277036/2024/PS-PEM-WSE

SUGGESTED PRICE FORMAT		Doc No:	PE-PF-445-154-A001
		Rev No:	0
		Date of issue	08.05.2024
NAME OF PROJECT:	1 x 660 MW SAGARDIGHI TPS UNIT 5, PHASE - III		
NAME OF PACKAGE:	CHEMICAL DOSING SYSTEM		
TECHNICAL SPECIFICATION:	PE-TS-445-154-A001 Rev. 0		

S. No.	DESCRIPTION	UNIT	HSN CODE	QTY	Total F.O.R Site prices
1.0	Total lump sum firm price inclusive of all prevailing taxes, duties and other levies for SUPPLY PART, MANDATORY SPARES & SERVICE PART SUPERVISION OF ERECTION & COMMISSIONING, 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, mandatory spares, startup and commissioning spares as required, forwarding, proper packing, shipment and delivery at site for project and package specified above complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.	Set	84041000	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, startup and commissioning spares as required, 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)	Set	84041000	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).	Lot	84041000	1	
2.3	Total lump sum firm price inclusive of all prevailing taxes, duties and other levies for SERVICES PART comprising of supervision of erection & commissioning for One (1) Visit for station for Four Days inclusive of charges of Air-Fair/Rail-Fair, Boarding/Lodging, Local conveyance, medical, insurance, training etc. for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order. (Price break up of SERVICES PART is to be furnished as per Annexure- III).	Set	998732	1	

Note:
1) PG to consider and suitably incorporate taxes, duties and other commercial aspects.

Particulars of bidder / authorised representative

Name	Designation	Signature	Date		Company Seal

277036/2024/PS-PEM-WSE

SUGGESTED PRICE FORMAT ANNEXURE-I			Doc No:	PE-PF-445-154-A001	
			Rev No:	0	
			Date of issue	08.05.2024	
NAME OF PROJECT:	**1 x 660 MW SAGARDIGHI TPS UNIT 5, PHASE - III**				
NAME OF PACKAGE:	**CHEMICAL DOSING SYSTEM**				
TECHNICAL SPECIFICATION:	**PE-TS-445-154-A001**				
S. No.	**DESCRIPTION**		**UNIT**	**QTY**	**Total F.O.R Site prices**
	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, startup and commissioning spares as required, 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	Hydrazine dosing skid		No.	1	
2.1.2	Ammonia dosing skid		No.	1	
2.1.3	NaOH dosing skid		No.	1	
2.1.4	Supply of **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**	

277036/2024/PS-PEM-WSE

SUGGESTED PRICE FORMAT ANNEXURE-II LIST OF MANDATORY SPARES	Doc No:	PE-PF-445-154-A001	
	Rev No:	0	
	Date of issue	08.05.2024	
LIST OF MANDATORY SPARES			
NAME OF PROJECT:	1 x 660 MW SAGARDIGHI TPS UNIT 5, PHASE - III		
NAME OF PACKAGE:	CHEMICAL DOSING SYSTEM		
TECHNICAL SPECIFICATION:	PE-TS-445-154-A001		

S. No.	DESCRIPTION	UNIT	QTY	Total F.O.R Site prices
1.0	**MECH. ITEMS**			
1.1	Piston Ring (Guide Ring)	Set	1 set (one set means complete replacement required for each type & Duty of Pump)	
1.2	Piston (Plunger)	Set	1 set (one set means complete replacement required for each type & Duty of Pump)	
1.3	Seals and other Wear out Part	Set	1 set (one set means complete replacement required for each type & Duty of Pump)	
1.4	Complete Set of Bearings	Set	1 set (one set means complete replacement required for each type & Duty of Pump)	
1.5	Crank Shaft	Set	1 set (one set means complete replacement required for each type & Duty of Pump)	
1.6	Cross Head	No.	1No. for each type and Duty of Pump	
1.7	Cross head guide bush	Nos.	3Nos. for each type and Duty of Pump	
1.8	Connecting Rod Plate	Set	1 set (one set means complete replacement required for each type & Duty of Pump)	
1.9	Complete Set of Valves	%	10% (rounded off to the next higher integer) of the total quantity used for each type and Size or Minimum 1 No. whichever is higher.	
1.1	Pump Discharge NRV	No.	1 No. for each type & Duty of Pump	
1.11	Strainer	Nos.	2 Nos. for each type and size	
2.0	**ELECTRICAL ITEMS**			
2.1	415 Volt Motor	No.	1 No. for each application	
2.1.1	Motor of each type and rating - 10% of the installed quantity or minimum 1 number whichever be higher.	%	10% of the installed quantity or minimum 1 number whichever be higher	
2.1.2	End Shield Cover Driving & Non-Driving End	Set	1 set for each type and rating of Motor	
2.1.3	Heaters	Sets	2 sets for each type and rating of motor	
2.1.4	Bearings (DE and NDE) for each type and rating of motor	Sets	2 sets	
2.1.5	Cooling Fan for all type and rating of LT motors	Set	One (1) set	
2.1.6	Dust seals and gaskets for each type of motors	Sets	Dust seals and gaskets for each type of motors	
2.1.7	Motor Terminal Block	No.	1 no. for each type and rating of Motor	
2.1.8	Complete Set of Coupling	Set	1 set for each type and rating	
3	**C&I ITEMS**			
3.1	**ELECTRONIC TRANSMITTERS**			
3.1.1	Pressure	No.	1 (One) no. complete set for each type and model/ range used in the system.	
3.1.2	Level	No.	1 (One) no. complete set for each type and model/ range used in the system.	
3.1.3	Differential Pressure	No.	1 (One) no. complete set for each type and model/ range used in the system.	
3.2	**GUAGES**			
3.2.1	Pressure Gauge	%	10% of total nos. used in the system or minimum 1 (one) no. whichever is more for each type and range.	
3.2.2	Differential Pressure Gauge	%	10% of total nos. used in the system or minimum 1 (one) no. whichever is more for each type and range.	
3.2.3	Magnetic Level Gauge	%	10% of total nos. used in the system or minimum 1 (one) no. whichever is more for each type and range	
3.3	**ERECTION HARDWARE**			
3.3.1	Transmitter's Manifold	Nos.	10% of total nos. used in the system or minimum 2 (Two) nos. whichever is more for each type, rating/ model and size used in the system.	
3.3.2	Impulse Line Root/Source valve	Nos.	10% of total nos. used in the system or minimum 2 (Two) nos. whichever is more for each type, rating/ model and size used in the system.	
3.3.3	Impulse Line Isolation valve	Nos.	10% of total nos. used in the system or minimum 4 (four) nos. whichever is more for each type, rating/ model and size used in the system.	
3.3.4	Impulse Line Drain valve	Nos.	10% of total nos. used in the system or minimum 4 (four) nos. whichever is more for each type, rating/ model and size used in the system.	
3.3.5	Impulse Line fittings	Nos.	10% of total nos. used in the system or minimum 4 (four) nos. whichever is more for each type, rating/ model and size used in the system.	
3.3.6	Impulse Pipe	Nos.	Each type/ size 25 Nos.	
3.3.7	Copper/ SS Tube	Meters	Each type/ size 100 meters.	
3.3.8	Fittings for Copper/SS Tube	Meters	Each type/ size 100 nos.	

