0$45'38.09"North Longitude $78^0$10'15.85"East At Tuticorin Taluk in Tuticorin district in the Southern Part of Tamil Nadu along the Bay of Munnar, India
6	Access to site	
6.1	Nearest Airport	Nearest airstrip is located at Pudukottai at a distance of 16.5 km
6.2	Nearest port	Tuticorin sea port is located adjacent to the plant.
6.3	Nearest Railway Station	The nearest railway station is Port Trust Railway Yard at a distance of 1.0 km
6.4	Nearest Town	Nearest town is Tuticorin, which is located 5.5 km away from the plant and nearest city is Pallayamkottai, away from 60 km from the plant.
6.5	Nearest Highway	National Highway No. 7A adjacent to plant
7	Meteorological data	
7.1	Site Elevation	The natural land profile of the site 1.46 m above mean sea level
7.2	Ambient Temperature DBT	
i.	Maximum DBT	36.5 ℃

ii.	Minimum DBT	20.8 °C
iii.	Performance DBT	27 °C
7.3	RELATIVE HUMIDITY	
i.	Maximum	82 %
ii.	Minimum	35 %
iii.	Performance	50%
7.4	Earthquake Zone	Zone II
7.5	Predominant Wind direction	East to West
7.6	Wind velocity	Civil/structural design will be done considering IS 875 part 3
7.7	Rainfall	
i.	Annual	437 mm
7.8	Availability of Raw Water	Main source of water of the plant is sea water, which shall be taken from the Bay of Munnar.

SECTION – C1
SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

1.0 BRIEF DESCRIPTION OF THE SYSTEMS:

The Chemical Dosing System shall consist of NaOH dosing system to dose dilute NaOH in ECW tank and ECW line.

2.0 *NaOH DOSING SYSTEM for ECW SYSTEM*

Sodium Hydroxide (NaOH) dosing system is provided to dose NaOH solution in Equipment cooling water lines to increase pH upto 9.5. The sodium hydroxide dosing is done in the ECW cycle during the initial fill and for the compensation of cooling water for any leakage during normal run. The 1% solution of NaOH is prepared manually by opening the inlet valve of DM water and adding NaOH lye in basket. The NaOH is being dissolved by locally starting the motorized stirrer. The dosing is done manually as per requirements of desired pH in ECW line judged by trial basis. Normally the leakage is occasionally and of small quantity . At the low level of solution in tank the solution is to be prepared again.

The dosing system consists of following (Refer Data Sheet-A and P&ID).

3.0 *SCOPE OF SYPPLY:*

The bidder's scope of supply includes the following under this specification:

a) One number NaOH Dosing tank.
b) Two (2X100%) NaOH Dosing Pumps.
c) Associated Piping, valves, fitting as indicated in the P&ID of NaOH dosing system and data sheet-A enclosed and as required to make the system complete.
d) Foundation nuts & bolts to fix each skid on the floor, as required.
e) Control & instrumentation as per P&ID of NaOH dosing system, Data sheet-A and as indicated in different section in this specification.
f) Commissioning spares as indicated in specification.
g) Mandatory spares as indicated in specification.

4.0 *SCOPE OF SERVICE:*

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

a) Design and engineering.
b) Fabrication of the skid mounted chemical dosing system.
c) Inspection and testing of the skid as per the approved quality assurance plan.
d) Supply of the skid mounted chemical dosing system up to the power plant site along with all accessories as defined in the technical specification.
e) Supervision of Commissioning by experienced/capable engineer **for one (1) visit of two (2) days to supervise in Commissioning.**
f) Painting as per technical specification.
g) Packing of skid (**Refer Note Below**)

Note: To prevent damage to the equipment of the skid during loading/unloading, transit and in view of the site storage suitable wooden packing with steel angel/frame shall be provided. Auto Stroke controller shall be packed separately in weather proof packing box.

SUB VENDOR LIST (TABLE-1)

SL NO.	ITEM	APPROVED SUPPLIERS	PLACE	REMARKS
	MECHANICAL:			
1	**TANK/DISSOLVING BASKET/WATER SEAL POT/ CO_2 ABSORBER/BREATHER**	SELF-MAKE OF MAIN VENDOR	AS APPLICABLE	
2	**AGITATOR/STIRRER**	REMI (REFER NOTE 1)	MUMBAI	
		CEECON	CHENNAI	
		FIBRE & FIBRE		
3	**GATE/GLOBE/NON-RETURN (CHECK) VALVES**	PRECISION ENGG.	MUMBAI	
		CRESENT VALVE	MUMBAI	
		BDK	HUBLI	
		LEADER	JALANDHAR	
		CHEMTECH	MUMBAI	
		TECHNO VALVE	MUMBAI	
		FOURESS	MUMBAI	
		FLUIDLINE	MUMBAI	
		STEELSTRONG	MUMBAI	
		L&T AUDCO		
		GM ENGINEEIRNG		
		A.V. VALVES		
		ATAM VALVES	JALANDHAR	
4	**2/3 WAY VALVE MANIFOLDS**	TECHNO VALVE	MUMBAI	
		HI TECH	AHMEDABAD	
		CHEMTROL		
		BLISS ANAND	GURGAON	
		APPROVED ORIGINAL SUPPLIER FOR THE RESPECTIVE INSTRUMENT	AS APPLICABLE	
5	**METERING PUMP WITH PRV**			
		MILTON ROY		
		VK PUMP		
		SWELORE		
		METACHEM		
		DENCIL		
		POSITIVE METERING		
		EXCEL HYDRO		
6	**PIPES**	CHOKSHI TUBES	AHMEDABAD	
		REMI	MUMBAI	
		RATNAMANI	AHMEDABAD	
		PRAKASH STEELAGE	SILVASA	

		KALYANI		
		PRAKASH		
		SAW		
7	**FITTINGS**	BHARAT FORGE	PUNE	
		RELIANCE FORGE	MUMBAI	
		EBY	MUMBAI	
		SIDDARTH & GAUTAM	FARIDABAD	
		MS FITTINGS	KOLKATA	
		PRADEEP METALS LTD	MUMBAI	
		TUBE PRODUCT INCOROPORATION	BARODA	
		CSA FITTINGS		
8	**FLANGES**	PRADEEP METALS LTD	MUMBAI	
		TUBE PRODUCT INCOROPORATION	BARODA	
		RELIANCE FORGE	MUMBAI	
		CD INDUSTRIES		
9	**PAINT**	BERGER PAINTS	KOLKATA	
		ASIAN PAINTS	MUMBAI	
		SHALIMAR PAINTS	KOLKATA	
		JENSON & NICOLSON	KOLKATA	
		GUNJAN PAINT	MUMBAI	
	ELECTRICAL:			
10	**LT MOTORS**	KEC	BANGALORE	
		SIEMENS	MUMBAI	
		ABB	FARIDABAD	
		CROMPTON GREAVES LTD	MUMBAI	
		BHARAT BIJLEE	MUMBAI	
		NGEF	BANGALORE	
		MARATHON	KOLKATA	
		JYOTI	VADODARA	
		LHP	SOLAPUR	
	C&I:			
11	**LOCAL CONTROL PANEL**	INDSUSTRIAL SWITCHGEAR & APPS	MUMBAI	BOM OF THE LCP SHALL BE SUBJECT TO BHEL/ CUSTOMER APPROVAL DURING DETAILED ENGINEERING.
		PROCON	CHENNAI	
		CONTROL & SWITCHGEAR		
		PYROTECH	UDAIPUR	
		DELTA CONTROL	MUMBAI	
		RITTAL		
		SUCHITRA		
		INDUSTRIAL CONTROLS & APPLIANCES LTD.		
12	**INST CABLES (SCREENED)**	RELIANCE	BANGLORE	
		DELTON	FARIDABAD / NEW DELHI	
		NICCO	KOLKATA	
		CHORDS CABLE	BHIWADI	
		UNIVERSAL	SATNA	

		INCAB	PUNE	
		POLYCAB	DAMAN	
13	**LT CONTORL CABLES**	DELTON	FARIDABAD/NEW DELHI	
		FINOLEX	PUNE	
		NICCO	KOLKATA	
		PARAMOUNT CABLES	ALWAR	
		FGI	KOLKATA	
		POLYCAB WIRES	DAMAN	
		TORRENT CABLES	NADIAD	
		FINOLEX	PUNE	
		INDUSTRIAL CABLE	RAJPURA	
		THERMOCABLES	HYDERABAD	
		ADVANCE CABLE TECHNOLOGIES	BANGALORE	
		APAR INDUSTRIES	MUMBAI	
		CMI LTD.	FARIDABAD	
		CRYSTAL CABLE INDUSTRIES	KOLKATA	
		DIAMOND POWER	VADODARA	
		ELKEY TELELINKS	NEW DELHI	
		GOVIND CABLES	KOLKATA	
		HAVELLS INDIA	NOIDA	
		KEI INDUSTRIES	DELHI	

14	LEVEL GAUGE	BLISS ANAND PVT. LTD.	
		TOSHNIWAL BROTHERS PVT.LTD.	MAKE:NIVO CONTROLS
		SIGMA INSTRUMENTS CO.	
15	TRANSMITTERS	ABB LIMITED	PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER
		Pune Techtrol Pvt. Ltd.	Only for capacitance Type Level Transmitter
		V. AUTOMAT & INTRUMENTS (P) LTD.	a)DISPLACEMENT TYPE TRANSMITTERS. b)PRESSURE AND DP TRANSMITTERS
		Moore Industries International Inc.	
		PANAM ENGINEERS	For Pressure and Diff. Pressure transmitter
		TOSHNIWAL INDUSTRIES PVT. LTD.,	
		Endress + Hauser (India) Pvt. Ltd.,	
		YOKOGAWA INDIA LIMITED,	
		SBEM PVT. LTD.	FOR CAPACITANCE TYPE.
		SIEMENS LIMITED	
		EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	
		SMART INSTRUMENTS LTD, BRAZIL	LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.

		NIVO CONTROLS PVT. LTD.	For Capacitance type only
		Honeywell Automation India Limited	
16	JUNCTION BOX	Shrenik & Company,	
	JUNCTION BOX	SUCHITRA INDUSTRIES	
	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Metal type junction box only
	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	
	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	
17	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	
	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	
	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	
	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	
17	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	
	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	
	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	
	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	
	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	
	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	
	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	
	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	
	INSTRUMENT FITTINGS	AURA INCORPORATED	
	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	
	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	
	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	
	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	
	INSTRUMENT FITTINGS	PANAM ENGINEERS	
19	Pressure gauge and differential Pressure gauge	SWITZER, CHENNAI. AN INSTRUMENTS, KOLKATA, H GURU, NEW DELHI. MANOMETER INDIA, MUMBAI. GIC, MUMBAI/GOA. GLUCK INDIA, MUMBAI. BUDENBERG GAUGE. DRESSER IND. FORBES MARSHALL. WAREE.	

Notes:-

1. Bidder to note that geared motor of REMI make for stirrers (for stirrers of REMI make ONLY) is acceptable to BHEL.

2. All the finally selected sub vendors shall be subject to customer approval during detailed engineering without any delivery/ commercial implications to BHEL/ Customer.
3. Calibration column may be purchased from sources as per pump manufacturer's recommendation.
4. The sub vendor list enclosed is indicative only and is subject to approval / acceptance by customer.
Bidder to propose his sub vendor list with back up documents (experience list, end user 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.

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
1	145-04000-A	CONTROL VALVE	SAMSON CONTROLS PVT. LTD.	Mr. Atul raje-MD D 281, MIDC Ranjangaon Ta Shirur Pune Phone- 02067246600 Pincode : 412220 Email : sales@samsoncontrols.net	Works-1-> Others D 281, MIDC Ranjangaon -Pune-MAHARASHTRA India Phone- 02067246600,8554997963 FAX : Pincode : 412220 Email : sales@samsoncontrols.net		
2	145-04000-A	CONTROL VALVE	FORBES MARSHALL ARCA PVT.LTD.	A-34/35 , MIDC ESTATE, H-BLOCK, PIMPRI, PUNE, Phone- 020-27442020, Pincode : 411018 Email : mnadgaundi@forbesmarshall.com	Works-1->Mr. Sanjeev Shinde A-34/35 MIDC Estate,H Block, Pimpri, -Pune-MAHARASHTRA India Phone- 9323176406 FAX : 020-27442040 Pincode : 411018 Email : sshinde@forbesmarshall.com	No technical limit exists except for feed control valve. For feed control valves, approved up to sub-critical power plants of 600 MW rating	
3	145-04000-A	CONTROL VALVE	INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	Works-1->D.SASIDHARAN, AGM(Works&PPC) KANJIKODE WEST, -PALAKKAD-KERALA INDIA Phone- 0491-2566536 FAX : 0491-2566135 Pincode : 678623 Email : sasidharan@ilpgt.com		
4	145-04000-A	CONTROL VALVE	Koso India Private Limited,	H 33 & 34, MIDC, Ambad, Nashik, Phone- 09650233433 Pincode : 422010, Email : jetmal.gour@koso.co.in	Works-1->P.J.ASHOK KUMAR/SEEMA ANAND Control Valve Division, H-33&34, MIDC, Ambad, -Nashik-MAHARASHTRA India Phone- 91 944 744 3198 FAX : 0491 - 5269914 Pincode : 422010 Email : pja@koso.co.in Works-2->+P.J.ASHOK KUMAR/SEEMA ANAND J-1,MIDC,Ambad -Nashik-MAHARASHTRA India Phone- 91 944 744 3198 FAX : 0491 - 5269914 Pincode : 422010 Email : pja@koso.co.in		
5	145-04000-A	CONTROL VALVE	KSB MIL CONTROLS LTD.	Mr.Jacob Cherian/Mr.Geo Jolly Meladoor, Annamanada P.O. MALA, Thrissur Phone- 0480-2695700 Pincode : 680741 Email : biju.simon@ksb.com	Works-1->Mr.Biju Simon/Mr.Jose Paul Meladoor, Annamanada, -Thrissur-KERALA INDIA Phone- 9447555500 FAX : 91 480 2890952 Pincode : 680741 Email : jose.paul@ksb.com		
6	145-04000-A	CONTROL VALVE	SUZHOU DELAN ENERGY SCIENCE & TECHNOLOGY CO., LTD.	No 566 Fangqiao Road Caohu Industrial Park, Xiangcheng Economic Development Zone, Suzhou Phone- 008618012776062 Pincode : 215143 Email : jeanielei@delan-valve.com	Works-1->Mr. Zong Xin CEO No 566 Fangqiao Road Caohu Industrial Park,Xiangcheng E. Z. -Suzhou-Foreign Country CHINA Phone- 008618012776062 FAX : Pincode : 215143 Email : jeanielei@delan-valve.com		
7	145-04000-A	CONTROL VALVE	R.K.CONTROL INSTRUMENTS PVT. LTD.	PLOT NO.A-250, OPP.POLICE STATION, WAGLE INDUSTRIAL ESTATE, THANE Phone- 25820943/2331 Pincode : 400604 Email : rkcipl@vsnl.com ; rkcipvt@bol.net.in	Works-1->SAVITH KUMAR PLOT NO. A-250, OPP.POLICE STATION,WAGLE INDUSTRIAL ESTATE, THANE -THANE-MAHARASHTRA INDIA Phone- 022-'66060942 FAX : 022-25820801 Pincode : 400 604 Email : rkadmin@rkcipl.co.in	For subcritical power plant up to 150MW	
8	145-04000-A	CONTROL VALVE	Mascot Valves Pvt. Ltd.	166-167 GIDC Naroda Ahmedabad Phone- 0792282 1619 Pincode : 382330 Email : dom.sales@mascotvalves.com	Works-1->Varun Patel Dir 166-167 ,GIDC Naroda -Ahmedabad-GUJARAT India Phone- 0792282 1619 / 3369 FAX : Pincode : 382330 Email : dom.sales@mascotvalves.com		
9	145-04000-A	CONTROL VALVE	Valvitalia S.P.A. ,	Mr. Salvatore Ruggeri Via Tortona 69, Rivanazzano (Pavia) Phone- +39-03839459875 Pincode : 27055 Email : dario.torluccio@valviatalia.com	Works-1->Mr. Salvatore Ruggeri Via Tortona 69,Rivanazzano (Pavia) -- Italy Phone- +39-03839459875 FAX : Pincode : 27055 Email : dario.torluccio@valviatalia.com; diego.poletti@valvitalia.com; sales@bhgassociates.com		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
10	145-04000-A	CONTROL VALVE	BOMAFA SPECIAL VALVE SOLUTIONS PVT LTD	Mr. K.M. Anklesaria/ R. M. Anklesaria Plot No: 285/2, Panchratna Estate, Near Ramol Bridge, Vatva Ahmedabad Phone- 079-40083825 Pincode : 382445 Email : info@bomafa-india.com	Works-1->Mr. K.M. Anklesaria/ Mr. R.M. Anklesaria Dir Plot No: 285/2, Panchratna Estate, Near Ramol Bridge, Vatva, -Ahmedabad-GUJARAT INDIA Phone- 079-40083825 FAX : Pincode : 382445 Email : info@bomafa-india.com		
11	145-04000-A	CONTROL VALVE	DRESSER VALVE INDIA PVT. LTD	Mr. Raj Raman/Mr. Rajkumar Moria S.F. No: 608,Chettipalayam Road, Echanari Post, Coimbatore Phone- +91-98451 19085 Pincode : 641021 Email : Anoop.Ramachandran@ge.com	Works-1->Mr. Anoop Ramchandran S.F. No: 608,Chettipalayam Road, Echanari Post, -Coimbatore-TAMIL NADU INDIA Phone- +919500978296 FAX : +91 4223011200 Pincode : 641021 Email : Anoop.Ramachandran@ge.com		
12	145-04000-A	CONTROL VALVE	Severn Glocon India Pvt. Ltd.	F96 & F97, Sipcot Industrial Park, Irungattukottai, Chennai, Phone- 044-47104200, Pincode : 602117, Email : info@severnglocon.co.in,	Works-1->Mr. K.Kaushik, F96 & F97, Sipcot Industrial Park,Irungattukottai, -Chennai-TAMIL NADU India Phone- 044-47104200, FAX : 044-47100073, Pincode : 602117, Email : info@severnglocon.co.in		
13	145-04000-A	CONTROL VALVE	EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	147, KARAPAKKAM VILLAGE, CHENNAI Phone- 23722184, 23716242 Pincode : 600096 Email : jatinder.singh@emerson.com	Works-1->Mr. Rangarajan (Head - Lean and Manufact 147,Karapakkam Village, -Chennai-TAMIL NADU India Phone- 0444903 4395 FAX : Pincode : 600097 Email : Rangarajan.M@emerson.com		
14	145-04000-A	CONTROL VALVE	WALDEMAR PRUSS ARMATURENFABRIK GMBH	Mr. Winfried Dremhel Schulenburgerlandstrasse 261, Hannover Phone- +49-511279260 Pincode : 30419 Email : dremhel@pruss.de; vogel@pruss.de	Works-1->Mr. Winfried Dremhel CEO Schulenburgerlandstrasse 261, -Hannover- GERMANY Phone- +49-511279260 FAX : Pincode : 30419 Email : dremhel@pruss.de		
15	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in	Works-1->C S Shankar 127, Sidco North Phase, Ambattur Estates, -CHENNAI-TAMIL NADU INDIA Phone- 8754491904 FAX : 044-26248849 Pincode : 600050 Email : cservice@switzerinstrument.com		
16	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com			
17	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de			
18	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com			
19	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
20	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD Phone- 0120-2712016 Pincode : Email : mktg@indfos.com			
21	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com			
22	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com	Works-1->LARRY DEGARMO/ ROY STUMBOUGH 14685 W. 105TH STREET, LENEXA -KANSAS- USA Phone- 913-888-0767 FAX : 913-888-0767 Pincode : 66215 Email : rstumbough@sorinc.com		
23	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,			
24	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net	Works-1->NA NA -- Phone- FAX : Pincode : Email :		OVERALL PENDING ORDER VALUE (EXCLUDING VALUE OF ORDERS ALREADY EXECUTED) FOR ALL PACKAGES FOR WHICH VENDOR IS REGISTERED SHALL NOT EXCEED RS. 1.0 CRORE
25	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	Works-1->Mr. Gautam Mukherjee Kusumba,Sonarpur Station Road,P.O. -Narendrapur, -Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email : gkm_ani@hotmail.com		
26	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net	Works-1->Mr. Partha Bose 44, Saheed Hemanta Kumar Bose,Sarani, -Kolkata-WEST BENGAL India Phone- +91 33 2548 7220 FAX : +91 33 2548 0429, Pincode : 700074 Email : parthabosebpi@gmail.com bosepanda@vsnl.net		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
27	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com		
28	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb,Yeshwanthpur -BANGALORE-KARNATAKA INDIA Phone- 080-23370300 FAX : 080-23379890 Pincode : 560022 Email : shikhahazra@hgurusouth.com		
29	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com		
30	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com	Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2,I.DA. NACHARAM , -HYDERABAD-TELANGANA INDIA Phone- 09866550762 FAX : 040 27152193 Pincode : 560076 Email : gshrinivasan@forbesmarshall.com		
31	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com.	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA India Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com		
32	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in	Works-1-> Others 26/2, G Type, Global Ind. Park Near Nahuli Railway Crossing, -Vapi-GUJARAT INDIA Phone- 9920576002 FAX : Pincode : 396105 Email : sales@nesstech.co.in, bkapadia@nesstech.co.in		
33	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com		
34	145-14000-A	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com.	Works-1-> PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, -BANGALORE-KARNATAKA INDIA Phone- 080-41586000, FAX : 080-28521442, Pincode : Email : uday.shankar@in.yokogawa.com		
35	145-14000-A	TRANSMITTERS	ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com		PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER	

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
36	145-14000-A	TRANSMITTERS	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com	a)DISPLACEMENT TYPE TRANSMITTERS. b)PRESSURE AND DP TRANSMITTERS	
37	145-14000-A	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com		Only for capacitance Type Level Transmitter	
38	145-14000-A	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No.: 218-230& 235, Industrial Estate,Makhupura, -Ajmer-RAJASTHAN India Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : rajeev.gupta@tipl.com		
39	145-14000-A	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in	Works-1->MR. MOHAN PADWAL 691/A/2,BIBWEWADI INDL ESTATE -PUNE-MAHARASHTRA INDIA Phone- 918600042374 FAX : 912024215670 Pincode : 411037 Email : wm@sbem.co.in	FOR CAPACITANCE TYPE.	
40	145-14000-A	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com.	Works-1-> M-171 to 173, MIDC, Waluj, -Aurangabad-MAHARASHTRA India Phone- 9881000474, FAX : 0240-2555179, Pincode : 431136, Email : Narendra.Kulkarni@wetzer.endress.com	"Except Displacement Type Level Transmitters"	
41	145-14000-A	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com	Works-1->Matt Moren/Gina Cruz 16650 Schoenborn St., North Hills -CALIFORNIA- USA Phone- +1 818 894 7111, ext FAX : +1 818 830 5588 Pincode : 91343 Email : gcruz@miinet.com		
42	145-14000-A	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com	Works-1->Mr. Santosh Shukla Others R-628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com	For Pressure and Diff. Pressure transmitter	
43	145-14000-A	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com	Works-1->Mr.Kedar Tillu 53, 54, 56 & 57,Hadapsar Industrial Estate -PUNE-MAHARASHTRA INDIA Phone- 9665034625 FAX : 020 66039905 Pincode : 411013 Email : kedar.tillu@honeywell.com		
44	145-14000-A	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com	Works-1->Kalpesh Chandan/Hrishikesh Aghor Plot No. A 145/4 TTC IND AREA,MIDC, PAWANE, -NAVI MUMBAI-MAHARASHTRA INDIA Phone- 9619688001 FAX : 022-66736000 Pincode : 400 705 Email : Kalpesh.chandan@emerson.com		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
45	145-14000-A	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in		LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.	
46	145-14000-A	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	Works-1->Ankit Varshney Kalwa Works, Thane-Belapur Road, Thane, -MUMBAI-MAHARASHTRA INDIA Phone- FAX : Pincode : 400708 Email :		
47	145-14000-A	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com	Works-1->Mr. Praveen Toshniwal 104-115, Electronic Complex, -Indore-MADHYA PRADESH India Phone- 0731-4081305 FAX : 0731-255075 Pincode : 452010 Email : sales@nivocontrols.com	For Capacitance type only	
48	145-21000-A	DIFFERENTIAL PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com			
49	145-25000-A	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net			
50	145-25000-A	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com	Works-1->B. Srinivas Suchitra Industries, Opp No 53, Muneshwara Black Devinagar, Lottagal hal -BANGALORE-KARNATAKA INDIA Phone- 080-23511247 FAX : Pincode : 560094 Email : suchitra_industries@yahoo.com		
51	145-25000-A	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com	Works-1->Mr.Pulin Shah/ Mr. Kaloesh Parmar 39 A/3 ,Panchratna Industrial Est,Sarkhej-Bavla Road, Changodhar -Ahmedabad-GUJARAT INDIA Phone- 98250 80339 1 FAX : 079-26932424 Pincode : 382213 Email : sales@sumip.com		
52	145-25000-A	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com	Works-1->Mr. Dineshbhai Zaveri CEO C-1/ 27&37, GIDC, Kabilpore, -Navsari-GUJARAT INDIA Phone- 02637-265140,265003 FAX : 02637-265308 Pincode : 396424 Email : flexpro@flexproltd.com	Metal type junction box only	
53	145-25000-A	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com	Works-1->JIGNESH MAHENDRA AJMERA DENA BANK BLDG., SHREE NAGESHINDL. ESTATE,STATION ROAD, -MUMBAI-MAHARASHTRA INDIA Phone- 022 67973578 FAX : Pincode : 400 088 Email : ajmera@ajmera.net		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
54	145-32000-A	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com		Over all financial limit for ordering as Rs.30 lacs (Rs.Thirty Lacs). The registration category & the financial limit may be reviewed after survey in March 2009 and approval thereof. Registered w.e.f. 22.01.2009.
55	145-32000-A	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone-(022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com		
56	145-32000-A	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com		
57	145-32000-A	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com			
58	145-38000-A	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com		Over all financial limit for ordering as Rs.30 lacs (Rs.Thirty Lacs).
59	145-38000-A	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone-(022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com		
60	145-38000-A	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com			
61	145-38000-A	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com		
62	145-45000-A	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com	Works-1->S. Harichandran/ P.S. Pandi B-11, Mugappair Industrial Estate, -CHENNAI-TAMIL NADU INDIA Phone- 044-25252537 FAX : 044-26252538 Pincode : 600037 Email : sales@hpvalvesindia.com		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
63	145-45000-A	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com	Works-1->Shahanawaz Khan Vishweshwar Ind. Premises Co-op Soc. Ltd,F-18/19, Pradhikaran,Bhosadi MIDC -PUNE-MAHARASHTRA INDIA Phone- 020-30694134 FAX : 022-23013010 Pincode : 411026 Email : shahanawaz.khan@perfectinstrumentation.com		
64	145-45000-A	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com			
65	145-45000-A	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com		
66	145-45000-A	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com			
67	145-45000-A	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com	Works-1->Miss Sonal Pithadia/Miss Pavan Chavda Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway, Laxmipura -Nandasan-GUJARAT INDIA Phone- 8460848087 FAX : 2764-267036/37 Pincode : 382705 Email : domestic@com-fit.com		
68	145-45000-A	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com	Works-1->Mr. Abbas Bhola Unit No. 16, Supreme Industrial Estate,Kaman Bhiwandi Road,Devdal, -Vasai East-MAHARASHTRA India Phone- 9920044113 FAX : 07303178243 Pincode : 401208 Email : ab@fluidfitengg.com		
69	145-45000-A	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com		Over all financial limit for ordering as Rs.30 lacs (Rs.Thirty Lacs).
70	145-45000-A	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
71	145-45000-A	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone-9892179529, Pincode : 400099, Email : santosh@panamengineers.com	Works-1->Mr. Santosh Shukla Others R-628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com		

Notes :-

i) The above sub-vendor list is tentative & for reference only. However Sub-Vendor List is subject to BHEL/ end user approval without any commercial/ delivery implication.

ii) New Sub-Vendor if proposed by Vendor during contract stage shall be subject to BHEL/ end user approval without any commercial/ delivery implication.

SUB-VENDOR LIST FOR LT MOTORS

SL NO.	VENDOR NAME	
1	ABB	14, MATHURA ROAD, FARIDABAD, HARYANA-121003
2	BHARAT BIJLEE LTD.	BHARAT BIJLEE LIMITED, 1ST FLOOR, 7-B, RAJINDRA PARK, PUSA ROAD, NEW DELHI - 110 060.
3	CROMPTON GREAVES	3RD FLOOR, EXPRESS BUILDING,9-10, BAHADUR SHAH ZAFAR MARG, NEAR ITO CROSSING,NEW DELHI-110002, INDIA
4	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032
5	KIRLOSKAR ELECTRIC CO LTD.	P.O. BOX 5555 , MALLESWARAM WEST ,BANGALORE 560055
6	LAXMI HYDRAULICS PVT. LTD	129/130, INDUSTRIAL ESTATE PATIL NAGAR, HOTGI ROAD SOLAPUR-413003, MAHARASHTRA
7	MARATHON	MARATHON ELECTRIC INDIA PRIVATE LTD.SECTOR - 11, MODEL TOWN, FARIDABAD - 121006
8	NGEF	POCKET NO.10, FLAT NO. 37 & 38, EXPANDABLE DDA FLATS, NASIRPUR DWARKA, PHASE-I NEW DELHI-110 045
9	RAJINDRA ELECT INDUSTRIES	14 SHAH IND.ESTATE VEERA DESAI RD,ANDHERI(W) MUMBAI-400053
10	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA

SUB-VENDOR LIST FOR GLANDS

1	ALLIED TRADERS & EXPORTERS	C-124 A, SECTOR-2, NOIDA -201 301, UTTAR PRADESH, INDIA
2	ARUP ENGG & FOUNDARY WORKS	391/119,PRINCE ANWAR SHAH ROAD, CALCUTTA-700068
3	BALIGA LIGHTING EQPT.PVT.LTD.	63A,CP RAMASWAMY ROAD, ALWARPET,P.B.No 6910, CHENNAI-600018
4	COMMET BRASS PRODUCTS	NUTAN CHEMICAL COMPOUND, WALBHAT ROAD, GOREGAON, MUMBAI-400063
5	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.
6	ELECTROMAC INDUSTRIES	27/28AF NEW EMPIRE IND.ESTT., R.KRISHNA MANDIR RD.JB NGR ,ANDHERI(E),MUMBAI-400059
7	INCAB	HARE STREET,KOLKATA,WEST BENGAL-700001

SUB-VENDOR LIST FOR LUGS

568142/2021/PS-PEM-MAX

1	DOWELLS	M/S. DOWELLS ELECTRICALS 47/47A, SATGURU INDUSTRIAL ESTATE. OFF AAREY ROAD, GOREGOAN (EAST). MUMBAI 400 063.
2	UNIVERSAL MACHINES LTD.	4,B.B.D.BAG (EAST) 90,STEPHEN HOUSE,5TH FLR CALCUTTA-700001

TABLE -2

LIST OF COMMISSIONING SPARES

Sl.No.	Description	Quantity
1.1	Oil Seals for drive end for motor	4 Nos.
1.2	Gaskets for drive end for motor	4 Nos.
1.3	Guide ring for plunger.	4 Nos.
1.4	Teflon rings for valve/s.	4 Nos.
1.5	Level gauge glass	4 Nos.
1.6	Back up fuse	4 Nos.
1.7	Pilot lamp	4 Nos.
1.8	Push Button	4 Nos.
1.9	Control fuse	4 Nos.
1.10	Bulb for Annunciation	4 Nos.

TABLE -3

LIST OF MANDATORY SPARES

Sl.No.	Description	Quantity
1.0	**Agitators**	
1.1	Impeller assembly	1 Nos. for each type and size
1.2	Bearings	2 Sets for each type and size
1.3	Shaft assembly	1 Sets for each type and size
1.4	Shaft seal	1 Sets for each type and size
1.5	Gear box, if applicable	1 no. of each type and size
1.	Complete agitator assembly	1 no. of each type and size
2.0	**Valves**	
2.1	Complete valves for each type	2 Sets
2.2	Seat, disc, spindle with nut for each type	2 Sets
2.3	Flats of each type and size of Non return valves	1 Set

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING) PROJECT: 2X500 MW TUTICORIN TPP (NTPL) (FGD SYSTEM PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-483-154-A001	
		VOLUME II-B	
		SECTION –C1	
		REV. NO. 00	DATE:

PAINTING SPECIFICATION

VOLUME : II-A

SECTION - V

PROTECTIVE COATING AND PAINTING

CONTENTS

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	INTENT OF SPECIFICATION	1
2.00.00	CODES & STANDARDS	1
3.00.00	GENERAL REQUIREMENTS	2
4.00.00	SURFACE PREPARATION	3
5.00.00	PAINT APPLICATION	7
6.00.00	INSPECTION	11
7.00.00	SPECIFICATION OF COATING SYSTEMS	15
8.00.00	TESTING REQUIREMENTS	23
9.00.00	INFORMATION / DATA REQUIRED	26
ANNEXURE-1	MARKET AVAILABLE COATING SYSTEMS AS PER SPECIFICATION	27

VOLUME : II-A

SECTION-V

PROTECTIVE COATING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

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

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

2.00.00 CODES & STANDARDS

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

a)	SSPC SP 10 / NACE 2 / SA 2½	:	Near white blast cleaning
B)	SSPC PA 2	:	Measurement of dry film coating thickness with magnetic gauges.
c)	ASTM D 45	:	Method for pull off strength using portable adhesion tester.
d)	NACE RP 0274 – 2004	:	High-voltage electrical inspection of pipeline coatings.
e)	NACE SP 0188 – 2006	:	Discontinuity (holiday) testing of new protective coatings on conductive substrates.
f)	NACE RP 0169 – 2002	:	Control of external corrosion of underground or submerged metallic piping systems.

g)	AWWA C 210 – 2007	:	Liquid-epoxy coating systems for the interior and exterior of steel water pipelines.
h)	IS 3589:2001 Annexure-b	:	Steel pipes for water and sewage specification.
i)	AWWA C 222-2000	:	Polyurethane coating for the interior and exterior of steel water pipe and fittings.
j)	IS 13213 : 2000	:	Polyurethane full gloss enamel (two pack)
k)	ISC HD 20 (11902)	:	Polyurethane coating for interior and exterior of steel pipe and fittings.
l)	ISC HD 20 (11055)	:	Solvent less liquid epoxy system by application of interior and exterior surface of steel pipeline.
m)	IS 10221	:	Coating and wrapping for buried piping

3.00.00 GENERAL REQUIREMENTS

3.01.00 The bidder shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to owner/consultant for approval.

3.02.00 The bidder shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that manufacturing quality plan (MQP) and field quality plan (FQP) shall also be submitted prior to commencement of supply of material and field application.

3.03.00 Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

3.04.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.

3.05.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.

3.06.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a purchaser approved method shall be adopted.

3.07.00 The colour scheme of the entire FGD Plant equipment and auxiliaries area, covered under this specification shall be approved by the purchaser in advance before application.

3.08.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by purchaser.

3.09.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti-corrosive painting.

3.10.00 For vessels / tanks requiring lining and anti-corrosive painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.

3.11.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.

3.12.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).

3.13.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.

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

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

3.16.00 All insulated piping shall have aluminium sheet jacketing.

4.00.00 SURFACE PREPARATION

4.01.00 Most metallic articles that are usually given protective coatings are heavily contaminated and require, at least, some cleaning treatment before the coating is applied. The importance of surface preparation cannot be over emphasized as many investigations have shown convincingly that the performance and durability of any protective coatings are, to a large extent governed by the thoroughness of surface preparation. Often they concluded

that careful cleaning and preparation of the surface were more important than the quality of the protective coating.

4.02.00 Surface contamination in the form of rust, scale, oil grease and dirt is often obvious. Invisible contamination may also be present and represents, on the whole, a greater hazard. Examples of the latter are soldering fluxes, perspiration in the form of hand marks, chlorides from marine atmosphere and sulfite from industrial atmosphere.

4.03.00 The following table gives a surface preparation specification in the descending order of Effectiveness:

Sl. No.	Methods of cleaning	Specifications NACE/SSPC
1.	White metal blast	NACE # 1, SSPC SP 5-63
2.	Near –white metal blast	NACE # 2, SSPC SP 10-63
4.	Acid Pickling	SSPC SP 8-63
5.	Brush Blast	NACE # 4, SSPC SP 7-63
6.	Flame Clean and Power Sanding	SSPC SP 4-63
7.	Power Tool Cleaning	SSPC SP 3-63
8.	Chip and Hand Wire Brush	SSPC SP 2-63
9.	Solvent Wipe	SSPC SP 1-63

4.04.00 The following table gives the Specifications for sand / shot / grit blasting

Sl. No.	Methods of Cleaning	Specification
1.	NACE # 1	White sand blast
2.	NACE # 2	Near-white sand blast
3.	NACE # 3	Commercial blast
4.	Pickle, phosphate treated	
5.	NACE # 1	Grit
6.	NACE # 1	Shot
7.	NACE # 4	Brush blast
8.	No surface preparation	

4.05.00 Inspection of blasted steel surface

For the purpose of inspecting the blasted steel surface with sand abrasive, the respective “Visual standards” shall be utilized.

The standards used in industry to describe surface preparation are:

i. National association of Corrosion Engineers (NACE)
ii. Steel Structural Painting Council (SSPC)
iii. Swedish Pictorial Standards

White metal blast (SSPC 5-63, NACE No.1, and SA-3)

This is defined as removing all rust, scale, paint etc. to a clean white metal which has a uniform Grey white appearance. Streaks and stains of rust or

other contaminants are not allowed.

Near white metal (SSPC 10-63, NACE No.2, SA – 2.5)

This provides a surface of about 95% as clean as white metal. Light shades and streaks are not allowed.

Commercial blast (SSPC 6-63, NACE No.3, SA –2)

This type of blast is more difficult to describe. It essentially amounts to about 2/3 of a white metal blast, which allows for very slight residues of rust and paint in the form of staining.

Brush of blast (SSPC 7-63, NACE No.4 SA-1)

This preparation calls for removal of loose rust, paint, scales, etc. Tightly adherent paint, rust and scale is permitted to remain.

4.06.00 Pictorial Standards of different surface preparation to be adopted

During surface preparation operations, the surface condition obtained shall be compared with pictorial standards available for getting the specified condition. These pictorial standards are available in steel structural painting Manual (Vol. 1), “Good painting practice “, visual standards of surface cleaning sp 7,6,10 and 5 are described in page No.185 and 186 viz. Fig 9,11,12 and 13.Surface profile gauge and surface compactor could be used to check surface conditions according to NACE standard TM 01 70 of NACE.

4.07.00 PRESSURIZED WATER CLEANING METHODS

These standards provides requirements for the use of high and ultra-high pressure water jetting to achieve various degrees of surface cleanliness. This standard is limited in scope to the use of water only without the addition of solid particles in the stream. These standards define four levels of working pressure:

SSPC-SP WJ-1/NACE WJ-1:	Water-jet cleaning of metals. Clean to bare substrate.
SSPC-SP WJ-2/NACE WJ-2:	Water-jet cleaning of metals. Very thorough cleaning.
SSPC-SPWJ-3/NACEWJ-3:	Water-jet cleaning of metals. Thorough cleaning.
SSPC-SP WJ-4/NACE WJ-4:	Water-jet cleaning of metals. Light cleaning.

This cleaning standard defines 4 levels of cleanliness for visible contamination by water jetting and 3 levels for non-visible contamination, such as chlorides and other soluble salts. See the full standard for complete definitions on the level of cleanliness.

4.08.00 SPECIFICATIONS FOR COPPER SLAG BLASTING:

1. The surface shall be cleaned of all dust and heavier layers of rust by copper slag blasting the entire internal surface to photographic standard SIS: 055900- 1967.

2. The consumption rate of copper slag is 1.6 Kg/Sqm of the blasted area. This has to be ensured strictly.

3. All tools, equipment, base material, hand and power tools for cleaning, including scaffolding material, copper slag blasting equipment, air compressor, etc. shall be arranged by the contractor at site in sufficient quantity.

4. The compressor used shall be of size enough to produce displacement of 5.6 to 7.0 Cum/Min of air at a pressure of 7 Kg/sq.cm. Standard blasting equipment, hoppers, hoses nozzles and attachments shall be used to obtain best test results and to maintain safety standards. The rate of cleaning shall be about 15 sq.mt. per hour at a pressure of 7 kg/sq.cm.

5. The abrasive used shall be of the physical properties as mentioned below and shall be free from oil, loan and mud etc.

6. The blast cleaned surface shall be blasted with dry compressed air before applying primer. This should be done even if the surface appears very clean and white in colour. The white colour may be due to deposition of silicon and reflection of light on the surface.

7. Proper earthing and bonding arrangements shall be made to prevent any damage by sparks produced by static electricity. Bonding shall be done between tank and blast nozzles and hopper and air compressor also. The bonding conductor should not be less than 16 SWG single strand copper cable.

8. The time gap between blast cleaning and application of primer shall not be more than THREE hours. Blast cleaning work shall, commence from top to bottom.

9. The blast cleaning operation shall be carried out keeping the nozzle at an angle of 30 degree to the vertical in order to prevent rebounding abrasive from showing down the abrasives emerging from nozzle and from under cutting the material to be removed.

10. A blast cleaning, the percentage of bare metal obtained shall be between 95% to standards of SA 2 ½ of the Swedish standard referred above. (Pictora) surface preparation standards for painting steel surfaces).

11. Arrangements for inspection of various stages of the job shall be made available by the Contractor so that the entire sand blasted area is available for inspection. Any defective work noticed shall be immediately rectified and even reblasting shall be done if necessary.

5.00.00 PAINT APPLICATION

The coating is a unique product. It is only after application on the substrate a coating becomes valuable and useful. The manufacturer shall produce high performance liquid coatings, yet the product usefulness lies in the hands of the applicator. That is the reason why stress is given for proper and careful application as a key to the success of any coating. Protection by coating mainly depends upon three factors

a) The material
b) The surface preparation
c) The application

If any one of the three is weak, protection value is affected to that extent.

High performance coatings are especially sensitive to misapplication and may fail drastically. Therefore, it is imperative that the instruction for application be followed explicitly, particularly when applying sensitive and expensive high performance coating systems.

The purpose of coating application is to develop a continuous highly adherent film with an even thickness over the substrate. To achieve this, various factors have to be considered such as type of coatings and weather conditions, application methods etc. It is advisable to avoid painting below 10^0C and above 40^0C, if the relative humidity is above 80%, during the rainy weather and wind velocity is above 24km/hr or else freezing will occur before the paint dries.

5.01.00 Application methods

There are a number of methods by which coatings can be applied. The two principal methods are by brush and spray. The other methods are paint pad applications, electrostatic spray, electro-coating, dipping and fluidized bed technique. The latter methods are primarily for in-plant application.

The choice of application methods depends on a number of factors. The first is the type of coating. Most of the oil-based coatings can be easily applied by brush but it is the slowest process. Spray application is the fastest for large flat surfaces. The type of surface is also a factor. For small and intricate areas, brushing is probably the best method. If the surface is used and pitted, application of the first coat by brushing is probably the best method.

Brushing can be done in almost all areas, since the liquid coating is transferred from the brush to the surface. Spraying however, causes problem with toxic solvents as well as a possible fire hazard due to fume build up.

Spraying in small, enclosed areas are usually not suggested. Clean up is also a factor. Cleaning a brush is the least difficult procedure and cleanup of spray equipment is the most time consuming and most complicated procedure.

5.02.00 Storing and handling of paints

Coating materials (paint) as they are packed at the manufacturing plant are thoroughly dispersed, with the pigments fully suspended and of a uniform consistency in terms of both texture and colour. Unfortunately, very few coatings are applied within a short time after manufacture. They may be placed in inventory at the manufacturing plant or sent to a distribution point where they will be held for a period of time. Also, the coating material may be purchased several months before its actual use and again under different conditions. Thus, coatings generally must be remixed and properly re-dispersed prior to actual application.

A pigment, which is usually heavier than the vehicle, tends to settle and may even cake at the bottom of the container. Coatings vary to a wide degree in this particular characteristic. Some may stay suspended for many years; others settle out hard at the bottom of the container. This is a defect. Paints, which gelled in the container or in which the pigment liveried (i.e. become thick and rubbery) are not satisfactory for use and cannot be practically redispersed. The formulation has to contain proper antisettling additive to avoid this defect.

The purpose of remixing and re-dispersion is to make the coating completely homogeneous, so that upon application the pigment and vehicle can produce the film that was intended by the manufacturer. In certain cases, particularly in oil-type vehicles, there may be skin on the surface of the liquid. These should be removed before re-dispersion, since they will not get redispersed into the vehicle.

5.03.00 Mixing

The mixing process is not practically easy, even if the system has not settled hard. This is often neglected by applicators, particularly in coatings, which have settled rather solidly. There have been examples of coatings that were applied with at least half of the pigment remaining at the bottom of the container un-dispersed and later thrown away with the container. This procedure does not allow for the maximum performance of coating properties and normally leads to rapid coating failure.

Mechanical mixing

It is always better to use a mechanical mixer of some type, since mechanical mixing always produces a more uniform coating and does so much more rapidly than manual mixing. Manual mixing should only be done under unavoidable circumstances and only in containers with the maximum of a 20-liter capacity.

Even when the coating has settled rather hard, the propeller-type agitator can break it up and re-disperse it to a point, which is closely equivalent to its original form. Nevertheless, care should be taken in the mixing operation, particularly to ensure that the material at the bottom and lower sides of the container has been well separated from the container and re-dispersed. Some materials form soft sediment, which clings to both the sides of the container and the bottom, making it necessary to scrape these off before they can be properly dispersed. This is usually done by manual operation. The mixing should be done in such a manner that splashing is avoided.

The speed of a mechanical mixer should be as low as possible in order to obtain the re-dispersion of the pigment in the vehicle. The coating should have a slight vortex at the surface. A large vortex tends to mix air into the coating, which can cause pinholes and air bubbles during application.

Manual mixing

If the manual mixing is necessary, the liquid portion of the coating should be separated into a clean container. The lower, thicker part of the coating can then be more readily mixed into a heavy paste, including the material, which is clinging to the sides of the container. Once the heavier material is mixed into a smooth paste, the remainder of the liquid from the second container can be remixed into the original container with the heavy material, making sure that the two are thoroughly mixed into a uniform coating. One way to do this is to pour the material back and forth between the two containers. This is called boxing. The materials should be poured back and forth several times to assure complete uniform mixing.

5.04.00 Two component coatings

In the case of two component coatings, there are two materials that must be checked to determine whether or not they are properly dispersed prior to being mixed together. Two component coatings are extremely common at the present time. They include numerous kinds of epoxy coatings, coal tar epoxy coatings, polyurethane coatings, and inorganic zinc coatings. With two component coatings, it is essential that the two components be separately and thoroughly mixed. Two component materials are designed to react chemically, so that if they are not thoroughly mixed, the chemical reaction may not take place properly. Mechanical blending of the two components is recommended to obtain a thoroughly mixed product. The two component materials often are in different colours so that a satisfactory mixing can be readily identified. The fully mixed coating should have a uniform colour and consistency.

5.05.00 Mixing dry powder and liquid

The primary example of mixing dry powder and liquid components is in the use of inorganic zinc coatings. In-organic zinc coatings are made from liquid component and dry powdered zinc. The first step is to determine whether or not the liquid component is thoroughly mixed and dispersed to a completely

homogeneous liquid. This usually is not difficult since most liquid components are lightly pigmented.

Second, stir the total contents of the powder slowly into the total content of the liquid until it becomes a well dispersed, free flowing material. In the case of inorganic zinc coatings, the manufacturers supply the liquid and the powder in two different containers in the exact amount that should be mixed. It is essential that the total powder and total liquid be used in order to obtain the desired final coating. Mixing small portions of zinc and liquid is not recommended, since correct proportions are seldom measured under field conditions.

5.06.00 Straining

Most coatings are thoroughly strained prior to being placed in their container. When the container is opened, if the contents have not settled to a hard deposit in the bottom, straining in the field may not be necessary. On the other hand, if the pigment has settled hard, if the coating has a skin on the surface, or if the product is a material such as inorganic zinc, straining is recommended. Straining prior to spraying often eliminates considerable downtime due to gun clogging by small particles those blocks the orifice in the gun.

Straining can be done with a fine fly screen with a mesh size 150µm or through nylon stocking. Nylon stocking does not contain any lint and is a very fine mesh that most coating materials can readily pass through. Mosquito netting or similar materials also are used, although they often contain some lint, which can cause problems.

5.07.00 Compatibility of different paints

While applying multicoated system of paint it is always desirable to have a first-hand knowledge of compatibility of different coating systems with one another. A general view of such information is given in the following table. This is only a general view.

Primer	Oleo resinous	Alkyd	Silicone alkyd	Vinyl	Chlorinated rubber	Epoxy (2 pack)	Urethane
Oleoresins	C	C	C	NR	NR	NR	NR
Alkyd	C	C	C	NR	NR	NR	NR
Silicone alkyd	C	C	C	NR	NR	NR	NR
Phenol resin	C	C	C	NR	NR	NR	NR
Vinyl	C	C	NR	C	C	C	NR
Chlorinated rubber	C	C	C	C	C	NR	NR
Epoxy	NR	NR	NR	C	C	C	C
Coal tar epoxy	NR	NR	NR	NR	NR	C	NR

Zinc-rich epoxy	NR	NR	NR	NR	C	C	NR
Inorganic zinc	NR	NR	NR	C	C	C	NR
Urethane	NR	NR	NR	NR	NR	NR	C

NOTE: C-Normally

NOTE: C-Normally compatible; NR- Not recommended due to known or suspected problems. Certain combinations marked "NR" may be used provided a suitable tie coat is applied.

6.00.00 INSPECTION

Inspection techniques shall be applied at various stages i.e. from purchase of coating materials to paint application and evaluation of performance during service. Inspection procedures at various stages before and after the application of coating systems over the oil installations have been described below:

6.01.00 Paint composition

The type of paint system shall be selected depending upon the environmental conditions. Generally primer, undercoat and finish coats are used in protective coating system. The purchased paint materials are used in protective coating system. The purchased paint materials shall be tested for the following properties to ascertain whether the supplied paint conforms to the specifications.

i. Type of film formers present
ii. Type of pigments present
iii. Thickness per coat
iv. Volume solids
v. Pigment volume concentration
vi. Area coverage per liter of the paint
vii. Specific gravity
viii. Drying time and
ix. Main pigment content in total pigmentation

It is the duty of the inspection engineer to get the paint system tested for the above factors. The painting operation shall be started only after the values obtained coincide with the required specification of the paint system.

It is essential to see that the surface is not wet during the application of the paint. Moreover paints should not be applied when the humidity of the environment is above 80%. The atmospheric temperature should not be below 10^{o}C during the painting operation.

6.02.00 Procedure for testing paint samples

The following laboratory test procedures shall be adopted for the characterization of the film-formers, pigments and studying the properties of the paint.

a) Type of film-formers present

The film former shall be separated out of the paint by means of centrifuging. It is then to be analyzed using infrared spectroscopy for identifying the functional group. i.e. the type of film formers.

b) Type of pigments present

After separating the pigment from the paint and proper drying, it shall be subjected x-ray diffraction for identifying the pigment.

c) Thickness per coat

Magnetic thickness gauges are used to measure the thickness of the paint film applied over the iron-substrate. The thickness is measured in micrometer (µm). Some of the thickness gauges operating under magnetic principle are elecometer, posi test and micro test. Thickness gauges operating on eddy current principle are used to measure coating thickness over metals other than steel/magnetic substrates.

d) Volume solids

Paint is a mixture of three major components such as pigment, binder and thinner.

The pigment and film-former will remain in the paint film after the evaporation of the solvent. The pigment and film former together are called as solids. The volume of these together in the liquid paint is called as volume solids. This is determined as follows:

A known volume of the paint is taken. Let it be V1. Distilling the solvent and collecting it in a measuring cylinder determine the volume of the solvent present of the paint. Let it be V2. By subtracting V2 from V1, we can determine the volume solids.

e) Pigment volume concentration (PVC)

Pigment volume concentration is defined as

$$PVC = \frac{\text{Volume of pigment}}{\text{Volume of pigment + Volume of binder}} \times 100$$

By separating out the pigment and binder form the paint and knowing their specific gravity, we can calculate PVC.

f) Area coverage per liter of the paint

This is determined by taking a known volume of the paint and applying it over a surface. The area covered by the known volume of the paint is determined. From this value, area covered by one liter of the paint is calculated.

g) Specific gravity

For determining specific gravity, a cup of known volume is taken. The difference in weight of the cup filled with paint and the empty cup gives the weight of paint of known volume. From this, we can calculate specific gravity.

h) Drying time

i) Touch Dry

In this case, if the coated surface is touched with finger, no finger mark should be found on the coating.

ii) Hard Dry
It is the condition of coating drying very hard. Unless the coating itself is damaged with force, no pressure could mar the coating in this condition. This condition is attained usually after seven days.

i) Flow properties (viscosity) of the paint (Ford cup method)

Ford cup is the mostly used instrument for studying the flow properties of the paint. Ford cups having different orifice sizes are available in the market. The varying orifice sizes are meant for measuring the flow time of different viscosities. Generally, the most viscous liquids require bigger orifice. The results are reported simply as seconds per cup. Number

6.03.00 Spot testing procedures

The following spot tests will be useful to identify the binders (film-formers) qualitatively before application at the site.

a) EPOXY RESIN

i) Filter paper test

This test can be carried out even with paint itself. 0.5 gms of paint part (binder part) / binder is taken in a 100 ml beaker and treated with 1ml concentrated sulfuric acid. The beaker is slightly heated at 60^{o}C for a few minutes. It is again mixed with 5ml of conc.H_2SO_4 until the colour intensity is similar to that of very dilute potassium-di-chromate solution. A drop of the solution is taken in a glass rod and is spread over a filter paper. If Bis-phenol-A-type of epoxy resin is present, a purple colour develops in 1 minute, the colour eventually turns blue.

ii) Formaldehyde Test

Few drops of the sample is dissolved in 1 to 2 ml of concentrated sulphuric acid if necessary by heating to 40°C to 50°C. One to two drops of formaldehyde solution is added in to it. An orange colour, which on dilution with water turns violet to blue indicates the presence of epoxy resins.

b) Chlorinated rubber resin

Few milligrams of the sample is allowed to stand in pyridine at room temperature for few minutes. Few drops of methanolic potassium hydroxide solution is added in to it. If chlorinated rubber resin is present in the solution, a yellow precipitate is formed which gradually darkness to a yellow-brown colour.

c) Isocyanate hardener

The aliphatic nature of isocyanate is confirmed by the following spot test. A small sample of isocyanate hardener is heated in a test tube util white fumes are evolved and these fumes are absorbed on a filter paper. One drop of a solution of 4-nitrobenzene-di-azofluoroborate in methanol (1%) on the filter paper should give any coloration, confirms the presence of aliphatic isocyanate. If any coloration is seen on the filter paper, this will confirm the presence of aromatic isocyanate

The infrared spectra of the aliphatic isocyanate will show peaks at 1370 cm-1 and 2250-2350 cm-1.

Physical, Chemical and Instrumental methods of paint analysis with their relevant standards are given in the following tables.

i) Physical Tests

Paint property	IS Standard	ASTM
Preparation of panels	IS 101 PART1 – SEC3	D 609
Preparation of Tin panels	IS 101 PART1 – SEC3	D 609
Viscosity (KU)	IS 101 PART1 – SEC5	D 562
Weight per Gallon	IS 101 PART1 – SEC 7	D 1475
Fineness of Grind	IS 101 PART3 – SEC 5	D 1210
Water content	IS 101 PART2 –SEC 1	D 95
Coarse particles and skins		D 185
Drying times Set to touch Dry for recoating Dry hard	IS 101 PART3 – SEC 1 & 2	D 1640
Pigment content	IS 101 PART8 – SEC 2	D 2371
Vehicle content		D 2371
Non – volatile content	IS 101 PART2 – SEC2 & PART8 – SEC –2	D 2369
Adhesion	IS 101 PART5 – SEC2	D 3359
Brushing properties	IS 101 PART1 – SEC4	

Exposure tests of paints on metals		D 1014
Salt spray resistance	IS 101 PART6 – SEC1	B 117
Accelerated weathering	IS 101 PART6 – SEC5	D 822
Leafing		D 480
Flexibility	IS 101 PART5 –SEC	D 522

ii) Chemical Tests

PAINT PROPERTY	TEST METHOD (ASTM)
Chemical resistance	D 1308
Liquid dryers	D 564
Aluminum	D 480
Aluminum silicate	D 718
Calcium carbonate	D 34
Extenders in colors	D 126
Iron oxide	D 768, D 50
Leaded zinc oxide	D 34
Red lead	D 49
Water soluble salts	D 2448, D 2455
Zinc oxide	D 34
Zinc powder	D 521
Zinc sulfide	D 34

iii) Instrumental Tests

Paint property	Test method (ASTM)	Instrument
Dry Opacity	A 2805	Reflectometer
Gloss	D 523	Gloss meter
Color	D 2244	Colorimeter
Vehicle Identification	D 3168 D 3271	Infrared spectrophotometer Gas chromatograph
Solvent solids Identification	D 3271	Gas chromatograph
Vehicle solids Identification	D 2621	Infrared spectrophotometer

7.00.00 SPECIFICATION OF COATING SYSTEM

7.01.00 Protective coating for steel structures

Most commonly used coating system for atmospheric zone of blast cleaned steel structures are given below:

7.01.01 System-1

Coating system used for atmospheric open exposure zone is one coat of inorganic zinc-rich primer, one coat of epoxy-Glass flake filled intermediate coating and one coat of aliphatic polyurethane provides better performance in more aggressive services. The coating system for closed atmosphere is also the same system with the replacement of aliphatic urethane with aromatic polyurethane top coat. The surface preparation of this Zinc rich primer requires sand blasted surface or grid blasted surface to the Swedish Specification of Sa 2.5. The coating systems are to be applied by spray method. The specification of the system is as given below:

i. Specification of Inorganic zinc rich primer

Colour	Green Grey
Gloss Level	Matt
Volume Solids	63%
Typical Thickness (DFT)	70-80 microns
Theoretical Coverage	8.40 m²/litre
Method of Application	Airless Spray, Air Spray
Drying Time	One Hour
Volatile Organic Compound	216 g/ Litre
Mix Ratio	Liquid Binder Base part(A) 3: Powder Zinc component part (B)1
Working Pot Life	2-2.5 hours
Shelf Life	1 year

ii. Specification for glass flake filled epoxy coating

Colour	As desired
Finish	Semi-Glossy
Type	Two packs
Application	By brush or spray
Dry film thickness/coat	100– 110 µm
Volume solids	Approx. 90 ± 2 %
Area coverage (theoretical)	8 to 9 sq.m/ litre
Surface dry	4 hrs.
Hard dry	24 hrs.
Over coating	24 hrs.
Recoatability	24 hours.
Full cure	1 week.
Shelf life	12 months

iii. Specification for Aliphatic Polyurethane top coat for open zone

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8 - 9 m²/litre
Method of Application	Airless Spray, Air Spray
Guiding data for airless spray:	
Nozzle tip (inch/1000)	15-21

Pressure at nozzle (minimum)	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part 1
Working Pot Life	3 hours
Shelf Life	2 years

iv. Specification for Aromatic Polyurethane top coat for closed zone

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8-9 m²/litre
Method of Application	Airless Spray, Air Spray

Guiding data for airless spray:

Nozzle tip (inch/1000):	15-21
Pressure at nozzle (minimum):	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part 1
Working Pot Life	3 hours
Shelf Life	2 years

7.01.01 System-2

The surface preparation is not possible through blast cleaning, then the surface is cleaned with wire brushing or power tool cleaning and coated with two coats of non aluminium epoxy mastic followed by an aliphatic polyurethane coating is recommended.

i. Specification for non aluminium Epoxy mastic paint (High build)

Colour	As desired
Finish	Semi-Glossy
Type	Two pack
Application	By brush or Airless spray
Dry film thickness/coat	100-110 microns
Volume solids	Approx. 80 ±2 %
Area coverage (theoretical)	6 to10 sq.m/litre
Surface dry	4 hrs.
Hard dry	12 hrs.
Recoatability	24 hours.
Full cure	7 days.
Shelf life	months (or as recommended by manufacturer

ii. Specification for Aliphatic Polyurethane top coat for open zone

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8-9 m²/litre
Method of Application	Airless Spray, Air Spray

Guiding data for airless spray

Nozzle tip (inch/1000):	15-21
Pressure at nozzle (minimum):	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part 1
Working Pot Life	3 hours
Shelf Life	2 years

7.02.00 Protective coating system for Pipelines without Cathodic Protection

There are a number of factors to be considered for the selection of an external pipeline coating including physical and chemical stability of the coating in the pipeline environment, adhesion, and resistance to impact. The pipeline should be cleaned and prepare the surface for painting as follows:

The pipeline surface shall be cleaned. The main objective of surface preparation is to ensure that all contamination (rust, mill scale, etc.) is removed to reduce the possibility of initiating corrosion so that a surface profile is created that allows satisfactory adhesion of the paint to be applied. The surface of the pipe is cleaned with a wire brush or power tool cleaning to get the surface of Sa 2/St 3. Thus prepared surface to be cleaned with lint free cloth, which also includes cleaning & dewatering (in case of valve chamber) and drying the surface. After preparing the surface of the pipe for painting, the primer coat, undercoat and finish coat shall be applied. The coating system recommended for the pipeline is high build epoxy mastic coating as primer followed by an epoxy glass flake filled coating with the top coat of aliphatic polyurethane. The specifications of the systems are given below:

i. Specification for Epoxy mastic paint (High build)

Colour	As desired
Finish	Semi-Glossy
Type	Two pack
Application	By brush or Airless spray
Dry film thickness/coat	100-110 microns
Volume solids	Approx. 80 ±2 %
Area coverage (theoretical)	6 to10 sq.m/litre
Surface dry	4 hrs.
Hard dry	12 hrs.
Recoatability	24 hours.

Full cure	7 days.
Shelf life	12 months (or as recommended by manufacturer

ii. Specification for glass flake filled epoxy coating

Colour	As desired
Finish	Semi-Glossy
Type	Two packs
Application	By brush or spray
Dry film thickness/coat	100– 110 µm
Volume solids	Approx. 90 ± 2 %
Area coverage (theoretical)	8 to 9 sq.m/ litre
Surface dry	4 hrs.
Hard dry	24 hrs.
Over coating	24 hrs.
Recoatability	24 hours.
Full cure	1 week.
Shelf life	12 months

iii. Specification for Aliphatic Polyurethane top coat for open zone

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8-9 m²/litre
Method of Application	Airless Spray, Air Spray

Guiding data for airless spray:

Nozzle tip (inch/1000):	15-21
Pressure at nozzle (minimum):	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part-1
Working Pot Life	3 hours
Shelf Life	2 years

7.03.00 Protective coating for all other surfaces

The surface shall be cleaned with wire brushing or by power tools (St3). These structures will be protected by three layer system of Epoxy zinc rich primer followed by Glass Flake filled epoxy and aliphatic polyurethane finish coat. The specifications of the coating system are given below:

i. Specification for Epoxy Zinc rich primer

Colour	Grey
Finish	Matt
Type	Two pack
Application	By brush or spray

Pigment (Main)	Zinc dust (30-40% by wt. of the total pigments.)
Type of epoxy	Condensation product of bisphenol-A and Epoxide equivalent Epichlorohydrin with terminal Epoxide groups 450-500
Curing agent	Polyamide (amine value 210-230)
Dry film thickness/coat	50-60 µm
Volume solids	55±2% (volume)
Area coverage (theoretical)	11 to 14 sq.m/litre
Surface dry	2-3 hrs.
Hard dry	24 hrs.
Re-coatability	24 hours.
Full cure	5 days.
Shelf life	6 months under sealed conditions

ii. Specification for Epoxy glass flake paint

Colour	As desired
Finish	Semi-Glossy
Type	Two packs
Application	By brush or spray
Dry film thickness/coat	100–110 µm
Volume solids	Approx. 90 ± 2 %
Area coverage (theoretical)	8 to 9 sq.m/ litre
Surface dry	4 hrs.
Hard dry	24 hrs.
Over coating	24 hrs.
Re-coatability	24 hours.
Full cure	1 week.
Shelf life	12 months

iii. Specification for aliphatic Polyurethane top coat

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8-9 m²/litre
Method of Application	Airless Spray, Air Spray

Guiding data for airless spray:

Nozzle tip (inch/1000):	15-21
Pressure at nozzle (minimum):	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part-1
Working Pot Life	3 hours
Shelf Life	2 years

7.04.00 Summary of Specification of Coating System

The summary of the coating system shall be as mentioned below:

Area	Surface preparation	Recommended coating scheme
Directly exposed to Sunlight- Steel structures	Copper shot blasting to Sa2.5	Scheme I
	Power tool cleaning to St3	Scheme II
Indoor –Steel Structures	Copper shot blasting to Sa2.5	Scheme III
	Power tool cleaning to St3	Scheme IV
Pipelines (over ground)	Power tool cleaning to St3	Scheme V
All other surfaces	Wire brushing / Power tool cleaning to St3	Scheme VI

7.04.01 Scheme-I: For blast cleaned structures and exposed to sunlight

For new steel structures/Existing steel structures	Exposed to sun light Outdoor)	
Surface preparation	Copper slag blasting to Sa2.5	
Primer	Zinc ethyl silicate	50 – 60µm
Undercoat	Epoxy Glass flake (high build)	100 – 110 µm
Top Coat	Aliphatic polyurethane (TiO_2) rutile	50 – 60µm
Total dry film thickness (DFT)		200 –230µm

7.04.02 Scheme-II: For under prepared structures and exposed to sunlight

For new steel structures/Existing steel structures	Exposed to sun light (Outdoor)	
Surface preparation	Power tool cleaning St-3/Paint strippers	
Primer	Epoxy mastic(non aluminium)	100 – 110µm
Undercoat	Epoxy mastic(non aluminium)	100 – 110 µm
Top Coat	Aliphatic polyurethane (TiO_2) rutile	50 – 60µm
Total dry film thickness (DFT)		250 –280µm

7.04.03 Scheme- III: For blast cleaned structures and not exposed to sunlight

For new steel structures/Existing steel structures	Not exposed to sunlight (Indoor)	
Surface preparation	Blast Cleaning to Sa2.5	
Primer	Zinc Ethyl Silicate	50 – 60µm
Undercoat	Epoxy Glass flake (high build)	100 – 110 µm
Top Coat	Aromatic polyurethane TiO_2 (rutile)	50 – 60µm
Total dry film thickness (DFT)		200 –230µm

7.04.04 Scheme-IV: For under prepared structures and not exposed to sunlight

Surface preparation	Mechanical chipping / Power tool cleaning St-3/Wire brushing St-2	
Primer	Self-priming epoxy mastic	100 – 150µm
Under coat	Self-priming epoxy mastic	100-110 µm
Top Coat	Aromatic polyurethane TiO_2 (rutile)	50 – 60µm
Total dry film thickness (DFT)		250 –320µm

7.04.05 Scheme- V: For pipelines (above ground)

Surface preparation	Mechanical chipping / Power tool cleaning St-3/Wire brushing St-2	
Primer	Self-priming epoxy	100 – 150µm
Under coat	Epoxy Glass flake (high build)	100-110 µm
Top Coat	Aliphatic polyurethane TiO_2 (rutile)	50 – 60µm
Total dry film thickness (DFT)		250 –320µm

7.04.06 Scheme-VI: Coating specifications for all other surfaces

Surface preparation	Power tool cleaning St-3/ Paint strippers	
Primer	Epoxy Zinc rich	50 – 60µm
Under coat	Epoxy glass flake	100-110µm
Top Coat	Aliphatic polyurethane TiO_2 (rutile)	50 – 60µm
Total dry film thickness (DFT)		200–230µm

8.00.00 TESTING REQUIREMENTS

8.01.00 Measurement of dry film thickness

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

8.01.01 Apparatus / instrument

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

8.01.02 Procedures

a) Number of measurements

For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).

b) If the structure is less than 300 square feet, each 100 square feet should be measured.

c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.

d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet

e) Coating thickness tolerance: individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness.

Area measurement must be within specified range.

8.02.00 Electrical inspection (holiday) test

8.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.

8.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.

8.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.

The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)

Testing voltage $v=7900\sqrt{t}\pm10\%$ where t=the average coating thickness, mm.

8.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.

8.03.00 Adhesion pull off test

After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.

8.03.01 Apparatus / instrument: adhesion tester consists of three basic components:

A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling “jaw” at the bottom and also dollies.

8.03.02 Prepare the test surface

Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.

8.03.03 Prepare dolly (test pull stub)

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

8.03.04 Select an adhesive

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

8.03.05 Attach the dolly to the surface

a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.

b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.

c) Attach the dolly to the coated surface and gently push downward to

displace any excessive adhesive.

d) Push the dolly inward against the surface, and then apply tape across the head of the dolly.

8.03.06 Adhesion test procedure

a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.

b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.

c) Slide the dragging indicator pin on the black column to zero by pushing it downward.

d) Firmly hold the base of the instrument in one hand and rotate the hand wheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum psi/mpa/kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum psi/mpa/kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) the force applied by the adhesion tester causes the dolly to dislodge.

e) Read the scale and record the adhesion value.

8.04.00 Coating repair

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

8.04.01 Surface preparation

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

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

8.04.03 Coating application

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

8.04.04 Repair inspection:

Repaired portion shall be electrically inspected using a holiday detector.

8.05.00 Welded field joints

8.05.01 Preparation

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

8.05.02 Electrical inspection

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

9.00.00 INFORMATION / DATA REQUIRED

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

ANNEXURE-I
MARKET AVAILABLE COATING SYSTEMS AS PER SPECIFICATION

Sl.No.	Specification	ASIAN PAINTS	BOMBAY PAINTS GRAUER & WEIL Paints	BERGER PAINTS	GRAND POLYCOTS	International Protective Coatings	KRISHNA CONCHEM
1.	Zinc Ethyl Silicate Primer	Apcosil 605 ZS	Zinc–o-sil 75	Zinc Anode 304	GP Prime 402	InterZinc 22	-
2.	Epoxy Zinc rich Primer	Apcodur CP 686			GP Prime 205	Inter Zinc 42	
3.	Self Priming Epoxy Mastic Paints	Rust-O-Cap	Penthdur Mastic 5527	Berger protecto Mastic	GP Prime guard 235	Interplus 256	-
4.	Epoxy Glass Flake Paint	Apcodur EP glass Flake	Pentadur Glass Flake 3580	Epilux Super Build ST Glass Flake Coating	GP SUPERGUARD GLASS-FLAKE	Interzone 505	Karaikote 100 S
5.	Aliphatic Polyurethane Paint	Apcothane CP 674	Pentathane 4512 (M)	Polyurethane Coating	GP Bond 141	Interthane990	-
6..	Aromatic Polyurethane Paint	---	--	--	GP COAT 131	---	

7.	Moisture Compatible anti Corrosion system			Epilux Durebild WSE Coating			Karaikote-6545
8.	Epoxy red oxide primer	AP CODUR Epoxy polyamide primer					
9.	Epoxy MIO Under coat	AP CODUR Epoxy MIO Under coat					
10.	Epoxy TiO2 Under coat	AP CODUR Epoxy 420HS					

QUALITY PLAN

568142/2021/PS-PEM-MAX

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN FOR CHEMICAL DOSING SYSTEM	SPEC. NO : PE-TS-483-154-A001	DATE:
BHEL		PROJECT: 2X500 MW TUTICORIN TPP (NTPL) (FGD SYSTEM PACKAGE)	QP NO.: PE-QP-483-154-A001	SHEET 1 OF 5

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
1.0	**WELDER'S QUALIFICATION**													
1.1	WELDING PROCEDURE SPECIFICATION (WPS)	CORRECTNESS	MA	SCRUTINY	100%		ASME IX	ASME IX	QW 482	√	P	V	V	
1.2	WELDER PERFORMANCE & PROCEDURE QUALIFICATION RECORD	WELD SOUNDNESS & WELDING PERFORMANCE	MA	PHYSICAL TEST	ASME IX		ASME IX	ASME IX	QW 483 & QW 484	√	P	V	V	
2.0	**TANKS**													
2.1	**RAW MATERIAL**													
2.1.1	PLATE	CHEM & PHY PROP.	MA	CHEM & PHY TEST	1/PLATE/ HT BATCH		ASTM A 240 GR. TP 304/316		MFG. TC/LAB REPORT	√	P	V	V	IDENTIFICATION BY BHEL
		IGC TEST	MI	IGC TEST			ASTM A 262 PR 'E'			√	P	V	V	
2.1.2	PIPE FOR NOZZLE	CHEM & PHY PROP.	MA	CHEM & PHY TEST	1/HT BATCH/SIZE		ASTM A 240 GR. TP 304/316		MFG. TC/LAB REPORT	√	P	V	V	
		MICRO STRUCTURE	MI	GRAIN STRUCTURE			FOR HEAT TREATMENT			√	P	V	V	
		IGC TEST	MI	IGC TEST			ASTM A 262 PR 'E'			√	P	V	V	
2.2	**IN PROCESS**													
2.2.1	DISHED ENDS	DIMENSION	MA	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT.		MFG. TC/LAB REPORT	√	P	V	V	
		SURFACE DEFECTS ON WELDING	MA	DP TEST	100%		ASTM E 165	NO SURFACE DEFFECTS		√	P	V	V	
3.0	**STIRRER**													
3.1	RAW MATERIAL FOR SHAFT	CHEM & PHY PROP.	MA	CHEM & PHY TEST	1/BAR				MFG. TC/LAB REPORT	√	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH		ASTM A 262 PR 'E'			√	P	V	V	
3.2	IMPELLER	CHEM PROP.	MA	CHEM TEST	1/PLATE		ASTM A 479 GR TP 304/316			√	P	V	V	
3.3	COMPLETE STRIRRER WITH MOTOR	PERFORMANCE IN WATER FILED TANK												
		VIBRATION	MA	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT.		MFG. TC	√	P	V	V	
		WOBBLING	MA	VISULA	100%		NO WOBBLING		MFG. TC	√	P	V	V	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		
Reviewed by:			Reviewed by:		

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	PROJECT: 2X500 MW TUTICORIN TPP (NTPL) (FGD SYSTEM PACKAGE)	QP NO.: PE-QP-483-154-A001	SHEET 2 OF 5

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
4.0	**MOTORS**	ROUTINE TEST	MA	MFG. TC	100%		APPROVED DRAWING/DOCUMENT.		MFG. TC	√	P	V	V	
		TYPE TES	MA	MFG. TC	1/SIMILAR FRAME SIZE		APPROVED DRAWING/DOCUMENT.		MFG. TC	√	P	V	V	
		DEGREE OF PROTECTION	MA	MFG. TC			APPROVED DRAWING/DOCUMENT.		MFG. TC	√	P	V	V	
5.0	**METERING PUMP**													
5.1	RAW MATERIAL													
5.1.1	WETTED PARTS	CHEM & PHY PROP.	MA	CHEM & PHY TEST	1/BAR		APPROVED DRAWING/DOCUMENT.		MFG. TC/LAB REPORT	√	P	V	V	
		SURFACE T EST	MI	UT ON BAR>25 MM DIA	100%		ASTM A 388	REFER NOTE-1		√	P	V	V	
				DP ON M/C SURFACE	100%		ASME-E-165	NO SURFACE DEFECT		√	P	V	V	
5.2	**FINAL INSPECTION**													
	PUMP WITH MOTOR	CAP/STROKE	MA	PERFORMANCE	100%		API 675	API 675	INSPECTION REPORT	√	P	V	V	SHALL BE TESTED WITH EITHER JOB MOTOR OR SHOP MOTOR OF SIMILAR FRAME SIZE
		ACCURACY	MA	SHOP TEST	100%		API 675	API 675		√	P	V	V	
		REPEATABILITY	MA	SHOP TEST	100%		API 675	API 675		√	P	V	V	
		POWER DRAWN @ 100% STROKE	MA	MEASURED AT WORK	100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		LEAKAGE	MA	HYDRO TEST	100%		@1.5X DESIGN PRESSURE	NO LEKEAGE		√	P	V	V	
		DIMENSIONS	MA	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		NOISE	MA	MEASUREMENT	100%		--	< 85 dbA AT 1 M RADIUS		√	P	V	V	
		VIBRATION	MA	MEASUREMENT	100%		--	≤45 MICRONS (PEAK TO PEAK)		√	P	V	V	
6.0	**PRESSURE RELIEF VALVE**	SET & RESET PRESSURE.	MA	PERFORMANCE	100%		API RP 520	API RP 520	MFG. TC	√	P	V	V	
		DIMENSIONS	MA	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT		MFG. TC	√	P	V	V	
		LEAKAGE DURING PERFORMANCE TEST	MA	VISUAL	100%		NO LEAKGE.	NO LEAKGE.	MFG. TC	√	P	V	V	

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SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
7.0	**VALVES (GATE/GLOBE/NRV/BALL)**													
7.1	RAW MATERIAL													
	BODY,BONNET COVER	CHEM & PHY PROP.	MA	CHEM.& PHY TEST	1/HT BATCH		APPROVED DRAWING/DOCUMENT		MFG. TC/LAB REPORT	√	P	V	V	
		HEAT TREAT.	MA	HEAT TREATMENT	1/HT BATCH		APPROVED DRAWING/DOCUMENT			√	P	V	V	
	TRIM MATERIAL	CHEM & PHY PROP	MA	CHEM.& PHY TEST	1/BAR/SIZE		APPROVED DRAWING/DOCUMENT			√	P	V	V	
7.2	ASSEMBLY													
		LEAKAGE (BODY & SEAT)	MA	HYDRO TEST	100%		APPROVED DRAWING/DOCUMENT	NO LEAKAGE	MFG. TC/LAB REPORT	√	P	V	V	
		LEAKAGE (SEAT)	MA	PNEUMATIC TEST	100%			NO LEAKAGE		√	P	V	V	
		DIMENSIONS	MA	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
8.0	FITTINGS/FLANGES													
	RAW MATERIAL	CHEM & PHY PROP.	MA	CHEM.& PHY TEST	1/HT BATCH		ASTM A 182 GR TP 304/316		MFG. TC/LAB REPORT	√	P	V	V	
		HEAT TREAT.	MA	HEAT TREATMENT	100%		ASTM A 182 GR TP 304/316			√	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH		ASTM A 262 PR 'E'			√	P	V	V	
9.0	**STRAINERS**													
9.1	RAW MATERIAL FOR BODY	PHY.& CHEM. PROPERTIES	MA	PHY. & CHEM.TEST	1/BAR/SIZE		APPROVED DRAWING/DOCUMENT		MFG. TC/LAB REPORT	√	P	V	V	
9.2	SCREEN	CHEMICAL	MA	CHEMICAL	1/SIZE		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		MESH SIZE	MA	MEASUREMENT	1/SIZE		APPROVED DRAWING/DOCUMENT			√	P	V	V	
9.3	FINAL INSPECTION	DIMENSIONS	MA	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT		MFG. TC	√	P	V	V	
		LEAKAGE	MA	HYDRO TEST	100%		APPROVED DRAWING/DOCUMENT	NO LEAKAGE	MFG. TC	√	P	V	V	
10.0	**PIPES**													

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Reviewed by:			Reviewed by:		

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SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
10.1	MATERIAL	CHEMICAL	MA	CHEMICAL	1/HT BATCH/SIZE		ASTM A 312 GR.TP 304/316		MFG. TC/LAB REPORT	√	P	V	V	IDENTIFICATION BY BHEL. REFER NOTE-2 AND NOTE-3.
		MECHANICAL TEST	MA	MECHANICAL TEST	1/HT BATCH/SIZE		ASTM A 312 GR.TP 304/316			√	P	V	V	
		MICRO STRUCTURE	MI	GRAINS STRUCTURE	1/HT BATCH/SIZE		FOR HEAT TREATMENT			√	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH/SIZE		ASTM A 262 PR 'E'			√	P	V	V	
		HYDRO TEST	MA	LEAKAGE	100%		NO LEAKAGE	NO LEAKAGE	MFG. TC/IR	√	P	V	V	
11.0	**INSTRUMENT (LG/PG/LT/PT/DPG/DPT)**													
	RAW MATERIAL FOR WETTED PARTS	CHEM. PROP.	MA	CHEM. TEST.	1/HT BATCH		APPROVED DRAWING/DOCUMENT		MFG. TC/LAB REPORT	√	P	V	V	
	FINAL INSPECTION	DIMENSION	MI	MEASUREMENT.	100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		ACCURACY	MA	CALIBRATION	100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		DEGREE OF PROTECTION	MA	TYPE TEST	100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
12.0	**CONTROL PANEL**													
		DIMENSIONS	MA	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT		INSPECTION REPORT	√	P	V	V	
		CONTINUITY, IR-HV-IR	MA	ELECTRICAL	100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		VERIFICATION OF MAKE	MA		100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		RATING OF COMPONENTS	MA		100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		PAINT SHADES, THICKNESS	MA		100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		ADHESION	MA		100%		APPROVED DRAWING/DOCUMENT			√	P	V	V	
		DEGREE OF PROTECTION	MI		100%		APPROVED DRAWING/DOCUMENT		MGF. TC/ LAB REPORT	√	P	V	V	

BHEL						BIDDER/ SUPPLIER	
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SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
13.0	**COMPLETE SKID ASSEMBLY**													
		DIMENSIONS & ORIENTATION	CR	MEASUREMENT	100%		APPROVED DRAWING/DOCUMENT			√	P	W	V	
		LEAKAGE, CHECK ON WELDMENTS		VISUAL & HYD TEST	100%		DISCH.PIPING - 1.5 x DISCH PR. OF PUMP, SUCTION PIPING -10 KG/CM2	NO LEAKAGE	INSPECTION REPORT	√	P	W	V	
		FUNCTIONAL TEST FOR INTERLOCKS	MA	VISUAL	100%		APPROVED DRAWING/DOCUMENT			√	P	W	V	
		LEAKAGE IN TANK		VISUAL & HYD TEST	100%		WATER FILL TEST FOR 2 HR.		NO LEAKAGE	√	P	W	V	
	PMI TEST FOR SS	GRADE CONFIRMATION	MA	CHEM. TEST	100%		APPROVED DRAWING/DOCUMENT		LAB REPORT	√	P	W	V	
		PAINTING	MA	VISUAL AND MEASUREMENT.	100%		APPROVED DRAWING/DOCUMENT		INSPECTION REPORT	√	P	V	V	
		PACKING	MA	VISUAL AND MEASUREMENT.	100%		APPROVED DRAWING/DOCUMENT		INSPECTION REPORT	√	P	W	V	

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER, **P**: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE. **MA**: MAJOR, **MI**: MINOR**, CR:** CRITICAL.

NOTE-1: WHEN BACK WALL ECHO IS SET TO 100% OF FSH IN SOUND AREA, DEFECT ECHO SHALL NOT EXCEED 20% OF FSH. MAX BACH WALL ECHO IS 20% OF FSH. TOTAL NO OF DEFECTS SHALL BE MAX. 5 NO IN ONE METER LENGTH. MIN DISTANCE BETWEEN TWO DEFECTS SHALL BE 3 TIMES THE DIA OF BAR.

NOTE-2: FOR PIPES PURCHASED DIRECTLY FROM MANUFACTURER'S OR AUTHORIZED DEALERS, APART FROM TC REVIEW, CHECK WILL BE AS PER CLAUSE 2.1.2 AND 10.0; HOWEVER, FOR HYDRAULIC TEST, MANUFACTURER TC SHALL BE REVIEWED. IN CASE ON IMPORTED PIPES PURCHASED FROM OPEN MARKET, TEST SHALL BE PERFORMED AS PER CLAUSE 2.1.2 AND 10.0 (INCLUDING HYDRAULIC TEST).