Note: Mandatory spares listed above is bare minimum requirement. In case any additional mandatory spares requirement is covered elsewhere in the tender specification apart from specified above, same shall be deemed to have been covered in bidders scope of supply.

Particulars of bidder / authorised representative

Name	Designation	Signature & Company Seal	Date

SUGGESTED PRICE FORMAT ANNEXURE-III	Doc No:	PE-PF-445-154-A001
	Rev No:	0
	Date of issue	08.05.2024

SUPERVISION OF E&C	
NAME OF PROJECT:	1 x 660 MW SAGARDIGHI TPS UNIT 5, PHASE - III
NAME OF PACKAGE:	CHEMICAL DOSING SYSTEM
TECHNICAL SPECIFICATION:	PE-TS-445-154-A001

S. No.	DESCRIPTION	UNIT	QTY	Total F.O.R Site prices
1.0	Total lump sum firm price inclusive of all prevailing taxes, duties and other levies for SERVICES PART comprising of supervision of erection & commissioning for One (1) Visit for station for Four Days inclusive of charges of Air-Fair/ Rail-Fair, Boarding/ Lodging, Local conveyance, medical, insurance etc. for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.	Set	1.00	
1.1	LUMP SUM CHARGES PER VISIT FOR ENGINEER (EXCEPT DAILY CHARGES)	Visit	1.00	
1.2	LUMP SUM DAILY CHARGES FOR ENGINEER	Days	4.00	

Note:
1. AMOUNT PAYABLE FOR ENGINEER PER VISIT TO SITE =VISIT CHARGES AS PER SL. NO. 1.1 ABOVE + (DAILY CHARGES AS PER SL.NO. 1.2 ABOVE X NO. OF DAYS AT SITE) (TO BE CERTIFIED BY BHEL SITE).
2. THE VISIT CHAGRES SHALL BE INCLUSIVE OF CHARGES OF AIR FARE/TRAIN FARE, BOARDING/LODGING, LOCAL CONVEYANCE, MEDICAL, INSURANCE ETC.

Particulars of bidder / authorised representative			
Name	Designation	Signature	

277026/2024/PS-PEM-WSE

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.

277014/2024/PS-PEM-WSE

THE WEST BENGAL POWER DEVELOPMENT CORPORATION LIMITED

(A GOVERNMENT OF WEST BENGAL ENTERPRISE)

1 X 660 MW SAGARDIGHI TPS UNIT NO. 5, PHASE-III

TECHNICAL SPECIFICATION
FOR
CHEMICAL DOSING SYSTEM

SPECIFICATION NO.: PE-TS- 445-154-A001

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

TITLE: 1 X 660 MW SAGARDIGHI TPS UNIT – 5, PHASE - III		SPECIFICATION NO.: PE-TS-445-154-A001
TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	SUB-SECTION:	
	REV. NO.: 0	DATE: 30.11.2021

SECTION-III

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The West Bengal Power Development Corporation Limited (WBPDCL) proposes to extend their on-going Phase-II extension project of 2x500 MW at Sagardighi by adding one super critical unit of 660 MW as Phase-III extension unit. Sagardighi TPS is located in the village Manigram in Murshidabad district of West Bengal, India. The West Bengal Power Development Corporation Limited, a Company fully owned by the Government of West Bengal formed in the year 1985, have commissioned 2x300 MW Thermal Power Plant together with all other infrastructure at Sagardighi Thermal Power Project. Presently WBPDCL is also working on their under-construction Phase- II extension project of 2x500 MW at Sagardighi.

The Bidder shall acquaint himself, by visiting the site, with the conditions prevailing at site. The information given here in under is for general guidance only.

2.00.00 APPROACH TO SITE

Sagardighi Super Thermal Power Station site is located at Manigram village, 13 KM north of Sagardighi town by the side of the SMGR (Sagardighi-Manigram-Gankar-Raghunathganj) Road at a distance 20 KM from National Highway 34 in Murshidabad District, West Bengal and around 240 KM from Kolkata, India. The nearest rail station is Manigram adjacent to the site on Bandel - Barhawara branch line and 6.5 KM from Sagardighi Railway Station on Sainthia - Azimgunj line of Eastern Railway. From Sagardighi railway station a railway line will branch off to the site for material unloading and coal marshalling. The equipment will be normally transported by rail only and under exceptional cases by road. The material consignments shall be as per the restrictions of rail and road transportation prevailing in the country.

Nearest Airport – Kolkata.

Nearest Seaport –Haldia.

3.00.00 LAND

The total land available for the Power Station and Plant auxiliaries will be generally as per the Site Location Plan (12A05-DWG-M-002) enclosed and flexibility will remain to make the final equipment layout based on equipment sizes.

All construction material, heavy equipment, over dimensioned consignments (ODC) for the station during construction may be transported through road/rail access. During operation stage, coal would be transported through rail access.

The total land, approximately 706 hectares, has already been acquired for the present and proposed extension. The locations of various facilities and plant auxiliaries for Unit 1 & 2 under Phase-I and Units 3 & 4 in Phase-II and the space provision for extension unit no. 5 (660 MW) will be as per the General Layout enclosed. About 456 acre of land has been kept for disposal of ash. The Bidder shall accommodate equipment offered under this specification generally within the spaces allocated for such equipment in the General Layout. Specific approval from Owner/Consultant shall be taken by the contractor prior to any revision or relocation.

Except where stated otherwise, the plinth levels of all buildings shall be 300 mm above the corresponding developed grade level and the road level shall be 150 mm above the developed grade.

4.00.00 SOURCE OF COAL

The Power plant shall receive coal from ECL mines. Coal is planned to be transported in rake loads through the existing Pakur- Tildanga-Dhulian-Monigram broad gauge line or through Pakur- Nalhati (proposed)–Takipara-Gosaingram-Poradanga-Monigram broad gauge line. The coal would be carried in rake loads of BOBR/BOX-N wagons.

It is considered that coal would be received from the same source as the plant under Phase-I and Phase-II station with similar characteristics and a new mine at Pachwara (north) in Jharkhand being developed by WBPDCL. These sources being connected by B.G. rail track, coal would be transported by rail only. For coal unloading, crushing and storage facility it is proposed that a new Wagon tippler along with crusher houses, conveyors will be installed in addition to existing coal handling plant of Phase-II station with suitable extension from the end of Transfer Point (TP-19).

5.00.00 SOURCE OF WATER

The source of water for this project is the River Bhagirathi (5 km) through the proposed intake pump house under implementation for Phase-II station. The water from the River Bhagirathi will be transferred and stored in the five (5) nos. Plant Raw Water Reservoirs by augmentation of the Intake water transportation system for phase - II for meeting the requirement of Phase-III Sagardighi TPS.

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

6.00.00 ASH DISPOSAL AREA

Bottom Ash (BA) shall be extraction in wet form and conveyed to the disposal area in lean slurry form. Whereas Fly Ash (FA) shall be extracted in dry form and stored in dry form for onward usage. However, arrangement shall be also

made to dispose fly ash in lean slurry form to ash dump yard located within 1 km from Plant boundary under exigency..