NOTE-3: NDT REQUIREMENT ON WELDING (TANK, PIPE, BREATHER/WATER SEAL/CO2 ABSORBER) SHALL BE AS -- A) ON BUTT WELD-- 25% DP & 25% RT FOR PUMP SUCTION SIDE & 100% DP & 100% RT FOR PUMP DISCHARGE SIDE. B) ON FILLET WELD--100% DP TEST

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
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Reviewed by:			Reviewed by:		

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DATA SHEET-A

SL.No.	Description	NaOH
1.0	No. of skid	One (1) for entire Plant.
2.0	**Mixing cum storage tank**	
2.1	No. of tanks per Skid	One
2.2	Capacity in litres	500
2.3	Type	
2.4	Material of the tank	SS-304
2.5	Thickness	3 mm
2.6	Motorised Stirrer	Provided with reduction gear for 200 RPM.
2.7	Dissolving basket	Provided (30 mesh B.S.) of SS 316
2.8	Type of agitator	Motor operated
2.9	Instrument	Refer P&ID.
3.0	**METERING PUMP**	
3.1	Quantity	2 Nos (1W+1S)
3.2	Type	Positive displacement (Plunger type) metering pump.
3.3	Capacity and Head	10 LPH and 10 kg/cm2
3.4	MOC	All wetted part SS 316
3.5	NRV and PRV	1 No per pump shall be provided.
4.0	**Piping:**	
4.1	Material & rating	SS-304(Sch 40 min)
3.2	Diameter	25 NB
5.0	**Valves:**	
5.1	Body Material	SS-304
5.2	Weld ends	Socket weld ends
6.0	**Fittings & Flanges**	**SS 304, CL 300**
7.0	**Structural steel**	**MOC: IS 2062**
8.0	**Ladder and platform (with Chequered Plate)**	**Shall be provided to reach top of tank and chemical filling**
9.0	**Nuts/Bolts/Fastners**	**MOC: Stainless Steel.**

DRAWING

(P&ID FOR NaOH DOSING SYSTEM)

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

BHEL
DM WATER INLET
25 NB
DV
A (H/HH/L/LL)
I (LL)
TRIP
DDCMIS
LFN51CL001
LT
LFN51 AM001
M
MANUAL FILLING CONNECTION
15 NB
VENT
15 NB
NaOH SOLUTION
CO2 ABSORBER TANK
OVERFLOW
15 NB
BASKET
LG
LFN51CL501
25 NB
DRAIN
25 NB
15 NB
DRAIN
25NB
DRAIN
NaOH MIXING CUM STORAGE TANK
VENT
25NB
WATER SEAL
25NB
DRAIN
15 NB
SAMPLE

L (H/L)
PT
LFN54CP001
25 NB
BHEL
TO ECW TANK
25 NB
TO ECW PUMP SUCTION HEADER
DV
LFN52CP501
LFN53CP501
PG
PG
15 NB
15 NB
LOW-LOW LEVEL PUMP TRIP
M
PUMP
STROKE ACTUATOR
M
PUMP
STROKE ACTUATOR
LFN52AA001
LFN51AP001
LFN53AA001
LFN52AP001
METERING PUMPS 2NOS.(2X100%)
25 NB
25 NB
DDCMIS/LCP
STRAINER CHOKED
A
DPT
DPG
LFN51CP001
LFN51CP501

LEGEND

	GATE VALVE NORMALLY OPEN
	GATE VALVE NORMALLY CLOSED
	GLOBE VALVE NORMALLY CLOSED
	GLOBE VALVE NORMALLY OPEN
LT	LEVEL TRANSMITTER (ULTRA SONIC TYPE)
LG	LEVEL GAUGE
M	MOTOR OPERATED (AC)
	FUNNEL
	COUNTER FLANGE
	DUPLEX FILTER
PT	PRESSURE TRANSMITTER
DPT	DIFFERENTIAL PRESSURE TRANSMITTER
DPG	DIFFERENTIAL PRESSURE GAUGE

DV: DOSING VENDOR

OWNER: NLC TAMIL NADU POWER Limited (A GOVERNMENT OF TAMIL NADU ENTERPRISE)
PROJECT: 2X500 MW PROJECT, TUTICORIN, NTPL (FGD SYSTEM PACKAGE).
ENGG / SUB CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT, NOIDA
DEPT CODE: A

	NAME	SIGN	DATE
DRN	VKB		
DESN	VKB		
CHD	RN/JP		
APPD	SB		

TITLE: P&I DIAGRAM FOR NaOH DOSING SYSTEM

MPL	C	MSE	I	MAX	E	DEPT.	SCALE
						SIGN	
						DATE	

DRAWING No. PE-DG-483-154-A001
SHEET 01 OF 01 REV 00
SIZE-A3

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568142/2021/PS-PEM-MAX

SECTION – C2
SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

568142/2021/PS-PEM-MAX

BHEL	TITLE: **ELECTRICAL EQUIPMENT SPECIFICATION** **FOR** **NaOH DOSING SYSTEM** **2X500 MW NTPL TUTICORIN TPS (FGD System Package)**	SPECIFICATION NO. VOLUME NO. : **II-B** SECTION: **I** REV NO. : **00** DATE: 18.08.2021 SHEET: 1 OF 1

CONTENTS

SECTION	TITLE	NO OF SHEETS
I	SPECIFIC TECHNICAL REQUIREMENTS	3
I	ELECTRICAL SCOPE BETWEEN BHEL & VENDOR (ANNEURE-I)	2
I	ELECTRICAL LOAD DATA FORMAT (ANNEXURE-II)	1
I	CABLE SCHEDULE FORMAT (ANNEXURE-III)	1
I	TECHNICAL SPECIFICATION FOR MOTORS	13
I	MOTOR DATASHEET-A	1
I	MOTOR DATASHEET-C	2
I	SUB VENDOR LIST	2
II	STANDARD SPECIFICATION FOR LV MOTORS	5
II	REFERENCE QUALITY PLAN	11
II	TECHNICAL SPECIFICATION FOR CABLE TRAYS & ACCESSORIES	5
II	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	2

The requirements mentioned in Section-I shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-II.

568142/2021/PS-PEM-MAX

TECHNICAL SPECIFICATION

FOR

NaOH DOSING SYSTEM
(ELECTRICAL PORTION)

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".

b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.

c) Supply of mandatory spares as specified in the specifications of mechanical equipments.

d) Electrical load requirement for NaOH Dosing SYSTEM (all AC & DC loads at different voltage levels like 415V AC, 240 V AC, 220 V DC etc).

e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL

g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.

h) Motor shall meet minimum requirement of motor specification.

i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.

j) Cable BOQ worked out based on routing of cable listing provided by the vendor for " both end equipment in vendor's scope"shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

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

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

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.

568142/2021/PS-PEM-MAX

4.0 List of enclosures :

a) Electrical scope between BHEL & vendor (Annexure –I)
b) Technical specification for motors.
c) Datasheets & quality plan for motors.
d) Electrical Load data format (Annexure –II)
e) BHEL cable listing format (Annexure –III)

REV : 0 DATE : 18.08.2021

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR FOR SKID MOUNTED SYSTEM (FOR EPC PROJECTS)

PACKAGE : NaOH DOSING SYSTEM
SCOPE OF VENDOR: SUPPLY
PROJECT : 2X500 MW NTPL TUTICORIN TPS (FGD System Package)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V, 3 phase, 4 wire AC supply shall be provided by BHEL. based on the load data provided by the vendor at contract stage for all equipment supplied by the vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local control panel	Vendor	Vendor*	Refer C & I specification for details
3	Local push buttons	Vendor	Vendor*	
4	Power cables, ordinary control cables and screened control cables	Vendor	Vendor*	Within the skid. If starters are in MCC, then outside skid, cables scope shall be as per note no. 1.
5	Junction box for control & instrumentation cable (if applicable)	Vendor	Vendor*	
6	Any special type of cable like compensating, co-axial, prefab, MICC & fibre optical	Vendor	Vendor*	Within the skid
7	Equipment grounding	Vendor	Vendor*	Within the skid. All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
8	Motors with base frame and fixing hardware for motors.	Vendor	Vendor*	Makes shall be subject to customer/ BHEL approval at contract stage.

REV : 0 DATE : 18.08.2021

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR FOR SKID MOUNTED SYSTEM (FOR EPC PROJECTS)

PACKAGE : NaOH DOSING SYSTEM
SCOPE OF VENDOR: SUPPLY
PROJECT : 2X500 MW NTPL TUTICORIN TPS (FGD System Package)

9	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor*	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
10	Below grade grounding	BHEL	BHEL	
11	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
12	Electrical Equipment GA drawing & skid GA drawing	Vendor	-	For necessary interface review.

NOTES : - 1. If motor starters are provided in main MCC then BHEL will provide power & control cable including supply, laying & termination.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

*E &C by vendor during factory assembling of 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.	VERIFICATION FROM MOTOR DATASHEET (Y/N)	KKS 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	20	21
																				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)/ CUSTOMER

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 (cc): 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)

		PROJECT TITLE	2X500 MW NTPL TUTICORIN FGD	NAME		DATA FILLED UP ON	
		SYSTEM	NaOH Dosing System	SIGN.		DATA ENTERED ON	
		DEPTT. / SECTION	MAX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

CABLE SCHEDULE FORMAT

ANNEXURE III

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

VOLUME: II-F/SECTION-II

A.C. & D.C. MOTORS

CONTENTS

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	Scope	1
2.00.00	Codes & Standards	1
3.00.00	Service Conditions	1
4.00.00	Type and Rating	1
5.00.00	Performance	3
6.00.00	Specific Requirements	5
7.00.00	Accessories	7
8.00.00	Tests	9
9.00.00	Drawings, Data & Manuals	9

ATTACHMENT

ANNEXURE-A	Design Data	11

VOLUME: II-F

A.C. & D.C. MOTORS

1.00.00SCOPE

1.01.0 This specification covers the general requirements of the electric motors for Limestone based flue gas de-sulphurisation system.

1.02.00Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

1.04.00 Recommended spare parts for three (3) years operation in addition to mandatory spares

2.00.00CODES & STANDARDS

2.01.00All motors shall conform to the latest applicable IS, IEC and CBIP Standards/Publications except when otherwise stated herein or in the driven equipment specification.

2.02.00 Equipment and materials conforming to any other standard, which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

3.00.00SERVICE CONDITIONS

3.01.00The motors shall be installed in hot, humid and tropical atmosphere, highly polluted area.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING

4.01.00**A.C. Motors**

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA) or closed air water

cooled (CACW) type. Temperature rise shall be limited to 70 deg C by resistance method for class F insulation.

4.01.03 All motors shall be rated for continuous duty (S1). They shall also be suitable for long period of inactivity.

4.01.04 All LT motor shall conform to minimum efficiency performance standards (MEPS) of IE3 mentioned in IS: 12615. All HT motors shall have efficiency and power factor higher than 90% and 0.83 power factor respectively.

4.01.05 The motor name plate rating at 50^0C shall have at least 15% margin for LT system and 10% margin for HT system, over the input power requirement of the driven equipment at rated duty point and also covering the maximum load demand of the driven equipment under entire operating range, including voltage and frequency variations, unless stated otherwise in driven equipment specification or in general electrical specification.

4.01.06 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service. The direction of rotation of motor and its cooling fan should be properly matched with the driven equipment.

4.02.00 **AC motor for VFD application**

4.02.01 Inverter duty motors are designed according to the requirements of IEC/TS- 60034 part 17 & part 25 or NEMA MG-1, Part-30, Part 31 and have performance characteristics match with the driven equipment and variable speed requirement.

4.02.02 Induction motors to be operated in adjustable-speed drive applications should be de-rated as per NEMA/IEC standard due to the reduction in cooling resulting from any reduction in operating speed and the effect of additional losses introduced by harmonics generated by the control.

4.02.03 Inverter duty motors shall have VPI/improved insulation systems that do not degrade readily due to transient voltage spikes and have an adequate thermal margin.

4.02.04 Inverter duty motors shall be self-ventilated without any auxiliary blower. Force ventilation shall be subject to purchaser approval.

4.02.05 Inverter motor shall be suitable for scalar (open loop) control, without any speed feedback signal, where fast response is not required. Vector (closed loop) control will be used with encoder if specified.

4.02.06 The breakdown torque at any frequency within the defined frequency range shall be not less than 150% of the rated torque at that frequency when rated voltage for that frequency is applied.

4.02.07 The motor should be capable of producing a breakaway torque of at least 140% of rated torque requiring not more than 150% rated current when the voltage

boost is adjusted to develop rated flux in the motor and when the inverter is able to produce the required minimum fundamental frequencies.

4.02.08 The motor shall be provided with insulated bearing on one side.

4.02.09 Normally the maximum safe speed shall be as per IEC/NEMA, however it should be co-ordinated with VSD requirement.

4.02.10 In case of a conflict, the requirement mentioned under clause no. 4.02.00 for motors for VFD application shall supersede the corresponding requirement for standard motors.

4.03.00 **D.C. Motors (If applicable)**

4.03.01 D.C. motor provided for emergency service shall be shunt wound type. It can also be of compound-wound type with the series field shorted.

4.03.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability. Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 PERFORMANCE

5.01.00 **Running Requirements**

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. The mill motors shall be suitable for operating at 75% of rated voltage for one (1) minute

5.02.00 **Starting Requirements**

5.02.01 Motor shall be designed for direct on line starting at full voltage. Starting current shall not exceed 600% of full load current (subject to IS tolerance of 20%) for HT motors rated upto 1000kW. For HT motors above 1000kW upto 3000kW starting current shall not exceed 600% of full load current without any positive tolerance. For HT motors above 3000kW starting current shall not exceed 450% of full load current without any positive tolerance.

For LT motors the starting current shall be as per the limit mentioned in the relevant standard with IE-3 efficiency class. For D.C. Motors the starting current shall be limited to 2 times full load current.

5.02.02 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.03 All motors (except mill motors) shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals Mill motors shall start with rated load and accelerate to full speed with 85% of rated voltage.

5.02.04 Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.

Cold Motor Starting

Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes.

(b) Hot Motor Starting

Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes.

(c) Motor shall also be suitable for three (3) equally spread starts per hour when the motor is under normal service condition.

5.02.05 Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% rated speed in reverse direction.

5.03.00 **Stress During Bus Transfer**

5.03.01 Motors subjected to bus transfer shall be suitable for sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.04.00 **Locked Rotor Withstand Time**

5.04.01 For motors with starting time up to 20 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 2.5 secs.

For motors with starting time more than 20 secs. and upto 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 5 secs.

For motors with starting time more than 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 10% of the starting time.

5.04.02 To prevent unwanted tripping of a high inertia load at start-up, there may be need to shunt out the motor's overload trip device. Speed switches mounted

on the motor shaft may be provided in such case. Heating experienced during start-up must still be considered when sizing the motor.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

5.05.00 Torque Requirements

5.05.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.

5.05.02 Pull out torque at rated voltage shall not be less than 205% of full load torque.

6.00.00 SPECIFIC REQUIREMENTS

6.01.00 **Enclosure**

6.01.01 All motor enclosures and terminal boxes shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction.

Motors, located inside a building and not directly exposed to coal dust or fly ash, could have screen protected drip proof enclosure conforming to IP-23.

6.01.02 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv.

6.03.00 **Cooling**

6.03.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA).

6.03.02 For large capacity motors, totally enclosed tube ventilated (TETV) may be considered for acceptance. In case of motors rated 3000kW and above, closed air circuit water cooled (CACW) motors may be offered for consideration before proceeding with design and manufacturing.

6.04.00 **Winding and Insulation**

6.04.01 All insulated winding shall be of copper.

6.04.02 HT and LT motors shall have Class F insulation with winding temperature limited to 120ºC. Windings shall be impregnated to make them non-hygroscopic and oil resistant. The lightning impulse and coil inter-turn insulation surge withstand level shall be as per IEC-60034 – Part 15.

6.05.00 **Tropical Protection**

6.05.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.05.02 All fittings and hardwares shall be corrosion resistant.

6.06.00 **Bearings**

6.06.01 Motor rated above 1000kW shall have insulated bearings to prevent flow of shaft currents.

6.06.02 Vertical shaft motors shall be provided with thrust and guide bearings.

6.07.00 **Noise & Vibration**

6.07.01 The noise level shall not exceed 85 db (A) at 1.0 meters from the motor.

6.07.02 Peak amplitude of vibration shall be limited within the values prescribed in IS: 12075 / IEC 60034-14.

6.08.00 **Motor Terminal Box**

6.08.01 Motor terminal box shall be detachable type, made of cast iron or pressed steel and located in accordance with Indian Standards clearing the motor base-plate / foundation.

6.08.02 Terminal box shall be capable of being turned 360 Deg. in steps of 90 Deg., unless otherwise approved.

6.08.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor. Terminal box for all LT motors shall be diagonally split type.

6.08.04 The terminal box shall have sufficient space inside for termination / connection of XLPE (11000V/3300V) or XLPE (415V) insulated armoured aluminium cables. Where the specified main cable size demands, adopter / extension box of suitable size shall be provided as a part integral to the motor, for easy termination of the cable.

6.08.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.08.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.08.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.08.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.08.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

6.08.10 The gland plate for single core cable shall be non-magnetic type.

6.08.11 Motors rated 1000kW and above shall be provided with neutral current transformers of PS class on each phase in a separate neutral terminal box for differential protection.

6.09.00 **Grounding**

6.09.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.09.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Motor above 90KW	:	50 x 6 mm GS Flat
Motor above 30KW up to 90KW	:	25 x 6 mm GS Flat
Motor above 5KW up to 30KW	:	25 x 3 mm GS Flat
Motor up to 5KW	:	8 SWG GI Wire

6.09.03 The cable terminal box shall have a separate grounding pad.

6.10.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate:

a) Temperature rise in Deg.C under rated condition and method of measurement.

b) Degree of protection (IP No.).

c) Bearing identification no. and recommended lubricant.

d) Location of insulated bearings.

7.00.00 ACCESSORIES

7.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 **Space Heater**

7.02.01 Motor of rating 30KW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240V, 1 phase 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.03.00 **Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with minimum four (4) numbers simplex or two (2) numbers duplex platinum resistance type winding temperature detectors per phase.

7.03.02 11000V and 3300V motor bearing shall be provided with one (1) duplex or two (2) simplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0 deg.C.

Leads of all duplex or simplex type motor winding RTDs and motor bearing RTDs shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDs shall be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.

7.04.00 **Indicator/Switch**

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:

a) 11000V and 3300V motor bearing temperature.

b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.

7.04.03 Alarm switch contact rating shall be minimum 0.5A at 220V D.C. and 5A at 240V A.C.

7.05.00 **Current Transformer for Differential Protection**

7.05.01 Motor above and including 1000KW shall be provided with three differential current transformers (PS class) mounted over the neutral leads within the enclosure. Loose three (3) numbers matching PS class CT shall be supplied for mounting on switchgear.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match with the requirements of differential protection relay.

7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit required cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they shall drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00**Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

Motor including fan shall be painted with corrosion proof paints.

8.00.00 TESTS

8.01.00 Upon completion, each motor shall be subject to standard routine tests as per IS. In addition, any special test called for in the driven equipment specification shall be performed.

8.02.00 Unless and otherwise stated, Six (6) copies of routine test certificates shall be submitted for approval prior to the dispatch of the motors from works.

8.03.00 The following type test reports shall be submitted for each type and rating of 11 kV & 3.3 kV motor:

a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

b) Fault level withstand test for each type of terminal box.

c) Lightning impulse withstand test on the sample coil as per IEC 60034, part-15.

d) Surge withstand test on inter-turn insulation as per clause no. 5.1.2 of IEC 60034, part-15.

SPARES

Recommended spares for three (3) years operation shall be quoted along with the bid clearly identifying the part numbers with recommended quantities.

09.00.00 DRAWINGS, DATA & MANUALS

Drawings, data & manuals for the motors shall be submitted as indicated below:

09.01.00 **Along with the bid**

a) List of the motors

b) Individual motor data sheet as per format of the proposal data sheets.

c) Scheme & write up on forced lubrication system, if any

d) Type test report

09.02.00 **After Award of the Contract**

a) Dimensional General Arrangement drawing

b) Foundation Plan & Loading

c) Cable end box details

d) Space requirement for rotor removal

e) Thermal withstand curves hot & cold

f) Starting and speed torque characteristics at 80% & 100% voltage

g) Complete motor data

h) Erection & Maintenance Manual

i) Efficiency curves.

j) List of motors.

k) Test reports

ANNEXURE – A

DESIGN DATA

1.0 SERVICE CONDITIONS

Refer Vol-IIA of Specification for FGD package.

2.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11000V, 3Ø, 3W, 50 Hz, non-effectively earthed. Fault level 40kA symm. for 3sec	Motors above 750kW
	3.3kV, 3Ø, 3W, 50 Hz, non-effectively earthed. Fault level 40kA symm for 3sec	Motors above 160kW up to & including 750kW
L.T. Supply	415V, 3Ø, 3W, 50 Hz, effectively earthed. Fault level 50kA symm for 1sec	Motors above 200W upto 160 kW
	240V, 1Ø, 2W, 50 Hz, effectively earthed.	Motors less than 200W, Lighting, space heating, A.C. control & protective devices
D.C. Supply	220V, 2W, unearthed. Fault level 25*kA for 1sec	D.C. alarm, control & protective devices

* Indicative only; actual value shall be decided by the Bidder, after substantiating the same by calculation.

3.0 RANGE OF VARIATION

A.C. Supply

Voltage: ± 10% Frequency: ± 5%

Combined Volt & frequency: 10%(absolute sum)

D.C. Supply

Voltage: (+10% to -15%)

TITLE	SPECIFICATION NO.
LV MOTORS	VOLUME II B
DATA SHEET-A	SECTION D
2X500 MW NTPL TUTICORIN FGD	REV NO. DATE: 20.02.2021
	SHEET 1 OF 2

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	160KW *
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz + 5 % to - 5%
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	○ Above 90 kW (Breaker Controlled)	:	50 KA for 0.25 sec.
	○ 90 kW & below (Contactor Controlled)	:	50 KA protected by HRC fuse
	f) LV System grounding	:	Solidly
5.0	Winding & Insulation	:	Class F with temp rise limited to class B
6.0	Minimum voltage for starting	:	80%
7.0	Power cables data	:	Shall be given during detailed engg.
8.0	Earth Conductor Size & Material	:	Shall be given during detailed engg.
9.0	Space heater supply (for motors >=30kw)	:	240 V, 1ϕ, 50 Hz
10.0	Rating up to which Single phase motor	:	Acceptable below 0.2 kW
11.0	Locked rotor current		
	a) Limit as percentage of FLC	:	As per IS 12615
12.0	Makes	: BHEL/ Customer approval (Package owner to take care)	
13.0	Paint shade	:	Blue (RAL 5012) – Corrosion proof
14.0	Degree Of protection for motor/ terminal box	:	Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-

i) Indoor motors - IP 23
ii) Outdoor motors - IP 55
iii) Cable box-indoor area - IP 23
iv) Cable Box-Outdoor area - IP 55

* **LT motors of continuous duty shall be energy efficient IE3 class conforming to IS-12615**

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

	TITLE	SPECIFICATION NO.
	MOTORS	
	DATA SHEET – C	**VOLUME II B**
		SECTION D
	2X500 MW NTPL TUTICORIN FGD	**REV NO. 00 DATE 20.02.2021**
		SHEET 1 **OF** 2

S. No.	Description	Data to be filled by successful bidder
A.	**General**	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	**Design and Performance Data**	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a Voltage	
6	b Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	
	c) At starting	

NAME OF VENDOR					
				REV.	
NAME	SIGNATURE	DATE	SEAL		

	TITLE	SPECIFICATION NO.
	MOTORS	
	DATA SHEET – C	**VOLUME** II B
		SECTION D
	2X500 MW NTPL TUTICORIN FGD	**REV NO. 00 DATE 20.02.2021**
		SHEET 2 **OF** 2

S. No.	Description	Data to be filled by successful bidder
C.	**Constructional Features**	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	**Characteristic curves/ drawings** (To be enclosed for motors of rating ≥ 55KW)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

568142/2021/PS-PEM-MAX

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

568142/2021/PS-PEM-MAX

1.0 INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

568142/2021/PS-PEM-MAX

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

ANNEXURE - A

NOTES AND DETAILS FOR CABLING SYSTEM

1.00.00 GENERAL

1.01.00 These notes and details shall be read and construed in conjunction with Specification and the drawings meant for cable tray details and supporting arrangements in Trench, Racks etc., enclosed elsewhere. In case of conflict between these notes and drawings, the latter shall prevail.

1.02.00 The Cabling System installation work shall conform to the requirements of the latest revisions of the following standards/codes

a) Indian Electricity Rules, 1956, with up to date amendment.

b) I.S. Code of Practice

2.00.00 CABLE ROUTING/LAYING

2.01.01 Cables shall generally be laid on ladder type cable trays either in trenches or overhead supported from building steel/structures except in some cases cables may have to be laid underground and for short runs in conduits for protection or crossing.

2.01.02 For interplant connections, the cables may be routed through an overhead cable bridge or cable trenches/tunnels selection being dependent on site constraints. Directly buried cable shall be avoided as far as possible. Owner's prior approval shall be taken for exceptional cases, where buried cables cannot be avoided.

2.01.03 For underground crossing of railways, roads etc. hume pipes shall be used and shall be laid at a depth of minimum 1000 mm such that cables shall not be damaged.

2.01.04 The cable racks in dust prone areas shall be supported from available structure in vertical configuration with suitable cover to avoid deposition of lignite dust as far as practicable.

2.01.05 Different voltage grade cables shall be laid in separate trays when trays are arranged in tiers. Power cables shall be on top trays and Control/Instrumentation cables on bottom trays, and it is recommended that trays for cables of different voltage levels be stacked in descending order with higher voltage level above.

2.01.06 Cables for redundant equipment/system shall be run in separate trays in separate route.

2.01.07 Cables from two different services viz. supply from station board and supply from unit board shall be fully segregated to prevent simultaneous damage due to fire in one of the services.

2.01.08 Low level signal cables and other special Instrumentation and Control cables shall run in separate trays. In general, a minimum of 1500 mm clearance shall be maintained between these cables and noise generating equipment (large motors, generators, transformers etc.).

2.01.09 The cable spreaders of each unit shall be compartmentalized by provision of fire proof partition wall.

2.01.10 The floor of the cable spreader rooms shall have to be made water proof so that water does not percolate to lower levels in the event of fire fighting operations. Adequate arrangement for efficient drainage of water shall be provided. The cable raceways should also be suitably curved to avoid water entry through this place.

2.02.00 **Cable Trays/Supports**

2.02.01 Cable trays and covers shall be pre-fabricated type, constructed from minimum 14 SWG sheet steel for trays and 16 SWG for covers and hot-dip galvanized after fabrication.

2.02.02 Cable tray supports shall be cantilever type for each installation. All supports and hardware shall be hot-dip galvanized. Support shall be fixed with bolts and no welding shall be done on the galvanized parts.

2.02.03 Standard cable tray width shall be 600 mm. However, trays with 450, and 300, 150 mm width may be used in some places considering the requirement and space restrictions. For instrumentation and control purpose, some perforated type cable trays of width 150 and/or 100mm may be used particularly in low space area and 600, 450, 300 mm perforated trays may be used depending on site requirement.

2.02.04 Cable trays shall be ladder type with 250 mm rung spacing, 100 mm depth and rung width not less than 50 mm.

2.02.05 All weld for cable tray supports shall have a minimum throat thickness of 6 mm.

2.02.06 Cable trays in areas subjected to excessive lignite dust, or mechanical damage shall have hot-dip galvanised sheet metal tray cover installed on front tray in vertical run and inverted `V' type on upper tray in horizontal run.

Where covers are used on trays containing power cables, consideration should be given to ventilation requirements. Areas where corrosive chemicals are likely to be handled, cable tray and covers shall be epoxy painted.

2.03.00 **Conduits**

2.03.01 Conduits shall be rigid steel coated type; minimum size of conduit shall be limited to 19mm.

2.03.02 Steel conduits with interior coating of silicon epoxy ester for ease of wire pulling shall be seamed by welding and flo-coat metal conduit/hot-dip galvanized. These shall be supplied in standard length of 5M with minimum wall thickness as specified in IS: 9537 Part-II. In chemical handling areas, Battery room etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion.

2.03.03 Conduit runs shall be supported at an interval of 750 mm for vertical run and 1000 mm for horizontal run.

2.03.04 Conduits shall be sized so that conduit fill (ratio of total cable area to conduit area) shall not exceed the following:

One Cable	:	53%
Two Cable	:	31%
Three Cables & Up	:	40%

2.03.05 Conduit runs shall be provided with necessary bends as required.

2.04.00 **Installation**

2.04.01 The Bidder shall install, terminate and connect up all cables and conduits with supporting arrangements as per drawings, cable schedules and interconnection chart/drawings.

2.04.02 The HV power cables of 11 KV/3.3 KV shall be laid in trays or racks as follows:

a) In single layer only.

b) 3 core cables to be laid giving one diameter gap of the largest diameter adjacent cable.

c) Single core cables to be laid in trefoil formation with a spacing equal to diameter of the trefoils.

2.04.03 1100V grade power cables shall be laid in single layer in trays.

2.04.04 1100V grade power cable shall be laid giving one diameter gap of the largest diameter adjacent cable.

2.04.05 Control and Instrumentation cables can be laid up to a maximum of three layers in each tray.

2.04.06 The trays shall be run with a vertical spacing of 300 mm for overhead cable trays as well as inside cable trenches. A minimum of 225 mm clearance shall be provided between the top of tray and beams, cold piping, 500 mm clearance for hot piping/object to facilitate installation of cables in tray.

5.05.02 Components shall be pre-moulded type, taped type or heat-shrinkable type. 11kV, 6.6kV and 3.3kV grade joints and terminations shall be type tested as per IS: 13573.

5.05.03 Kits shall be complete with the alumunium solderless crimping type cable lugs and ferrule as per DIN standard.

5.06.00 **Cable Glands**

Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS 6121 or to EN 50262. Ingress Protection rating for cable glands with seal, when offered conforming to EN 50262, shall be minimum IP 66 in line with BS. Cable glands shall be made of tinned brass gland, double compression type complete with necessary armour clamp and tapered washer, etc. Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall match with the sizes of different H.V./L.V./Control cables supplied/erected.

5.07.00 **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.

5.08.00 **Cable Clamps and Straps**

5.08.01 Trefoil clamps for single core cables shall be pressure die-cast aluminium or fibre glass or nylon with necessary G I fasteners. Trefoil clamps shall have adequate mechanical strength to forces generated by peak value of maximum system short circuit current.

5.08.02 Cable clamps required for multicore cables on vertical run shall be made up of 25x3mm size aluminium strip. For clamping the multicore cables, self-

ii) Heat Shrinkable sleeve type for HV & MV cables and LV power cables. However terminating kits for HV & MV cables shall be of heat shrinkable type of make with specific approval of Purchaser.

e) For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

f) The straight through jointing kits shall be suitable for underground installation with uncontrolled backfill and possibility of flooding by water. Straight through joints shall be used for LV power cable sizes of 70sqmm and above. The jointing kit shall be one of the following types: -

i) 'TAPEX' of M-seal make or equivalent for LV power cables
ii) Heat Shrinkable sleeve type for HV & MV cables and LV power cables. However straight through joints for HV & MV cables and LV power cables shall be of heat shrinkable type of make with specific approval of Purchaser.

5.29.02 Raceway & Conduit

The design and specifications for the raceway and conduit systems used in supporting and protecting electrical cable shall be in accordance with the provisions of the appropriate codes and standards.

5.30.00 **Conduit**

5.30.01 Conduit shall be used to protect unarmoured conductors routed to individual devices and where the quantity of cable does not economically justify the use of cable tray.

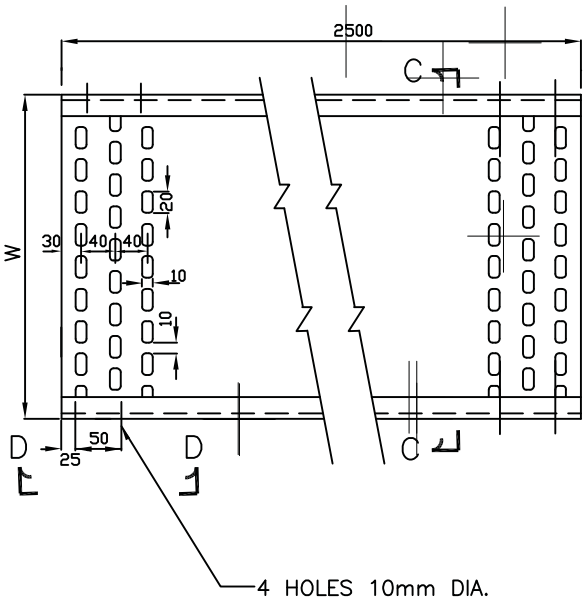
5.30.02 Rigid conduit shall be used for hazardous and outdoor areas.

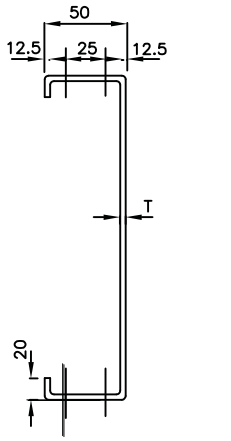
5.30.03 Galvanized rigid steel conduit shall be used for all conduit encased in concrete and all exposed conduit.

5.30.04 All conduits cast in concrete shall be routed in exposed runs parallel or perpendicular to dominant surfaces with right-angle turns made of symmetrical bends or fittings. Conduit shall be routed at least 150mm from the insulated surfaces of hot water, steam pipes, and other hot surfaces. Where conduit must be routed parallel to hot surfaces, special high temperature cables shall be used.

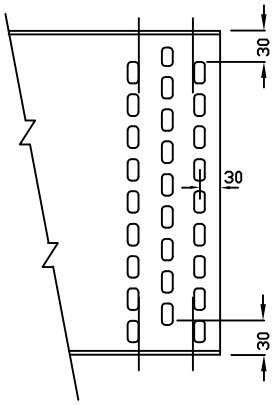
5.31.00 **Duct Banks & Manholes**

5.31.01 All underground duct banks shall consist of plastic conduit encased in reinforced concrete. The minimum nominal diameter/hume pipes of the plastic ducts shall be 125mm. A 75mm galvanized steel conduit shall also be installed where required for digital and analog low-level circuits requiring noise immunity from adjacent power circuits.

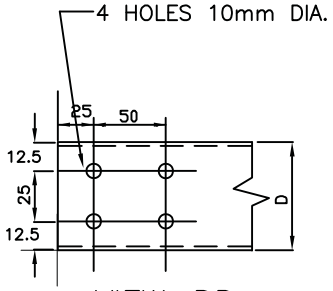




SECTION–CC
(100/50 TRAYS)



ARRANGEMENT OF
PERFORATIONS

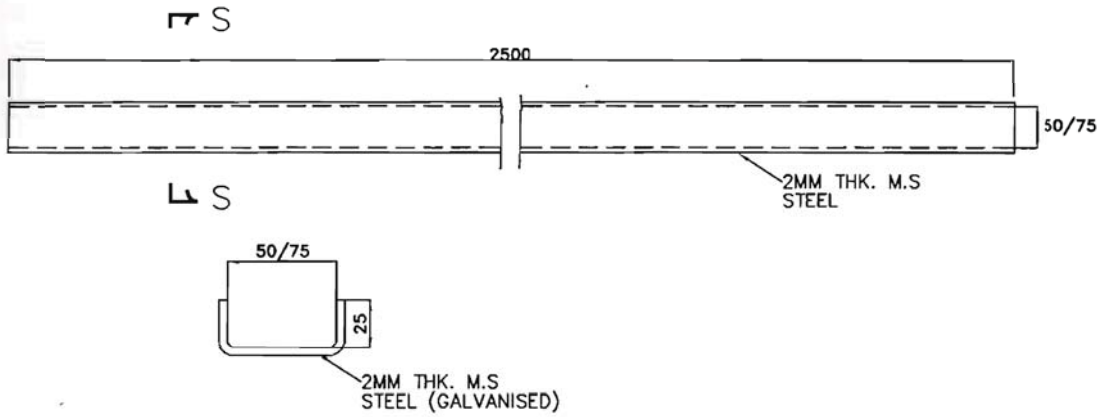


VIEW–DD
(100,50W TRAYS)

TRAY WIDTH W (mm)	100	50
TRAY DEPTH D (mm)	50	50
T (mm)	2	2

PERFORATED TYPE TRAY

	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	DWG. NO.



SECTION S–S

CABLE TROUGHS

SEE GENERAL NOTES IN SHEET 11.

TYPICAL DETAILS OF CABLE TRAY AND ACCESSORIES	BHEL DRAWING NO. PE–DG–427–507–E005	
	SH 10 OF 11	REV 00

SECTION – C3
SPECIFIC TECHNICAL REQUIREMENTS
(CONTROL AND INSTRUMENTATION)

OPERATION AND CONTROL PHILOSOPHY:

The normal mode of operation of NaOH dosing system shall be from **DDCMIS** including **ON/OFF** command to individual pumps.
A local panel comprising of **'ON' & 'OFF'** push button and an emergency **'OFF'** push button along with '**ON/OFF'** indication shall be provided. The emergency '**OFF'** Push Button shall be wired directly to MCC whereas **ON & OFF** push button shall be routed to **DDCMIS.** The respected Auto stroke controllers shall also be provided in the local panel.
The local /remote selection along with remote control shall be provided in **DDCMIS** only.
The stroke position & adjustment will be done from DDCMIS and the stroke actuator shall be suitable for accepting 4-20 mA DC signal. The pumps shall be provided with 24 V DC, 2- wire LVDT Type Position feed back transmitter to generate 4-20 mA DC signal to indicate stroke position.
The starter of all the motors shall be clubbed with main plant MCC.
All controls, fault indicators/alarms, interlocks, logics shall be implemented in DDCMIS only.
The ON/OFF operation of all motorized stirrers/pumps shall also be provided in DDCMIS with local ON/OFF and emergency OFF facility along with ON/OFF check backs.

The following signals/status shall be shown on local panel.
• Pump 1/2-ON, Stirrer 1-ON.
• Pump 1/2-OFF, Stirrer 1- OFF.
• Pump 1/2-Tripped, Stirrer 1- Tripped.

Following interlocks shall be provided at low-low Level in the mixing cum storage tank.
i) Running Dosing pump shall be tripped.
ii) Stirrer motor of the respective tank shall be tripped.

Following fault indications with alarm shall be provided in DDCMIS:
i. Low level in the mixing cum storage tank.
ii. Running Dosing pump motor & stirrer motor tripped due to low-low level.
iii. Dosing Pump-1/2 trip due to over load.
iv. High pressure at pump discharge header.
v. Low pressure at pump discharge header.

Following conditions to be ensured before starting a pump/stirrer
ii Level in the tank adequate.
iii MCC not disturbed.
All the field instruments shall be terminated at local panel.

Following interlocks shall be provided at High Pressure in Pump downstream.
i) Running Dosing pump shall be tripped.

	NTPL TUTICORIN (2X500 MW) FGD SYSTEM PACKAGE	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) FOR NaOH DOSING SYSTEM	

C&I SPECIFICATION FOR NaOH DOSING SYSTEM (DCS BASED)

	NTPL TUTICORIN (2X500 MW) FGD SYSTEM PACKAGE	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) FOR NaOH DOSING SYSTEM	

TABLE OF CONTENTS :-

S. No.	DESCRIPTION
SECTION-C	
1	SPECIFIC TECHNICAL REQUIREMENTS (C&I)
SECTION-D	
1	GENEREAL REQUIREMENTS
2	CODES and STANDRADS
3	INSTRUMENTS & VALVES SPECIFICATIONS
4	DRIVE INTERFACE
5	INSTRUMENT INSTALLATION DIAGRAM
6	INSTRUMENT STUB DETAILS
7	ELECTRICAL MOTOR ACTUATOR
8	LIST OF DELIVERABLES
9	MANDATORY SPARES
10	KKS PHILOSOPHY
11	CABLE INTERCONNECTION & TERMINATION PHILOSOPHY
12	SUB VENDOR LIST

	NTPL TUTICORIN (2X500 MW) FGD SYSTEM PACKAGE	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) FOR NaOH DOSING SYSTEM	

Specific Technical Requirements (C&I):

1.0 Chemical Dosing System (NaOH Dosing) shall be operated from DCS (DCS-BHEL Scope of supply) through operator work stations.

2.0 Bidder to provide local control panel(LCP) for NaOH dosing system. This LCP will act as interface between the DCS and the field devices for commands & feedbacks. In addition, LCP shall have the provision of command (start/stop) & feedback interface with plant DCS.

3.0 Bidder to supply all the instruments (LT, LG, PT, DPT, DPG, PG etc.) required for the package along with necessary fittings, accessories and valve manifold etc. All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments. All the instruments shall be corrosive resistive coating and suitable for sea water applications.

4.0 The requirements given are to be read in conjunction with detailed Technical specification enclosed.

5.0 The scope of C&I cables and their erection and commissioning shall be referred in Electrical scope sheet defined in Electrical specification.

6.0 All the instruments PG/DPG/DPT/PT etc. as applicable shall have chemical/ diaphragm seal.

7.0 Bidder to include all the instruments required for the package along with fittings, accessories and valve manifolds.

8.0 All field instruments enclosure shall be IP-65 local panel/cabinet enclosure shall be IP-55, unless otherwise specified.

All transmitters shall be smart type and shall have 4-20mA DC signal with superimposed digital communication (HART). Each Temperature element shall be complemented with temperature transmitters, compensating cable, JB/rack & other erection hardware.

9.0 The solenoid operated valves shall have limit switches for open/ close feedback. Operating coil voltage of solenoid valve shall be 24 V DC.

10.0 BLANK

11.0 All the root valves shall be in bidder’s scope. Double root valve shall be provided for all pressure tapings where the pressure exceeds 40kg/cm2.

12.0 The junction boxes for termination of instruments /actuator limit switches/solenoid valve limit switches etc. are in bidder’s scope. Bidder to provide all erection hardware including junction boxes, local panel, canopies, structural steel as required. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc.

13.0 240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) shall be provided by BHEL at a single point, further distribution to various instruments/equipment's shall be in Bidder's scope. Bidder to include the necessary power distribution board in his scope. Any power supply other than the above, if required for any instrument/ equipment has to be derived from the above supply & all the necessary hardware for the same shall be in Bidder's scope.

14.0 Bidder to furnish electrical/UPS load data during detailed engineering.

15.0 BLANK.

16.0 Electrical Actuators shall be with integral starter.

17.0 Power supply derived for Transmitters, contact interrogation, interposing relay and solenoid shall generally be ungrounded 24V DC only. In all cases redundancy in power modules shall be considered.

18.0 Bidder to note that all the transmitters/instruments supplied by Bidder shall be rack mounted. The racks shall be preassembled and provided by Bidder. Also no instruments / analysers & JBs/Racks should be protruding on the walkway.

All transmitters shall be suitably grouped together and mounted inside (i) Local Instruments Enclosures (LIEs) in case of open areas of the plant and (ii) Local Instrument Racks (LIRs) in case of covered areas.

19.0 Each valve/instrument shall be fitted with a stainless steel or aluminium nameplate indicating the valve/instrument service and reference number.

20.0 Integral to equipment which are not indicated in the tender drawings, but are required for control, monitoring and operation of the equipment/plant system for which no P&IDs are enclosed, all the instruments shall be provided to meet the actual system requirements and meeting redundancy and other requirements under technical specifications subject to Employer's approval.

21.0 For other critical binary and analog inputs required for protection and interlock purpose of other equipment (e.g. those interlocks which may result in loss of production, non-availability of a major equipment etc.), triple sensors shall be provided.

22.0 Temperature elements, electronic transmitters etc. are to be provided for all the cases. Use of process actuated switches is acceptable only in the cases as indicated in the tender drawings.

23.0 Single Input DIN rail mounting type temperature transmitters (mounted in JBs) shall be provided by the Contractor for all temperature elements under Contractor's scope.

24.0 Process connection & piping including LIE / LIR, all impulse piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories shall be provided on as required basis for proper installation & completeness of impulse piping system and air supply system, as stipulated elsewhere in the specification.

25.0 The system shall be arranged so that the failure of any monitoring device or control components or spurious intermediate grounding in the signal path shall not open the signal loop nor cause the loss or malfunction of signal to other devices using the same signal.

26.0 To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.

27.0 The design of the control systems and related equipment's shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved and shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips is avoided /minimized.

28.0 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable).

29.0 Bidder to perform tests of C&I items/instruments/systems as per quality plans/type test attached in the specification.

30.0 The equipment shall be of modern, compact design incorporating the latest developments in proven technology. All instruments whether for local indication or remote transmission shall be of good quality and shall have an accuracy and repeatability appropriate to their duty.

31.0 Bidder shall provide Cable Schedule in BHEL excel format which shall be provided during detailed engineering. Also, Cable Interconnections for Complete System shall be in Bidders' scope. DCS side details for hardwired signals shall be furnished by BHEL during detailed engineering.

32.0 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. In case of any contradiction most stringent clause/condition shall prevail.

33.0 Interface of MCC, field instruments, Solenoid valve/actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in Section-D.

34.0 For codes & standards refer detailed specification.

35.0 Instrument installation and accessories required shall be in Bidder's scope. Vendor submitted 'Instrument Installation Diagram' shall be subject to customer approval during detail engineering without any commercial and time implication. The instruments for which Installation Diagram is not attached, vendor's Installation Diagram for such items will also

be subject to customer approval during detail engineering without any commercial and delivery implication.

36.0 Drawings/Documents and data to be furnished after award of the contract shall be in line with MDL furnished elsewhere in the specification.

37.0 Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract: List of Drawings/Documents and data to be furnished by bidder after award of the contract are mentioned under section" List of Documents/Deliverables".

- GA & wiring diagram of local panel.
- IO list and drive list
- Power requirement.
- Local control panel & instruments data sheet.
- Instrument schedule
- Cable interconnection and cable schedule
- Alarm Schedule
- Control scheme
- Control write-up
- GA & wiring diagram of local panel.
- Any other document decided during detailed engineering

Notes:

1. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.
2. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.
3. In case of any discrepancy in Section-C and Section-D of the specification, Section-C shall prevail.

8.00.00 **GENERAL REQUIREMENTS**

8.01.00 Integrated DCS based closed loop control, open loop control and sequential control and bulk data acquisition system for FGD System in hierarchical levels has been envisaged for the plant. (BHEL scope)

8.02.00

8.03.00 All field process transmitters shall be smart (HART based) type.

8.04.00 Final control device for regulating duty control shall have pneumatic actuator with HART based smart pneumatic positioners. Actuators for isolating and inching duty valves shall be, in general, electrical motor operated. Solenoid operated pneumatic actuator will be used for on-off duty control valves All the position limit switches employed in the pneumatic on-off valves shall be non-contact type.

8.05.00 Process switch (Pressure / Level switch) function shall generally be derived from analog process transmitters.

8.06.00 Process transmitter and valve positioner shall communicate with the DCS in the form of analog signal 4-20 mA DC along with superimposed digital signal through HART protocol. ~~Separate handheld smart configurator shall be furnished for local and manual configuration / adjustment of all HART instrument / devices.~~

8.07.00 Power supply for Transmitters, contact interrogation, relay and solenoid shall be generally 24V DC. Power supplies for interrogation, relay and solenoid shall be provided from Bulk power supply modules separate from control system rack power supply. In all cases redundancy in power supplies & modules shall be considered.

8.08.00 Temperature measurement shall have upscale / down scale protection features to protect from process upset in case of sensor failure. Both the elements of duplex temperature sensors shall be brought to junction boxes.

8.09.00 Temperature transmitters shall be provided for all control applications. Transmitter shall be two wire type and current output of 4-20 mA DC with superimposed digital signal in HART protocol. For temperature monitoring functions, temperature elements (TC / RTD) shall be connected to their respective input module of PLC through instrumentation signal / Triad cable in case of RTD type element, extension / compensating cable for K type TC.

8.10.00 All alarm and trip signal shall be configured in NC mode of configuration so that any breakage in the wire can be identified with alarm.

8.11.00 Bidder shall be fully responsible for safe and efficient operation of the control

loops and interlock / protection logic even under all plant disturbances, disabilities, emergencies and component failures.

8.12.00 Critical maintenance purpose manual isolation valves of equipment, suction valves of critical pumps shall have open & close end position status indication at ~~PLC.~~ DCS

8.13.00 All regulating duty control valves shall have mechanical position indicator and contact less position transmitter (4-20mA DC output) for monitoring the position from local and control room respectively. Air lock relays shall be provided with all regulating duty pneumatic drives to achieve stay put / fail safe condition on air failure. Hand wheel shall be provided for local operation. Pneumatic tubing for the control valve hook up including integral tubing of valve shall be of stainless steel material.

8.14.00 Motor winding temperature of HT motors and bearing temperature of HT motors & driven equipment shall be measured in all cases. In general bearing & winding temperature shall be measured with Duplex Resistance temperature detector (RTD).

8.15.00 Bearing temperatures of any equipment driven by H.T. motors shall be provided with direct mounted dial Temperature gauge at each bearing of driven equipment and motor.

8.16.00 All temperature-measuring elements (RTD / TC) shall be of duplex ungrounded type and both the elements shall be terminated at junction box. Extension / Compensating cable for TC and Triad cable for RTD shall be used for interfacing with PLC. Temperature elements shall be supplied with thermowell.

8.17.00 Flow Elements with Flow Transmitters & Flowmeter (Electro-magnetic type, Coriolis mass flow) for flow measurement of process medium like water, air, flue gas, slurry etc. shall be provided by Bidder based on application and as approved by Owner. Wherever DP type transmitter is used for flow measurement, square root extraction is to be performed in the DCS based system.

8.18.00 Pressure gauges, pressure switches and pressure / differential pressure transmitters shall be provided with diaphragm seal in case of dirty, corrosive & viscous fluid application. Diaphragm material shall be suitable for process fluid. Similarly the wetted part material for level transmitter / switches / gauges / analyzers in corrosive application shall have suitable grade material compatible with the corrosive fluid in contact. In all other cases material grade of the wetted part shall in no case be lower than stainless steel unless the process fluid calls for some other material.

8.19.00 Ergonomically & aesthetically designed furniture viz. control desks & chairs shall be provided at the local control room for various workstations. Similarly, furniture shall be provided for equipment like programming stations, PCs and various peripherals. Control desk and Video wall shall be from reputed

manufacturer/s. Local control room interior shall be designed with latest state of the art design prevailing in the modern power plant.

8.20.00 KKS identification system shall be adopted for the tagging. Bidder shall follow the KKS Tag numbering philosophy while preparing all instrumentation & control related documents.

8.21.00 The SI / MKS system of units shall be used for design, drawings, diagrams, instruments etc.

8.22.00 **Vibration Monitoring System**

Microprocessors based standalone online Vibration Monitoring System (VMS) shall be provided for rotating machine condition monitoring & diagnostic. On-line Vibration Monitoring System shall be provided for all HT drives (160 KW & above).

Each HT drive (160 KW & above) shall be provided with vibration sensors on the DE and NDE bearings of motors and fans / pumps. On each bearing there shall be two vibration sensors, one in X direction and other in Y direction along with key phasor for on line vibration monitoring and analysis.

Each vibration monitoring panel shall have local LCD display mounted on the panel.

8.23.00 **Process Connection & Instrument Hook Up (as applicable)**

Instruments	**EQUIPMENT / PIPE SIDE**	**INSTRUMENT SIDE**
Level Instruments		
Internal Displacer	4" – Flanged	4" - Flanged
External Displacer	2" – Flanged	2" - Flanged
Level gauge	¾" –Flanged	¾" - Flanged
DP Type	½" (min.)-welded 1" – welded for vessel like HP heaters, LP heaters, De-aerator etc. application	½"- NPT
External cage Level switch	1"- welded	1"- welded
Flow Instruments		

Instruments	EQUIPMENT / PIPE SIDE	INSTRUMENT SIDE
DP Type	½" - welded in general 1" – welded for high pressure / temperature main steam, feed water, PRDS etc. application	½" - NPT
Pressure Instruments		
Conventional	½" (min.)-welded 1"- welded for high pressure/ temperature. application	½" - NPT
Diaphragm type-HFO application	3"- Flanged	3"- Flanged
Temperature Instruments		
Thermowell	Generally - M 33 X 2 (M) 1½" Flanged- For air/FG path application	½" NPT
Analyzer		
Liquid analyzer	½"- 1" – welded	½"

8.24.00 **Electrical Power Supply Systems**

240V AC Redundant Package UPS system with 60 minutes back-up to cater various C&I system loads in FGD control room including PLC, HMIs, field instruments / analyzers, Relay based Local Control Panel etc. and PLC / Proprietary control and monitoring system for package systems (if any), Vibration Monitoring System shall be provided by the bidder.

UPS Power supply (max. 1 kVA) required for the FGD C&I loads, located in main plant CCR, shall be made available to the bidder at purchasers ACDB terminals as single redundant feeder. Cabling from the purchaser ACDB to FGD load points/ ACDB is under the scope of the bidder.

DC power distribution for PLC and loop-powered field instruments shall be derived from the UPS supply and the required DC distribution boards will be located within PLC cabinets. Any other DC power supply required for the plant will also be suitably derived and distributed. (UPS specification shall be covered

in Electrical Volume)

8.25.00 **Instrumentation & Control Cabling**

8.25.01 Instrumentation cables shall be copper, overall screened for binary signals and individual & overall screened for analog signals. All cables shall be FRLS type (inner & outer sheath) and armoured. Inter panel cables inside Control Rooms may be unarmoured. All the unarmoured cables shall run through conduits.

8.25.02 Fiber Optic cables in the field shall be laid through HDPE conduits for buried section and through dedicated encased perforated GI trays for over-ground section.

8.25.03 Bidder to follow the the following philosophy

1) DI & DO signal cannot be routed through the same cable.
2) Single pair or single triad cable is not acceptable. Minimum of 2 pairs or 2 triad cable shall be used.
3) Each multi-pair or multi-triad cable shall have 20% or minimum 1 pair / 1 triad cable whichever is maximum as spare.

8.25.04 Cable size & type shall be as below for different type of signals and control system shall be followed in general.

1) Cables for analog signals will be instrumentation paired cable of 0.5 sq. mm copper conductor size, with individual pair shielding & overall shielding.
2) Cables for binary signals will be instrumentation paired cable of 0.5 sq. mm copper conductor size with overall shielding only.
3) Conductor cross section for triad signal cables will not have individual conductor cross section below 1.5 sq. mm.
4) For interposing relay drive connection individual conductor cross section will not be below 1.5 sq. mm.
5) Cables for power supply to each solenoid valves will be control cable of 3C x 2.5 sq. mm copper conductor size for all voltage level.

9.00.00 **TYPE TEST**

9.01.00 **General Requirements**

a) The Bidder shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. List of major tests are furnished below for solid state equipment. For the balance systems & instruments, which are not indicated here, type tests may be conducted as per manufactures

standard or if required by relevant standard.

b) The Bidder / sub-vendor / manufacturer is required to conduct certain type tests specifically for this project as specified in respective sections and to be witnessed by Owner / Consultant or their authorized representative, even if the same had been conducted earlier. Incase Owner / Consultant decides to waive any of the Type tests for any item based on tests conducted by Bidder in the last five years, Test certificates for same shall be provided for review / acceptance and the final decision rests with Owner / Consultant.

c) Submission of type test results and certificate shall be acceptable provided:

i) The same has been carried out by the Bidder / sub-vendor on exactly the same model / rating of equipment.

ii) There has been no change in the components of offered equipment from tested equipment.

iii) The test has been carried out as per the latest standards along with amendments.

d) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder within the quoted price and no extra cost shall be payable by the Owner on this account.

e) The schedule of conduction of type tests / submission of reports indicating the test standard shall be submitted and finalized during pre-award discussion for Owner / Consultant's review & approval.

f) For the type tests to be conducted, Bidder shall submit detailed test procedure for approval by Owner / Consultant. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording, precautions to be taken etc. for the tests to be carried out.

9.02.00 **Special requirements for Solid State Equipments& Systems**

The type tests reports, as a minimum, over and above the requirements of above clause which are to be submitted for each of the major C&I system shall be as indicated below:

9.02.01 **Electromagnetic Immunity as per EN 61000-6-22**

a) Equipment furnished by Bidder shall incorporate necessary techniques to eliminate measurement and control problems caused by electromagnetic interferences especially encountered in power plant

environment. Equipment, which is vulnerable to such interference, shall be suitably immunized to eliminate possible problems.

b) Required shielding, input balancing, ripple amplitude and grounding for field signals and for the control systems to achieve an installation with minimum noise coupling from all sources.

c) Any additional equipment, deliverables required for effectively eliminating the noise problems shall be identified and included.

d) Electromagnetic emission as per EN 61000-6-43

9.02.02 Surge-Protection For Solid State Equipment

All solid state systems / equipment shall be immuned and able to withstand the electrical noise and surges as encountered in actual service conditions inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90a-1989. Hence, all front end cards which receive external signals like analog input & output modules, binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meet the surge withstand capability as defined in ANSI 37.90a. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, IEC / EN 61000-4-4 & IEC / EN 61000-4-5 for Electrical fast transient / burst and Surge immunity may also be adopted for SWC test.

9.02.03 Type Test Requirement for C&I Systems

Sl. No.	Item	Test Requirement	Standard	Test to be specifically conducted	Approval required on Test Certificate	Remarks
1.	Transducers	As per Standard	IEC-688, IS-12784	NO	YES	
2.	Thermocouples	Degree of Protection Test	IS-2147	NO	NO	
3.	RTD	As per Standard	IEC-751	NO	NO	
4.	C.J.C. Box	Degree of Protection Test Ambient Temp. effect	IS-2147 Approved Procedure	NO NO	YES YES	
5.	Electronic Transmitter	As per Standard	BS-6447 / IEC-770	NO	YES	

Sl. No.	Item	Test Requirement	Standard	Test to be specifically conducted	Approval required on Test Certificate	Remarks
6.	E/P Converter	As per Standard	Mfr. Standard	NO	YES	
7.	Dust Emission Monitor	Degree of Protection Test	IS-2147	NO	YES	
8.	Instrumentation Cables Twisted & Shielded			YES	YES	
	a) Conductor	• Resistance Test	VDE-0815			
		• Diameter Test	IS-10810			
		• Tin Coating Test (drain wire)				
	b) Insulation	• Loss of mass	VDE-0472			
		• Aging in air ovens	0472 **			** As per VDE 0207 for Teflon insulated cables
		• Tensile Strength and Elongation	VDE 0472 **			
		• Heat Shock	VDE 0472 **			
		• Hot Deformation	VDE 0472			
		• Shrinkage	VDE 0472			
		• Bleeding & Blooming	IS-5831			
	c) Inner Sheath	• Loss of mass	VDE-0472			
		• Heat Shock	VDE 0472 **			
		• Cold Bend / Cold Impact Test	IS-5831			
		• Hot Deformation	VDE 0472			
		• Shrinkage	VDE 0472			

Sl. No.	Item	Test Requirement	Standard	Test to be specifically conducted	Approval required on Test Certificate	Remarks
	d) Outer Sheath	• Loss of mass	VDE-0472			
		• Aging in air ovens	VDE 0472 **			
		• Tensile Strength and Elongation Test before and after ageing	VDE 0472 **			
		• Heat Shock	VDE 0472 **			
		• Hot Deformation	VDE 0472			
		• Shrinkage	VDE 0472			
		• Bleeding & Blooming	IS-5831			
		• Colour Fastness to Water	IS-5831			
		• Cold Bend / Cold Impact Test	IS-5831			
		• Oxygen Index Test	ASTMD-2863			
		• Smoke Density Test	ASTMD-2843			
		• Acid Gas Generation Test	IEC-754-I			
	e) Fillers	• Oxygen Index Test	ASTMD-2863			
		• Smoke Density Test	ASTMD-2843			
		• Acid Gas Generation Test	IEC-754-I			
	f) AL-MYLAR Shield	• Continuity Test				
		• Shield Thickness				
		• Overlap Test				
		• Noise	IEEE			

Sl. No.	Item	Test Requirement	Standard	Test to be specifically conducted	Approval required on Test Certificate	Remarks
		Interference	Transactions			
	g) Overall Cable	• Flammability	IEEE 383			
		• Noise Interference				
		• Dimensional Checks	IS 10810			
		• Cross talk				
		• Mutual Capacitance	VDE 0472			
		• HV Test	VDE 0472			
		• Drain Wire Continuity				
9.	Pressure Gauge	• Degree of Protection Test	IS-2147	NO	NO	
		• Temperature Interference Test	IS-3624	NO	NO	
10	Temperature Gauge	Degree of Protection Test	IS-2147	NO	NO	
11	Pressure & Differential Pressure Switch	• Degree of Protection Test	IS-2147	NO	NO	
		• As per Standard	BS 6134	NO	NO	
12	Level Switch	Degree of Protection Test	IS-2147	NO	NO	
13	Conductivity Level Switch	Degree of Protection Test	IS-2147	NO	YES	
14	Control Valves	CV Test	ISA 75.02	YES	NO	
15	Flow Nozzles & Orifice Plate	Calibration	ASME PTC, BS-1042	YES	NO	
16	PLCs	All tests as per IEC-1131	IEC-1131			
17	LIE / LIR / Junction Box	Degree of Protection Test	IS-2147	YES	YES	
18	Flue Gas O_2	Degree of	IS-2147	NO	YES	

GENEREAL REQUIIREMENTS (INSTRUMENTS)

6.06.00 **Instrument Accuracy, Standard Scales and Ranges**

6.06.01 **Instrument Accuracy**

a) Accuracy of linear instruments shall meet the specified accuracy over its span.

b) Flow meter shall meet the specified accuracy criteria when operating between 25 and 100 percent of full-scale flow value. The accuracy guarantee shall include the effect of errors in the differential head measuring device, square root converter and signal generator.

c) Level measurement shall be linear with respect to the measured level based on a specific gravity of 1.00.

d) Wherever the measured parameter like flow is influenced by process pressure & temperature, required correction against pressure and temperature shall be introduced for such measurement.

e) Temperature compensation shall produce corrections over a flow range from 10 percent to 100 percent of maximum flow subject to a plus or minus tolerance of one-half of one percent of the maximum flow.

6.06.02 **Instrument Scale Displays**

a) All displays shall be in engineering units. Instrument scales displayed on screen shall have graduations with scale divisions based on multiples of 10. The smallest division shall preferably be a whole number approximately 1% of the scale range if not otherwise impracticable.

b) Pressure instrument shall have the unit suffixed with ‘a’ or ‘g’ to indicate absolute or gauge pressure, respectively.

c) Scales and charts of all instruments shall have linear graduations

6.06.03 **Instrument Ranges**

Unless otherwise impractical, Instrument range shall be selected in such a way so that the normal reading lies within 50% to 70% of full scale for linear parameters and within 70% to 90% of full scale for flow measurements. Deviation indicators shall have the null position at mid-scale. The normal operating parameter shall be identified with a clear green mark.

6.07.00 **Environmental Conditions**

6.07.01 Control & Instrumentation system shall be suitable for continuous operation in the environmental condition as per the project metrological data provided elsewhere in the specification and shall meet the minimum design requirement of 50°C and 95% RH.

Equipment which cannot meet the stipulated environmental condition shall be installed in air conditioned environment..

6.07.02 Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO_2 and other flue gas constituents in the plant can have deleterious effect on printed circuit board, connectors and components. This hazard shall be taken into design considerations.

6.07.03 Instruments, devices and equipment for location in outdoors/ indoor/ air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation in the operating environment and also during periods of air conditioning failure without any loss of function, or departure from the specification.

SL. NO.	LOCATION	ENCLOSURE TYPE
1.	Indoor type non- ventilated enclosure in non-hazardous area	IP-54
2.	Indoor type ventilated enclosure in non-hazardous area	IP -42
3.	Enclosure in Air conditioned area	IP-32 with suitable canopy at top to prevent ingress of dripping water.
4.	Outdoor type in non-hazardous areas	IP-65 with anticorrosion coating.
5.	Outdoor in hazardous areas	As per requirements of the NEC Code for the location

6.08.00 **Name plate**

6.08.01 Each instrument / item of plant shall have nameplate, permanently attached to it in a prominent position, made of non-hygroscopic & non-corrosive material (generally stainless steel) upon which is to be engraved as per the existing philosophy.

6.08.02 Stainless steel tag plate shall be wired to the instrument. Inscription on equipment (labels) shall be in English.

6.08.03 Caution / Danger & Hazardous name plates shall be in English, Tamil & Hindi.

7.00.00 **CODES AND STANDARDS**

7.01.00 The design, construction and testing of all equipment, facilities, components and systems shall be in accordance with standards/ codes issued by Bureau of Indian Standards (BIS) and/or equivalent international standards/ codes. A non-exhaustive list of reputed international standards is given below:

a) American National Standards Institute (ANSI)

b) American Petroleum Institute (API)

c) American Society of Mechanical Engineers (ASME)

d) American Society of Testing and Materials (ASTM)

e) American Water Works Association (AWWA)

f) American Welding Society (AWS)

g) British Standards (BS)

h) Deutsches Institut fur Normung (DIN), Germany

i) Heat Exchange Institute (HEI), USA

j) Hydraulic Institute Standards (HIS), USA

k) International Electro-technical Commission (IEC)

l) Institute of Electrical and Electronics Engineers (IEEE)

m) International Organisation for Standardization (ISO)

n) National Electric Code (NEC), USA

o) National Electrical Manufacturers Association (NEMA), USA

p) National Fire Protection Association (NFPA), USA

q) Tubular Exchanger Manufacturers Association (TEMA), USA

r) VDE association for Electrical, Electronic and Information Technologies (VDE), Germany

Other International Standards, equivalent or superior to the above Standards can also be adopted. However, in the event of any conflict between the requirements of the International standards / codes and the requirements of the BIS standards / codes, the latter shall prevail.

7.02.00 The following latest edition of codes and standards prevailing at the time of award of contract shall generally be applicable.

1) **Temperature Measurement**

a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).

b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982.

c) Temperature Measurement by electrical resistance thermometers - IS: 2806

d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760.

2) **Pressure Measurement**

a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).

b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.

3) **Flow Measurement**

a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II.

b) Measurements of fluid flow in closed conduit - BS 1042.

4) **Electronic Measuring Instruments and Control Hardware**

a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319

b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 / 1974.

c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1 / 1975.

d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).

e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC / EN 61000-4-4 & IEC / EN 61000-4-5.

f) Printed circuit boards – IPC-TM-650, IEC 326-2 & IEC 326-4.

g) General requirements and method of tests for printed wiring boards - IS-7405 (Part-I) /1994, IEC 326-2.

h) Edge socket connectors - IEC 130-11.

i) Requirements and methods of testing of wire wrap terminations-- DIN 41611 Part-2.

j) Dimensions of attachment plugs and receptacles- ANSI C73-1973.(Supplement ANSI C73a – 1980)

5) **Instrument Switches and Contacts**

a) Contact Rating - AC services NEMA ICS Part-2 125, A-600

b) Contact Rating - DC services NEMA ICS Part-2 125, N-600

6) **Enclosures**

a) Enclosures for Industrial Controls and Systems–NEMA ICS-6-110.15 through 110.22

b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972)

7) **Apparatus, Enclosures and Installation Practices in Hazardous Area**

a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978.

b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11.

c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.

d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1978.

8) **Annunciators**

a) Specifications and guides for the use of general-purpose annunciators - ISA 18.1- (1979) (R2004).

b) Surge withstands capability tests - ANSI C37.90 -1989 / IEC /EN 61000-4-4 & IEC /EN 61000-4-5.

9) **Interlocks, Protections**

a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.

b) Surge withstands capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974.

c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/1973.

10) **UPS System**

a) Practice and requirements for semi-conductor power rectifiers - ANSI C34.2.
b) Relays and relay systems associated with electrical power apparatus IEEE Standard - 3.13.

c) Surge withstands capability tests - ANSI C 70.90 A/1971, IEC-255.4.

d) Recommended practice for sizing large lead storage batteries for generating stations and sub-stations -IEEE-485.

11) **Control Valves**

a) Control valve sizing (Incompressible fluids) - ISA-S39.1 / 1972.

b) Control valve capacity test (Incompressible fluids) -ISA-S39.2 / 1972.

c) Control valve sizing (Compressible fluids) - ISA-S39.3 / 1972.

d) Control valve capacity test (Incompressible fluids) -ISA-S39.4 / 1972.

e) Control Valve seat leakage – ANSI / FCI 70.2

f) Face to face dimensions of Control Valves - ANSI B16.10

g) Control Valve Capacity Test Procedure – ISA – 575.02

12) **Instrument Tubing**

i) Seamless Carbon Steel Pipe - ASTM-A-106.

ii) Forged carbon steel fittings - ASTM-A-105.

iii) Dimensions of fittings - ANSI-B16.11.

iv) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.

v) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.

vi) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316

vii) Seamless Alloy Steel Pipe ASTM A 335 P22

viii) Seamless Stainless Steel Pipe ASTM A-312 TP 316

13) **Cables**

a) Thermocouple extension wires / cables - ANSI MC96.1.

b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402

c) Guide for design and installation of cable system in power generating station (insulation, jacket materials)-IEEE Standard 422.

d) Requirements of vertical tray flame test - IEEE 383

e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33.

f) Specification for PVC insulated (heavy duty) electric cables or (Latest revision) equivalent - IS-1554 Part-1

g) Conductors for insulated electric cables and flexible cords or equivalent - IS-8130, 1984

h) PVC insulation and sheath of electric cables or equivalent - IS-5831

i) PVC insulated cables for working voltage upto and including 1100 volts or equivalent - IS-694 (Latest)

j) Mild steel wires, formed wired and tapes for armouring of cable or equivalent - IS-3975

k) Test on single vertical insulated wire or cable - IEC 332 (Part-1)

l) Swedish Chimney Flame Test - SS 424-1475

m) Test methods for insulations and sheaths of electric cables and cords - IEC 540

n) Colour coding of instrumentation cables - VDE 0815

o) Minimum oxygen concentration to support candle-like combustion of plastics - ASTM D2863

p) Density of smoke from the burning of decomposition of plastics - ASTM D2843

q) Test on gases evolved during combustion of materials from cables - IEC 754

r) Determination of the amount of halogen acid gas - IEC 754 (Part-1)

s) Methods of test for cables - IS 10810

t) Drums for electric cables - IS: 10418

14) **Electronic Cards, Subassemblies and Components**

a) **Unpackaged**

i)	Vibration	:	IEC-68.2.6
ii)	Shock	:	IEC-68.2.27
iii)	Drop & Topple	:	IEC-68.2.31

b) **Packaged**

Vibration, Drop & Static Compression - NSTA.

c) **Electromagnetic Compatibility / Immunity**

i)	Electrical Fast Transient immunity	:	IEC / EN 61000-4-4
ii)	Surge Immunity	:	IEC /EN 61000-4-5
iii)	Radiated Electromagnetic Field	:	EN 61000-4-3
iv)	Electrostatic Discharge immunity	:	EN 61000-4-2
v)	Electromagnetic Emissions	:	VDE 0871, Class-B

15) **Cable Trays, Conduits**

a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits)- IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979.

b) Galvanizing of carbon steel cable trays - ASTM A-386.

VOLUME : II-E

SECTION-III

INSTRUMENTATION AND CONTROL SYSTEM

1.00.00 FIELD INSTRUMENTS

This section provides general guidelines for field instruments, systems and equipment to be supplied under this specification, **as applicable for the Bidder's Scope of Work** for completeness of C&I system. All measuring instruments / equipment and systems / sub-systems offered by Bidder shall be from reputed experienced manufacturer of specified type and range of equipment, whose guaranteed and trouble free operation has been established. All instruments / equipment shall be of proven reliability, accuracy, repeatability requiring a minimum of maintenance and comply with the acceptable international standards. All instruments / equipment and accessories shall be supplied as per technical specifications, ranges, make as approved by Owner / Consultant.

All local gauges as well as transmitters, sensors, and switches for parameters like pressure, temperature, level, flow etc. and vibration transmitters as required shall be provided. In general, transmitters shall be provided for remote monitoring, alarm, interlock and control. Use of process actuated switches shall be avoided as far as possible unless the same is required as per manufacturer's standard & proven practice.

All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified.

For all instruments envisaged for corrosive liquid applications, they shall be provided with wetted parts made of Monel / Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by Contractor).

All instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments. Anti-corrosive paint shall be applied to the field mounted enclosures / instruments.

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

1.02.00 **Ultrasonic Level Transmitter**

01.		Principle of operation	:	Detection of reflected ultrasonic pulse

02.	Signal processing	:	Microprocessor Controlled Signal Processing
03.	Type	:	Smart
04.	Display	:	Large alpha-numeric back lit LCD/LED
05.	Calibration & configuration:		Accessible from front of panel
06.	Diagnostic	:	On-line
07.	Status	:	For power, Hi / Lo / V. Hi / V. Lo-level indication, fault etc.
08.	Construction	:	Plug-on board
09.	Power supply	:	240 V AC 50 Hz / 24V DC
10.	Signal Output	:	4-20 mA DC (isolated) - 600 Ohm load with HART protocol.
11.	Hysteresis	:	Fully adjustable preferred
12.	Output contacts	:	2SPDT Potential free changeover contacts @ 5A 230V AC.
13.	Accuracy & Repeatability	:	0.25% of span or better
14.	Resolution	:	0.1% of span
15.	Operating temp.	:	Transmitter-55 o C and Sensor – 80 o C
16.	MOC Sensor	:	SS 316 in general / PTFE, PP for corrosive application.
17.	Humidity	:	1% to 95% non condensing.
18.	Enclosure	:	IP-65 powder coated die cast aluminium
19.	Cable connection	:	½” NPT with cable gland
20.	Mounting	:	2” flanged for sensor and Transmitter on panel / surface.
21.	Accessories	:	Cable gland, prefab cable, mounting accessories.

Note : Sensors and transmitter shall be separately mounted.

1.03.00 **Radar type Level Measurement**

01.	Type	:	Radar based on Time Domain Reflectometry / Pulse / FMCW as per application	
02.	Antenna	:	Co axial / single rod type guided wave or Horn type as required for the application	
03.	Communication	:	Two wire 4-20mA DC, HART protocol	
04.	Enclosure	:	Explosion proof /IP 65 as per application	
05.	Cable Entry	:	½" NPT	
06.	Calibration	:	a)	Self calibration with internal reference
			b)	Zero & Span calibration
07.	Programming	:	Handheld programmer & Local keypad	
08.	Process Connection	:	Flanged /screwed	
09.	Electronic Housing	:	Epoxy painted Die-Cast aluminium alloy	
10.	Antenna / Flange assembly:		316 SS or Hestalloy (as required)	
11.	Output Indicator	:	Digital Integral Display	
12.	Accuracy	:	5 mm or 0.1% of probe length	
13.	Accessories	:	a)	Programming tool kit, if required
			b)	Gasket

1.04.00 **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

1.05.00 **Pressure Switch and Differential Pressure Switch**

01.	Type	:	a)	Piston for high pressure application
			b)	Bellow / Diaphragm for low pressure application
02.	Sensing element material	:	AISI SS-316. All other wetted part SS316.	
03.	Case Material	:	Epoxy coated Die-cast aluminum alloy with neoprene gasket.	
04.	Setter Scale	:	Required.	
05.	Over range	:	150% of maximum pressure	
06.	Adjustments	:	Internal Set Point adjustable over span	
07.	Process Connection	:	1/2" NPT (M) bottom connected	
08.	Switch configuration	:	One DPDT (Two SPDT)	
09.	Switch Rating	:	240V, 5A AC/220V, 0.5A DC	
10.	Switch Type	:	Snap acting, shock & vibration proof	
11.	Terminal Block	:	Suitable for full ring lugs for cable connection.	
12.	Cable connection	:	½" NPT conduit connection or compression gland.	
13.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area).	
14.	Performance	:	Repeat accuracy ±1.0%	
15.	Nameplate	:	Tag number, service engraved in stainless steel tag plate	
16.	Accessories	:	a)	Remote diaphragm seal with SS-316 capillary for viscous &corrosive application. MOC of seal material shall be as per process fluid requirement.
			b)	Retention ring and screws for surface mounting.

c) 1/2" NPT 2 Valve SS-316 manifold constructed from bar stock for pressure switch

d) 1/2" NPT 3-Valve SS-316 manifold constructed from bar stock for DP switch

e) ½" NPT cable gland

1.06.00 **Level Switch**

1.06.01 **Type-1**

a)	Type	:	External cage float operated, magnetically coupled
b)	Float material	:	AISI 316 stainless steel
c)	External cage & other wetted part	:	AISI 316 stainless steel
d)	External cage mounting	:	Side Side, on standpipe
e)	External cage connection	:	1" Flanged
f)	Switch housing	:	Epoxy coated die cast aluminum alloy with neoprene gasket conforming to IP-65.
g)	Enclosure class	:	IP 65
h)	Type of switch	:	Snap acting magnetically operated
i)	Switch configuration	:	1DPDT
j)	Contact rating	:	5A, 240VAC / 0.25A, 220V DC
k)	Accessories	:	Counter flange, nuts & bolts, suitable gasket etc. Globe type Drain Valve. ½"NPT cable gland
l)	Application	:	Clean & non acidic fluid application in over ground tanks

1.06.02 **Type-2**

a)	Type	:	Float operated, magnetically coupled

b)	Float material	:	Polypropylene
c)	Housing	:	Polypropylene
d)	Mounting	:	Side mounted.
e)	Process connection	:	1/2” NPT (F) / Flanged
f)	Switch type	:	1 DPDT
g)	Enclosure class	:	IP 65
h)	Contact rating	:	5A, 240VAC/ 0.25A, 220V DC
i)	Cable meters (minimum)	:	Integral FRLS PVC stranded copper (5
j)	Application	:	Acid application in over ground tank

1.06.03 **Type-3**

01	Type	:	Capacitance type
02	Probe	:	a) Rod or suspended electrode b) Rope type probes may be used only where required probe length is greater than 1.5 meters. c) Reference rod for non grounded tank.
03.	Probe Mounting	:	1-1/2” Flanged
04.	Material of construction	:	316 SS and to suit fluid type
05.	Insulation	:	PTFE / PP / Kynar Part / Full as required
06.	Enclosure	:	Powder coated Die cast aluminium with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
07.	Mounting	:	Probe on tap, switch unit separate on surface
08.	Supply voltage	:	240V AC ±10%, 50Hz / 24V DC±10%,
09.	Relay output	:	2 SPDT
10.	Contact rating	:	5A min. at 240V AC on resistive load

11.	Response time	:	100 msec or better
12.	Cable connection	:	½" NPT with cable gland
13.	Accessories	:	Counter flange, cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric. Diagnostic & status LED on front of enclosure.

1.06.04 **Type-4**

a)	Type	:	Non-contact Ultrasonic type
b)	Signal processing	:	Microprocessor Controlled
c)	Display	:	Large alpha-numeric back lit LCD / LED
d)	Calibration & configuration	:	Accessible from front panel
e)	Diagnostic	:	On-line
f)	Status	:	For power, Hi / Lo / V. Hi / V. Lo-level indication, fault etc.
g)	Construction	:	Plug-on board
h)	Power supply	:	240 V AC 50 Hz / 24V DC (UPS supply)
i)	Hysteresis	:	Fully adjustable
j)	Output contacts	:	Potential free changeover contacts @ 5A 230V AC.
k)	Repeatability	:	0.25% of span or better
l)	Operating temp.	:	Transmitter-55^{o} C and Sensor- 80^{o} C
m)	MOC Sensor	:	SS 316 in general. PTFE, PP for corrosive application.
n)	Humidity	:	95% non-condensing.
o)	Enclosure	:	IP-65 powder coated die cast aluminum
p)	Cable connection	:	½" NPT with cable gland
q)	Mounting	:	2" flanged

r)	Accessories	:	Cable gland, mounting accessories.
s)	Application	:	Sludge pits and overhead tanks containing slurry, viscous and dirty fluid like slaked lime, lime preparation tank etc.

1.07.00 **Gauge Glass**

01.	Type	:	Reflex or transparent. Resistant to mechanical shocks by steel armour.
02.	Glass	:	Toughened borosilicate
03.	Body material	:	forged Carbon steel / stainless steel as per process requirements
04.	End connection	:	As per ASME PTC and drain /vent valve 15NB
05.	Accuracy	:	± 2%
06.	Pressure rating	:	Twice the maximum working pressure
07.	Scale	:	Linear vertical
08.	Range selection	:	Covers 125% of max. of scale
09.	Test Pressure	:	1.5 times to the max. design pressure at 38°C
10.	Housing	:	CS /304SS
11.	Accessories	:	SS Ball check valves, gaskets, companion flange, SS drain and vent valve, nuts & bolts etc.

1.08.00 **Sight Glass**

01.	Type		:	Flap-type
02.	End connection		:	Screwed / Flanged
03.	Material :			
	a)	Body	:	SS-304
	b)	Cover Plate	:	SS-304
	c)	Indicator	:	SS-316
04.	Sight Glass		:	Toughened Borosilicate

	05.	Gasket	:	Neoprene
	06.	Bolts & Nuts	:	High tensile steel
	07.	Hydraulic Test Pressure	:	1.5 times maximum working pressure
	08.	Accessories	:	As required

1.09.00 **Temperature Gauge**

	01.	Type	:	Bimetallic & all angle tiltable
	02.	Sensing Element Material	:	Bimetal strip helix
	03.	Stem Diameter	:	1/4”
	04.	Stem Material	:	AISI 304
	05.	Thermometer connection to well	:	½” NPT / SS 304
	06.	Case Material	:	Sturdy, corrosion resistant series 304 stainless steel case and bezel.
	07.	Dial Size	:	5” in general
	08.	Scale	:	Anti parallax heavy gauge aluminum with white matte finish glare free. Black lettering on white background.
	09.	Pointer	:	Balanced, lightweight aluminum with matte black finish.
	10.	Dampener	:	Dampening pointer oscillation
	11.	Mounting	:	Surface with adjustable angle.
	12.	Over range Protection	:	150% of range or more
	13.	Dial connection	:	Back connection with stem
	14.	Range	:	Normal temperature – 50 ~ 70% of range approximately.
	15.	Zero adjuster	:	Adjustable screw at back.
	16.	Window	:	Shatterproof glass.
	17.	Accuracy	:	±1 % or better (Grade A / ASME B40.3)

18.	Enclosure Class	:	IP-65		
19.	Accessories	:	a)	Forged/bar stock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M).	
				Material of construction of Thermowell:	
				- SS 316: In general	
				- Inconel: For flue gas application	
				- Tungsten carbide: For lignite mill application.	
				Bidder shall provide Wake frequency calculation for thermowell as per ASME PTC 19.3 (latest edition).	
			b)	Installation accessories as required.	
20.	Nameplate	:	Tag number, service engraved in stainless steel tag plate		

1.10.00 **Thermocouples**

01.	Type	:	a)	Type-K (Chromel-Alumel)	
			b)	Duplex	
			c)	Ungrounded	
02.	Wire gauge	:	16 AWG for Type-K		
03.	Standard	:	ANSI-MC 96.1 for thermocouple		
04.	Protecting Tube :-				
	a) O.D.	:	8 mm		
	b) Material	:	316-SS Seamless		
	c) Filling	:	Magnesium Oxide (Purity above 99.4%)		

05.	Characteristics	:	Linear with respect to temperature within ± ½% of top range value	
06.	Accuracy	:	As per IEC 751 / ANSI MC 96.1 (special class)	
07.	Head	:		
a)	Type	:	IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area)	
b)	Material	:	Epoxy coated Die cast aluminum or better	
c)	Terminal blocks	:	Nickel plated Brass - screw type/ silver plated	
d)	Instrument connection to well	:	½" NPT	
e)	Cable connection	:	½" NPT gland and grommet.	
f)	Others	:	Terminal head cover with SS chain and suitable gasket	
08.	Accessories	:	a)	Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection
			b)	Compression fittings/unions
			c)	Flanges etc. (for flanged connections only)
			d)	Forged/bar stock thermowell as per ASME PTC 19.3 code. Process connection M 33X2 (M) in general or 1½" Flanged for Flue gas/ /Air etc. application.
			e)	Material of construction of Thermowell: - SS 316: In general - Inconel: For flue gas application Bidder shall provide Wake frequency calculation for thermowell as per ASME PTC 19.3 (latest edition).

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

Notes:

1. Extension cable exposed to atmosphere in the conventional method melts away due to high temperature, at the top of mill or due to lignite burning. Hence the terminals of temperature sensors shall not be at the top of mills itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

2. Thermocouples provided for steam services like MS temp, HRH, CRH, Turbine metal temp, super heater / de super heater area, where the process pipe is inside the insulation of boiler penthouse, Thermowells are inaccessible and terminal head and connecting cable cannot withstand high temperature, for such services thermocouples shall be provided with flexible extension SS316 Sheath of 10-15 meters.

1.11.00 **Resistance Temperature Detector**

01.	Type	:	Platinum (Duplex), Ungrounded
02.	Resistance	:	100 ohm at 0 degC
03.	Base	:	Wound on ceramic (anti-inductive)
04.	Wiring	:	3 /4 Wire
05.	Protecting Tube	:	
a)	O.D.	:	8 mm
b)	Material	:	SS-316, Seamless
c)	Filling	:	Magnesium oxide (Purity above 99.4%).
06.	Calibration	:	DIN 43760 Class A
07.	Characteristics	:	Linear with respect to temperature within ± ½% of top range value
08.	Head :		
a)	Type	:	IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area)
b)	Material	:	Epoxy coated Die cast aluminum or better
c)	Terminal blocks	:	Nickel plated Brass-screw type / silver plated

d)	Cable connection	:	½" NPT gland and grommet.	
e)	Instrument connection to well	:	½" NPT	
f)	Others	:	Terminal head cover with SS chain and suitable gasket	
09.	Accessories	:	a)	Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection
			b)	Compression fittings/unions
			c)	Flanges etc. (for flanged connections only)
			d)	Forged/bar stock thermowell as per ASME PTC 19.3 code. Process connection M33X2 (M).
			e)	Material of construction of Thermowell:
				SS 316: In general
10.	Nameplate	:	Tag number, service engraved in stainless steel tag plate	

Notes: The specifications for RTDs of winding/ bearings of motor/ pump can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, the type of RTD shall be PT100.