7.00.00 DETAILS OF EXISTING FACILITIES OF PHASE-II

INTRODUCTION

The proposed phase-III, Unit No. 5 is an extension project with many auxiliary systems being common and shared with the Phase-II units (Unit Nos. 3 & 4). It is not the intent to describe all systems in details. Facilities being shared by both Phase-II & Phase-III units and which have a common terminating and control philosophy are outlined below:

MAIN & AUXILIARY COOLING WATER SYSTEMS & ACCESSORIES

Condenser cooling water and auxiliary cooling water system of Phase-III will be independent of Phase-II. Separate pump house and pumping system shall be installed for Phase-III. Only CT make-up system of Phase-II will be shared for Phase-III. However, DMCW system of boiler of Phase-II has excess capacity, which can be utilized for phase-III. The detail of excess cooling water capacity is furnished below:

Provision kept of miscellaneous BOP coolers in DMCW (SG) pump capacity of Phase-II:

i) AHP compressor coolers – 2X300 = 600 m^3/hr (for 2X500 MW units)
ii) MRS compressor coolers - 2X30 = 60 m^3/hr (for 2X500 MW units)
iii) Plant air compressor coolers - 2X175 = 350 m^3/hr (for 2X500 MW units)

Cooling water consumption for miscellaneous BOP coolers (both working and standby) of Phase-II:

i) AHP compressor coolers 158 m^3/hr (for 2X500 MW units)
ii) Fluid Coupling of Ash slurry pumps = 40 m^3/hr (for 2X500 MW units)
iii) BA overflow pumps = 30 m^3/hr (for 2X500 MW units)
iv) MRS compressor coolers - 30 m^3/hr (for 2X500 MW units)
v) Plant air compressor coolers - = 185 m^3/hr (for 2X500 MW units)

The following excess capacity of DMCW(SG) system of Phase-II is available, which can be shared by miscellaneous BOP coolers of Phase-III (except BAOF pump and vacuum pumps), by suitable extension of existing supply and return header of Phase-II :

i) AHP system coolers- 372 m^3/hr
ii) MRS compressor coolers - 30 m^3/hr
iii) Plant air compressor coolers - = 165 m^3/hr

Bidder to check and confirm that excess available capacity of DMCW (SG) system of Phase-II would be adequate for satisfactory operation of the above mentioned BOP systems of Phase-III. With this consideration, the capacity of DMCW (SG) can be optimized for Phase-III.

Condensate Storage Tanks & Transfer System:

In addition to two (2) nos. installed Condensate storage tanks of Phase-II, One (1) no. similar capacity Condensate storage tank (CST) of capacity 750 m^3 shall be installed for Phase-III.

Inside CST pumps, the following horizontal centrifugal pumps are installed for Phase-II:

a) Three (3) nos. (2W+1S) cycle make-up (DMSW)pumps of capacity 120 m^3/hr and TDH 50.0 MWC at rated capacity

b) Two (2) nos. (1W+1S) boiler fill(SG Fill) pumps of capacity 190 m^3/hr and TDH 140.0 MWC at rated capacity

c) Two (2) nos. (1W+1S) CPU Regeneration pumps

In addition to these, installed pumps, the CST pump house have the provision for the following pumps of Phase-III:

a) One (1) no cycle make-up pump

b) One (1) no boiler fill pump (though no additional pump is considered for Phase-II, as the capacity of boiler fill pumps of Phase-II is envisaged to be sufficient for requirement of Phase-III).

c) Two (2) nos. (1W+1S) CPU Regeneration pumps

The proposed pumps of Phase-III shall be selected and interconnected such that the aggregate pumping capacity of Phase-II & III can be shared by all the units of both Phase-II & III.

WATER & WASTEWATER TREATMENT SYSTEMS

Pre-Treatment System-.

A Pre-Treatment Plant for Phase-II (Unit Nos. 3 & 4) have been envisaged which shall cater the requirement for Phase-III (Unit 5). As per the WBD developed for 3,4 & 5 the total clarified water requirement works out as 4789 m^3/hr. therefore the requirement of construction of additional PT Plant is not called for. However the detail of the Pre-Treatment System is given below.

Raw water will be taken through a flow control station to Aerator where raw water will be aerated and then led to Stilling Chamber where its turbulence will be broken.

To inhibit incidental growth of organic matters in raw water, pre chlorination of raw water in Stilling Chamber shall be carried out by use of gaseous chlorine.

Water will then flow to three (3) nos. Distribution Chambers through three (3) nos. Parshall Flumes. From Distribution Chambers, water would be directed to three (3) nos. proposed High Rate Solids Contact Clarifiers. Chemicals such as Ferric Chloride, Lime solution & Polyelectrolyte will be added at the inlet of each of the High Rate Solids Contact Clarifiers.

Clarified water from Clarifiers will flow through channel and be stored in a Clarified Water Reservoir for further use.

The sludge generated from Clarifiers as addressed above will be collected in a common Sludge Sump. Sludge will be pumped from Sludge Sump by means of three (3) nos. Sludge transfer Pumps to the Effluent Treatment Plant. An arrangement for sludge recirculation to Clarifiers shall be provided to aid flocculation in case of low turbidity in raw water.

All chemicals required for the entire plant will be stored in the ground floor of a two-storied Chemical House. Chemicals will be unloaded from the trucks and thereafter be stacked in the respective storage space at ground floor by means of an Electrically Operated Monorail Hoist. However, preparation of chemical solution of Ferric Chloride, lime and polyelectrolyte for injection to raw water shall be carried out in the first floor of the Chemical House. Chemicals will be lifted from ground floor to first floor by means of another Electrically Operated Monorail Hoist. The water required for preparation of solutions is supplied from Overhead Clarified Water Tank to be located above Chemical House or directly from the Service Water Line.

The Chlorination System will be complete with Electrically Operated Monorail Hoist, Chlorine Ton Containers, Booster Pumps, Strainers, Pipe Works and Diffuser Systems up to points of injection, Emergency Chlorine Leak Absorption System and all other necessary accessories and auxiliaries.

The Chlorinators will be connected with Chlorine Ton Containers. The water to the Booster Pumps will be supplied from Overhead Clarified Water Tank located above Chemical House. All the necessary equipment (Chlorinators, Chlorine Ton Containers, etc.) will be located indoor at ground floor of the Chemical House as addressed above.

The water to the booster pumps will be supplied from Overhead Clarified Water Tank.

De-mineralization System

A De-mineralization Plant for Phase-II (Unit Nos. 3 & 4) have been envisaged which shall cater the requirement for Phase-III (Unit 5), considering 500 MW sub-critical unit. In view that Unit #5 is now rated to 660 MW super-critical technology, the requirement of DM water has been reduced as evident from attached WBD. Therefore the requirement of construction of additional DM Plant is not called for. However the detail of the De-mineralization System is given below.

Clarified Water will be pumped from Clarified Water Reservoir (located in Raw Water Treatment Plant area) by three (3) nos. DMF Feed Pumps to UF-RO-MB Exchanger Plant.

Clarified Water will enter the Dual Media Filters and suspended solids present in it will be removed.

From the Dual Media Filters, water shall flow to UF Modules through Pre-Filter. The UF Modules shall be backwashed automatically as per the requirement. Permeate from UF Modules shall be stored in 'UF Permeate Water Storage Tank' for further treatment by Reverse Osmosis. Reject from UF Modules shall be collected to Backwash Collection Pit and feed to the Waste Water Treatment System.

Ultrafiltered water from UF Permeate Storage Tank shall be pumped to Cartridge Filter for further filtration, prior to RO Modules.

Required quantity of antiscalant shall be dosed before Cartridge Filters in order to reduce scale formation tendency of feed water on the surface of the RO Membranes. Sodium Bi Sulphite shall be dosed to de-chlorinate the water and acid shall be dosed to maintain the pH.

After Dosing, filtered Water from Cartridge Filter shall be passed through RO High Pressure Pump to deliver water at desired pressure to the inlet on RO Modules.

The entire RO System shall be designed to achieve minimum 85% recovery. Permeate shall be passed through Degasser Tower to reduce the dissolved CO2 content in the water. Water from Degasser Towers shall be collected to the Degassed Water Storage Tank.

Degassified RO Permeate, finally be pumped to MB Exchanger for further reduction of TDS, to get desired quality of Water.

For chemical cleaning of UF System, One (1) no..UF Cleaning Solution tank, two (2) nos. UF Cleaning Chemical Pumps and one (1) no. 5 micron cartridge filter along with necessary piping and instrumentation as addressed in the P&I Diagram shall be provided.

A full-fledged chemical cleaning system comprising One (1) no. chemical cleaning tank, one (1) no. chemical solution circulating pumps and one (1) no. 5 micron cartridge filter along with necessary piping and instrumentation as addressed in the P&I Diagram shall be provided for RO Skid.

The entire UF-RO-MB Exchanger System along with Chemical Dosing / Cleaning Systems shall be located indoor within DM Plant Building.

EFFLUENT TREATMENT SYSTEM

An Effluent Treatment Plant is already under construction for the Treatment of liquid waste to be generated from Unit# 3, 4 & 5. The wastewater streams from different sources of the Power Plant will be collected, treated and then reused to the maximum extent possible within the Plant. Various waste waters are to be handled and treated for reuse.

However few items have been envisaged for Phase-III (Unit 5) which is described below.

One (1) no. Retention pit and two (2) nos. transfer pumps for service oily waste from Power House Area which will pump the effluent from Power House Area to the existing Waste water Treatment Plant.

One (1) no. Retention pit and two (2) nos. transfer pumps oily effluent from Transformer Yard area which will pump the effluent from Transformer Yard area to the existing Waste water Treatment Plant.

COAL HANDLING SYSTEM

The Existing Coal Handling Plant has been designed to cater the requirement for Phase-II & III stations together. One (1) track hopper for Phase-I, one (1) additional track hopper (Capacity: 5100T) and one (1) wagon tippler (Rated capacity 20 Tips/Hour and Design capacity 25 tips/Hour) along with one (1) side arm charger (Rated / Design capacity 29 Loaded wagons of 140 T) in Phase-II are provided. These are adequate for Phase-III extension unit#5 also. Further two (2) nos. of stacker-cum-reclaimers having 2000 / 2200 TPH rated / design capacity for Phase-II station are adequate for both Phase- II & III units. In the existing crushers, coal would be sized to (-) 20 mm. Crushed coal would thereafter be led either to the boiler bunkers or to the stack yard. In the main route, coal will be directly taken to the powerhouse via TP # 19. Existing four (4) nos. in-line magnetic separators, two (2) nos. metal detectors, two (2) nos. suspended magnets, four (4) nos. belt weighers, two (2) nos. coal sampling units will be commonly used for phase-II & phase-III units.

New set of 2000 / 2200 TPH rated / designed capacity twin stream conveyors as per the same for existing CHP would be installed under Phase-III beyond Transfer Point 19 of unit #4 upto unit #5 bunkers.

New set of 1650 / 1500 TPH, 1200 / 1320 TPH (rated / designed) capacity twin stream conveyors considered from New Wagon Tippler to TP-20. This conveyor stream will also feed to conveyor 22A & 22B for Stacking on the Existing Stock Pile.

Existing system facilities to be commonly used for Phase-II & III and new dedicated system facilities for Phase-III

The major equipment for the coal handling plant installed for Phase-II & shall serve Phase III also is listed below :-

1. a) Track Hopper	:	5100T with paddle feeders to twin stream conveyors
b) Wagon Tippler	:	One (1) no (Rated capacity 20 Tips/ Hr and Design capacity 25 ips / hr.).
c) Side Arm Charger	:	One (1) no
2. Conveyors	:	Twin stream conveyor line of 2000 / 2200 TPH rated / design capacity.
3. Crushers	:	**Type:** Ring granulator. **Number:** Four (4) (2 working + 2 standby) **Capacity:** 1200 TPH (Rated) / 1320 TPH (Design) **Input coal size:** (-) 300 mm **Output coal size:** (-) 20 mm
4. Vibrating Screen	:	**Type:** Roller screen type. **Number:** Four (4) (2 working + 2 standby) **Capacity:** 1200 TPH (Rated) / 1320 TPH (Design)
5. Paddle Feeder	:	Capacity 1200 TPH rated / 1320 TPH design x 2 in each stream of conveyors.
6. Stacker-cum-reclaimer	:	**Type:** Hydraulic motor-driven rail-mounted unidirectional having slewing and adequate lifting arrangement. **Stacking Capacity:** 2000 TPH (Rated) / 2200 TPH (Design) **Reclaiming Capacity:** 2000 TPH (Avg.) / 2200 TPH (Peak)

Quantity: Two (2)

Coal size: (-) 20 mm

7. Apron feeder : 2000 / 2200 TPH rated / design capacity

ASH HANDLING SYSTEM

BAHP Water System

Six (6) nos. (4W+2S) BAHP water pumps (Make- Flowmore& Model - 5822 (HS) / 350 X 300) with drive, each of capacity 1000 CMH and discharge pressure of 70 MWC, are already installed in existing ash water sump & pump house (common for Phase-II & III). Space for two (2) nos. BAHP water pumps (one shall cater the HP water requirement of bottom ash system and the other for wet fly ash system) with drive for Unit#5, had been kept in the existing ash water sump & pump house.

For details and disposition of existing equipments of Phase-II and space provision for proposed equipment of phase-III, please refer layout of ash water sump & pump house (Dwg. No I-5034-M-GA-002).

BALP Water System

Three (3) nos. (2W+1S) BALP water pumps (Make – Flowmore & Model - 5821A / 300 X 250) with drive, each of capacity 757 CMH and discharge pressure of 25 MWC, are already installed in existing ash water sump & pump house. Space for one (1) no BALP water pump with drive for Unit#5, had been kept in the existing ash water sump & pump house.

For details and disposition of existing equipments of Phase-II and space provision for proposed equipment of phase-III, please refer layout of ash water sump & pump house (Dwg No I-5034-M-GA-002).

Eco Water System

Three (3) nos. (2W+1S) Eco water pumps (Make – Flowmore & Model - F5824A / 100 X 75) with drive, each of capacity 48 CMH and discharge pressure of 45 MWC, are already installed in existing Boiler area for Phase-II i.e. Unit #3 & #4. Space for one (1) no eco water pump for Unit # 5, had been kept in the existing Boiler area (Phase-II).