1.12.00 **Field Mounted Temperature Transmitters**

01. Working Principle	:	Smart
02. Type	:	Two wire
03. Input	:	Thermocouple K and RTD (Pt 100)-3/4 wire
04. Isolation	:	500V AC
05. Output Signal	:	Simultaneous transmission of digital and 4-20 mA DC signal. HART protocol.
06. Signal Processing Circuitry	:	Microprocessor based Solid State Electronic

07.	Span and Zero	:	Adjustable in field, Non-interacting facility for elevation and suppression of zero.
08.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
09.	Output Indicator	:	LCD type
10.	Span Adjustability	:	Yes
11.	Nameplate	:	Tag number to be engraved on metallic tag plate rigidly fixed to the body.
12.	Body	:	Die Cast aluminum
13.	Operating Voltage	:	16-48 V dc
14.	Load	:	600 Ohms at 24V DC (Min.)
15.	Performance		
	a) Accuracy	:	0.4% of span
	b) Repeatability	:	±0.05% of span
	c) Cold Junction Compensation	:	Built-in
	d) Calibration	:	As per N.I.S.T Monograph 125 for T/C and European Curve Alpha = 0.00385 for RTD
16.	Accessories	:	a) Universal mounting bracket suitable for pipe and surface mounting.
			b) Hi-tensile Carbon Steel U-bolts.
			c) ½" NPT cable gland

1.13.00 **Temperature Switch**

01.	Type	:	Bimetallic / gas filled-in
02.	Stem /Bulb Material	:	AISI SS-316
03.	Capillary	:	SS Capillary & Flexible armour

04.	Case material	:	Epoxy coated die-cast aluminum alloy with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
05.	Over range Protection	:	120%
06.	Instrument connection	:	Bottom
07.	Setter Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.
08.	Switch configuration	:	One DPDT (Two SPDT)
09.	Switch rating	:	240V, 5A AC/220V, 0.5A DC
10.	Switch type	:	Snap acting, shock and vibration-proof.
11.	Adjustability	:	Internal Set point adjustable over span
12.	Cable connection	:	½" NPT conduit connection or compression gland.
13.	Compensation	:	a) Capillary compensation with invar wire throughout the capillary length. b) Case compensation
14.	Performance	:	
	a) Repeatability	:	< 1 % of full range
15.	Capillary length	:	3 meters (minimum)
16.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
17.	Accessories	:	a) Forged thermowell, Mounting accessories, b) ½" NPT cable gland. c) Material of construction of Thermowell: SS 316 : In general Standard : ASME PTC 19.3

1.14.00 Not used.

1.15.00 **Instrument Air System**

The instrument Air Supply System for various pneumatic Control & Instrumentation devices like pneumatic actuators, power cylinders, I/P converters, pneumatically operated valves etc. shall be complete in all respect with necessary Air Filter Regulators, valves, piping/tubing etc. Each pneumatic instrument shall have an individual air shut off valve. The pressure-regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built in filter-housing blow down valve.

Filter shall be of minimum 5-micron size & sintered bronze material.

1.15.01 **Air Filter Regulator**

01.	Filter Element	:	Sintered Bronze
02.	Filter Size	:	5 microns
03.	Input Air	:	10.0 Kg/Sq. cm (maximum)
04.	Output	:	Adjustable from 0-2.5 Kg / Sq. cm and 0-7.0 Kg / Sq. cm (continuous) as applicable.
05.	Effect of Supply	:	Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm
06.	Bowl Material	:	Metallic.
07.	Accessories	:	2" dial size output pressure gauge
08.	Feature	:	No perceptible drop of pressure on opening the drain port.

1.15.02 **Power Cylinders (Pneumatic)**

01.	Mounting Type	:	a)	Fixed position mounting (End mounting).
			b)	True union mounting
02.	Control Signal	:	4-20 mA DC for modulating purposes. 24V DC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive.
03.	Supply Air	:	0-7 Kg / Cm^2.

04.	Selection	:	Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation.
05.	Casing	:	IP-55.
06.	Accessories	:	a) Air lock relay b) Hand wheel. c) Air filter regulator with gauge. d) Volume Booster. e) Limit Switches. f) Smart Positioner with Input and Output pressure gauges, local keypad & display. g) Solenoid Valve h) Integral non contact type position Transmitter (4-20 mA DC linear output). i) Junction box with cable gland
07.	Fail-safe operation	:	For regulating duty- stay put / Fail safe position against power & air fail.
08.	Repeatability	:	Better than 0.5% of full travel.
09.	Hysterisis	:	Less than ±1% of full travel
10.	Travel time	:	Better than 20 sec.
11.	Operating Temp. limit	:	80°C (min.)

1.15.03 **Electric to Pneumatic (E/P) Converters**

01.	Air Supply	:	1.5 kg/cm^2
02.	Max. supply Pressure	:	7 kg/cm^2
03.	Input Signal	:	4-20 mA DC (as required by the design of control system).
04.	Output Signal	:	0.2 to 1.0 kg/cm^2

05.	Control Action	:	Air to Close, Air to Open and Fail freeze-field selectable.
06.	Response Time	:	5 seconds for 0 to 90% output pressure
07.	Repeatability	:	+/- 0.1% span typical
08.	Accuracy	:	+/- 0.25% span typical
09.	Linearity	:	0.5% of span or better
10.	Hysteresis	:	0.1% of span or better
11.	Ambient Temp. effect	:	Less than 0.02% of span per ºC between -20 ºC to +60 ºC
12.	Supply pressure effect	:	Less than 1%
13.	Span and zero adjustment:		Screw
14.	Mounting	:	Close to Actuator (but not on the actuator)
15.	Output Capacity	:	To suit the actuator
16.	Protection Class	:	IP 65
17.	Allowable Drift Rate	:	± 2% of set point / hour maximum

On loss of control signal, the last set point pressure shall be maintained so that the associated control valve remains in stay put condition.

1.15.04 **Smart positioner**

01.	Type	:	Universal design (linear or rotary application)
02.	Input Signal	:	4-20mA DC, 2 wire loop with 24V DC.
03.	Output Signal (position F/B)	:	i) 4-20mA with HART Protocol ii) Configurable end position switch
04.	Supply Pressure	:	Single acting 1.2 to 7.0 bar Double acting 1.2 to 10.5 bar
05.	Air Delivery	:	Single acting 10.0 SCFM at 2.1 bar supply

			Double acting7.2 SCFM at 2.1 bar supply
. 06.	Housing	:	IP 65
07.	Repeatability	:	+/- 0.3% of span or better
08.	Accuracy	:	+/- 0.1% of span or better
09.	Communication	:	Hart protocol
10.	Power-up with position control	:	< 150 ms or better
11	Power interruption without Reset	:	<100ms or better
12. Body Material		:	Aluminium
13. Response Time		:	Less than 10 sec
14. Features		:	i) Noncontact position feedback sensor
			ii) Integral Electro-Pneumatic convertor
			iii) Self calibration with tunable response time
			iv) Online diagnostics
			v) Pressure gauges to be provided on positioner (I/P & O/P pressure)

1.15.05 **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.

1.15.06 **Air Lock Relay**

01.	Type	:	Single acting with actuator (spring return) and double acting with double acting piston cylinder
02.	Max. supply Pressure	:	7 kg/cm^2
03.	Set Pressure	:	1.4 ~ 7 kg/cm^2
04.	Ambient Temperature	:	-5 to 60°C
05.	Port Size	:	¼" NPT(F)

1.15.07 **Position Limit Switch**

01.	Type	:	Proximity type
02.	Temperature Range	:	-25 to 85°C
03.	Protection Class	:	IP-65

	04.	Switch configuration	:	2 SPDT
	05.	Contact rating	:	5A min. at 240V AC on resistive load

1.16.00 **Flow Elements**

1.16.01 **Orifice Plate**

	01.	Application	:	Low fluid velocity flow measurement
	02.	Design Standard	:	Concentric as per ASME PTC 19.5 (part-II), ISA RP-3.2 or BS-1042, Part-I
	03.	Tapings	:	Flanged weld neck. No. as required plus one additional pair of taps
	04.	Diameter Ratio	:	Between 0.4 to 0.7
	05.	Plate material	:	Stainless steel or better
	06.	Thickness	:	3 mm for main pipe diameter upto 250 mm, 6 mm for main pipe diameter above 250 mm and 10 mm for main pipe diameter of 500 mm and above.
	07.	Meter run pipe	:	Same as main pipe material
	08.	Root valve	:	Globe type, Body same as main pipe material, trim ss or better
	09.	Impulse pipe	:	Same material as main pipe upto root valve
	10.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
	11.	Accessories	:	Flanges, gaskets, nuts & bolts, root valves jack screw, meter run pipe, Drain & vent hole as per application etc.

1.16.02 **Flow Nozzle**

	01.	Application	:	High fluid velocity flow measurement
	02.	Design Standard	:	Long radius, welded type as per ASME PTC 19.5 (Part-III) or BS – 1042
	03.	Number of Tapings	:	As required plus one additional pair of taps

2.00.00 CONTROL PANEL / DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES (As applicable)

2.01.00 Push Button

01.	Type	:	Shrouded square format
02.	Face Dimension	:	32 x 32 mm (maximum)
03.	Contact Configuration	:	2 NO + 2 NC
04.	Contact Addition	:	Add-on block up to 4 each with 2 pairs of contacts
05.	Contact Material	:	Hard Silver Alloy
06.	Contact Rating	:	500V / 10 A
07.	Utilization Category	:	AC11 / DC11
08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth
09.	Mechanical Life	:	1 million operations
10.	Construction	:	Aluminum shrouding with plastic lens
11.	Colors	:	Red, Green, Yellow, Black, etc.
12.	Connection	:	Screw terminals
13.	Enclosure Class	:	IP-52
14.	Legend	:	Engraving

2.02.00 Illuminated Push Button

01.	Type	:	Square format
02.	Face Dimension	:	32 x 32 mm (maximum)
03.	Contact Configuration	:	2 NO + 2 NC (minimum)
04.	Contact Addition	:	Add-on-Block up to 4 each with 2 pairs of contacts
05.	Contact Material	:	Hard Silver Alloy
06.	Contact Rating	:	500 V/ 10A

	07.	Utilization Category	:	A C11 / DC11
	08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth
	09.	Mechanical Life	:	1 Million Operations
	10.	Lamp	:	LED with built-in resistors as required
	11.	Lamp Rating :-		
		a) Voltage	:	240 V AC /24V DC
		b) Watt	:	0.5 Watt (approx)
	12.	Lamp and Lens		
		Replacement	:	From front
	13.	Construction	:	Transparent Plastic Lens
	14.	Color	:	Red, Green, Amber, Yellow etc.
	15.	Connection	:	Screw terminals
	16.	Enclosure Class	:	IP-52
	17.	Legend	:	Engraving
	18.	MTBF lamp	:	100000 hours

2.03.00 **Selector Switch**

	01.	Type	:	2/3/4 position stay put type with rotary lever actuator.
	02.	Face Dimension	:	32 x 32 mm (maximum)
	03.	Contact Configuration	:	4 pair of contacts
	04.	Contact Addition	:	Add-on-Block up to 4 each with 2 pairs of contact
	05.	Contact Material	:	Hard silver Alloy
	06.	Contact Rating	:	500 V/10 A
	07.	Utilization Category	:	AC11 / DC11
	08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth

	09.	Mechanical Life	:	1 million operations
	10.	Construction	:	Aluminum shrouding
	11.	Connection	:	Screw terminals
	12.	Enclosure Class	:	IP-52

2.04.00 **Indicating Lamp**

	01.	Type	:	LED with built-in resistor
	02.	Face Dimension	:	32 x 32 mm (maximum)
	03.	Voltage	:	240 V AC / 24V DC
	04.	Watt	:	0.5 Watt (approximate)
	05.	Lamp and Lens Replacement	:	From front
	06.	Construction	:	Transparent Plastic lens
	07.	Color	:	Red, Green, Amber, Yellow etc.
	08.	Connection	:	Screw terminals
	09.	Legend	:	Engraving
	10.	MTBF	:	100000 hours

3.00.00 **CONTROL VALVES, ACTUATORS & ACCESSORIES**

3.01.00 **General Requirements**

3.01.01 Control Valves and accessories furnished by the Bidder shall be designed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, ASME Boiler and pressure vessel code, Indian Boiler Regulation (IBR), ISA and other standards as specified elsewhere as well as in accordance with the applicable requirements of the “Federal Occupational Safety and Health Standards, USA” or acceptable equal standards.

All the control valves, their actuators and accessories to be furnished under this section shall be fully suitable and compatible with the services covered under the specification.

3.02.00 **Control Valve Sizing and Construction**

3.07.00 **Control Valve Accessory Devices**

All pneumatic actuated control valve accessories such as air locks, hand wheels / hand-jacks, Non-contact type limit switches, microprocessor based smart electronic Positioners, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements. For further details please refer clause no. 1.32.00 of this section of the specification.

3.08.00 **Tests**

All valves shall be tested in accordance with the Quality Assurance Programme (QAP). Bidder shall submit QAP for Owner's approval. The tests shall include but not be limited to the following :

a) Non destructive test as per ANSI B 16.34.

b) Hydrostatic shell test as per ANSI B 16.34 prior to seat leakage test.

c) Valve closure test and seat leakage test as per ANSI B 16.34 and as per the leakage class

d) Functional Tests: The fully assembled valves with actuator and all accessories shall be functionally tested to demonstrate from open to close position and vice versa. Valve lift shall be checked at 5 points at 0, 25, 50, 75 and 100% in both the directions with increasing and decreasing inputs. Performance of the valve with Positioner shall be as follows :

   i) Linearity : +/- 1%
   ii) Hysteresis : +/- 1%
   iii) Sensitivity : +/- 0.5%
   iv) Deadband : +/- 1%
   v) Reproducibility : 0.3% of total stroke
   vi) Overall accuracy : +/- 1%

e) CV test: CV test shall be carried out as type test on each size, type and design of the valves as per ISA 75.02 standard and test report shall be submitted for Owner's approval.

4.00.00 **CONTROL DESK / PANEL / RACK / ENCLOSURE**

4.01.00 **General**

a) All control desks, panels, system cabinets, local panels and local instrument enclosures, racks shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, grounding, ventilation, space heating, anti-vibration pads, internal piping, detachable lifting hook and accessories as per IS:5039-1969 as required for completeness of the system.

b) Convenient and logical approach to operational interfaces and to enhance aesthetics in the overall view of the panel / desk shall be considered.

c) All panels, desks, cabinets shall be free standing type and have bottom entry for cables unless otherwise specified. The bottom of desks, panels, cabinets, enclosures shall be sealed with bottom plate, compression cable glands and fire proof sealing material to prevent ingress of dust and propagation of fire. Thickness of gland plate shall not be less than 3 mm.

d) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the steel plate shall conform to the requirements of UL 50 or equivalent standard. Panels and cabinets shall be of adequate strength to support mounted components and to support a concentrated load of 100 Kilograms on their top after erection.

e) For items susceptible to vibration, suitable rubber gaskets or padding shall be provided to prevent damage or malfunction.

f) All electronic system cabinets shall be designed for 50°C operating under maximum ambient temperature without air conditioning system in service. Further cabinets, panels shall be so designed that temperature rise due to heat load does not exceed 10°C above ambient temperature under all operating conditions. Necessary louvers, fans, limited packing density, adequate spacing between instruments, devices etc. shall be provided to maintain temperature rise within permissible limits.

g) Desk, panels, cabinets enclosures wiring and piping shall be arranged to enable the removal of instruments and devices without unduly disturbing them.

h) All panels, desks, enclosures interiors shall be illuminated with rapid start fluorescent strip fixtures with door actuated switches. Door switch terminals shall be shrouded. All illuminated lights shall be provided with individual switch in parallel with door switch.

i) Sufficient number of power receptacles with disconnect switches shall be installed within panels, desks, enclosure and racks.

j) The local instrument enclosures / racks shall be provided locally for mounting of electronic transmitters and switches, etc.

k) All panels, desks, cabinets shall be properly grounded. The grounding scheme shall be as approved by the Owner / Consultant.

l) Exterior steel surface shall be sand blasted, ground smooth, filled, primed, sanded and smooth enamel painted to give a good finish subject to minimum paint thickness of 65-75 microns for sheet thickness of 3 mm and 50 microns for sheet thickness of 2mm. Minimum 2 coats of primer and two sprays of final finish colour shall be applied to all surfaces.

m) The colour of the panels shall be glossy white with fire resistant paint in the panel interior. External colour of the panels shall be as light grey RAL 7032 for other system cabinets, etc.

n) Panel / cabinet shall have detachable type eyebolt on top for lifting.

o) Panel shall be provided with three point latch and lock.

p) Pocket shall be provided on the inner side of panel doors for keeping drawings & documents.

q) Nameplates on the panel and terminal blocks shall be provided.

r) All items like MCB, Terminals, instruments, lamps etc. inside the panels / cabinets shall be neatly arranged with easy access/ maintenance approach to avoid undue disturbing the wiring.

s) Power supply feeders shall be double so that a single failure shall not affect the operation of the system. Required isolation & protection through MCB shall be provided in all cases. Alarm shall be provided against failure of a single power supply.

t) Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. All panel mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.

4.02.00 **Surface Preparation and Painting**

All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below:

a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.

Two spray coats of epoxy primer shall be applied to all exterior and interior surfaces, each coat of primer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil.

b) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.

c) Colour shade for the control desk shall be finalized during detailed engineering.

4.03.00 **Wiring**

All control and instrument wiring used within the panels shall conform to NEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Features shall not be limited to the following:

a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All interconnections between sections of panels / desks shall be furnished.

b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification.

c) All wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Wires shall not be looped around the terminal screws or studs.

d) Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.

e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt or mA shall be electrically and physically isolated from other high voltage AC and DC wiring.

f) Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.

g) Where pre-fabricated cables are used for direct connection to electronic cubicles plug-in type connectors shall be used.

h) Shield wires of field signal cables shall be terminated on separate earthed terminals at panel end.

i) Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings shall not cause fatigue failure of the conductor.

j) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without unduly disturbing the wiring. No wire shall be routed across the face or rear of any device in a manner, which shall impede the opening of covers or obstruct access to leads, terminals or devices.

k) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 110V AC, 240V AC, 220V DC etc.

l) Wire shall be multi-stranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.

m) Conductor sizes used for internal wiring shall not be lower than the followings:

i)	Power supply / receptacle / illumination wiring	:	2.5 sq. mm or higher as per load.
ii)	4-20mA DC current and low voltage signal upto 48V DC	:	0.5 Sq. mm

n) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.

o) 20% spare conductor shall be provided in the field cable for future use.

4.04.00 **Grounding**

a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.

b) All panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 6 mm cross section, extending along the entire length of the panel / desk / cabinet assembly. This signal ground bus shall be bolted to the panel structure on the insulated post. All shield wires shall be connected to this bus for onward connection to the earth pit. System DC power ground shall also be connected to the earth pit in similar way.

c) The panel /desk /enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI / copper flat ground riser or by means of insulated copper ground cable of required cross section with lug for protection ground.

d) Each circuit requiring grounding shall be individually and directly connected to the panel ground bus.

e) Signal cable shields shall be grounded at the panel end only and shall never be left open. The ground in between panels of a shipping section shall be firmly looped.

f) Manufacturer recommendation and scheme shall be followed for all system panel grounding.

g) Electrical transmitters and switching devices, operating at a voltage less than 50V shall be grounded through the steel structure.

4.05.00 **Miniature Circuit Breakers (MCB)**

MCB shall be used for protection and isolation of logic circuit and power distribution circuit.

4.06.00 **Fuse Blocks**

Where fuse blocks are required by the specifications or the manufacturer's design, they shall be modular type with bakelite frame and reinforced retaining clips. Blocks shall be class H.2 pole, screw terminal fuse blocks. Blocks for other current and voltage ratings shall be similar in construction.

4.07.00 **Fuses**

Where slow blow fuses are required for protection of instruments /devices they shall have ampere ratings of 1/4, 1/2, 1 or 2. Where fast acting fuses are required for protection of equipment they shall have ampere ratings of 1, 3, 6, 10, 15, 20 or 30. Indicating fuses or blocks to quickly identify a failed fuse shall be provided to the extent possible.

4.08.00 **Terminal Blocks**

a) Terminals shall be chromated galvanized DIN rail mounted screw less cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm^2. Terminal blocks shall conform to IEC 947-7-1.

b) The characteristics of the terminal blocks shall be as follows.

i) High contact force, independent of conductor cross-section and large contact surface area.

ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.

iii) Inspection and maintenance free (resistant to thermal aging and vibration)

iv) Low and constant voltage drop

c) Material of the clamping yoke of screwed terminals shall be electroplated, chromated, case hardened steel with high strength clamping screw. For screw less terminals, the tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass.

d) Terminals shall be of non-flammable suitable thermoplastic material such as polyamide.

e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block. Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.

f) Terminal blocks shall be provided with white marking strips / self-adhesive marker cards. Power terminals shall have protection covers.

g) At least 20 percent spare unwired terminals shall be provided for all panels /cabinets /desks /junction box etc. This shall be in addition to spare wired terminals of spare IO channels and wired spare modules.

h) For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.

i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.

j) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.

k) The terminals for DCS / PLC input /output connections to SWGR / MCC, actuator starter, solenoid valves etc. shall be provided with built in test and disconnect facilities to permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections. Technical detail for the same shall be finalized during detailed engineering.

l) It shall also be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.

m) Where more than one connection to a terminal block is required, two tier terminals shall be used.

n) Terminal blocks shall preferably be assigned different colors depending upon voltage and current levels.

4.09.00 **Nameplates and Labels**

a) Nameplate shall be furnished for each instrument or device mounted on the panel / desk.

b) The material shall be laminated phenolic, 3 mm thick with white letters on black background.

c) The nameplates for panels / consoles shall be provided both on the front and the rear.

d) Nameplates for all devices shall be located adjacent to the respective devices.

e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions.

4.10.00 **Wiring Diagram**

Each panel & enclosure shall have drawing pockets to store the relevant drawings of the respective panels. For the junction box printed wiring schedule engraved in black on white bakelite sheet shall be suitably affixed inside the junction box.

4.11.00 **Control Desks**

4.11.01 All devices mounted on the panel / desks shall be flush type. Instruments / devices shall be so mounted that the removal and replacement can be accomplished individually without interruption of services to others.

4.11.02 Desk shall be ergonomically designed to suit the user / operators needs on a 24 x 7 basis. Aesthetic, ergonomy and lighting shall be considered while positioning of the desk, large video screen and panels in control room.

4.11.03 Control desk shall be free standing floor mounting type tabletop design with compartments for locating the computers and other hardware. Desk shall be of latest technology aesthetic design and constructed from aluminium extrusion with high pressure laminate 25 mm thick MDF board for work surface as per Owner / Consultant's approved colour. Aluminium structure shall be anodized or powder coated paint finish.

4.11.04 Desk should have concealed cable trays and wire management system, which shall be easily accessible for maintenance. The cable management should be designed to support vertical and horizontal cables with proper hardware and accessibility. Cable tray shall be designed from steel with powder coated paint finish.

4.11.05 Design shall include earthing bolts on left side end and right side end of the Desk.

4.11.06 Crating of the desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing and all panel mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.

4.11.07 OWS and other application terminals mounted on the control desk shall be powered from UPS feeders and each feeders shall be provided with MCB at the upstream of the permanent Power receptacles. A minimum of two set of Alarm Accept/Reset Push Button shall be provided on each Control Desk.

4.11.08 The desks shall be complete with vibration dampener and foot leveler.

4.11.09 **Technical Specification of Control Desk**

i) The frame / structure should be minimum 2mm thick Powder Coated Extruded Aluminum profile.

ii) The Table Top / Work Surface shall be 36mm thick, Medium Density Fiber (MDF) board with high pressure laminate or Acrylic Plastic Solid Surface (APSS).Top surface shall be finished with anti-scratch material.

iii) Foot extension shall be of Cast Aluminum & painted.

iv) Foot Leveler shall be injection molded glass filled nylon foot with steel insert.

v) END Caps & Extruded PVC Caps shall be provided where required.

vi) Front edge shall be extruded PVC or rounded post-formed laminate.

vii) Concealed cable tray shall be powder coated steel.

viii) Provision shall be made for keeping Multi-media speakers.

ix) Design shall include Earthing bolts on left side end and right side end of the Workstation Desk / Rack.

x) Design should include cutouts for Push buttons, Public Address System and Function Keyboard mounting on the Furniture.

xi) Retractable keyboard tray in the control desk shall be provided.

xii) Retractable tray with telescopic slide for CPU/PC block shall be provided.

xiii) Front and Rear door shall be considered.

4.12.00 Not used.

4.13.00 **System Cabinets / Panels**

01.	Material of construction	:	Cold rolled steel sheet
02.	Thickness of Sheet	:	2 mm thickness for load bearing and 1.6mm for non-load bearing.
03.	Construction	:	Welded throughout as per (metallic parts) approved National Standards.
04.	Panel height	:	2300 mm (approx.)
05.	Doors	:	Full height front & rear door, recessed, turned back edges. Double door for panel width more than 800 mm.
	a) Thickness of Sheet	:	2 mm
	b) Hinges	:	Concealed stainless steel type

c)	Door latches	:	Three point type
d)	Door gaskets	:	Neoprene rubber on fixed frame to result dust proof / weather proof enclosure.
e)	Opening of the doors	:	Outward
f)	Louvers	:	With removable wire mesh to ensure dust and vermin proof.
06.	Colour of interior	:	Glossy white
07.	Colour external	:	Light grey RAL 7032
08.	Painting	:	Epoxy powder coated or better
09.	Gland plates	:	Removable 3 mm thick (bottom)
10.	Cable entry	:	Bottom
11.	Hardware	:	a) Anti vibration pad- 15 mm b) Predrilled base channel ISMC - 100 or equivalent for all sides. c) Stainless steel buff- finished 2 mm thick kick plate for all sides. d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws. e) Rubber strips to ensure air tightness between kick plate and finished floor. f) Detachable lifting hook / Eye bolt g) Drawing pocket at front & rear door h) Door switch, lamps, thermostat, heaters and fans i) Door lock with master key

4.14.00 **Furniture**

Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe.

4.14.01 **Workstation Furniture**

Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (A4/A3 color laserjet) etc. shall be provided.

4.14.02 **PC Rack**

PC Racks shall be provided to mount CPUs of workstations/ PCs of OWS/LVS etc. in control room. For each PC / workstation / monitor at least one chair shall be included.

4.14.03 **Chairs**

Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

4.15.00 **Local Instrument Enclosure (**Closed type enclosure shall be provided in all areas)

4.15.01 Transmitters, switches and devices located in the field shall be grouped together and shall be installed in the Enclosure in case of outdoor area such as Boiler area etc. and in Open Type Rack in case of covered area. Racks and enclosure shall be factory prefabricated & painted and complete with internal piping, tubing, manifold valve, isolation valves, blow down valves, integral junction box, wiring, illumination etc. with outside access doors, Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging. No more than six instruments shall be grouped in a single rack /enclosure

4.15.02 The local instrument enclosures shall be constructed from 2.0 mm thick sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Gaskets shall be used in between all mating sections to achieve protection class of IP-55. Enclosure doors shall have three point lock.

4.15.03 The local instrument racks shall be free standing type constructed from suitable 3 mm thick channel frame of steel and shall be provided with a canopy at top to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel and extended beyond the ends of the rack.

4.15.04 Bulk heads, especially designed to provide isolation from process line vibration shall be provided. Bulkhead plates shall be removable type and thickness of not less than 6 mm shall be employed.

4.15.05 2” NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters/ switches at accessible height. Adequate support for manifold, impulse pipe and cable tray shall be provided and the same shall be adjustable.

4.15.06 All internal wirings and / or data bus connections, if any, between the transmitters and terminal junction box shall run through flexible dust tight conduits connected to the terminal box hub. No exposed wirings within transmitter racks, both open and closed type, is admissible.

4.15.07 All racks shall have a common closed drain trough to connect transmitter drain points to a common header after suitable pressure breaking. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. The trough shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header. Individual Instrument blow down line shall be connected to the common blow down drain header through regulating globe type blow down valves. The common blow down drain header shall be 2" NB ASTM A106, Sch-80 Gr. C installed at a slope of 1:25.

4.15.08 The junction box for enclosure and racks shall conform to IP 65 protection class. Junction box shall be provided as an integral compartment at one side of the enclosure / rack with front opening type door. Junction box shall be complete with DIN rail mounted terminals, MCB, receptacles and earth bar. All wiring shall be laid in PVC cable tray. Cable gland plate shall be provided for cable entry from bottom. Earth bar shall be made of tinned copper continuous and of 25 X 6 MM size.

4.15.09 Each rack shall be provided with receptacle, light fixture with wire guard and lighting switch. Light fixtures shall be installed on the ceilings of rack / enclosure.

4.15.10 Type, size and material grade of the impulse pipes, fittings and valves are listed elsewhere in this specification

4.15.11 Bidder shall furnish the drawing and documents showing detail arrangement of racks and enclosure and hook up along with instrument grouping at detailing stage for Owner / Consultant’s approval.

5.00.00 FGD CONTROL SYSTEM & CEMS

5.01.00 General Requirements

5.01.01 FGD system automation shall be realized in a dedicated hot redundant Programmable Logic Control (PLC) based control system.

9.00.00 **ERECTION HARDWARE**

This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.

9.01.00 **Electrical Accessories**

9.01.01 Electrical conduit and associated materials shall conform to the requirements of the articles which follow:

a) **Rigid Steel Conduit**

i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.

ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.

iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.

iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.

b) **Flexible Conduit**

i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.

ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.

c) **Special Fittings**

i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.

ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

iii) Conduit supports shall be furnished and installed in accordance with the specifications.

9.01.02 **Junction Box**

01.	Type of Enclosure	:	Dust tight & weatherproof conforming to IP 65
02.	Material	:	3 mm sheet steel/ fiberglass reinforced polyester (UV stabilized)
03.	Type of Cover	:	Solid unhinged with retention chain/ screwed at all four corners
04.	Paint	:	RAL 7032 – Siemens Grey
05.	Mounting	:	Surface/ 2” pipe stanchion (At a dry compartment at one side of the enclosure/ rack with front opening type door)
06.	Cable Entry	:	3 mm (min) Bottom / side Gland plate
07.	Gasket	:	Neoprene
08.	Grounding	:	Brass earth lug with green screw head External-two (2) nos., Internal – one (1) no.
09.	No. of Drain holes	:	Two at bottom capped
10.	Identification	:	Label for JB & tags for cable
11.	Accessories	:	a) Rail mounted cage clamp type screw less terminals (suitable for conductor size up to 2.5 sq. mm of suitable voltage grade) with markers and 20% spare terminals. b) Cable gland (Brass) & raceways

9.01.03 **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.

9.01.04 **Cable Tray**

01.	Material	:	Mild steel
02.	Thickness	:	not less than 2.0 mm
03.	Finish	:	Hot dip galvanized
04.	Perforation	:	As per MFR standard.
05.	Cover	:	Suitable for tray

9.02.00 **Process Hook Up Accessories & Specification (as applicable)**

Material and rating of the hook up items shall generally suit the piping and fluid condition. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for Owner / Consultant's approval. For the design guide line Bidder shall refer to Section-I of this Volume.

9.02.01 **Specification for Process Hook Up Materials**

Sr. No	System	Piping class	Impulse Pipe Material	Sche -dule	Materials for Valve / Fittings	Stem Mate-rial	Rating of Fitting	Pr. Class of valve
1.	Auxiliary steam	G	ASTM-A106 Gr. B	80 (½ inch)	ASTM-A 105	ASTM -A182 Gr. F-6a	3000 lb	800
2.	Air / Flue Gas Outside Furnace	K	ASTM-A106 Gr. B/C	80 (¾ inch)	ASTM-A 105	ASTM -A182 Gr. F-6a	3000 lb	800
3.	Air / Flue Gas Inside Furnace	L	ASTM-A335 Gr. P-22	80 (¾ inch)	ASTM-A 182 Gr. F-22	ASTM -A182 Gr. F-6a	3000 lb	800

Sr. No	System	Piping class	Impulse Pipe Material	Sche -dule	Materials for Valve / Fittings	Stem Mate-rial	Rating of Fitting	Pr. Class of valve
4.	DM Cooling Water	M	ASTM A312 TP 316	40 (1/2 inch)	ASTM A182 F316	SS or better	3000 lb	800
5.	Cooling Water	N	ASTM-A106Gr . C	80 (½ inch)	ASTM-A 105	SS or better	3000 lb	800

Note:

1) Above requirements to be complied by Bidder as applicable for the FGD system. Rating of piping/ fittings / valves etc. is subjected to be approved by Owner as per the final design pressure & temperature finalized during the detail engineering as per ANSI B31.1.

2) Material shall be compatible with that of the impulse pipe material and design parameter.

3) For DM water services, complete erection hardware material shall be SS316 only.

9.02.02 **Seamless Stainless Steel Pipe**

01.	Reference	:	ASTM A-312 TP 316
02.	Material Grade	:	TP 316
03.	Type	:	Seamless /Plain end
04.	Size	:	½" NB
05.	Schedule	:	40
06.	Standard Length	:	5 meter

9.02.03 **Stainless Steel Pipe Fittings**

01.	Reference	:	ASTM A-182 F 316 / ANSI B16.11
02.	Type	:	Forged
03.	Rating	:	3000 lbs / 6000 lbs / 9000 lbs
04.	Size	:	½" NB

	05.	End connection	:	Generally socket weld
	06.	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

9.02.04 **Seamless Stainless Steel Tube**

	01.	Reference	:	ASTM A-213 TP 316
	02.	Material Grade	:	TP 316
	03.	Size	:	½" OD X 2.1 MM Thick
	04.	Type	:	Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
	05.	Properties	:	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
	06.	Test Pressure	:	400 Kg/Sq. cm (minimum)
	07.	Tolerance	:	± 0.13 mm for outside diameter ± 15 % for wall thickness
	08.	Standard Length	:	5 meter
	09.	Test	:	Flare, Hardness, Ball and Bubble Test

9.02.05 **Stainless Steel Tube Fittings**

	01.	Reference	:	ASTM-A-182
	02.	Type	:	Double ferrule double compression
	03.	Material	:	316 Stainless steel forged
	04.	Ferrule	:	316 Stainless Steel
	05.	Type of Fittings	:	Male / female connector, elbow, cross / equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.

	06.	Size	:	To suit SS tubing and NPT end connection

9.02.06 **C.S. Pipe**

	01.	Reference	:	ASTM-A 106 Gr. C
	02.	Material	:	Cold drawn seamless black C.S.
	03.	Type	:	Seamless / Plain ends
	04.	Size	:	½" NB
	05.	Schedule	:	80, 160, XXS as required
	06.	Standard Length	:	5 meter

9.02.07 **C.S. Pipe Fittings**

	01.	Reference	:	ASTM-A 105 / ANSI B16.11
	02.	Type	:	Forged
	03.	Rating	:	3000 lbs / 6000 lbs / 9000 lbs
	04.	Size	:	½" NB
	05.	End connection	:	Generally socket weld
	06.	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

9.02.08 **A.S. Pipe**

	01.	Reference	:	ASTM-A 335 P22 AS PER ANSI B 36.10
	02.	Material	:	Cold drawn seamless A.S.
	03.	Type	:	Seamless / Plain ends
	04.	Size	:	½" NB
	05.	Schedule	:	XXS
	06.	Standard Length	:	5 meter

9.02.09 **A.S. Pipe Fittings**

01.	Reference	:	ASTM-A 182 F22 AS PER ANSI B 16.11
02.	Type	:	Forged
03.	Rating	:	9000 lbs
04.	Size	:	½" NB
05.	End connection	:	Generally socket weld
06.	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

9.02.10 **Carbon Steel Globe Valve**

01.	Reference	:	ASTM A-105
02.	Type	:	Globe
03.	Construction	:	Forged Body Cadmium Plated
04.	End Connection	:	½" Socket Weld
05.	Rating	:	Cl. 800 / CL. 2500
06.	Material	:	Body - Carbon steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
07.	Packing	:	Teflon / Grafoil as required
08.	Yoke	:	ASTM A105
09.	Handwheel	:	Carbon steel
10.	Design standard	:	As per ANSI B 16.34

9.02.11 **Stainless Steel Globe Valve**

01.	Reference	:	ASTM A-182 F316
02.	Type	:	Globe

	03.	Construction	:	Forged Body
	04.	End Connection	:	Socket Weld
	05.	Proof Pressure	:	400 Kg/cm^2
	06.	Material	:	Body - Stainless steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
	07.	Packing	:	Teflon as required
	08.	Yoke	:	ASTM A182 F316
	09.	Handwheel	:	Carbon steel
	10.	Design standard	:	As per ANSI B 16.34

9.02.12 **Alloy Steel Globe Valve**

	01.	Reference	:	ASTM A-182 F22
	02.	Type	:	Globe
	03.	Construction	:	Forged Body
	04.	End Connection	:	½" Socket Weld
	05.	Rating	:	CL. 2500
	06.	Material	:	Body - Alloy steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
	07.	Packing	:	Grafoil as required
	08.	Yoke	:	ASTM A182 F22
	09.	Handwheel	:	Carbon steel
	10.	Design standard	:	As per ANSI B 16.34

9.02.13 **Condensate Pot**

	01.	Reference	:	ASTM A182 F22 / ASTM A105

	02.	Material	:	Alloy steel / carbon steel as per application
	03.	Construction	:	Drilled from barstock
	04.	End connection	:	3 nos. ½" socket weld end
	05.	Accessories	:	Vent valves

9.02.14 **Instrument Valve Manifold**

	01.	Type	:	a) Two valve manifold b) Five valve manifold c) Three valve manifold
	02	Mounting	:	Remote 2" Pipe Mounting
	03.	Construction	:	Single block (bar stock)
	04.	Material	:	Forged body and bonnet AISI 316 stainless steel
	05.	Ports	:	1/2 " NPT (F)
	06.	Rating	:	420 Kg/Sq. cm at ambient
	07.	Operating Temperature	:	(-)30 to (+)170°C
	08.	Packing	:	PTFE Wafer
	09.	Seat & Stem	:	AISI 316 SS
	10.	Plug	:	AISI 316 SS free to turn on stem / 17-4 PH
	11.	Handle Bar	:	AISI 316 SS
	12.	Connection	:	Straight
	13.	Accessories	:	a) Plugs for all ports b) Mounting Bracket, bolts, nuts

9.02.15 **Air Header**

				For Panel	**For Field**
	01.	Material of Construction	:	Stainless steel	Stainless steel

	02.	Inlet Connection	:	2" NPT (M)	1" NPT (M)
	03.	Header Take-off	:	Stainless Steel	Stainless Steel
	04.	Take off Connection	:	1 / 2” NPT (M)	1/ 2” NPT (M)
	05.	Take-off Valves	:	Stainless Steel	Stainless Steel
	06.	Tube Take-off	:	Tube adapter on valve	Tube adapter on valve
	07.	Drain	:	SS drain valve at lowest point	SS drain valves at lowest point

9.02.16 **Seamless Stainless Steel Tube**

01.	Reference	:	ASTM A-269 TP 316
02.	Material Grade	:	TP 316
03.	Size	:	¼” OD x 0.049” wall thickness
04.	Type	:	Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
05.	Properties	:	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
06.	Test Pressure	:	400 Kg/Sq. cm
07.	Tolerance	:	± 0.13 mm for outside diameter ± 15 % for wall thickness
08.	Standard Length	:	5 meter
09.	Test	:	Flare, Hardness, Ball and Bubble Test

10.00.00 **SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT**

10.01.00 Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.

10.02.00 The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.

10.03.00 Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid, if applicable. Minimum two (2) nos. antistatic wrist band in each control panels are mandatory and shall be included in the bid.