Ash Conditioning Water System

Two (2) nos. (1W+1S) ash conditioning water pumps (Make – Flowmore & Model - F5824 / 100 X 75) with drive, each of capacity 106 CMH and discharge pressure of 50 MWC, are already installed in existing silo utility building. Space for one (1) no ash conditioning water pump for the proposed silo of Unit#5, had been kept in the existing silo utility building.

For details and disposition of existing equipment of Phase-II and space provision for proposed equipment of phase-III, please refer layout of silo utility building (Dwg No I-5034-M-BE-016).

Seal Water System

Two (2) nos. (1W+1S) seal water pumps (Make – Flowmore & Model - M5972 / 150 X 100) with drive, are already installed in existing ash slurry pump house for Phase-II i.e. Unit #3 & #4. Space for Two (2) nos. (1W+1S) seal water pumps for Unit # 5, had been kept in the existing ash slurry pump house.

Civil foundations for the proposed pumps have already been constructed in the existing slurry pump house. The base plate of the proposed pumps shall be matched with the foundation.

For details and disposition of existing equipment of Phase-II and space provision for proposed equipment of phase-III, please refer layout of ash slurry sump & pump house (Dwg No I-5034-M-GA-001).

Ash Slurry Disposal System

Four (4) nos. (2W+2S) ash slurry pump (Make – Indure & Model - A-918-401) chain (each slurry pump chain consists of 2 nos. pumps in series and there is space provision for future series pump also) with drive, each of capacity 1270 CMH, are already installed in existing ash slurry sump & pump house for Phase-II i.e. Unit #3 & #4. Space for one (1) no ash slurry pump chain for Unit # 5, had been kept in the existing ash slurry sump & pump house.

Civil foundations for the proposed pumps have already been constructed in the existing slurry pump house. The base plate of the proposed pumps shall be matched with the foundation.

For details and disposition of existing equipments of Phase-II and space provision for proposed equipment of phase-III, please refer layout of ash slurry sump & pump house (Dwg No I-5034-M-GA-001).

Silo

Three (3) nos silos, each of capacity 2400 Tons, are already installed in existing silo area for Phase-II i.e. Unit #3 & #4. Space for one (1) no silo for Unit # 5, had been kept in the existing silo area.

For details and disposition of existing silos of Phase-II and space provision for proposed silo of phase-III, please refer layout of ash compressor house (Dwg No I-5034-M-GA-015).

Silo Fluidizing Air System

Five (5) nos. (3W+2S) water cooled silo aeration blowers (Make - Swam & Model - RH-250 WC) with drive and heater, each of capacity 1860 CMH and discharge pressure of 10 MWC, are already installed in existing silo utility building for Phase-II i.e. Unit #3 & #4. Space for one (1) no silo aeration blower and heater for Unit # 5, had been kept in the existing silo utility building.

For details and disposition of existing equipment of Phase-II and space provision for proposed equipment of phase-III, please refer layout of silo utility building (Dwg No I-5034-M-BE-016).

Instrument Air System

Four (4) nos. (2W+2S) oil free, water cooled screw compressor (Make - Atlas Copco & Model ZR 110) with drive and heat of compression (HOC) dryer (Make - Atlas Copco), each of capacity 900 CMH (FAD) and discharge pressure of 8 Kg/cm2 (g), are already installed in existing ash compressor house for Phase-II i.e. Unit #3 & #4. Space for one (1) no instrument air compressor & HOC dryer for Unit # 5, had been kept in the existing ash compressor building.

For details and disposition of existing equipment of Phase-II and space provision for proposed equipment of phase-III, please refer layout of ash compressor house (Dwg No I-5034-M-GA-018).

Recycle Water System

Space for two (2) nos. (1W+1S) recycle water pump with drive for phase-III, had been kept in the existing ash clarifier area.

Space for one (1) no ash slurry disposal pipe (450 NB x 9.52 MM Thk.) for Unit # 5, had been kept in the existing slurry piping corridor of Phase-II. Please refer Dwg No I-5034-M-BE-015 & I-5034-M-BE-025 for layout of existing ash slurry disposal piping & ash dyke.

MILL REJECT SYSTEM (COMPRESSED AIR SYSTEM)

Two (2) nos. (1W+1S) oil free, water cooled screw compressor (Make - ELGI and Model No. - EG110 - 5.5 WC) with drive, each of capacity 20 m3/min (FAD) and discharge pressure of 5.0 Bar (g), are already installed in existing Plant Compressor House (Common for Phase-II & III) for Phase-II i.e. Unit #3 & #4. Space for one (1) no conveying air compressor for Unit # 5, had been kept in the existing plant compressor building.

Civil foundation for the proposed MRS Compressor has already been constructed in the existing plant compressor house. The base plate of the proposed compressor shall be matched with the foundation.

For details and disposition of existing equipments of Phase-II and space provision for proposed equipment of phase-III, please refer layout compressor house (Dwg. No.PE-V0-373-160-505).

Cooling water requirements for conveying air compressor shall be met from existing DMCCW system. The supply and return lines shall be connected at the tie in points from the existing DMCCW system.

PLANT COMPRESSED AIR SYSTEM

Plant air compressor house will be common for Phase-II & III. Instrument air and service air compressors, dryer, receivers and interconnecting piping system for phase-II are installed in the compressor house. Provision of one (1) no. Instrument air Compressor and one (1) no. Service air Compressor, with dryer, receivers and interconnecting piping system are kept in the compressor house for Phase-III. The brief details of existing facilities of Phase-II are indicated below:

a) Instrument Air Compressors- Three (3) nos. (2W+1S) Motor driven oil free screw compressors with air dryer, each of capacity 36 Nm^3/min (FAD-46.53 m^3/min) and discharge pressure of 8.0 kg/cm^2(g)at after cooler outlet at rated capacity.

b) Service Air Compressors- Two (2) nos. (2W+0S) Motor driven oil free screw compressors with air dryer, each of capacity 36 Nm^3/min (FAD-46.53 m^3/min) and discharge pressure of 8.0 kg/cm^2(g)at after cooler outlet at rated capacity.

c) Air Receivers- Five (5) nos., each of capacity 10m^3.

For details and disposition of existing equipment of Phase-II and space provision for proposed equipment of phase-III, please refer P&ID & layout Compressor house of Phase-II (Dwg. no. PE-V0-373-555-A002 & PE-V0-373-555-A001 respectively).

The proposed compressors of Phase-III shall be selected and interconnected such that the aggregate compressed air capacity of Phase-II & III can be shared by all the units of both Phase-II & III.

FIRE PROTECTION SYSTEM

Two (02) nos. inter-connections with isolation valves for hydrant system and Two (02) nos. inter-connections with isolation valves for spray system shall be considered at site for proposed integration with the hydrant and spray network of Phase-III with Phase – II. Please refer Composite piping layout of hydrant and spray network of Phase-II (Dwg. no. PE-V0-373-522-A0013) for locations of inter connection points.

LP PIPING (PIPE RACK)

Existing pipe rack of Phase-II shall be utilized to carry pipe lines from new pumps/ compressors of Phase-III to be installed in existing pump/compressors

houses of Phase-II. Suitable augmentation/ modification/strengthening of existing pipe racks of Phase-II shall carried out by the bidder.

FUEL OIL HANDLING SYSTEM

No further extension of unloading and storage capacity is envisaged for installed fuel oil handling system, which is sufficient for requirement of Phase-I, II& III units.

Pressurizing pumps will supply oil from the HFO/LDO storage tanks to the burner. Three (3) nos.HFO (2 W+ 1S) & two (2) nos. LDO (1W +1S) pressurizing pumps (each having capacity equivalent of 2X500 MW units) are installed under Phase-II system.

There is provision for one additional HFO pressuring pump along with HFO Heater to be installed in pressurizing pump house to cater the requirement of Phase-III. Installed LDO forwarding pumps of Phase-II can also cater requirement of Phase-III. HFO & LDO Pressurizing pump discharge lines, which has been extended up to Unit #4 of Phase-II, shall be further extended by bidder to feed Phase-III.

HFO supply and return lines to and from boiler of phase-III to be extended from existing HFO supply and return header respectively (terminated with isolation valve) of Phase-II. Similarly, LDO supply line to boiler of phase-III to be extended from existing LDO supply header (terminated with isolation valve) of phase-II.

The proposed HFO pressurizing pump with heater of Phase-III shall be of identical capacity with the existing equipment to utilize existing equipment foundations at site.

ELECTRICAL EQUIPMENT & ACCESSORIES

Necessary power supply for Phase-III Fuel oil pump will be arranged from existing FO Switchboard. Accordingly existing FO switchboard shall be modified as specified elsewhere.

If the new equipment of Phase-III 400kV air insulated switchyard can be accommodated in the existing switchyard control building, same needs to be modified if required.

For further details regarding the existing facilities of Phase – II, please refer Volume – II F1 and F2: Technical Specifications for Electrical Equipment and accessories.

CONTROL & INSTRUMENTATION

The following are the existing Stage-II facilities which shall be used for Unit #5 C&I works.

	System	Existing Facilities to be used
a)	Fuel Oil Pressurizing & Heating System	Existing spare I/O cards and spare I/O slots of Unit #3 & Unit #4 DCS [Stage-II] shall be used for augmentation of the new Fuel Oil Pressurizing & Heating System of Unit#5 of Stage-III. Relevant control shall be implemented in the existing DCS processors.
b)	Compressed Air System	New Instrument Air Compressor and Service Air Compressor shall share the existing serial network of Compressors of Unit#3 & Unit#4 DCS [Stage-II] for DCS soft communication. The new Instrument Air Compressor shall also be interfaced with the existing electronic sequencer module (ES-6) provided for the existing Instrument Air compressors of Unit#3 & Unit#4 DCS [Stage-II] for group interlocks.
c)	Mill Reject Handling System	The control shall be implemented in the existing MRHS PLC of Unit#3 & Unit#4 [Stage-II], located in the existing CPU regeneration Area control room. The new MRH System shall use the existing processor of the PLC. New IO panel for additional IO cards for the new system shall be installed in the assigned location of the existing control room for Future IO Panel. The UPS for the new MRH system PLC IO Panel shall be derived from the existing UPS ACDB located in the existing CPU Regeneration Building Control Room (Stage-II).
d)	Ash Handling System	The operation and control of new Unit#5 AHP facilities shall be through the existing PLC of Stage-II (located in the Compressor House Control room). Existing PLC processor (PLC-1), shall cater to the control of the common systems including Ash Water & Ash Slurry System, Fly Ash Unloading System, Instrument Air System & various sump draining systems. Additional IO panels shall be installed in the locations assigned for future IO panels in the Compressor House Control Room, Ash Water Pump House RIO Room and Silo Utility Building RIO Room of Stage-II units.

		One new redundant processor shall be installed in the existing Processor Panel located in the Compressor House Control room to cater the new Unit#5 Bottom Ash & Fly Ash Evacuation System. Extended RIO of the new processor shall be procured for the Unit#5 systems. For new PLC CPU/ IO at existing (Stage-II) Compressor House Control Room, existing UPS system in the Existing [Stage-II] Compressor House Control Room shall be considered. New Energy Meter, Numerical Relays, Air Compressor etc. shall share the existing serial network for interface with existing PLC for Unit#3 & Unit#4 [Stage-II].
e)	Coal Handling System	Spare IOs cards at Remote IO Unit of existing Stage-II CHP PLC near TP-17 of Stage-II shall be used for the augmentation of new CHP system of Unit#5 (Stage-III). The control shall be implemented in the existing PLC processor. However, for Wagon Tippler & Crusher separate new PLC based system with connectivity with existing PLC at HMI network level shall be envisaged. Existing “3D Level Mapping Software” loaded in the CHP PLC for Unit#3 & #4 of Stage-II shall be used for the new Unit#5 Bunker Level indication System. The existing Fiber Optic network for CHP PLC interface with Bunker Level indication System of Stage-II shall also be used by the new Bunker Level indication System for CHP PLC interface.
f)	GPS Master Clock System	All the microprocessor based control systems like DCS, PLC based systems, CCTV, TSI & Rotating machine condition monitoring system etc of unit#5 shall be time synchronized with the Existing GPS Master clock of Phase-II.
g)	Fire Alarm System	Existing Fire Alarm Panel at Fire Station of phase II shall be used to display parameters / Alarms of new Fire Alarm System of unit#5. Main FAP of unit#5 shall be connected to the phase II FAP located at existing fire station.

CIVIL, STRUCTURAL AND ARCHITECTURAL WORK (BUILDINGS CONSTRUCTED WITH SPACE FOR PHASE III)

Necessary Walkway connection between operating floors of Power House of Phase – II (Existing) and Phase – III shall be considered by Bidder.

Few civil foundations have already been constructed for future equipment. Such existing foundation details including bolts, inserts etc. to be studied in detail before procurement of specific equipment for respective purposes so that the same can safely be placed over the existing foundations complying all technical compatibility. In case this is not at all possible, new foundations need to be constructed after complete demolition of existing foundations.

For further details regarding the existing facilities of Phase – II, please refer Volume – II G1, G2 and G2: Technical Specifications for Civil, Structural and Architectural..

8.00.00 SALIENT DESIGN DATA

8.01.00 For implementation of the project, the Bidder shall consider the following Site and Meteorological data:-

a)	Location	:	Manigram village, Sagardighi, Raghunathganj sub-division, Murshidabad District, West Bengal.
b)	Latitude and Longitude	:	24^0 22’ 13.7” N, 88^0 6’ 15.8” E (Topo sheet No.78/D/3)
c)	Nearest Towns	:	Ajimganj, Jangipur, Raghunathganj.
d)	District Head Quarters	:	Berhampore - 40 km.
e)	Approach Road	:	20 km from National Highway (NH-34)
f)	Nearest Railhead	:	Manigram railway station on Bandel-Barhawara branch line 1 km from site.
g)	Source of Water	:	Bhagirathi River - 5 km
h)	Source of Coal	:	Pachwara (North) mine block in Jharkhand.
i)	Fuel Transportation	:	By rail in rake loads of BOBR/BOX-N wagons.
j)	Surrounding Habitations	:	Villages - Manigram, Chhamugram, Karaia, Thakurpara on the south; Bhumhar, Khasittor, Ekrakhi on the west;

Dhalo, Bagpara, Santoshpur on the north and Harirampur, Chandparam, Dogachhi on the east.

k) Level : Within 34.5 m contour. Land is above HFL (highest flood level) of the area.

l) Soil : Less fertile alluvial soil.

m) Land Use : Within existing plant boundary of WBPDCL.