TYPICAL DRIVE INTERFACE

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	09.08.2018	AAM	AKP	AT	FIRST ISSUE
REVISION STATUS					

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL DRIVE INTERFACE

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14	
CHECKED	AKP	SCALE	NIL	
APPROVED	AT	DATE	09.08.2018	REV 0
DWG. NO.	17A14-DWG-I-0021			1 SHEET OF 8

FILE LOCATION:
PLOT DATE:

S/N	DESCRIPTION	SHEET NO.
1.	COVER SHEET	1 OF 8
2.	INDEX SHEET	2 OF 8
3.	PLC INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)	3 OF 8
4.	PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED)	4 OF 8
5.	PLC INTERFACE FOR UNIDIRECTIONAL HT/LT DRIVE (BREAKER OPERATED)	5 OF 8
6.	PLC INTERFACE FOR BIDIRECTIONAL DRIVE (WITH NON INTEGRAL STARTER)	6 OF 8
7.	PLC INTERFACE FOR ON/OFF SOLENOID ACTUATED DRIVE	7 OF 8
8.	PLC INTERFACE FOR CONTROL VALVE	8 OF 8

FOR TENDER PURPOSE ONLY

FILE LOCATION:
PLOT DATE:

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	09.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

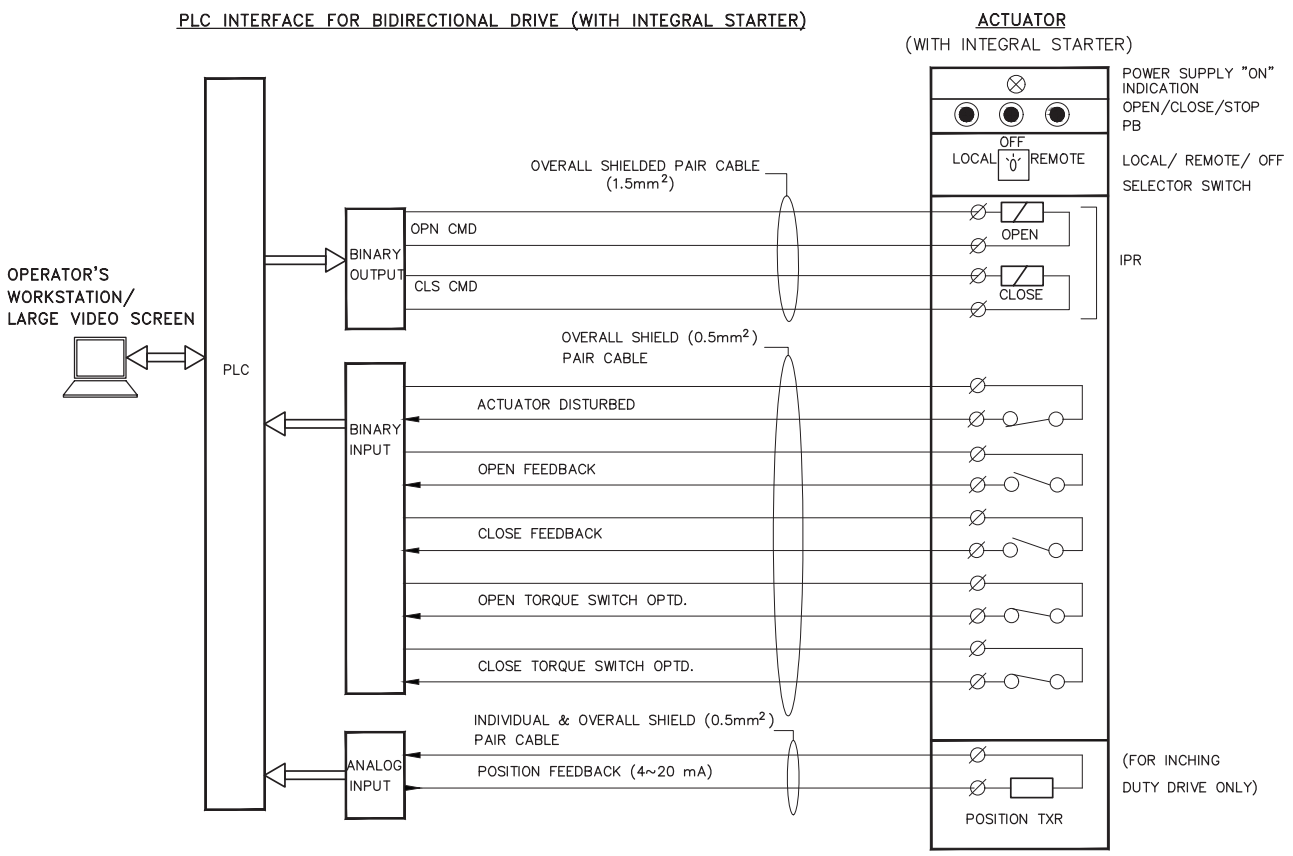
OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL DRIVE INTERFACE

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	09.08.2018
DWG. NO.	17A14-DWG-I-0021		REV 0
			SHEET 2 OF 8



NOTE:

1. ACTUATOR DISTURBED CONSIST OF FOLLOWING SIGNALS:–
   a) LOSS OF POWER SUPPLY,
   b) LOSS OF CONTROL SUPPLY, MOTOR THERMOSTAT TRIP,
   c) THERMAL OVER LOAD RELAY TRIP,
   d) TORQUE OPEN/CLOSE CUT OFF,
   e) LOCAL/OFF/REMOTE SEL. SWITCH IN LOCAL OR OFF MODE.
   f) VALVE JAMMED.
   g) EMERGENCY STOP PB PRESSED.
2. PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
3. IPR – INTERPOSING RELAY (TO BE LOCATED INSIDE THE INTEGRAL STARTER)
4. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIREMENTS (FOR EXAMPLE REDUNDANCY)

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
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REVISION STATUS

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PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

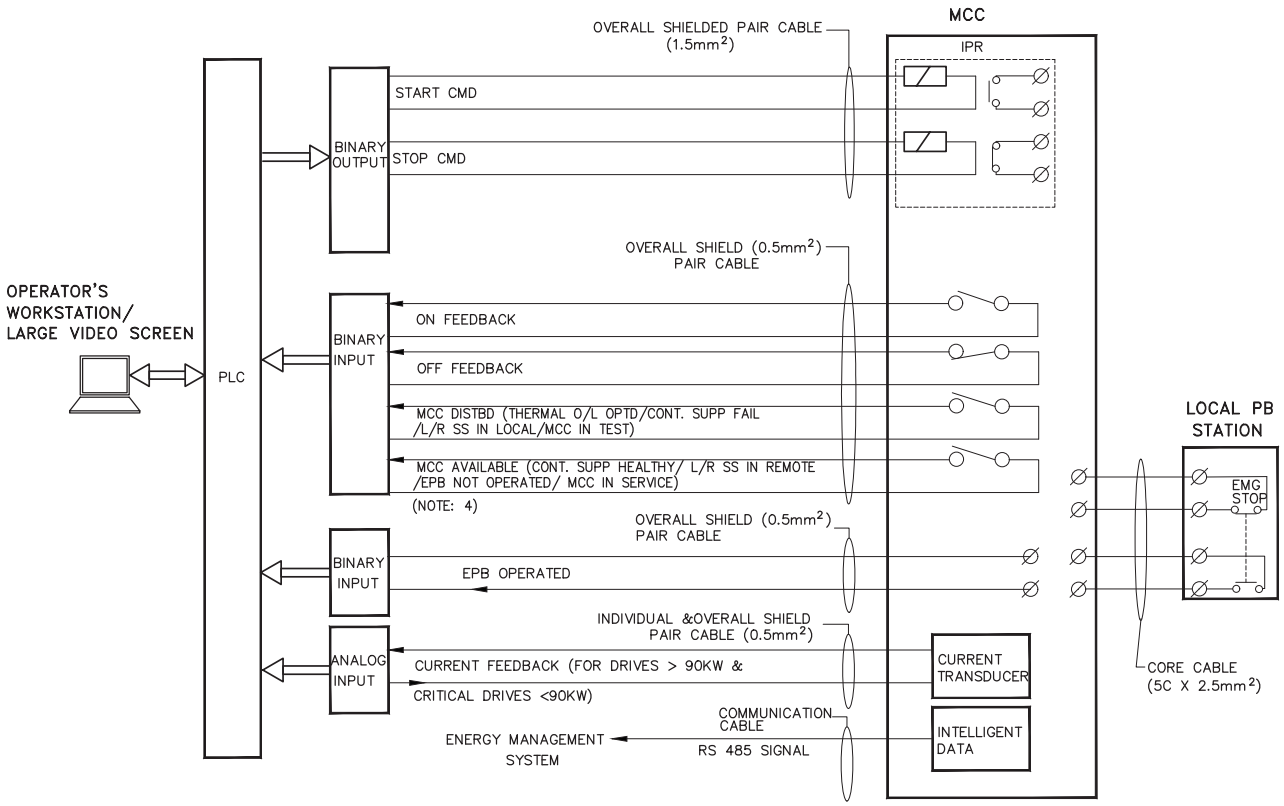
TITLE: TYPICAL DRIVE INTERFACE

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	09.08.2018
DWG. NO.	17A14–DWG–I–0021		REV 0
			SHEET 3 OF 8

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\21-08-2018\17A14-DWG-I-0021-R-0-SHT-3-8.dwg
PLOT DATE: 21 August 2018, 12:08 PM

PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED)



NOTE:

1. IPR – INTERPOSING RELAY
2. PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
3. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIRMENTS (FOR EXAMPLE REDUNDANCY).

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
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REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

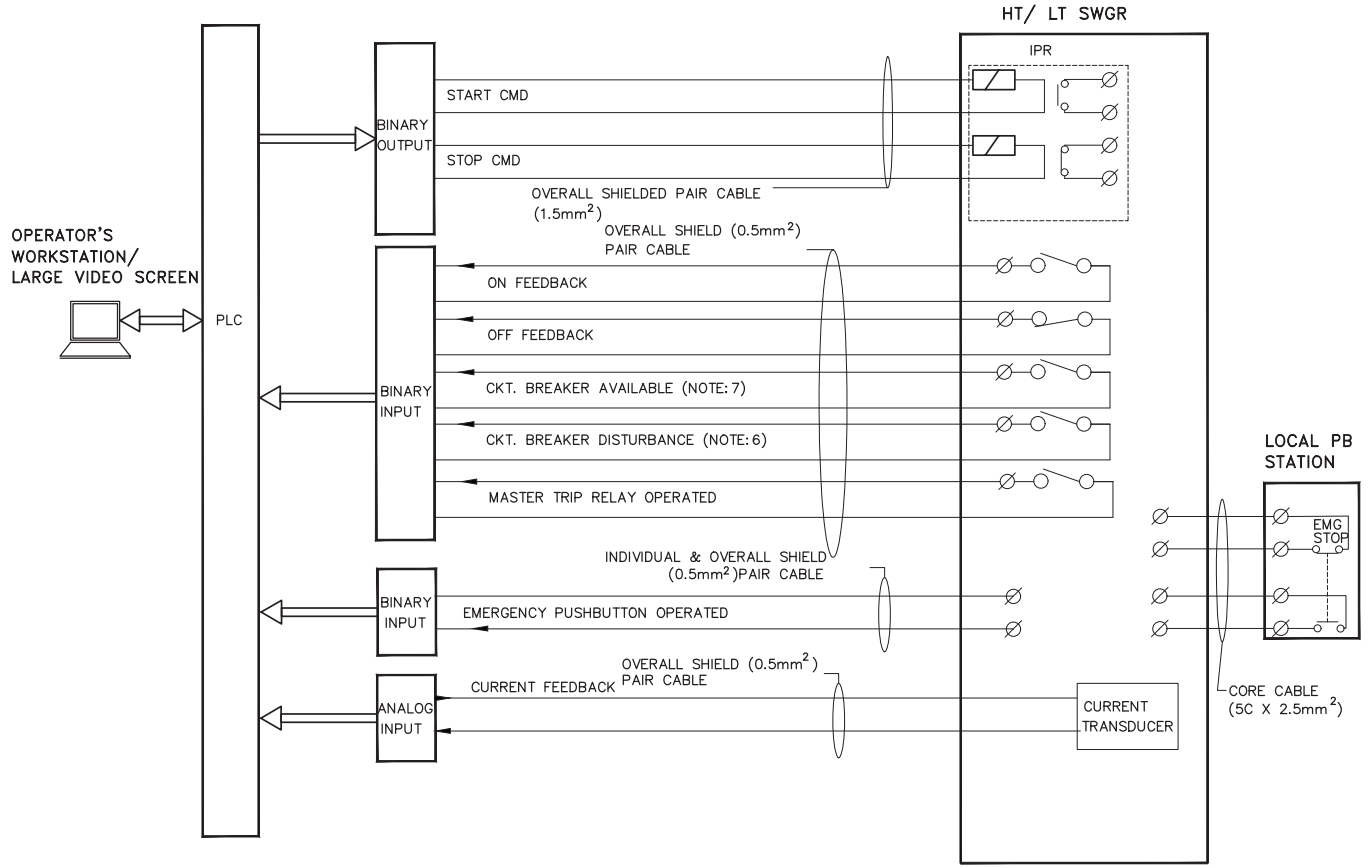
TITLE: TYPICAL DRIVE INTERFACE

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	09.08.2018
DWG. NO.	17A14–DWG–I–0021		REV 0
			SHEET 4 OF 8

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\21-08-2018\17A14-DWG-I-0021-R-0-SHT-4-8.dwg
PLOT DATE: 21 August 2018, 12:07 PM

PLC INTERFACE FOR UNIDIRECTIONAL HT/ LT DRIVE (BREAKER OPERATED)



NOTE:

1. IPR – INTERPOSING RELAYS
2. PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
3. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIRMENTS (FOR EXAMPLE REDUNDANCY).
4. MOTOR WDG AND BRG TEMPERATURES SHALL BE CONNECTED TO THE RESPECTIVE PLC RTD I/O CARDS.
5. ALL COMMANDS AND FEEDBACKS SHALL BE REDUNDANT FOR HT DRIVES & CRITICAL LT DRIVES.
6. CKT BREAKER DISTURBANCE CONSISTS OF THE FOLLOWING:–
   - –BREAKER IN TEST POSITION
   - –TRIP COIL UNHEALTHY
   - –CONTROL SUPPLY FAIL
   - –L/R SELECTOR SWITCH IN LOCAL
7. CKT. BREAKER AVAILABLE CONSISTS OF THE FOLLOWING:–
   - –BREAKER IN SERVICE POSITION
   - –CONTROL SUPPLY HEALTHY
   - –BREAKER SPRING CHARGED
   - –BREAKER (L/R SS) IN REMOTE
   - –MTR NOT OPERATED.
   - –EPB NOT OPERATED

FOR TENDER PURPOSE ONLY

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REVISION STATUS

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PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL DRIVE INTERFACE

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CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

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DWG. NO.	17A14–DWG–I–0021		REV 0
			SHEET 5 OF 8

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\21-08-2018\17A14-DWG-I-0021-R-0-SHT-5-8.dwg
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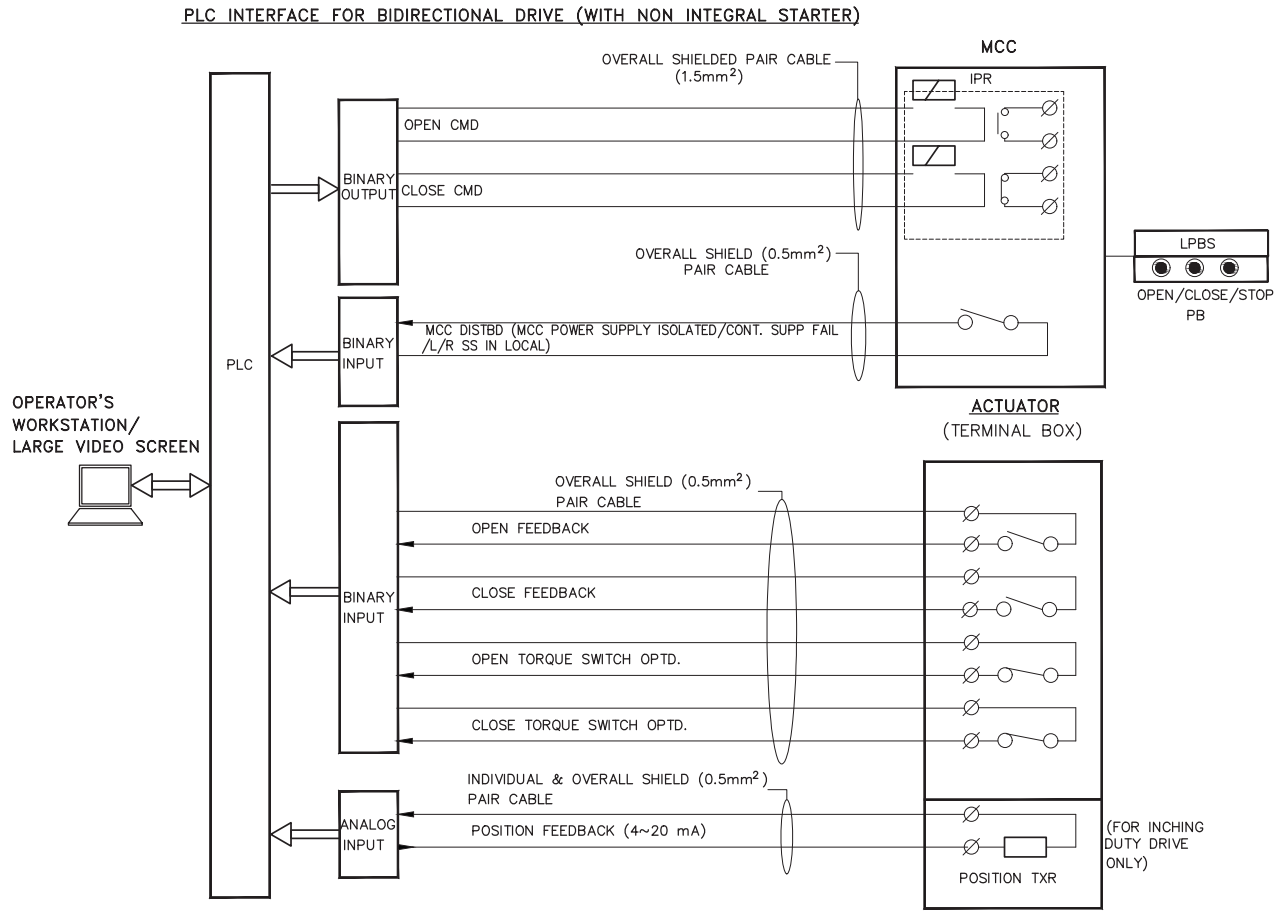

NOTE:

1. IPR – INTERPOSING RELAY
2. PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
3. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIRMENTS (FOR EXAMPLE REDUNDANCY).

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
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REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL DRIVE INTERFACE

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

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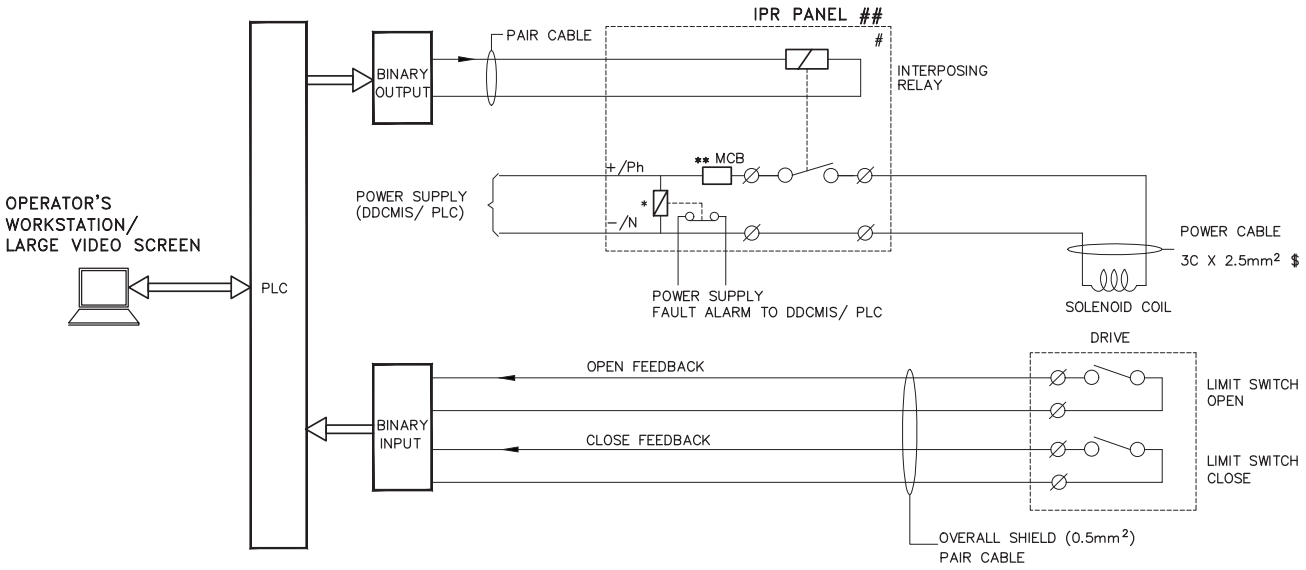
APPROVED	AT	DATE	09.08.2018
DWG. NO.	17A14–DWG–I–0021		REV 0
			SHEET 6 OF 8

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\21-08-2018\17A14-DWG-I-0021-R-0-SHT-6-8.dwg
PLOT DATE: 21 August 2018, 12:10 PM

PLC INTERFACE FOR ON/OFF SOLENOID ACTUATED DRIVE



NOTE:

1. ** MCB SHALL BE PROVIDED FOR EACH SOLENOID.
2. * COMMON FOR ALL SOLENOIDS OF SIMILAR COIL VOLTAGE RATING.
3. PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
4. TWO INDEPENDENT OUTPUTS FROM PLC SHALL BE PROVIDED TO PUSH – PULL TYPE VALVES WITH DUAL COIL SOLENOIDS. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIRMENTS.
5. $ POWER CABLE CROSS SECTION SHALL BE AS PER CABLE SIZING CALCULATION.
6. # FOR DOUBLE SOLENOID VALVES, SAME ARRANGEMENT SHALL BE APPLICABLE FOR SECOND SOLENOID.
7. ## IPR PANEL SHALL BE INTEGRAL FOR THE PLC BASED SYSTEMS.

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
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REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL DRIVE INTERFACE

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

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APPROVED	AT	DATE	09.08.2018
DWG. NO.	17A14–DWG–I–0021		REV 0
			SHEET 7 OF 8

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\21-08-2018\17A14-DWG-I-0021-R-0-SHT-7-8.dwg
PLOT DATE: 21 August 2018, 12:11 PM

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	10.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

FILE LOCATION:
PLOT DATE:

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14-DWG-I-0022		REV 0

SHEET 1 OF 16

NOTES :

1..PROVISION OF SINGLE OR DOUBLE ROOT VALVE AND DRAIN VALVE SHALL BE IN ACCORDANCE WITH THE PRESSURE/TEMPERATURE REQUIREMENT. FOR LINE PRESSURE EQUAL TO OR GREATER THAN 40 KG/SQ.CM 2 NOS ROOT VALVE AND 2 NOS DRAIN VALVE SHALL BE REQUIRED.

2..MATERIAL, SIZE AND RATING OF THE PROCESS HOOK UP ITEMS SHOWN IN THE DRAWING ARE INDICATIVE ONLY. ACTUAL REQUIREMENT SHALL BE AS PER PROCESS CONDITION & SPECIFICATION V.IIE/S-III

3..DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2" NB ASTM A 106 SCH 80 Gr.C. DRAIN HEADER SHALL BE TO THE NEAREST DRAIN PIT AS PER SITE CONDITION.

4..ALL FITTINGS SHALL BE WITH DOUBLE COMPRESSION FERRULE & NUTS.

5..UNION SHALL BE USED AT EVERY 6M INTERVAL OF IMPULSE LINE OR AS REQUIRED.

6..IMPULSE LINE SHALL BE SUPPORTED WITH U-CLAMPING AT EVERY 2.5M SPAN.

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
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REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

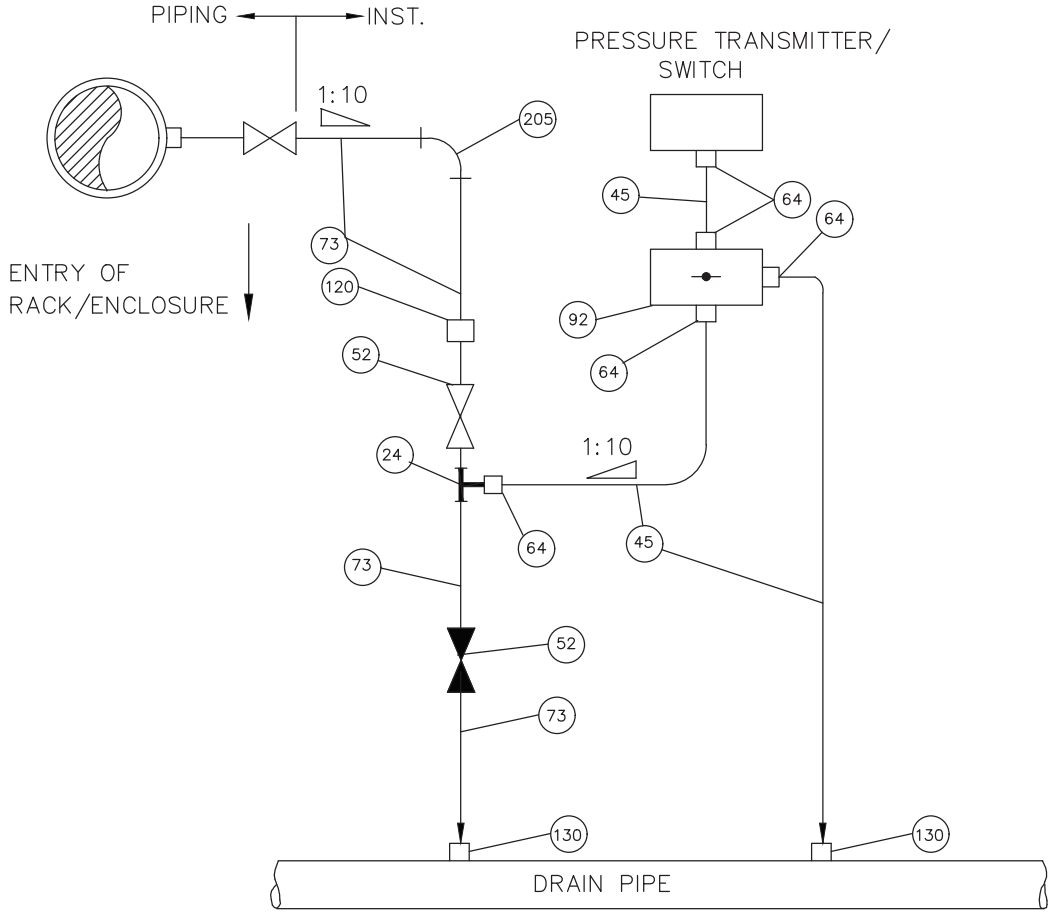
DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14-DWG-I-0022		REV 0

SHEET 3 OF 16

FILE LOCATION:
PLOT DATE:

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED BELOW SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	1	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	2	GLOBE VALVES, 1/2" SW
64	8	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	15 M	IMPULSE PIPE, 15 NB
92	1	2 VALVE MANIFOLD, 1/2" NPT (F)
120	1	BULK-HEAD UNION, 1/2" SW
130	2	HALF COUPLING, 1/2" SW
205	1	90° ELBOW, 1/2" SW

SERVICE : WATER.

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
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REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

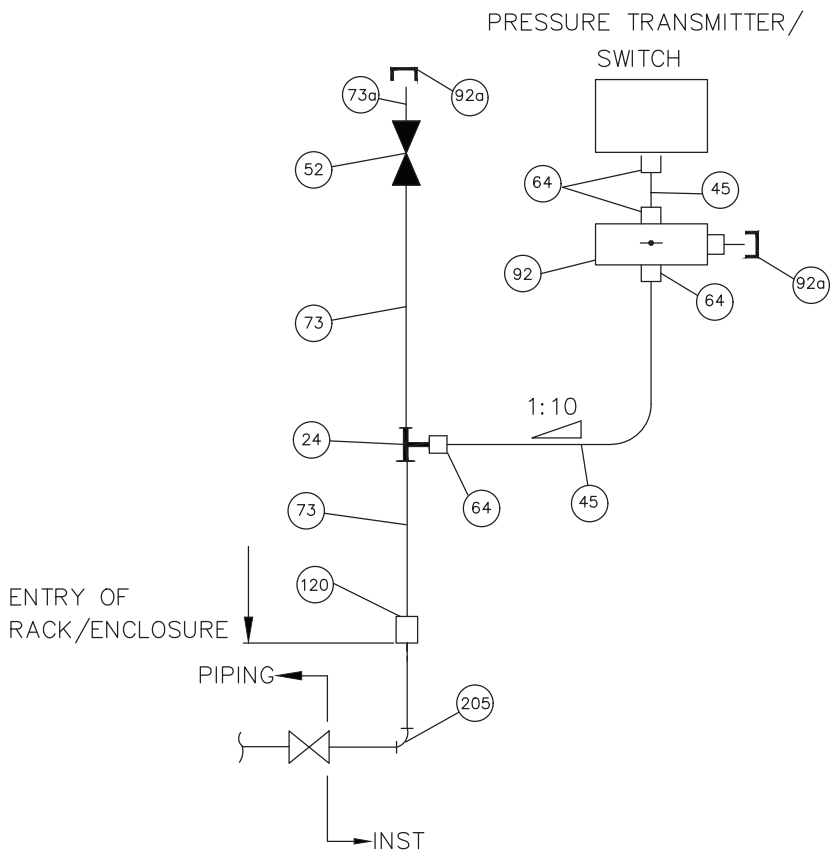
TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14-DWG-I-0022		REV 0
			4 SHEET OF 16

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\INST INSLL\17A14-DWG-I-0022-R-0-SHT-5-20 (PT).dwg
PLOT DATE: 16 August 2018, 12:15 PM

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED ABOVE SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	1	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	1	GLOBE VALVE, 1/2" SW
64	4	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD
73	15 M	IMPULSE PIPE, 15 NB
73a	1	NIPPLE, 1/2" SW X 1/2" NPT (F), 150 MM
92	1	2-VALVE MANIFOLD, 1/2" NPT (F)
92a	2	VENT PLUG, 1/2" NPT (M)
120	1	BULK HEAD UNION/COUPLING, 1/2" SW
205	1	90° ELBOW, 1/2" SW

SERVICE : AIR

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
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PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
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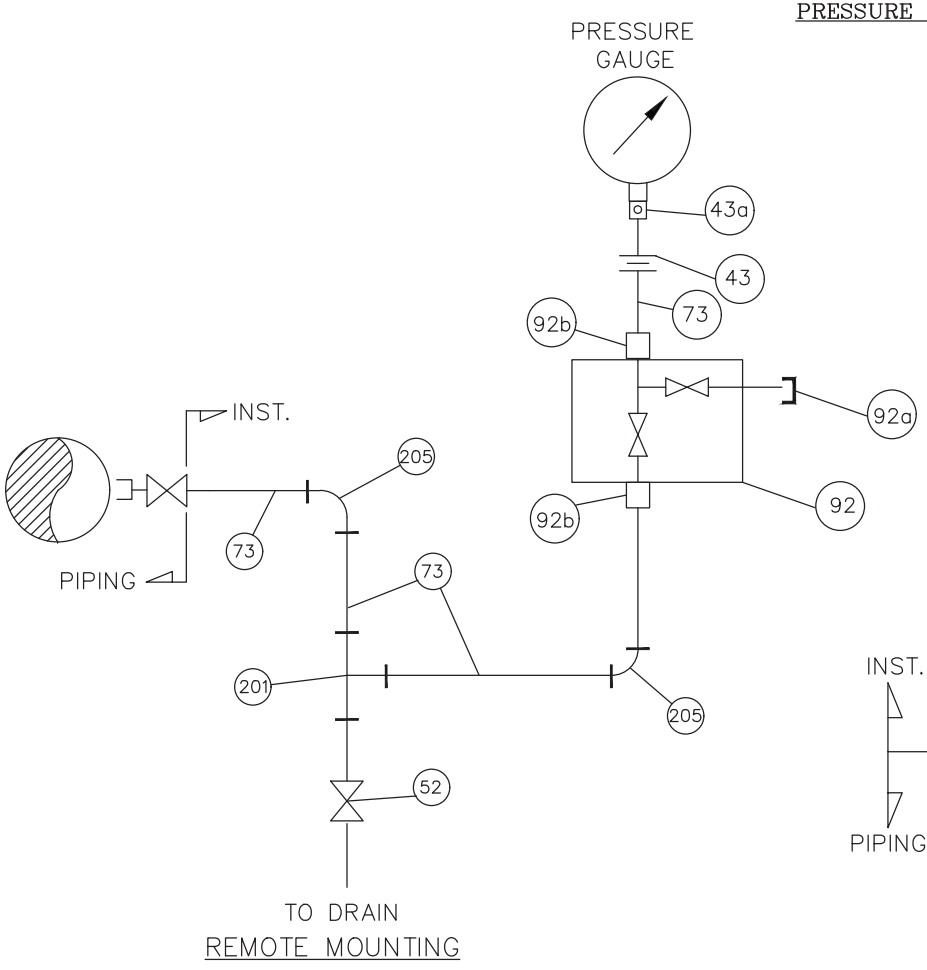
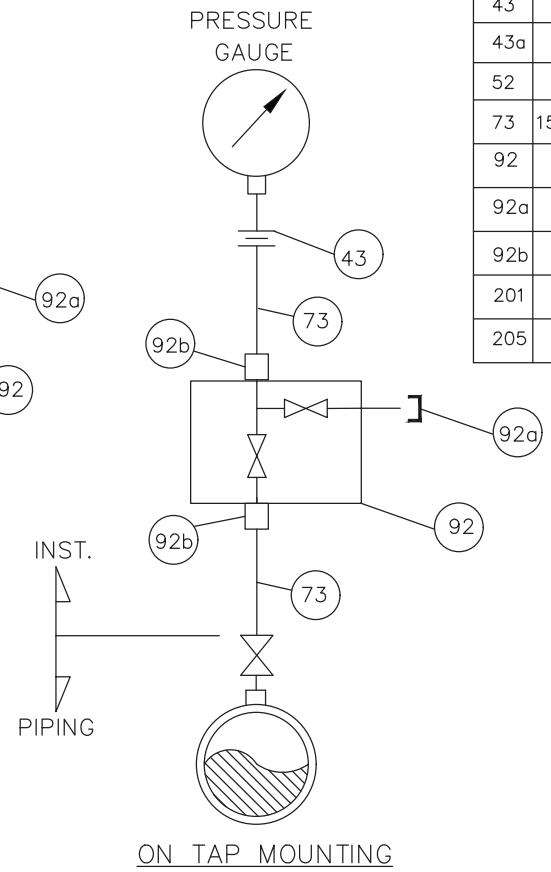
DWG. NO.	17A14-DWG-I-0022		REV 0
			SHEET 5 OF 16

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\INST INSLL\17A14-DWG-I-0022-R-0-SHT-7-20 (PT).dwg
PLOT DATE: 16 August 2018, 12:16 PM

PRESSURE GAUGE





BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
43	1	THREE PIECE UNION, 1/2" SW X 1/2" NPT (F)
43a	1	SNUBBER, 1/2" NPT (M) X 1/2" NPT (F) (AT PUMP DISCHARGE)
52	1	GLOBE VALVE, 1/2" SW
73	15Mtrs	IMPULSE PIPE 15 NB
92	1	2 VALVE MANIFOLD, 1/2" NPT (F)
92a	1	VENT PLUG, 1/2" NPT (M)
92b	1	ADAPTOR, 1/2" SW X 1/2" NPT (M)
201	1	EQUAL TEE 1/2" SW
205	2	90° ELBOW 1/2" SW

SERVICE : WATER

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
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TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

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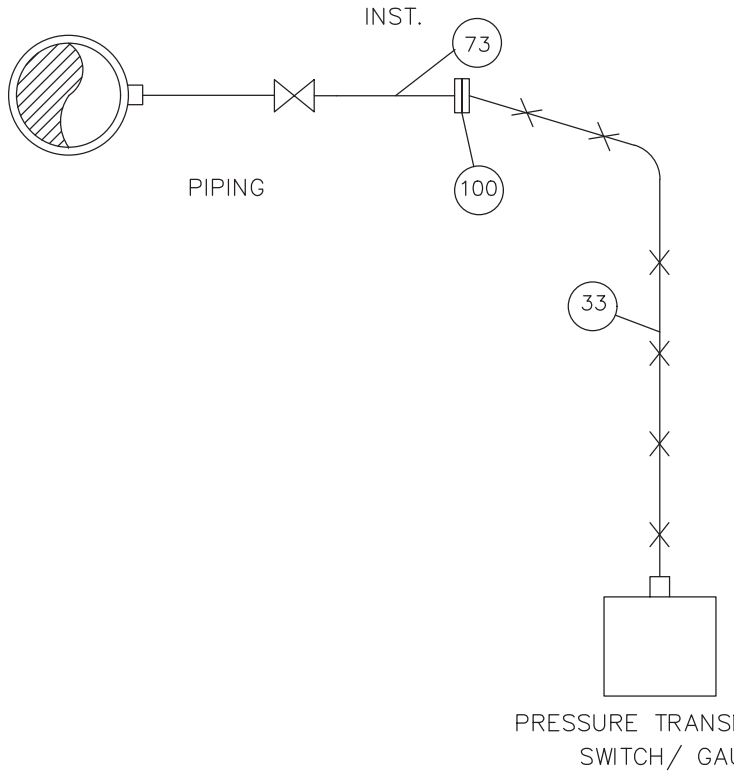
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14-DWG-I-0022		REV 0
			SHEET 10 OF 16

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\INST INSLL\17A14-DWG-I-0022-R-0-SHT-13-20 (PG).dwg
PLOT DATE: 16 August 2018, 12:21 PM

PRESSURE TRANSMITTER/PRESSURE SWITCH WITH REMOTE DIAPHRAGM SEAL



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
33	A/R	SS ARMOURED CAPILLARY TUBE
73	1 M	IMPULSE PIPE, 15 NB
100	1	FLANGE ASSEMBLY TO SUIT 1/2" PIPE

SERVICE: CORROSIVE/ VISCOUS/SOLID BEARING OR SLURRY SERVICE

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	10.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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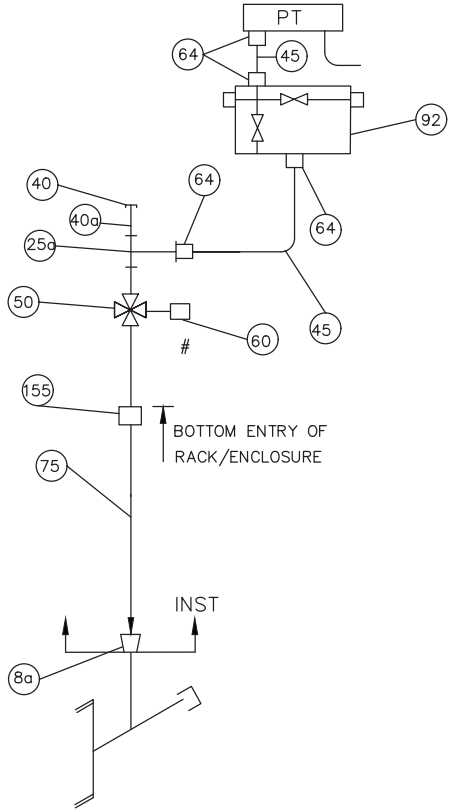
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14-DWG-I-0022		REV 0
			SHEET 11 OF 16

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\INST INSLL\17A14-DWG-I-0022-R-0-SHT-15-20 (DIA SEAL).dwg
PLOT DATE: 16 August 2018, 12:23 PM

PRESSURE TRANSMITTER
MOUNTED ABOVE SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
8a	1	REDUCER 1" NB X 3/4" NB–SW
25	1	EQUAL TEE, 3/4" SW
25a	1	UNEQUAL TEE, 3/4" SW (2) X 1/2" NPT (F)
40	1	PLUG, 3/4" NPT (M)
40a	1	NIPPLE, 3/4" SW X 3/4" NPT (F), 150 MM
45	3 M	TUBE, 1/2" OD
50	1	FOUR WAY VALVE SIZE :(2 X 3/4" NB–SW)X(2 X 1/2"NPTF)
60	1	QUICK DISCONNECTING FITTING SIZE:1/2"NPT(M)
64	4	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
75	A/R	IMPULSE PIPE, 15 NB
93	1	3 VALVE MANIFOLD, 1/2" NPT(F)
155	1	BULK HEAD UNION, 3/4" SW

SERVICE : FLUE GAS.

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
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KOLKATA • MUMBAI • CHENNAI • NEW DELHI

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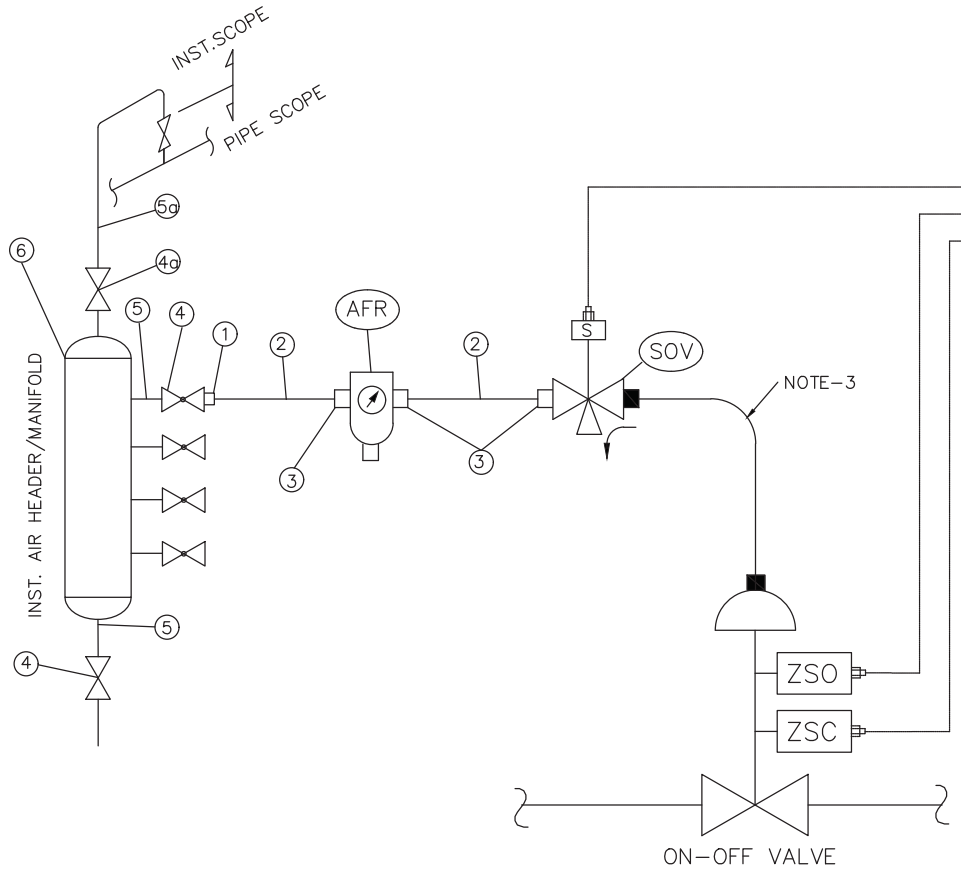
DWG. NO.	17A14–DWG–I–0022		REV 0
			SHEET 14 OF 16

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\INST INSLL\17A14–DWG–I–0022–R–0–SHT–18–20 (PT–FLUE).dwg
PLOT DATE: 16 August 2018, 12:27 PM



PNEUMATIC SOV HOOK UP SCHEME

ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
1	MALE CONNECTOR	1/2"NPT(M) X 6 mm OD	1	
2	TUBE	6 mm OD X 1 mm THK.	10 MTRS.	
3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD	3	
4	ISOLATION VALVE	BALL TYPE 1/2" SW X 1/2" NPT(F)	2	
4a	ISOLATION VALVE	BALL TYPE 1" SW	1	
5	PIPE	1/2" NB	A/R	
5a	PIPE	1" NB	A/R	
6	AIR MANIFOLD	2" NB	1	

NOTES.

1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.

2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.

3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.

4...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.