Meteorological data of site is given below:

a) Design ambient dry bulb temperature : 50 ºC maximum
5 ºC minimum

b) Highest wet bulb temp : 26.9 ºC

c) Maximum relative humidity : 84%

d) Average relative humidity : 73%

e) Average annual Rainfall : 1389 mm

f) Wind load : In accordance with IS-875 for a basic wind speed of 47 m/sec, up to a height of 10 metres above mean ground level.

g) Seismic Zone : Zone III as per IS: 1893 latest edition.

h) Altitude : 34M above MSL

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IA - Specific Technical Requirements (Mech.)

SUB-SECTION IB - Specific Technical Requirements (Electrical)

SUB-SECTION IC - Specific Technical Requirements (C&I)

SECTION - IA

SPECIFIC TECHNICAL REQUIREMENTS - MECHANICAL

	TITLE: 1 X 660 MW SAGARDIGHI TPS UNIT NO. 5, PHASE - III	SPECIFICATION NO. PE-TS-445-154-A001
		SECTION I
		SUB SECTION - I A
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	REV.NO. 0 DATE: 30.11.2021

1. SCOPE:

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 along with spares for erection, start-up and commissioning as required, forwarding, proper packing, shipment and delivery at site and supervision of E&C for 1 x 660 MW SAGARDIGHI TPS UNIT-V PHASE-III Chemical Dosing System, complete with all accessories for the total scope as specified hereinafter for the following systems:-

a) HYDRAZINE DOSING SYSTEM - 1 Nos. Skids.
b) AMMONIA DOSING SYSTEM - 1 Nos. Skids.
c) NaOH DOSING SYSTEM - 1 Nos. Skids.

2. DESIGN BASIS:

Customer specification.

The following drawings/ data sheets are enclosed for the reference:

a) P&ID for Hydrazine dosing system.
b) P&ID for Ammonia dosing system.
c) P&ID for NaOH dosing system.
d) DATA SHEET – A for all above systems.

3. SCOPE OF SERVICE

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

a. Design and engineering.
b. Fabrication of the skid mounted 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. Painting as per approved painting requirement to be finalized during detailed engineering. However, the same shall be prepared in line with the painting requirement enclosed in ANNEXURE IV of technical specification.

4. DESIGN PHILOSOPHY

Chemical dosing systems are designed to dose required quantity of chemicals to maintain the quality of boiler feed water. Chemicals are dosed both in low pressure side of feed water cycle as well as in ECW system.

5. LOW PRESSURE CHEMICAL DOSING

The LP dosing consists of Hydrazine dosing system, ammonia dosing system for boiler feed water and NaOH dosing skids for ECW system. The details of each dosing system are given below:

4.1 HYDRAZINE DOSING SYSTEM: (TOTAL NO. OF SKIDS= 2 NOS.)

(Refer Drawing no. PE-DG-445-154-A001)

One number of Hydrazine Dosing System consists of the following:

a) Two numbers Hydrazine Solution Dosing Tanks.
b) Three nos. (3 X 100%) Hydrazine Dosing Pumps for outlet of Condensate Polisher & Three nos. (3 X 100%) Hydrazine Dosing Pumps for Deaerator outlet.
c) One number barrel and one no. barrel pump with flexible hose.
d) Associated Piping, valves, fitting as indicated in the P&ID of Hydrazine Dosing System and data

sheet-A enclosed and as required to make the system complete.

e) Control & Instrumentation as per P&ID of Hydrazine Dosing System, Data sheet-A, Section IIA, IC and IIC.

4.2 AMMONIA DOSING SYSTEM: (TOTAL NO. OF SKIDS= 2 NOS.)

(Refer Drawing no. PE-DG-445-154-A002)

One number of Ammonia Dosing System consists of the following:

a) Two numbers Ammonia Solution Dosing Tanks.
b) Three nos. (3 X 100%) Ammonia Dosing Pumps for outlet of Condensate Polisher & Three nos. (3 X 100%) Ammonia Dosing Pumps for Deaerator outlet.
c) One number barrel and one no. barrel pump with flexible hose.
d) Associated Piping, valves, fitting as indicated in the P&ID of Ammonia Dosing System and data sheet-A enclosed and as required to make the system complete.
e) Control & Instrumentation as per P&ID of Ammonia Dosing System, Data Sheet-A, Section IIA, IC and IIC.

4.3 NAOH DOSING SYSTEM FOR ECW SYSTEM: (TOTAL NO. OF SKID = 2 NOS)

(Refer Drawing. No. PE-DG-445-154-A003)

One number of NaOH Dosing System consists of the following:

a) One number NaOH Mixing cum storage tank.
b) Two (2 X 100%) 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) Control & instrumentation as per P&ID of NaOH Dosing System, Data Sheet-A, Section IIA, IC and IIC.

6. CIVIL SCOPE

Nil.

7. TERMINAL POINTS (also refer P&I Diagrams enclosed)

a) All piping beyond battery limit of skid as indicated in P&ID's enclosed with the technical specification is excluded from bidder's scope.
b) Electrical scope shall be as per Std. Electrical Scope Matrix attached in Section IB of the technical specification.
c) All drains shall be brought at one point on the skid by the bidder via a drain header and further connection to the nearest plant drain shall be done by BHEL/ Customer.
d) Counter flanges for all the piping terminal points (as per P&IDs) and for the terminal point of drain header shall be in bidder's scope.

8. QP AND SUB VENDOR APPROVAL

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

7.2 The sub vendor list (Annexure- II) 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 performance certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL/ Customer.

9. DOCUMENTS TO BE SUBMITTED BY BIDDER ALONG WITH THE BID

BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS:

- Deviation, if any in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed).
- Compliance certificate (stamped & signed).
- Un-priced Schedule duly filled in (stamped & signed).
- List of Recommended spares, if any (stamped & signed).

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

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

10. DRAWING/ DOCUMENTS REQUIREMENT

For the drawings/ documents submission schedule, please refer ANNEXURE-III.

For the drawings/ documents submission procedure, please refer ANNEXURE-VII. 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.

11. SPARES

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

12. MANDATORY SPARES

a) The list of mandatory spares considered essential by the BHEL & Customer is indicated in Annexure- V.
b) All mandatory spares shall be delivered at site at least two months before scheduled date of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipment.
c) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the item in the station (project), **unless specified otherwise** and the fraction will be rounded off to the next higher whole number.
d) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.
e) The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.

f) Each spare part shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers, and other packages must be suitably marked and numbered for the purpose of identification.
g) The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.

13. START-UP AND COMMISSIONING SPARES

Start-up and Commissioning spares are those which would be required during equipment or system testing, start up and commissioning. All spares used until the plant is finally handed over by the bidder to the Customer come under this category. All start-up and commissioning spares as required shall be provided by the bidder without any additional cost to the BHEL and Customer. The list of minimum start-up and commissioning spares are attached in Annexure-VI. However, bidder to provide additional spares as per their system requirement without any commercial and delivery implication to BHEL/ customer during detailed engineering List of spares shall be furnished by BIDDER along with the offer.