5...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	10.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

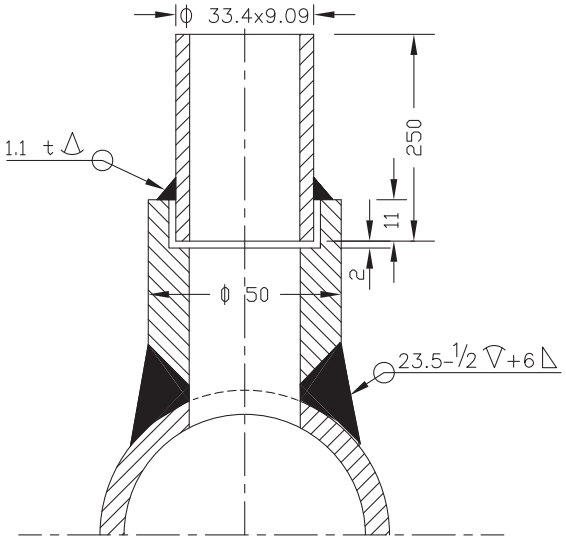
PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14-DWG-I-0022		REV 0
			SHEET 16 OF 16

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\INST INSLL\17A14-DWG-I-0022-R-0-SHT-20-20 (SOV).dwg
PLOT DATE: 16 August 2018, 12:29 PM

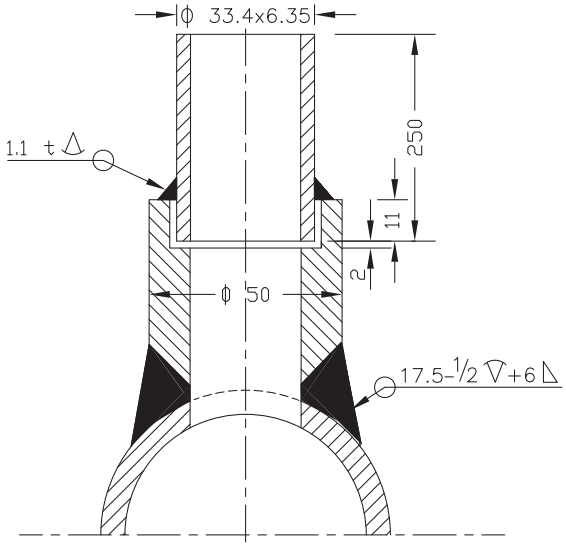
INSTRUMENT STUB DETAILS

PRESSURE MEASUREMENT

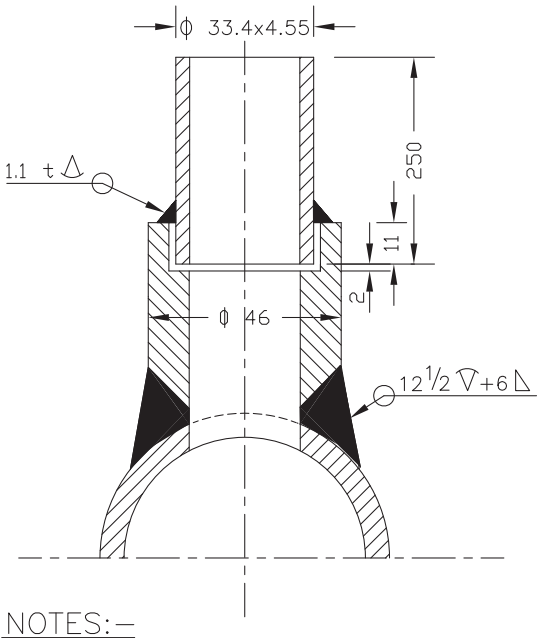
(SYSTEM PR.>40Kg/Sq Cm CL 9000)



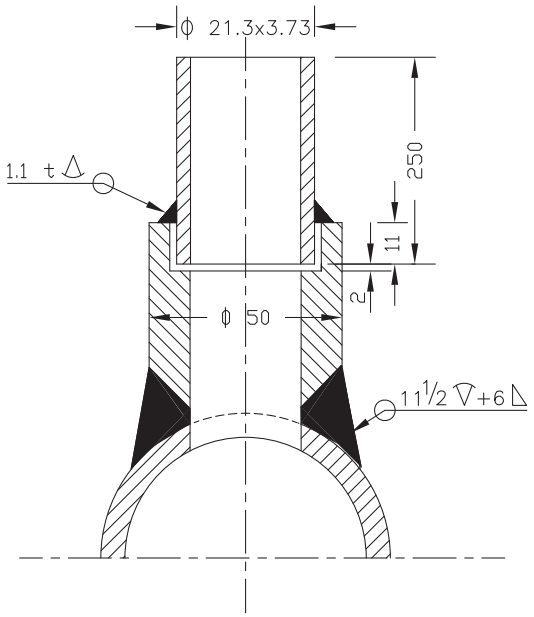
(SYSTEM PR.>40Kg/Sq Cm CL 6000)



(SYSTEM PR. <40Kg/Sq cm Nb 25 CL 3000)



(SYSTEM PR. <40Kg/Sq cm Nb 15 CL 3000)



NOTES:–

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFIRM TO ANSI B 16.11.
2. THE LENGTH OF THE NIPPLE SHOULD BE 250mm.
3. THE OTHER END OF THE NIPPLE SHALL BE SOCKET WELDED WITH 1" GLOBE VALVE OF MATERIAL AS PER ANSI B 16.1.
4. TWO ISOLATED VALVES ARE TO BE USED FOR PRESSURE = >40 Kg/Cm2.
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
6. ORIENTATION OF TAP WILL BE VARY WITH TYPE OF PROCESS FLUID AND NATURE OF RUN OF THE PIPE.
7. ACTIVITIES TO BE COMPLETED AT THE SHOP, WELD THE COUPLING (OR BOSS) ON THE PIPE AND DRILL PRESSURE CONNECTION HOLE (SAME AS I D OF NIPPLE) IN THE PIPE IN ALLIGNMENT WITH HOLE IN THE COUPLING.
8. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.

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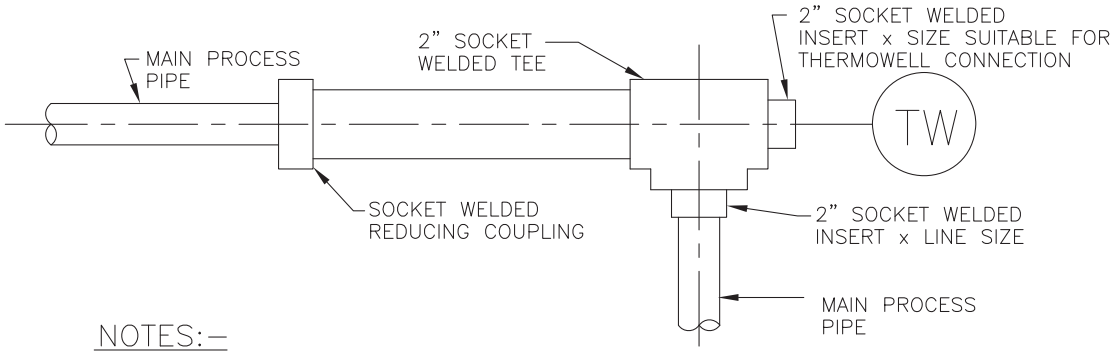
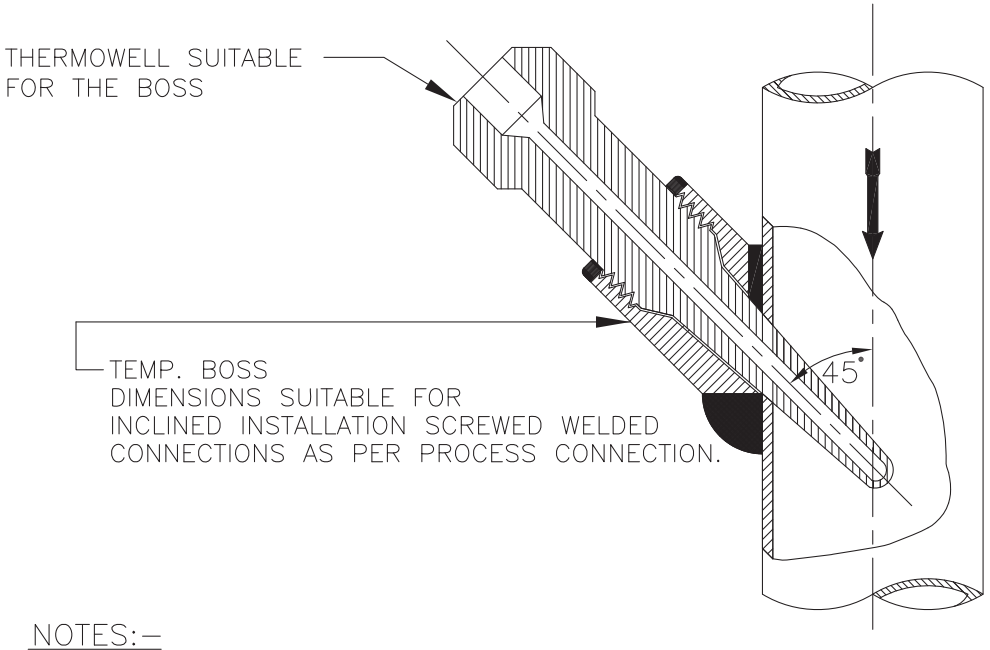
TEMP. MEASUREMENT



NOTES:–

1. THIS TYPE OF THERMOWELL INSTALLATION IS SUITABLE FOR THE PROCESS PIPE OF 2" NPS AND SMALLER.
2. FOR STEAM SERVICE THIS TYPE OF THERMOWELL INSTALLATION 90° BEND MAY BE USED ONLY IN VERTICAL PLANE.
3. THE LENGTH OF THE LARGER PIPE SECTION SHALL BE MINIMUM 150mm (IT MUST BE GREATER THAN THERMOWELL LENGTH).



NOTES:–

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION MAY BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (ATLEAST 3–4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDE OF THE INSTALLED THERMOWELL).

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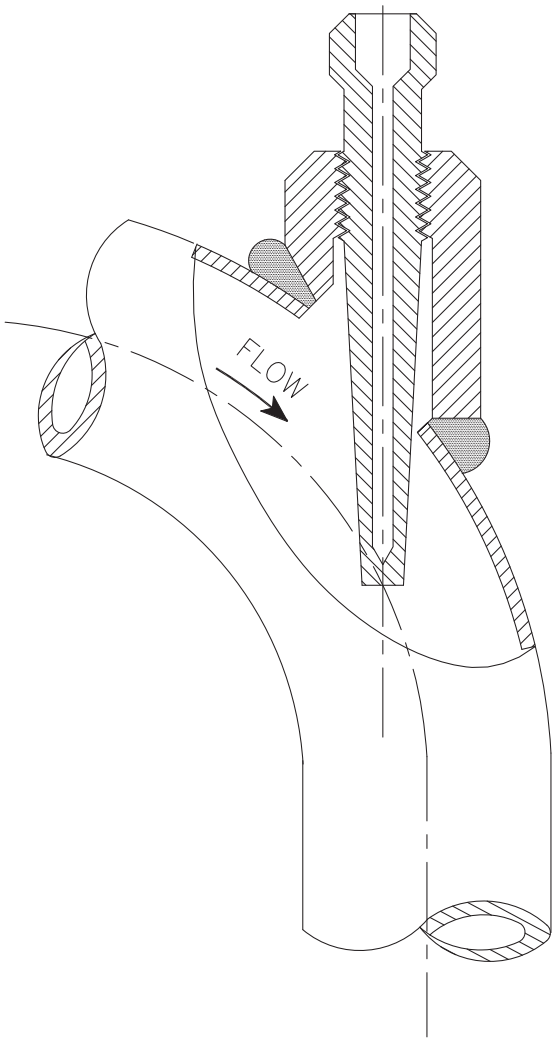
TEMP. MEASUREMENT



NOTES:–

1. FLOW INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE.

2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF MINIMUM 3" SIZE SHALL BE USED.

3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE MAY BE USED FOR LIQUID SERVICES. ONLY STEAM SERVICES EXPANDER SECTION MAY BE USED IN VERTICAL PLAN.

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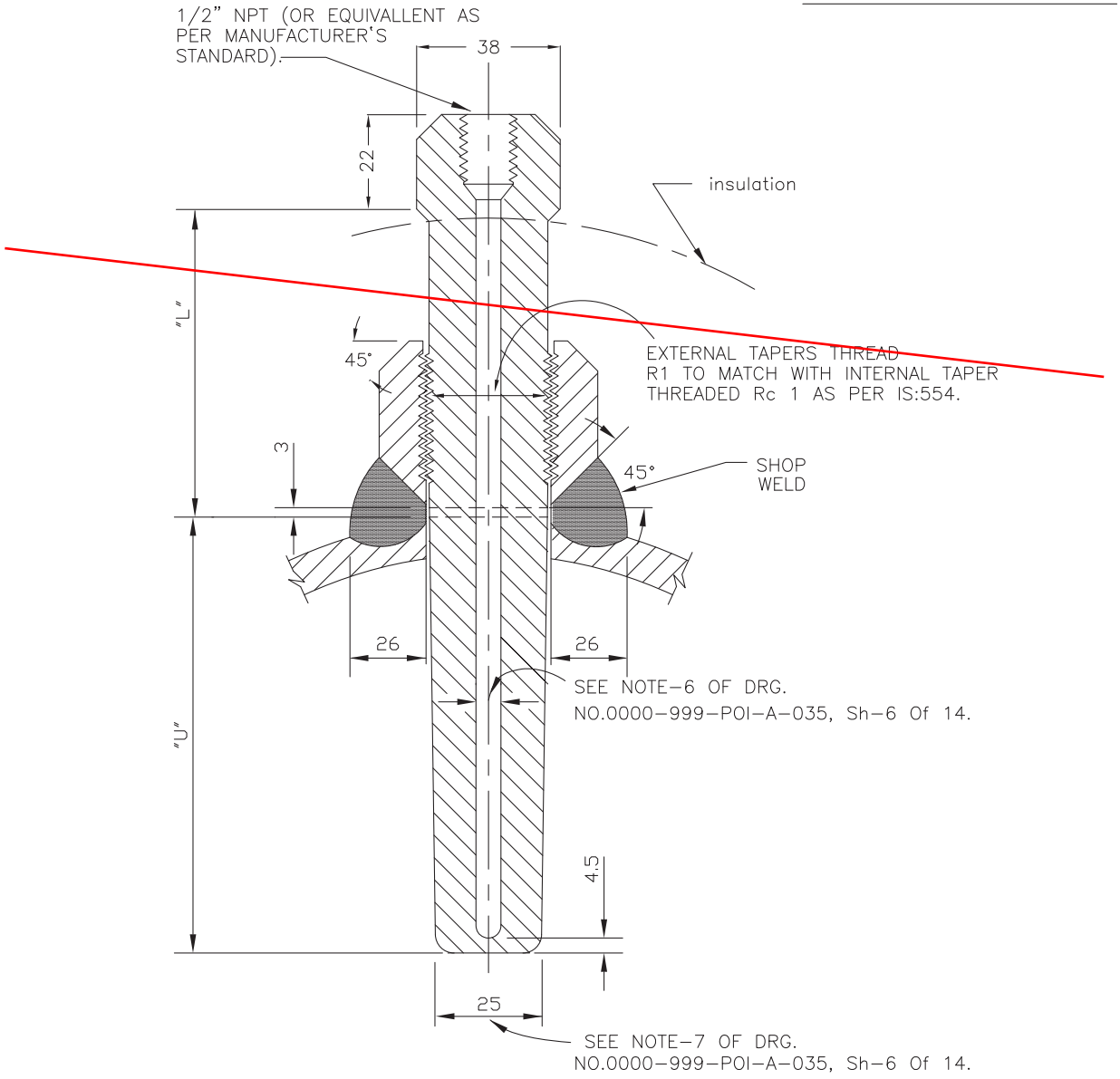
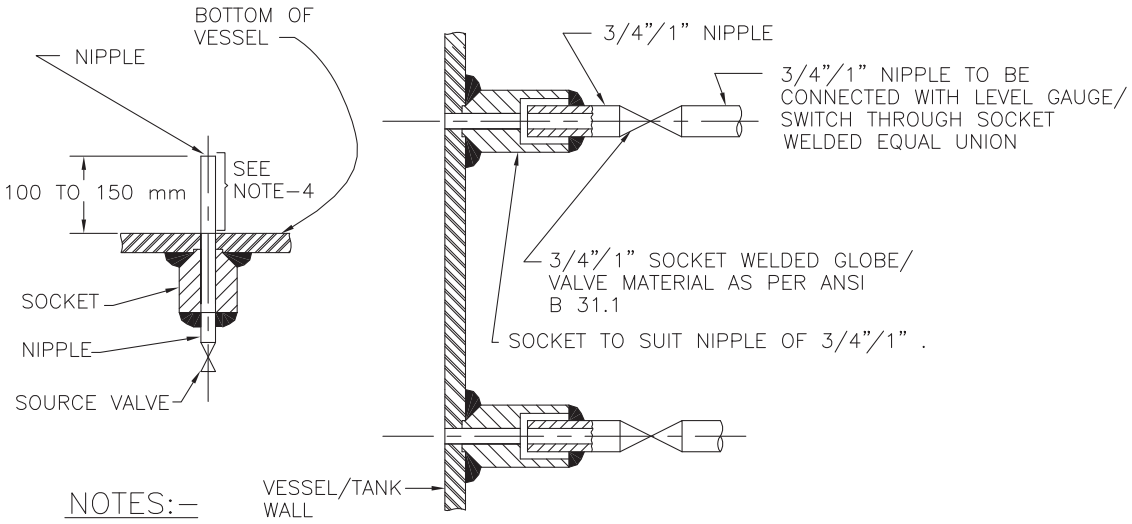


NOTES:-

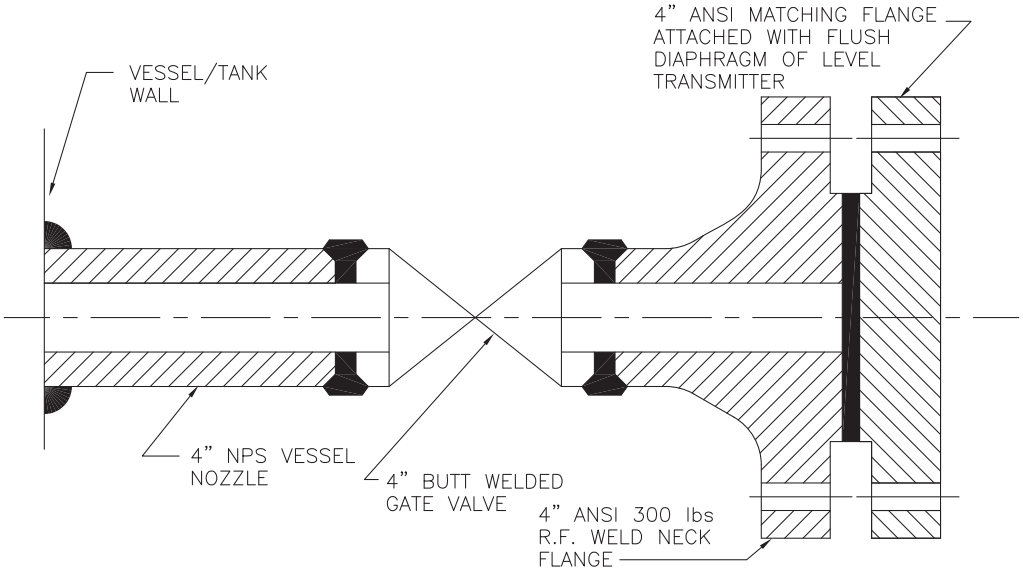
1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESSURE/TEMPERATURE BELOW 40 Kg/Cm2(g)/400°C
2. FOR PRESSURE TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. PIPES HAVING PROBABILITY OF PROLONGED VIBRATION SEAL WELDING MAY BE DONE ALL AROUND AFTER TIGHTENING THERMOWELL WITHIN THE BOSS.
4. SEE NOTES-2 TO 14 OF DRG. NO. 0000-999-POI-A-035, Sh-6 Of 14.

LEVEL MEASUREMENT



NOTES:-

1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR LEVEL GAUGE AND EXTERNAL CAGE TYPE FLOAT OR DISPLACER OPERATED LEVEL SWITCH.
2. FOR GAUGES 3/4" NIPPLE ALONG WITH 3/4" SW SOURCE VALVE AND FOR SWITCHES 1" NIPPLE ALONG WITH 1" SW SOURCE VALVE SHALL BE PROVIDED AS PROCESS CONNECTION.
3. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECTED TO INTERFACE AND TURBULENCE FROM INLETS AND OUTLETS.
4. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100 mm TO 150 mm ABOVE THE BOTTOM OF THE VESSEL.



NOTES:-

1. THIS TYPE OF PROCESS CONNECTION SHALL BE PROVIDED FOR TANK LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID USING FLUSH DIAPHRAGM/WAFER TYPE LEVEL TRANSMITTER.
2. WELDING OF MATCHING FLANGE TO GATE VALVE SHALL BE DONE BY BIDDER.

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VOLUME: II-F

SECTION-III

ELECTRIC MOTOR ACTUATORS

1.00.00 SCOPE

1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.00.00 CODES & STANDARDS

2.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS), IEC, ANSI & NEMA Standards except when otherwise stated herein or in the driven equipment specification.

2.02.00 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up-to-date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 SERVICE CONDITIONS

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment / system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

4.00.00 RATING

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve / damper or minimum S2-15 minutes.

4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

4.03.00 A safety factor of 300% shall be used for sizing of operators for valves and dampers and all drive system components. Operators shall be capable of transmitting design torque (including safety factor) within the torque range specified by the actuator manufacturer. The strength of the operator mounting, based on the required operator torque, shall not exceed 30% of the yield strength in any mode of stress.

5.00.00 PERFORMANCE

The actuator shall meet the following performance requirements:

5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.

5.02.00 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).

5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 SPECIFIC REQUIREMENT

6.01.00 Construction

6.01.01 The actuator shall essentially comprise the drive motor, torque / limit switches, gear train, clutch, hand wheel, position indicator / transmitter, in-built thermostat for over load protection, single phase preventer protection, space heater and internal wiring. Actuator shall be integral type. Two sets of torque and limit switches shall be provided to use in PLC logic and electrical logic/ interlock independently.

6.01.02 The actuator enclosure shall be totally enclosed IPW-67, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.

6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 Motor

6.02.01 The drive motor shall be three phase, 415V, 50Hz squirrel cage, induction machine with minimum Class F insulated with three thermoswitches embedded, one in each winding of the motor for protection against burnout and IPW-67 enclosure, designed for high torque and reversing service.

6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.

6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.

6.02.04 Earthing terminals shall be provided on either side of the motor.

6.03.00 **Limit Switches**

Each actuator shall be provided with following limit switches: -

6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.

6.03.02 4 end-of-travel limit switches, two for each direction of travel.

6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.

6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.

6.03.05 Limit switches shall be drum type and adjustable to open, close and intermediate position.

6.03.06 The motor actuators shall have 2 nos. potentiometric type transmitters.

6.04.00 **Hand Wheel**

Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.

6.05.00 **Position Indicator/Transmitter**

The actuator shall have:

6.05.01 One (1) built-in local position indicator for 0-100% travel

6.05.02 One (1) position transmitter, potentiometer type, for remote indicator

6.06.00 **Space Heater**

A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.

6.07.00 **Wiring**

All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules.

6.08.00 **Terminal Box**

The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2x2.5 Sq.mm copper conductor.

6.09.00 **Interfaces**:

i) Open/Close command termination logic with position & torque Limit Switches, positioner circuit shall be suitably built in the PCB inside the actuator.

ii) For Binary Drive (both ON-OFF and Inching type) :- Open/Close command & status thereof and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided.

iii) Interface with the control system shall be through hardwired signal only. Inter posing relays provided in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system.

iv) For Modulating drive: - the command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided.

v) Open/close command termination logic shall be suitably built inside actuator.

7.00.00 ACCESSORIES

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

7.01.00 One (1) triple pole breaker

7.02.00 One (1) reversing starter, with mechanically interlocked contactors, 3 thermal overload relays, 2 N.O. + 2 N.C. auxiliary contacts for each contactor.

7.03.00 One (1) remote-local selector switch

7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights

7.05.00 415/110V control transformer with primary & secondary fuses.

8.00.00 TEST

8.01.00 The actuator and all components thereof shall be subject to tests as per relevant standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

8.02.00 Following routine test for integral starters shall be conducted as per IEC/IC standard. (a) Meggar Test, (b) Continuity test, (c) Operational test. Test certificates duly signed by inspecting agency shall be furnished.

8.03.00 The actuator shall be type tested as per IEC/National Standard, by international/national recognized test house. The test certificates issued by this house shall be furnished. Otherwise, the equipment shall have to be type tested, free of charge, to prove the design.

9.00.00 DRAWINGS, DATA & MANUALS

9.01.00 **To be Submitted with Bid**

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues.

9.02.00 **To be Submitted after Award of Contract**

a) Actuator Data Sheet

b) Internal wiring diagram and suggested control schematic

c) Torque switch and limit switch contact development

d) Manufacturer's Catalogue

e) Instruction manual indicating clearly the installation methods, check ups and tests to be carried out before commissioning of the equipment.

9.03.00 The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.

KKS PHILOSOPHY

DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	A	A	Y	Y	B	B	B

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-**1.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

ANNEXURE-1

List of System / Sub-System Codes used in Power Plant:

ANNEXURE-2

Standard Equipment Codes:

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holders, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level

CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level

i) Use 10, 20, 30... To distinguish between main systems having same Alpha Codes. Examples:

a) Main Steam (Left) and Main Steam (Right)

b) BFP – A/B/C

c) ID Fan – A/B, FD Fan A/B, AH – A/B

ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.

iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

i) Valves and Dampers --- *Equipment Code – AA*

		N1	N2 N3
Motorised *(on/off duty)*	-	*0*	*01 to 50*
Motorised (inching duty)	-	*0*	*51 to 99*
Pneumatic (Control)	-	*1*	*01 to 50*
Motorised (thyrestor Control)	-	*1*	*51 to 99*
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99

NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99
Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99

ii) Field Instruments

Field Transmitters & Analog Signals	-	0	01 to 99
Field Switches & Binary Signals	-	1	00 to 99
PG Test Point	-	4	00 to 99
Gauges	-	5	00 to 99
Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
(Reserved for protection Signals used by Hardwar)			

Example of Numerical Key Usage:

In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ……. Where system code is same.

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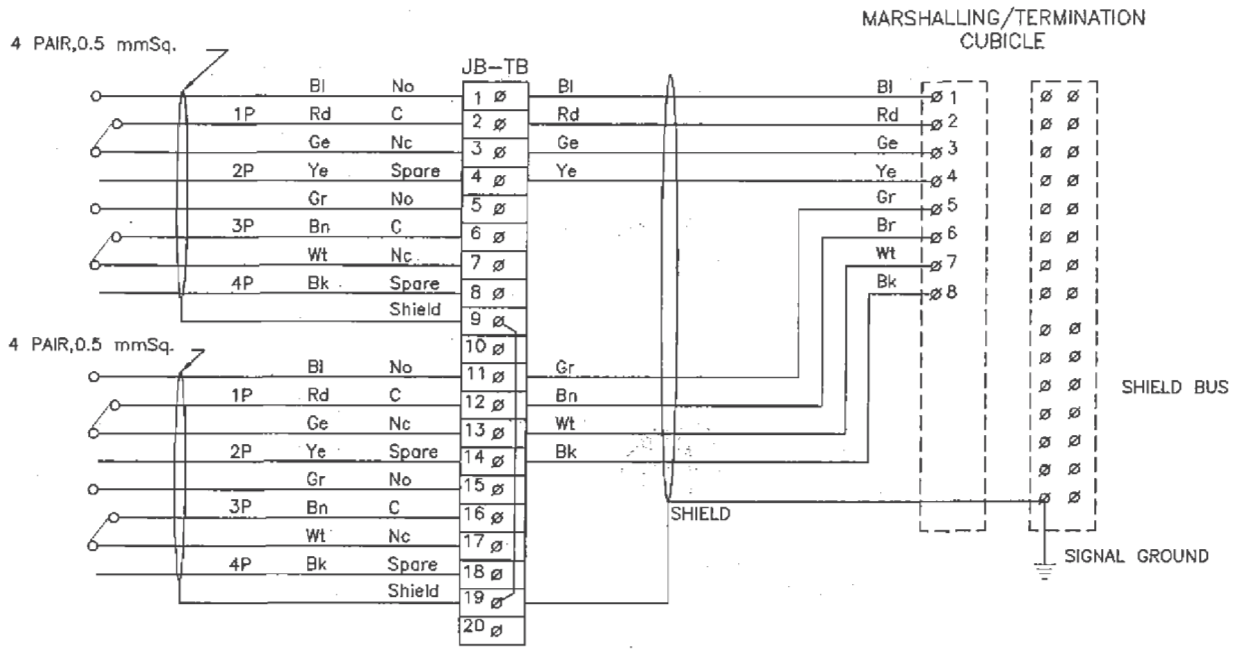
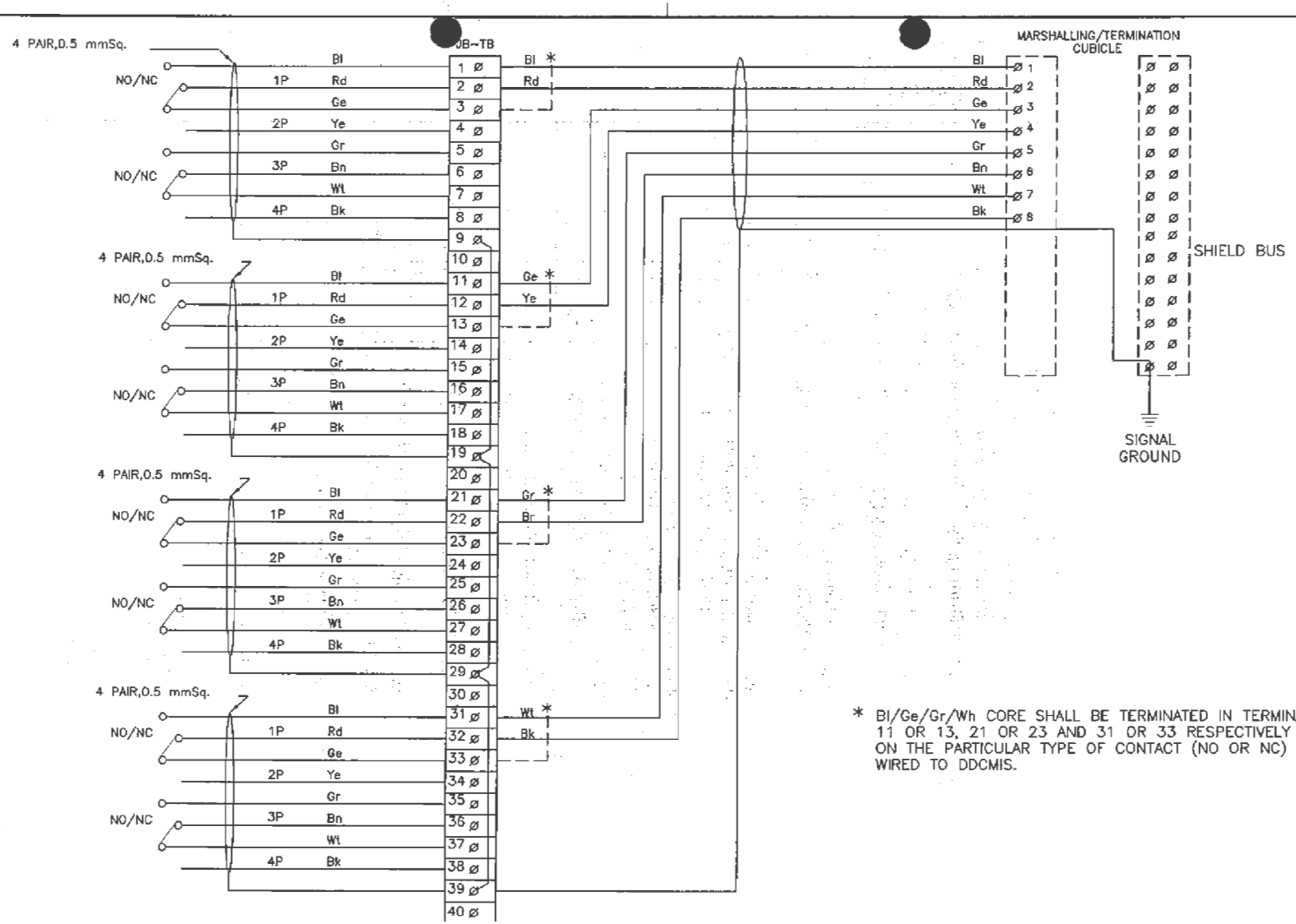


REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.06

CLEARED BY

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

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 01 OF 14	A



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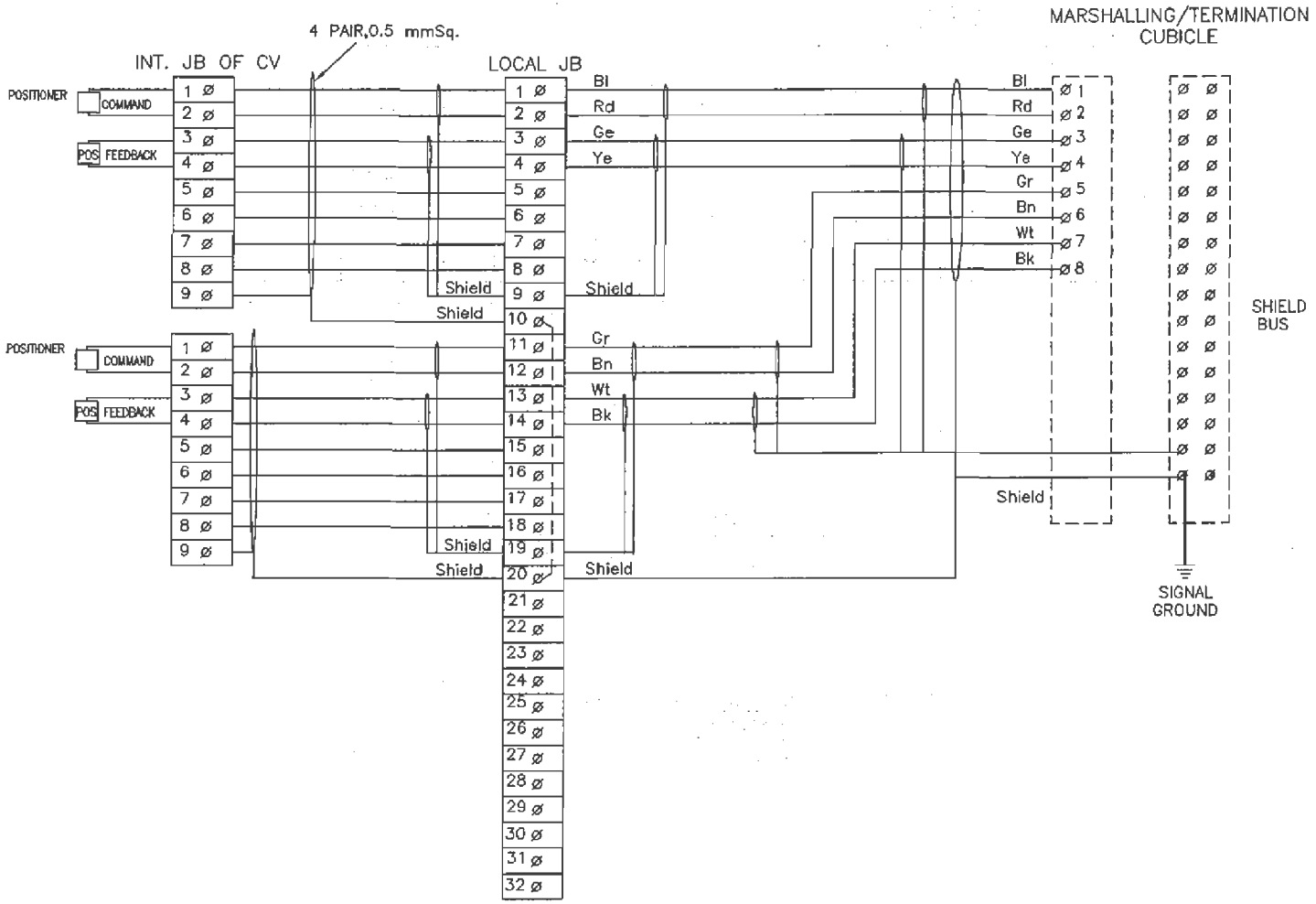
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.08

CLEARED BY.

TITLE	SIZE	SCALE	DRG. NO.	REV. NO.
INTERFACING OF FIELD INSTRUMENTS SWITCH TERMINATION DETAILS NO/NC	A3	NTS	0000-999-POI-A-065 SH 02 OF 14	A



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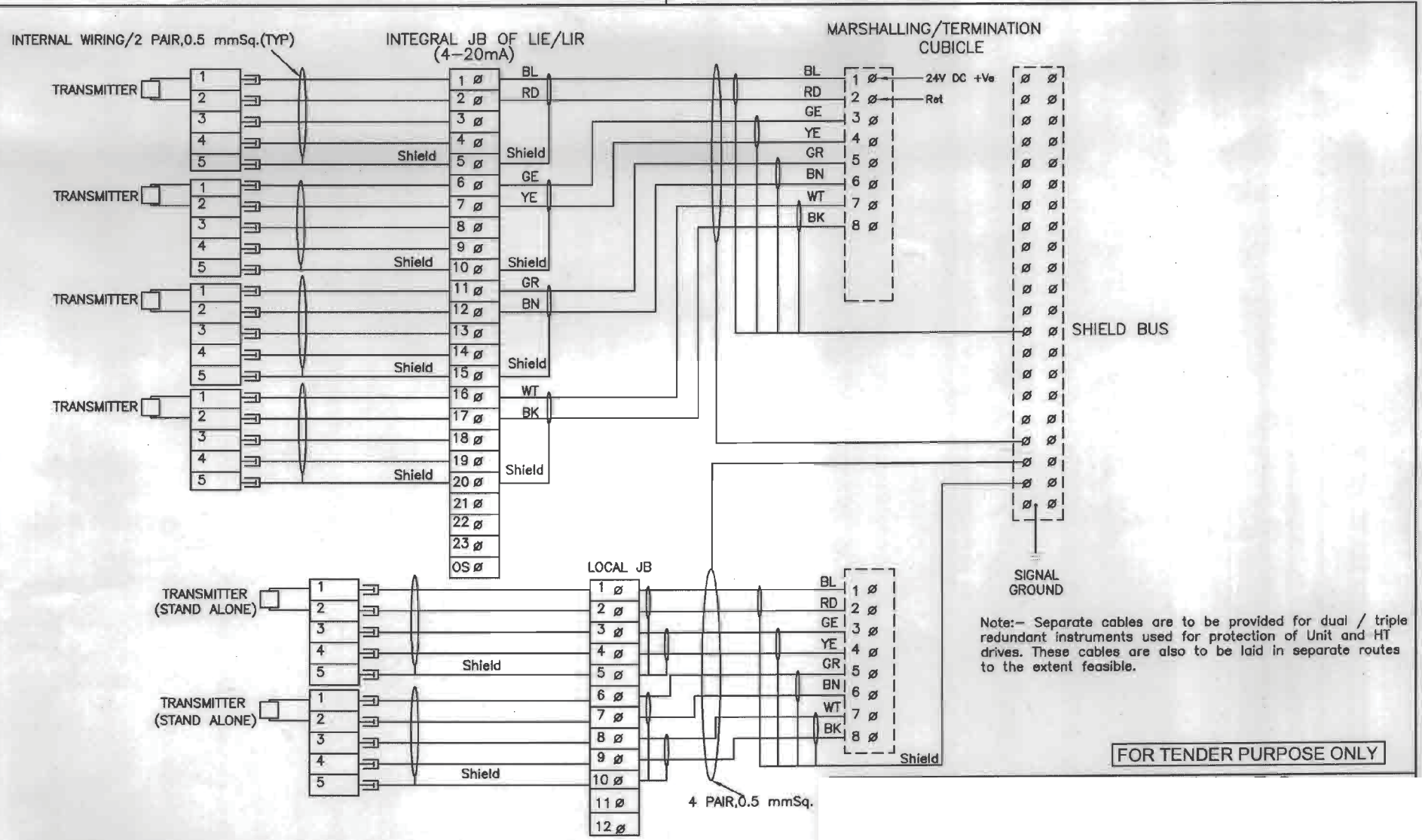
INTERFACING OF FIELD INSTRUMENTS
CONTROL VALVE

DRG. NO.	REV. NO.
0000-999-POI-A-065 SH 03 OF 14	A



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INTERFACING OF FIELD INSTRUMENTS
4-20mA

	DRG. NO.	REV. NO.
TS	0000-999-POI-A-065 SH 04 OF 14	C

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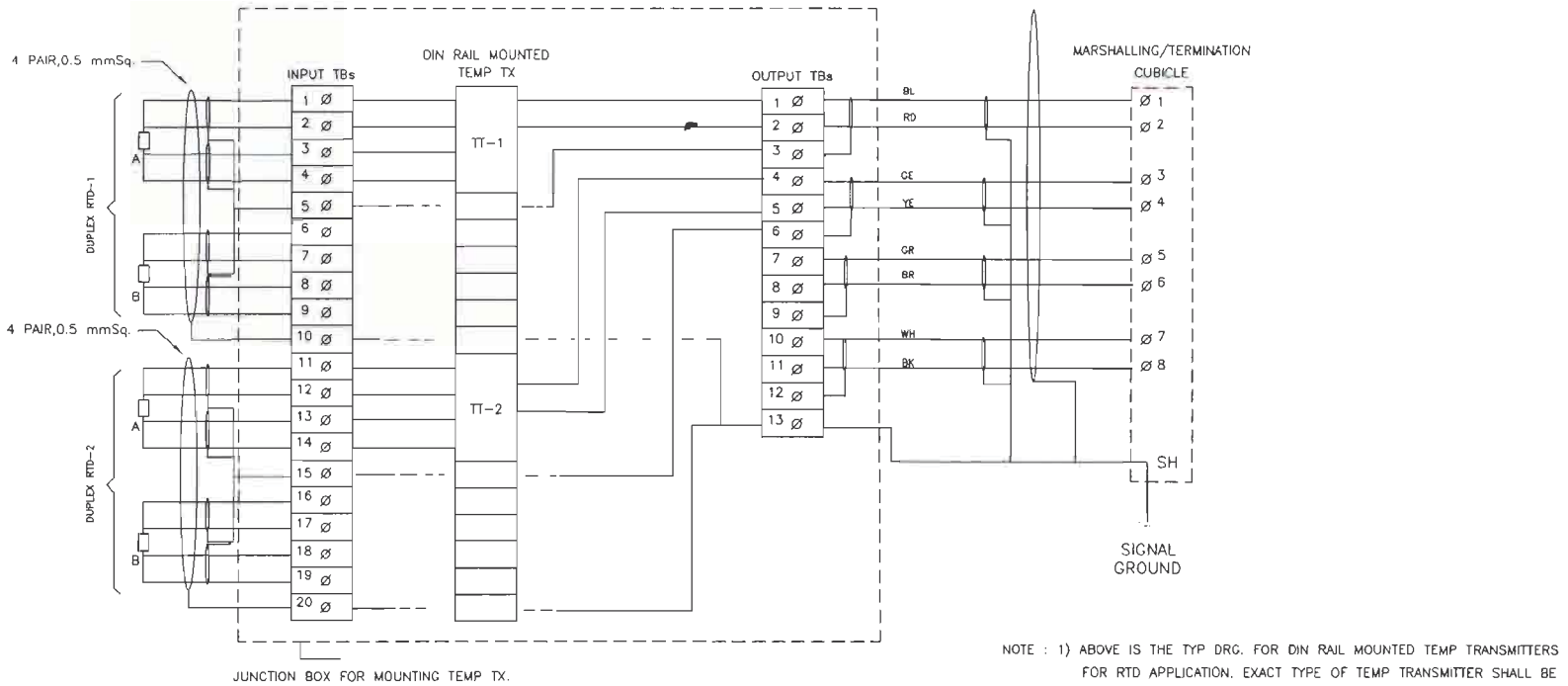

NOTE : 1) ABOVE IS THE TYP DRG. FOR DIN RAIL MOUNTED TEMP TRANSMITTERS FOR RTD APPLICATION. EXACT TYPE OF TEMP TRANSMITTER SHALL BE AS PER PART-A OF SPECIFICATION.
2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINALISED DURING DETAILED ENGG. STAGE.

TITLE			
INTERFACING OF FIELD INSTRUMENTS TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS INJBs			
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 06 OF 14	C

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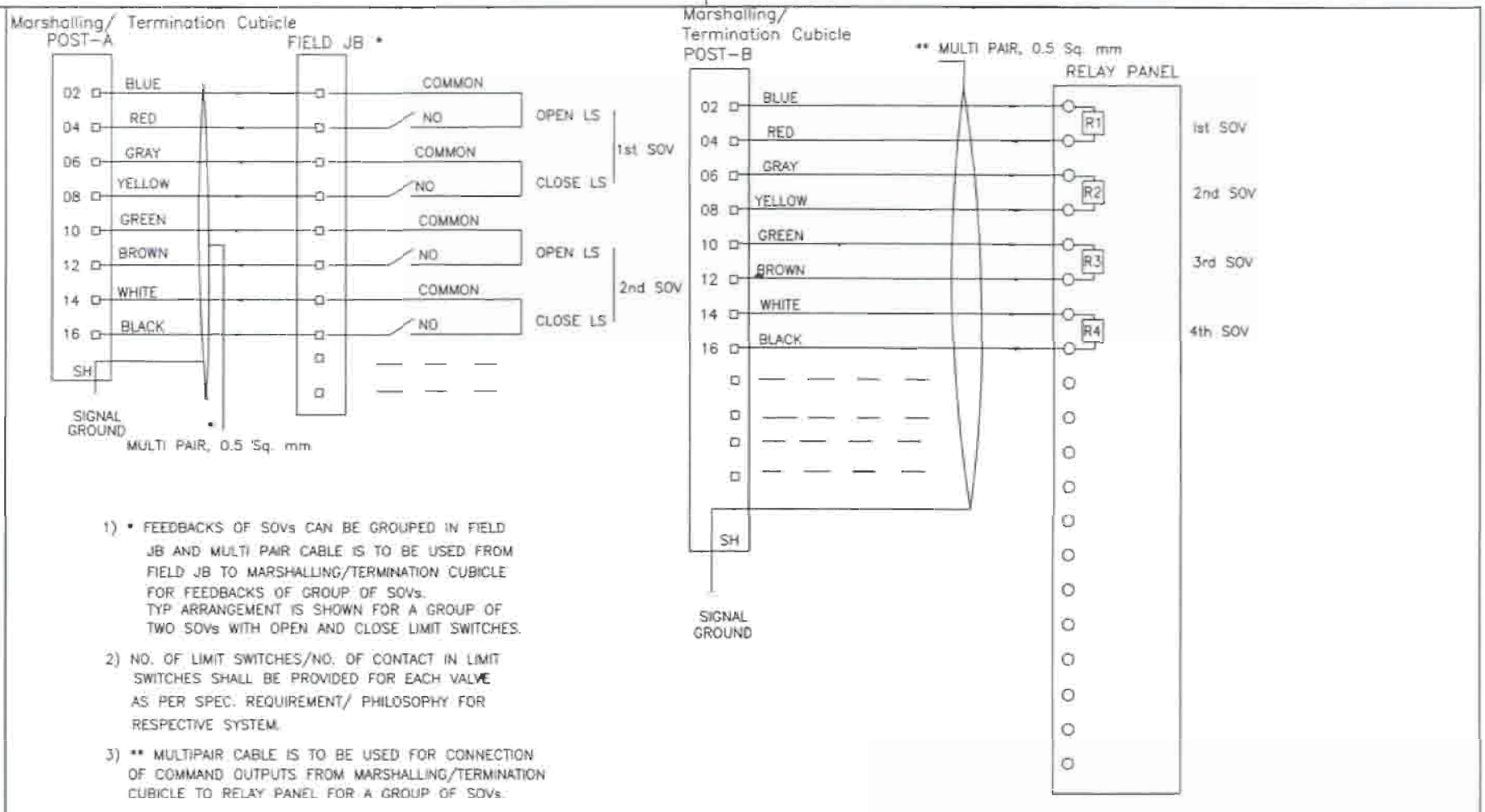
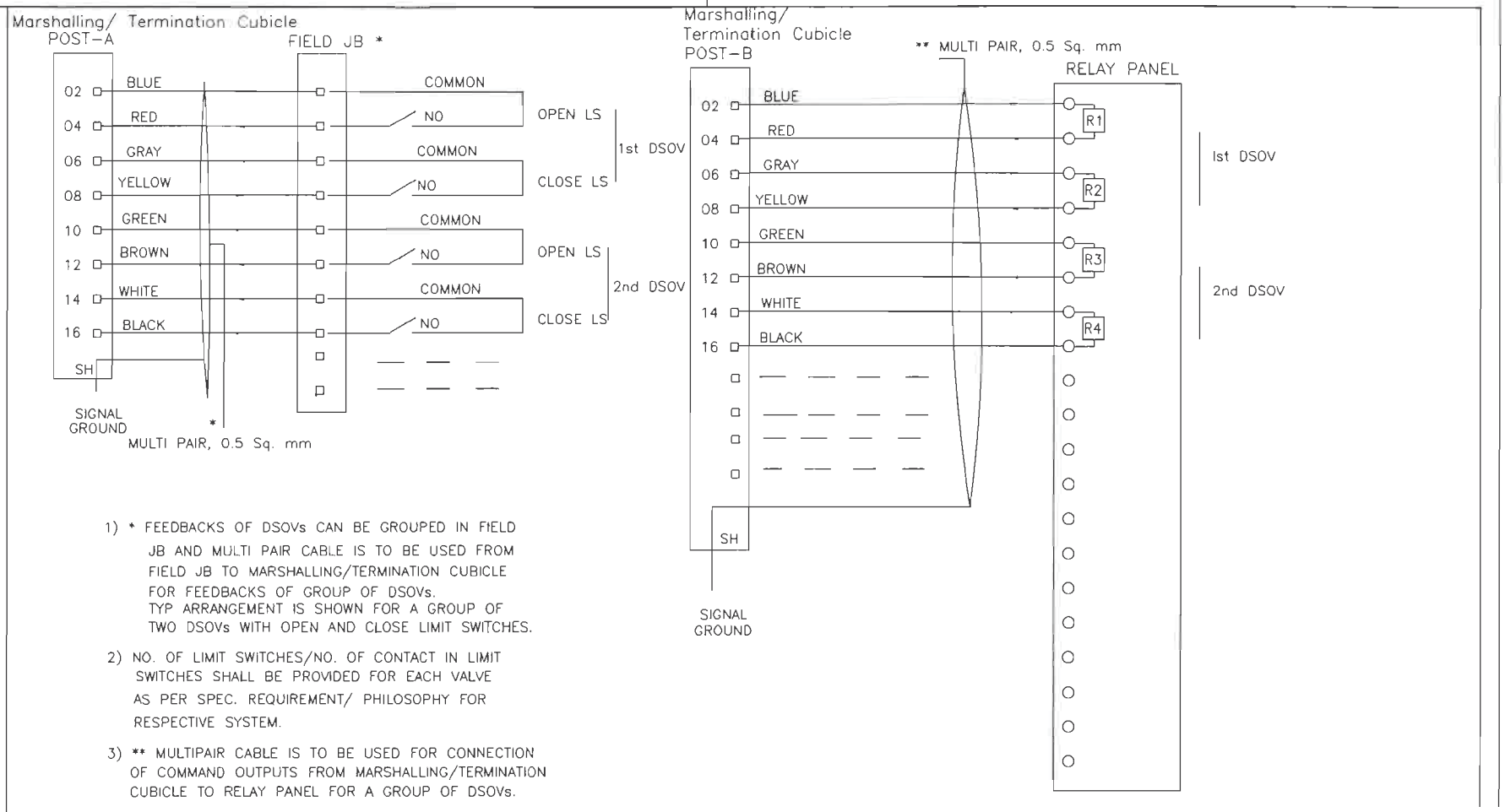


1) * FEEDBACKS OF SOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF SOVs. TYP ARRANGEMENT IS SHOWN FOR A GROUP OF TWO SOVs WITH OPEN AND CLOSE LIMIT SWITCHES.

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)		
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 08 OF 14	C



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.

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TITLE			
INTERFACING OF FIELD INSTRUMENTS INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR (DOUBLE COIL SOLENOID)			
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 09 OF 14	C

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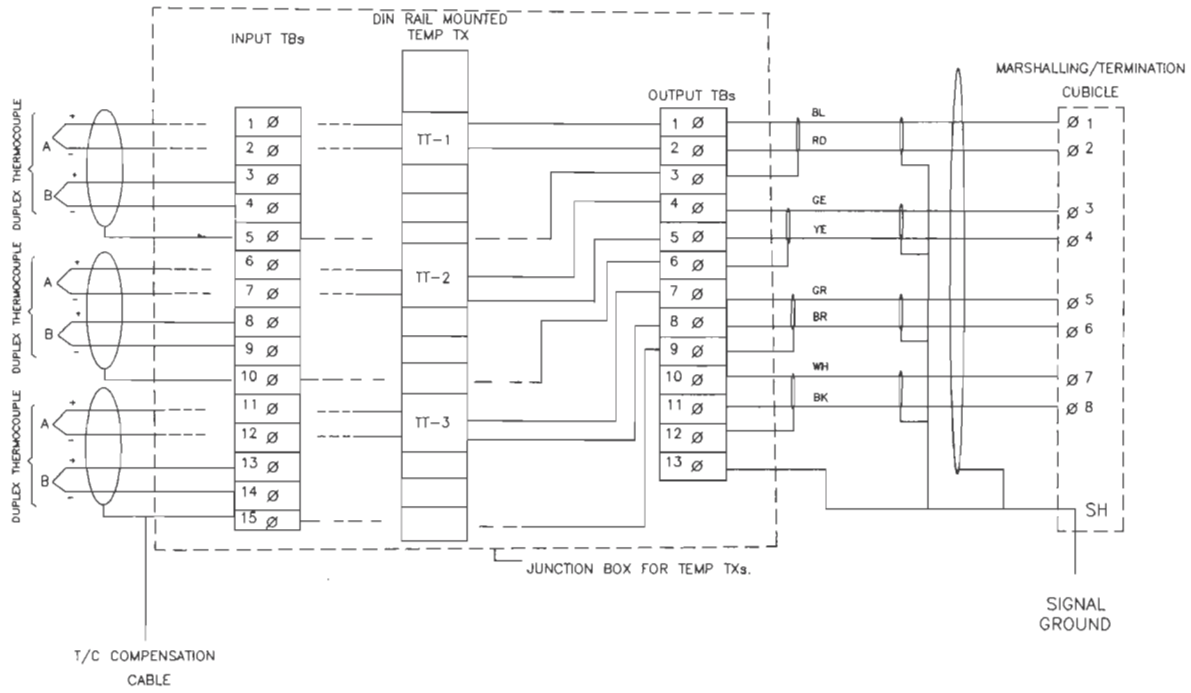

NOTE: 1) ABOVE IS THE TYP DRG. FOR DIN RAIL MOUNTED TEMP TRANSMITTER FOR T/C APPLICATION. EXACT TYPE OF TEMP TRANSMITTERS SHALL BE AS PER PART-A OF SPECIFICATION.

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			
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 11 OF 14	C

SECTION – D
GENERAL TECHNICAL REQUIREMENTS (MECHANICAL)

VOLUME : II-A

SECTION - IV

GENERAL TECHNICAL REQUIREMENTS

CONTENTS

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	CODES AND STANDARDS	1
2.00.00	DESIGN CRITERIA	2
3.00.00	REDUNDANCY	3
4.00.00	NAME PLATES / RATING PLATES / LABELS	3
5.00.00	SAFETY AND SECURITY	5
6.00.00	GUARDS	5
7.00.00	LOCATION AND LAYOUT REQUIREMENTS	6
8.00.00	OPERATION AND MAINTENANCE CONSIDERATIONS	8
9.00.00	MATERIALS	9
10.00.00	LUBRICATION	10
11.00.00	LUBRICANTS, SERVO FLUIDS AND CHEMICALS	10
12.00.00	PLANT LIFE AND MODE OF OPERATION	11
13.00.00	PACKAGING & MARKING	11
14.00.00	PROTECTION	12
15.00.00	PAINTING	13
16.00.00	COLOUR CO-ORDINATION AND FINISH	13
17.00.00	ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT	13
18.00.00	INSPECTION AND TESTING	15
19.00.00	TRAINING OF OWNER'S PERSONNEL	16
	ATTACHMENTS	
ANNEXURE-I	LIST OF STANDARDS FOR REFERENCE	19
ANNEXURE-II	CRITERIA FOR LAYOUT	21

VOLUME : II-A

SECTION - IV

GENERAL TECHNICAL REQUIREMENTS

1.00.00 CODES AND STANDARDS

1.01.00 Except where otherwise specified, the design of FGD Plant package shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the Annexure-I to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the FGD Plant package in the same detail as would be possible had there been a Standard Specification.

1.02.00 The Bidder shall submit along with his bid the list of main codes and standards proposed to be used for the design, construction and testing of the plant. Where the Bidder proposes alternative codes or standards in place of those mentioned in this technical specification, he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.

1.03.00 Wherever specified or required to the FGD Plant package shall conform to all applicable statutory regulations such as Indian Boiler Regulations, Indian Electricity Rules, Indian Explosives Act, Factories Act etc. Wherever required, approval for the FGD Plant package supplied under the specification from statutory authorities shall be the responsibility of the Bidder.

1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern. And if they are equally stringent, the Bidder shall follow the hierarchy as follows:

i) Local regulations
ii) Local codes and standards
iii) This Technical Specifications
iv) Industry codes and standards

1.05.00 In case of any change of code, standards and regulations between the date of purchase order and the date the Bidder proceeds with manufacturing the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Bidder to bring such changes to the notice of the Owner and advise Owner of the resulting effect.

1.06.00 Combining or mixing of codes and standards of different institutions with respect to individual engineered components/equipments shall not be permitted without the written approval of the Owner.

2.00.00 DESIGN CRITERIA

2.01.00 Capability

The Flue Gas Desulphurisation (FGD) System shall be designed to comply with the design and guarantee point conditions mentioned below and should achieve Sulphur Dioxide (SO_2) level of not exceeding 150 mg/Nm^3 and 150 mg/Nm^3 respectively at 6% excess oxygen level at the stack outlet under all plant operating conditions. The SO_2 removal efficiency shall not be less than 95 % under all operating condition. These shall be modified to more conservative values if Contractor experience warrants the same. However, no credit shall be given to the Contractor for this during evaluation of the bids. Utilization of these values in no way relieves the Contractor of his responsibility to meet all the guarantee requirements.

a) Design Point : BMCR load with worst Coal, 45 deg.C and 60% RH ambient condition

b) Guarantee Point : TMCR load with worst Coal, 27deg.C and 60% RH ambient condition

2.02.00 Equipment Sizing Margins

The following equipment sizing design margins shall be used, as a minimum, based on normal operation of the plant (2x500MW at TMCR) with Coal having highest Sulphur content unless other margins are specified in this Design Specifications.

Equipment/ System	Mass Flow Margin	Pressure Margin
Absorber (gas and slurry)	10%	NA
Limestone Grinding system	10%	NA
Gypsum Dewatering System	10%	NA
Hydro-cyclone	10%	NA
Pumps	10% min.	15% (friction losses)
Blowers/Compressors/ Vacuum pumps	10% min.	10%
Conveyors	10% min.	NA
Crushers	20% min.	NA
Flue Gas Booster Fans	20%	44%

2.03.00 Off-normal operation

2.03.01 The FGD system shall also be capable of operating with partial bypass of flue gas.

2.03.02 The flue gas temperature at inlet to FGD shall be about 175^0C. However, in case of APH failure the flue gas temperature may rise to about 375^0Cfor a short duration and the FGD system shall be designed to suitably withstand such operation without any damage to the system.

2.03.03 The FGD plant shall be capable of following the load imposed by the boiler, including rate of load changes, minimum load and the anticipated daily and annual load schedules. Furthermore, the FGD plant shall be capable to be put in operation, while the boiler is in operation at any load, without any disturbance in the operation of the Units.

3.00.00 REDUNDANCY

3.01.00 Redundancy of design shall be such that the performance of primary and auxiliary equipment shall be sufficient to meet the availability requirements of the plant.

3.02.00 Each equipment whose failure could result in damages to another equipment, or reduce the availability of the plant shall be backed up by a stand-by equipment.

3.03.00 Each equipment whose unavailability due to a failure could result in damages to another equipment or create a health & safety risk for the personnel shall be backed up by a stand-by equipment, one of them being fed by an emergency source in case of external black out.

3.04.00 Design of availability of the FGD Plant equipment & auxiliaries will be such that a failure with consequential shutdown of one Absorber & auxiliaries will in no circumstances be at the origin of a shutdown of the other Absorber & auxiliaries.

3.05.00 Redundancy criteria applicable for specific systems have been addressed in respective sections of the specification (Volume IIB to II-I) and tender drawings (Volume IIJ).

4.00.00 NAME PLATES/ RATING PLATES/ LABELS

4.01.00 Instruction plates, nameplates (rating plates) or labels shall be permanently attached to each main and auxiliary item of FGD Plant equipment & auxiliaries, including instruments, in a conspicuous position. These plates shall be of stainless steel and shall be engraved with the identifying name, type, identification number and manufacturer's serial number, together with the loading conditions under which the item of plant has been designed to operate.

4.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Bidder shall pay specific attention to the nameplates/labels during painting, so that these are not painted over. Direction of flow is also to be engraved. All actuated valves shall be provided with labels, which shall include the valve and actuator reference number.

4.03.00 All nameplates and labels shall be in English language. All measurements shall be in S.I. units.

4.04.00 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

4.05.00 Nameplates shall be 3 mm thick laminated white, black, white traffolyte for electrical and control panels and stamped stainless steel with lettering of a minimum height 5 mm for other equipment of FGD Plant Equipment & auxiliaries. Warning labels and emergency equipments shall have red lettering in place of black. Danger labels shall have red lettering on a white background. Labels shall be of sufficient size to carry a full description of the FGD Plant item and its complete KKS identifier. The size and location of nameplates shall be subject to Approval of the Owner. Lettering in all cases shall be machine-made and made to be legible after prolonged time in the range of ambient conditions prevailing at the Site.

4.06.00 Universal designation system utilizing six level breakdown KKS numbering system shall be followed for equipment identification. Each piece of equipment, motor, pump, valve, instrument, switchgear cabinet, junction box, control panel, panel board and associated apparatus shall be provided with tag plates indicating tag number and description. All major equipment (including the absorber, hydrocyclone, ball mills, belt filters, auxiliary transformers, booster fans, large pumps and blowers and motors) shall be provided with the data plates, indicating the name of the vendor, type, serial number, year of fabrication, main characteristics, and all further information necessary for a complete identification of the equipment.

4.07.00 All piping shall be painted and/or marked in accordance with the fluid contained according to a power plant color code to be proposed by Bidder and approved by Owner.

4.08.00 Tags shall be fitted by stainless steel self-tapping screws, stainless steel banding such that they are not readily lost or broken during routine operations and maintenance.

4.09.00 Surfaces of labels for cubicles and control equipment shall have a matte or satin finish to avoid dazzle. Colors shall be permanent and free from fading. Danger labels shall have red lettering on a white background. Labels shall be

provided on front and rear access doors of all cubicles. Labels shall also be provided inside cubicles to assist the identification of apparatus and terminals.

4.10.00 All lifting beams, cranes, rails, jibs, hoists, slings, straps and other lifting equipment shall be properly tested and permanently marked with their lifting capacity.

5.00.00 SAFETY AND SECURITY

5.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.

5.02.00 Ready and safe access with clear head room shall be provided to all parts of the FGD Plant Equipment & auxiliaries for operation, inspection, cleaning and maintenance. All platforms shall be fenced and all stairways shall be provided with handrails.

5.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the personals in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The FGD Plant Equipment & auxiliaries layout shall be designed to localise and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, etc. as necessary shall be followed in all respects.

5.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of prohibited materials in any form as mentioned elsewhere in this specification.

6.00.00 GUARDS

6.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.

6.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.

6.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.

6.04.00 Guards for couplings and rotating shafts shall be in accordance with latest revisions of BS PD 5304-2005/ BS EN 953-1998 or similar approved standard. All rotating shafts and parts of shafts must be covered.

6.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.

7.00.00 LOCATION AND LAYOUT REQUIREMENTS

The majority of FGD Plant Equipment & auxiliaries (excluding Absorber and DG sets) shall all be of indoor installation. A broad list of buildings housing such equipment is given elsewhere in this specification. Layout should facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the FGD Plant Equipment & auxiliaries. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout drawings show the location of major facilities. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the FGD area as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.

Bidder may give alternate layout of their own with different orientation and relocation but all the equipments and facilities as in tender drawing/specification should be covered and the overall BTG area layout as shown in tender drawing is to be maintained.

While preparing the detailed layout and deciding upon the transportation and construction/ erection strategy and functional requirements, the following aspects shall be ensured:

a) Face of the buildings and facilities shall be located in such a way so as to have an offset of minimum 20 m with respect to center line of double lane road and 15 meter with respect to center line of single lane road.

b) The spacing between various buildings and facilities shall be suitably decided so as to avoid interference between the foundations.

c) The area for construction/erection facilities like lay-down, pre-assembly, offices and stores will be accommodated within the areas available in General Layout Plan.

d) All statutory requirements including safe distances between various facilities as per applicable rules/acts/laws including local by-laws will be complied with.

e) Minimum clearances/ dimensions

i)	Around the equipment	:	1200mm
ii)	Width of all staircases	:	1200mm (Minimum)
iii)	Clear Head room within Plant Buildings for pipes, ducts, Structures & cable trays etc.	:	2.5m (Minimum)
iv)	Clear head room in outdoor Power Block area for cable trays & piping	:	8m (BOS)
v)	Clear head room in other outdoor Areas for cable trays & piping	:	3m (BOS)
vi)	Clear head room for conveyors	:	8m (BOS)

f) All piping shall be routed at a clear height of 2500mm (min.) from the nearest access level to clear man movement.

g) A walkway of 600mm (minimum width) with pipe hand rails & toe guards shall be provided all along length of the trestle for maintenance of cables & pipes. Ladders for approach to these platforms shall be provided near roads, passage ways and turning points.

h) Head room for man movement shall be minimum 2.5m at ground floor in boiler area and 2.1m over all platforms.

i) Height of trestles at approach roads to various buildings/facilities shall be 8M. In case building are located in off-site area and are adjacent to each other, then as a good engineering practice, the height of trestle shall be maintained all over as 8.0M.

j) Each equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of factory act and TAC.

k) All cranes shall be provided with approach rung ladders at least at two places. Where ever cranes can't be maintained in situ on the carriage, facility to draw them to maintenance platforms as well as provision of suitable platforms with access facility shall be provided.

l) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as

specified.

m) The plinth level with respect to the existing grade level shall be as indicated elsewhere in this specification.

n) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.

o) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.

p) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified elsewhere in this specification shall be complied with.

q) Top cover over underground pipes/cables shall be minimum one (1) meter.

r) Cubicle for operating personnel shall be located at safe place near the equipment.

s) Cable racks / pipe racks shall have hand railings in walkways on both sides at appropriate heights.

t) All the buildings and facilities will be approachable by the fire tenders.

u) Utility pipes except fire water pipes will be routed over ground on trestles. No trenches for pipes will be envisaged as far as possible. In the Power block area, Fire water pipes will be routed in RCC trenches.

v) Wherever steam pipes or pipes conveying hazardous fluids are running over the trestle, fire water pipes shall not be routed on the same trestle.

8.00.00 OPERATION & MAINTENANCE CONSIDERATIONS

8.01.00 Space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that

they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with hand railing and access ladders/structural steel staircase shall be provided as per layout availability to facilitate operation and maintenance.

8.02.00 Lifting devices i.e. hoists, chain pulleys, etc. shall be provided for handling of any equipment and/or part having weight in excess of 250 Kg during erection and maintenance activities**.** Suitable monorail beams, hooks etc. for this purpose shall be provided in the buildings. The monorail shall be extended to outside the buildings by minimum 2m. The monorail beam shall extend through suitable opening in the building fitted with an approved double flap steel door [with chain or better opening and closing mechanism], removable handrails, platforms etc to enable removal of equipment to ground level or vice-versa.

Lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall also be provided by the Bidder for lifting the various equipment and accessories covered under this specification.

8.03.00 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Wherever feasible common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.04.00 Suitable machinery-hatch, removable steel gratings / covers / hand-railing etc. shall be provided in Buildings, etc. as found necessary during detailed engineering.

9.00.00 MATERIALS

9.01.00 In selecting materials of construction of equipment, the Bidder shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new and shall be of the quality most suited to the proposed application.

9.02.00 As far as possible, materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Owner/ Consultant to assess the suitability of the material for the particular application.

Materials used for various components shall be those which have already proven operating experience in similar type of applications.

9.03.00 All parts which could deteriorate or corrode under the influence of the

atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

9.04.00 Prohibited Materials

The use of the following materials is prohibited:

a) High alumina cement in structural elements

b) Wood wool slabs in permanent framework to concrete

c) Calcium chloride in mixtures for use in concrete works

d) Naturally occurring aggregate for use in reinforced concrete that does not comply with the applicable codes and standards

e) Cast iron for any oil service

f) Carcinogenic material and suspected carcinogenic materials by World Health Organization.

g) Asbestos or any other fibrous form of hydrated magnesium silicate

h) Any other material generally known to be deleterious if used or incorporated in such project like the facility.

10.00.00 LUBRICATION

10.01.00 Suitable efficient lubrication system shall be provided where necessary to ensure smooth operation free from undue wear.

10.02.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.

10.03.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant which may drop from operating parts.

10.04.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.

10.05.00 The Bidder shall supply grease gun equipment suitable to service each type of nipple fitted

11.00.00 LUBRICANTS, SERVO FLUIDS AND CHEMICALS

11.01.00 The Bidder shall provide a detailed and comprehensive specification for all lubricating oils, greases, control fluids and essential chemicals required for the entire plant. A sufficient supply of these shall be provided by the Bidder for initial commissioning, first fill and one year's topping.

11.02.00 The Bidder shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants, control fluids and chemicals shall be provided. The Bidder shall endeavour to reduce the varities and grades of required lubricants and control fluids to a minimum, match them to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognised standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.

11.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment. Safety data sheets for all lubricants, oils, chemicals etc .specifying composition, application, chemical properties and preventive or accidental care that must be taken before and after use shall be papered by the Bidder and submitted to Owner for approval

12.00.00 PLANT LIFE AND MODE OF OPERATION

The complete FGD Plant Equipment & auxiliaries including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty intended.

The critical components of the FGD Plant, the life of which is limited by time and temperature dependent mechanisms such as corrosion, thermal stress, creep and low cycle fatigue, etc. are to be designed considering expected duty conditions and cyclic load variations.

The allowable stresses shall be reduced so that life expectancy to minimum 2,00,000 hours of operation can be achieved.

The plant would be designed for base load operation as well as cyclic load variation. The load variation is expected to be as per schedule depending on power demand. The FGD Plant Equipment & auxiliaries shall be suitable for shutdown on every weekend, if required. Moreover, the FGD Plant Equipment & auxiliaries should be capable to operate frequently down to 40% load.

13.00.00 PACKAGING & MARKING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations

from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Bidder shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

As per the information available, the dimensions of over-dimensioned (OD) consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below:

a) Width of the Package (from centre-line of rails - 1.6 metres on both sides) : 3.2 Meters

b) Height of the package from rail top : 4.47 Metres

The above indicates the dimensions which can be normally transported on the wagons without infringement of the "moving gauge". However, Bidder shall conduct his own route survey and transportation logistics for transportation of the equipments to project site by road/rail/sea and indicate the same in his proposal. In case of sea transportation, Bidder to consider unloading of equipment at Tuticorin port. Transportation to project site from the nearest railway station or sea port shall be considered by road only.

The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Bidder shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Bidder, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

14.00.00 PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other suitable covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other suitable protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Male threaded openings shall be closed with rough usage covers or plugs. Female threaded

openings shall be closed with forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of piping, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Bidder's expense.

15.00.00 PAINTING

15.01.00 Please also refer to Section V of Volume-IIA, for details of painting.

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

16.00.00 COLOUR CO-ORDINATION & FINISH

16.01.00 Exterior surfaces throughout the FGD Plant area shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

16.02.00 Interior surfaces throughout the FGD area 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 equipment and services provided shall be colour coded for ease of identification.

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

16.04.00 Final colours and finishes shall be to the Approval of the Owner.

17.00.00 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

17.01.00 Environment Protection

17.01.01 The FGD Plant Equipment & auxiliaries area shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to ensure zero discharge from liquid effluents and other effluents within the limits specified in Environment (Protection) Rules 1986 as amended till date.

In case 'The Ministry of Environment, Forest and Climate Change (MOEFCC)' stipulate any other conditions not specified hereunder while clearing the project, the same shall be complied by the Bidder.

17.01.02 Any specific requirement of State Pollution Authorities over and above the above stipulation shall also be complied with by the bidder.

17.02.00 Noise Level Requirement

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

a) Maximum noise level shall not exceed 85 dB (A) when measured at 1 meter away from the noise emission source, at a height of 1.5 meters above finished floor level.

b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, `Ambient Air Quality Standards' in respect of noise.

c) Maximum noise level shall not exceed 105 dB(A) for safety valves and associated vent pipes and 90 dB(A) for regulating drain valves. For operating control valves, the noise level shall be within the limit of 85 dBA. For all valves & orifices, the measurement shall be made one (1) metre down stream of the devices and one (1) metre from the surface of the pipe for any combination of pressure drop and flow.

d) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or The Ministry of Environment, Forest and Climate Change regulation during tenure of the contract, the Bidder shall comply with the requirement.

17.03.00 Environmental design specifications

17.03.01 Construction materials and system contents prohibited

a) No equipment or construction materials brought onto or incorporated into the Facility shall contain asbestos at any content level. Only suitable substitutes for asbestos are permitted to be used.

b) Chemicals that are not accompanied by a material safety data sheet shall not be permitted to be used in any Work Area or incorporated into the Work.

c) No ozone depleting substances (as defined by the 1987 Montreal Protocol) at any level are allowed to be used in systems provided by Bidder. Only suitable substitutes are permitted.

17.03.02 Ambient noise mitigation

The Facility noise levels shall not exceed the more stringent of Applicable Law or the Noise Compliance Guarantee.

The Bidder shall abate ambient noise to public receptors in accordance with the more stringent of Applicable Law or the Noise Compliance Guarantee. Mitigation measures that shall be considered during project design include, but are not limited to, the following:

a) Selecting equipment with lower sound power levels;

b) Installing silencers for fans, blowers, compressors;

c) Installing suitable mufflers on engine exhausts and compressor components;

d) Installing acoustic enclosures for equipment causing radiating noise;

e) Applying sound insulation to improve the acoustic performance of buildings;

18.00.00 INSPECTION AND TESTING

18.01.00 Inspection and Tests during Manufacture

18.01.01 The method and techniques to be used by the Bidder for the control of quality during manufacture of all FGD Plant Equipment & auxiliaries shall be as stipulated elsewhere in the specification.

18.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

18.01.03 Before any item of FGD Plant Equipment & auxiliaries leaves its place of manufacture. the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

18.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

18.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Owner. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Owner.

18.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to despatch from place of manufacture.

18.01.07 All materials used for the manufacture of equipment covered under this

specification shall be of tested quality. Relevant test certificates shall be made available to the Owner. The certificates shall include tests for mechanical properties and chemical analysis of representative material.

18.01.08 All pressure parts shall be subjected to hydraulic testing as per the requirements of IBR. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than thirty (30) minutes.

18.01.09 All necessary non-destructive examinations shall be performed to meet the code requirements of ASME or IBR as applicable.

18.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed. Statutory payments in respect of IBR approvals including inspection shall be made by Bidder. Bidder's scope and responsibility shall also include preparation and submission of all necessary documents in the specific formats and manner stipulated by the statutory bodies, coordination and follow up for above approvals.

18.02.00 Inspection and Testing at Site

18.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested under the supervision of the Technical Advisor of the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

18.02.02 The Bidder shall provide complete details of his standard procedure for testing the quality of erection and the performance of erected FGD Plant Equipment & auxiliaries. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the pipe work and the adequacy of joints made at site.

18.03.00 For details of specific tests required on individual equipment refer to respective Technical volumes of this specification.

19.00.00 TRAINING OF OWNER'S PERSONNEL

The Bidder shall extend all possible assistance and co-operation to the Owner regarding the transfer of technology and developing expertise in the area of operation and maintenance of the FGD Plant Equipment & auxiliaries.

The details of the training programme will be discussed and finalised with the successful Bidder.

19.01.00 Training at Bidder's Premises

19.01.01 The Bidder shall conduct training of engineers and plant operators of the Owner on engineering, operation and maintenance of the Plant at the Bidder's or Associates or Sub-Bidder's premises where adequate training facilities are available during the design and manufacturing stage.

19.01.02 The training may also be arranged by the Bidder in any Plant where the equipment manufactured by the Bidder or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Bidder. All expenses inherently related to the training shall be borne by the Bidder and shall include but not be limited to travel expenses (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

19.01.03 The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the operation and maintenance of the FGD Plant Equipment & auxiliaries. The Bidder shall be responsible for the development of the Training Module and Programme Schedule which shall be submitted to the Owner for approval.

19.01.04 The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee. Three (3) sets of the materials included in the training modules shall be handed over to the Owner upon completion of the training. An evaluation shall be jointly undertaken by the Bidder and the Purchaser's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

19.01.05 The content of the training programme shall include but not be limited to:

1. Limestone based Flue Gas Desulphurisation Plant for Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.
2. Plant operation and systems training for operators including simulator training as applicable.
3. Maintenance training programme covering electrical, mechanical and instrumentation and control.

19.01.06 The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the FGD Plant Equipment & auxiliaries. Said training programme shall be submitted to the Owner for approval.

The Bidder shall provide qualified English speaking instructors and training coordinator(s) during the tenure of the training programme.

19.02.00 Operation and Maintenance Training at Site

19.02.01 The Bidder shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Bidder's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the first FGD Unit.

19.02.02 The following instructors shall be at the Site continuously during the training:

a) One (1) for Flue Gas Desulphurisation Plant
b) One (1) for Limestone Handling system (part time)
b) One (1) for Electrical Works
c) One (1) for Instrumentation and Control

19.03.00 The total man-months for training of engineers shall be maximum thirty (30), having following indicative break-up:

Discipline	**No. of Man-months**
Operation	12
Mechanical Maintenance	4
Electrical Maintenance	4
Control & Instrumentation	6
Maintenance Planning	4
	30

However, the details of the training programme will be discussed and finalised with the successful Bidder.

19.03.01 On-the-Job Training

19.03.02 During the period of pre-commissioning, commissioning and trial operation, the Owner shall provide operation and maintenance personnel to assist the Bidder in the operation and maintenance of his supply and work under the direction of the Bidder for the purpose of on-the-job training.

19.03.03 The Owner shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The Bidder shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.

ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

a) International Organisation for Standardisation (ISO).

b) International Electro-technical Commission (IEC).

c) American Society of Mechanical Engineers (ASME).

d) American National Standards Institute (ANSI).

e) American Society for Testing and Materials (ASTM).

f) American Institute of Steel Construction (AISC).

g) American Welding Society (AWS).

h) Architecture Institute of Japan (AIJ).

i) National Fire Protection Association (NFPA).

j) National Electrical Manufacturer's Association (NEMA).

k) Japanese Electro-technical Committee (JEC).

l) Institute of Electrical and Electronics Engineers (IEEE).

m) Federal Occupational Safety and Health Regulations (OSHA).

n) Instrument Society of America (ISA).

o) National Electric Code (NEC).

p) Heat Exchanger Institute (HEI).

q) Tubular Exchanger Manufacturer's Association (TEMA).

r) Hydraulic Institute (HIS).

s) International Electro-Technical Commission Publications.

t) Performance Test Codes (PTC).

u) Applicable German Standards (DIN).

v) Applicable British Standards (BS).

w) Applicable Japanese Standards (JIS).

ANNEXURE-I

x) Electric Power Research Institute (EPRI).

y) Standards of Manufacturer's Standardization Society (MSS).

z) Bureau of Indian Standards Institution (BIS).

aa) Indian Electricity Rules.

bb) Indian Boiler Regulations (IBR).

cc) Indian Explosives Act.

dd) Indian Factories Act.

ee) Tariff Advisory Committee (TAC) rules.

ff) Pollution Control regulations of Ministry of Environment, Forest and Climate Change, Govt. of India .

gg) Central Board of Irrigation and Power (CBIP) Publications.

hh) National Building Code (NBC).

ii) Indian Road Congress (IRC).

ANNEXURE-II

CRITERIA FOR LAYOUT

PLOT PLAN LAYOUT REQUIREMENTS

The guidelines will be applied in general, unless otherwise stated in other technical Volumes. In addition to these guidelines, Bidder shall refer the attached Area Plans, drawing no. 17A14-DWG-M-0002A, 0002B and 0002C for tentative arrangement of the various facilities under this package.

	ITEM	SPECIFICATION REQUIREMENT
A.	Site conditions to be considered	
1.	Prevalent wind direction(s) during dry seasons (for deciding the location of limestone stock pile and unloading areas, minimising the pollution effect due to dust)	West to East. Also see wind-rose in plot plan.
2.	Location of:	
	a) Plant drainage outfall point(s).	Towards North East
	b) Railway entries & exits.	Not Applicable
B.	Layout Requirements	
1.	Maximum permissible slope in	
a)	Rail track	Not applicable
b)	Road	1 in 30
c)	Sides of unpaved embankment	1 in 2
2.	Required road width	
a)	Main Plant access road	10.0 Metres with 1.5 m wide shoulders on either side.
b)	Primary roads without access for 500 T crane	7.5 Metres with 1.5 m wide shoulders on either side
c)	Access ways	4.0 Metres with 1.2m shoulders on either side.

ANNEXURE-II

d)	Road to the absorber area :	Yes.
3.	Required minimum horizontal distance between the nearest points of	
a)	Plant boundary and the boundary of residential area	(Local municipality/factory rule)
b)	Electrical transformer and any other	As per the Tariff Advisory building/facilityCommittee Rules.
c)	Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee Rules.
d)	Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Expolsives Act) and Indian Petroleum Code.
4.	Required minimum vertical clearance	
a)	Under pipes/cable racks at road crossings	8.0 Metres.
b)	Soil coverage over underground pipes for CW/ACW piping	1.0 Metre (minimum) 1.5M
c)	Outdoor Pipe/Cable trench (if required)	150 mm above FGL
d)	Minimum height of equipment (switchgear, cabinet etc.) above floor for HT cable entry	500 mm
e)	Minimum height of equipment (switchgear, cabinet etc.) above floor for LT cable entry	300 mm
5.	Railway Wagon clearance	Not applicable
6.	Minimum Clearance between any road edge and building/structure/ any fixed installation.	3 Metres.

ITEM	SPECIFICATION REQUIREMENT

ANNEXURE-II

7.	Required level, above the local developed grade level, of	
a)	top of all roads	150 mm.
b)	all outdoor paved areas	150 mm.
c)	Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes.

568142/2021/PS-PEM-MAX

VOLUME-III

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING) PROJECT: 2X500 MW TUTICORIN TPP (NTPL) **(FGD SYSTEM PACKAGE)**	BHEL DOCUMENTS NO.: PE-TS-483-154-A001 VOLUME: III SECTION: REV NO: 00 DATE:

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

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

DEVIATION SHEET (COST OF WITHDRAWL)

TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING).
PROJECT: 2X500 MW TUTICORIN TPP (NTPL) (FGD SYSTEM PACKAGE).

TECH SPC NO: PE-TS-483-154-A001

TENDER ENQUIRY REFERENCE:-

NAME OF BIDDER:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF 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.

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING) PROJECT: 2X500 MW TUTICORIN TPP (NTPL) (FGD SYSTEM PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-483-154-A001	
		VOLUME III	
		REV. NO. 00	DATE:

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

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

2. QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.

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

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

5. There are no other deviations with respect to specification other than those furnished in the ‘Schedule of Deviations’.

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

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

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

9. Any special tools & tackles, if required, shall be in bidder’s scope.

10. Performance guarantee test parameters shall stand valid till the satisfactory completion of Performance guarantee test and its acceptance by BHEL/Customer.

11. Prices for recommended spares (if any) for three year operation shall be furnished separately and not to be included in the base price.

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING) PROJECT: 2X500 MW TUTICORIN TPP (NTPL) (FGD SYSTEM PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-483-154-A001	
		VOLUME III	
		REV. NO. 00	DATE:

DRAWING/DOCUMENTS SUBMISSION SCHEDULE FOR CHEMICAL DOSING SYSTEM

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 **Sec-C1**. The submission of soft copy or hard copy of the drawing/document whichever is later will be considered as final date of submission of the drawing/document. The bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

Bidder to note that the drawings to be submitted by bidder in the event of award of contract shall be as per the below given drawing/document list. Bidder to note that any additional drawings/documents requirement during detailed engineering shall be provided by bidder without any technical, commercial and delivery implications to BHEL. Bidder confirmed that every revised submission incorporating comments – within 7 days.

Bidder further confirmed that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

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

Sl. No.	BHEL Drg. No.	Title	CATEGORY	No. of weeks for document submission after placing LOI/LOA	SIZE OF DRAWING/ DOCUMENT
1	PE-V1-483-154-A004	P&I DIAGRAM	A	4	A1
2	PE-V1-483-154-A005	GA DRAWING	A	4	A1
3	PE-V1-483-154-A006	DATA SHEET FOR SYSTEM	A	6	A4
4	PE-V1-483-154-A007	LCP DRAWING	A	6	A4
5	PE-V1-483-154-A008	QAP	A	4	A1
6	PE-V1-483-154-A009	O& M MANUAL	A	8	A4

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

- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- Vendor's internal proxy setting should not block DMS application's link
    - (http://124.124.36.198/wrenchwebaccess/login.aspx)

- DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
- For quick access bidder may refer the link http://bhelpem.com/DMSManuals/DMSManuals.html

	TITLE: TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM (NaOH DOSING) PROJECT: 2X500 MW TUTICORIN TPP (NTPL) (FGD SYSTEM PACKAGE)	BHEL DOCUMENTS NO.: PE-TS-483-154-A001	
		VOLUME III	
		REV. NO. 00	DATE:

NOTES:

1. A= APPROVAL. I = INFORMATION.
2. ANY ADDITIONAL DRAWINGS-DOCUMENTS REQUIRED DURING DETAILED ENGINEERING STAGE SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL, TECHNICAL AND DELIVERY IMPLICATION TO BHEL AND CUSTOMER.
3. BIDDER TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/NTPC APPROVED FORMATS LIKE MS EXCEL, MS WORD OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST, FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, ETC. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.
4. DOCUMENTS PERTAINING TO PROVENNESS TO BE SUBMITTED BY THE BIDDER.
5. DWG. / DOCUMENT SHALL BE UPLOADED BY THE SUCCESSFUL BIDDER ON WRENCH /DMS. PROCEDURE FOR THE SAME WILL BE INFORMED AFTER AWARD OF CONTRACT.

DECLARATIONS

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

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

Bidders Company Name …….

Authorized representative's
Signature ……..

Name …….

Bidder's Name

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