Bidder shall be responsible for the ready and timely availability for all the start-up and commissioning spares as required during various stages of testing, cleaning and commissioning up to handing over of each unit of the total plant.

An adequate stock of start-up spares shall be available at the site such that the start-up and commissioning of the equipment/systems, Performance guarantee test and handing over the equipment/ systems to the Customer will be carried out without hindrance and delay. All start-up spares which remain unused after the taking over of the plant shall remain the property of the Customer.

14. SPECIAL TOOLS AND TACKLES

a) One set of all special tools shall be furnished and shipped with each piece of equipment for dismantling, maintenance, adjustment, and calibration of the equipment. The tools shall be shipped in separate heavily constructed wooden boxes provided with hinged covers and padlock hasps.
b) The Contractor shall supply under this contract all maintenance tools for each piece of equipment/ system and it shall be boxed separately and the boxes shall be appropriately marked for shipment and identification of contents.
c) A weather-proof itemized list of the contents shall also be attached to the outside of each container.
d) The maintenance tools shall include all special handling rigs, bars, slings, cable and all specialized equipment for control system maintenance such as extender boards, scopes, and all software and hardware. Further, Bidder shall also include a full set of regular maintenance tools and tackles required. Bidder shall also include all maintenance tools and tackles in their scope. Total price of all the maintenance tools and tackles shall be included in the quoted lump sum price.

15. PACKING

To prevent damage to any equipment/ item of the skid during transit, wooden/ angle iron/ steel frame supports to be provided wherever required. Special attention shall be provided while packing and loading for overhead equipment.

THE ACTUATOR OF THE PUMP SHALL BE PACKED IN AIR TIGHT PACKING ALONG WITH THE PUMP IN INSTALLED CONDITION FOR PREVENTING DAMAGE OF ACTUATOR.

Bidder shall submit the packing details during detailed engineering for approval. Any changes required in packing details shall be complied by the bidder without any price and delivery implication.

16. PAINTING

Bidder to note that painting shall be as per approved painting schedule to be finalized during detailed engineering. However, the same shall be prepared in line with the schedule enclosed in Section IA/ Annexure-IV.

17. DESIGN REQUIREMENTS

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

a) In addition to the requirements of Section-I & II the following shall also be complied under scope of this specification: The P&ID is enclosed herein in this section for bidder's compliance.
b) The material of construction specified in Data Sheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subjects to Customer/ BHEL approval during detailed engineering.
c) All instrument-wetted parts will be suitable for requested application.
d) All high points on any, tanks, pumps, piping or instrumentation will be vented and provided with valve. All low points on any, tanks, pumps, piping or instruments will be drained and provided with valve.
e) 5 mm (min.) thick IS 2062 Checker plate shall be provided covering the skid frame and for elevated platform for the preparation/ measuring tank, wherever applicable. The tanks support, pumps and pipe supports and LCP/ LCP supports shall be welded to the checker plate.
f) Stuffing box shall be provided for mounting the agitator to avoid air ingress.
g) Vent/ overflow pipe from tank shall at least reach the bottom half of the breather/ water seal/ CO_2 absorber.
h) SS pad shall be provided for welding MS structural supports to SS tanks.
i) Step ladder and chemical charging platform shall be provided for easy access to top of tank.
j) All the terminal points shall be easily accessible and towards one side of skid.
k) All valves shall be easily accessible for the operator.
l) All tanks/ pumps shall have name plate clearly indicating the equipment name.
m) Pipe fittings of the system shall be done using elbows and tees. Pipe bending is not acceptable.
n) All equipment shall have SS name plate.
o) All LCP shall be mounted in their respective dosing skids only.
p) Energy efficient level IE3 LT Motors shall be provided by the bidder.
q) All the terminal points where flange joints are involved, bidder shall terminate it along with matching counter flange, nuts, bolts, gaskets etc.
r) KKS codes for all drives and instruments for the project have to be followed.
s) All the instruments/ equipment/ electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply.

18. MISCELLENEOUS REQUIREMENTS

a) Initial charge of all lubricants & grease.
b) All special tools necessary for proper maintenance or adjustment of the equipment packaged in permanent box.
c) Finish paints for touch-up painting of equipment after erection at site in sealed container.
d) All the first fill and one Year's topping requirements or 10 % of first fill quantity, whichever is more of consumable such as greases, oil, lubricants, servo fluids/ control fluids, gases and etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be furnished by the bidder. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.
e) Document approval by Customer/ BHEL under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing

and require written approval.

f) Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to Customer and BHEL for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

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

h) Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the BHEL's switch gear /MCC on account of changed loads.

i) Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment / scope drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor".

j) Bidder to submit BBU during detailed engineering after approval of Basic documents. BBU shall be equal to BOQ for the package and there shall be no price and delivery implication is applicable to BHEL / CUSTOMER for the same. None of the items supplied for the project as non-billable. Incomplete BBU shall not be reviewed by BHEL.

k) Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.

l) Relevant requirements as per GTR, GCC, ECC & SCC. Any statutory requirement / clearance required for the packages from government / local body shall be in bidder's scope.

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

n) Vendor to attend regular engineering meeting with BHEL and Customer fortnightly in BHEL or Customer office as decided during detail engineering. Vendor will depute his entire concerned engineering representatives along with the project manager for discussion and approval. Meeting can be held at site also.

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

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

ANNEXURES

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

ANNEXURE I: QUALITY PLAN

ANNEXURE-I

		MANUFACTURER'S NAME & ADDRESS :		QUALITY PLAN				PROJECT	1 x 660 MW SAGARDIGHI TPS UNIT V PHASE - III			
				ITEM: CHEMICAL DOSING SYSTEM		QP.NO : REV. : 0						
				SUB - SYSTEM : CHEMICAL DOSING SYSTEM		DATE : PAGE : 1 OF 4		PACKAGE CONTRACT NO.	CHEMICAL DOSING SYSTEM			
								MAIN SUPPLIER	BHEL/ PEM, NOIDA			
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY**			REMARKS
									M	B	R	
1	2	3	4	5	6	7	8	9	10			11
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	CHEMICAL.& PHY. PROPERTIES	MA	CHEM &.PHY TEST	1/PLATE/HT BATCH	ASTM A 240 GR.TP 304	ASTM A 240 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	IDENTIFICATION BY BHEL
		IGC TEST	MI	IGC TEST	1/PLATE/HT BATCH	ASTM A 262 PR.'E'	ASTM A 262 PR.'E'					
2.1.2	PIPE FOR NOZZLE	CHEMICAL.& PHY. PROPERTIES	MA	CHEM.& PHY.TEST	1/HT BATCH/SIZE	ASTM A 312 GR.TP 304	ASTM A 312 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		MICRO STRUCTURE	MI	GRAIN STRUCTURE	1/HT BATCH/SIZE	FOR HEAT TREATMENT	FOR HEAT TREATMENT	MFG.TC/LAB REPORT	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH/SIZE	ASTM A 262 PR.'E'	ASTM A 262 PR.'E'	MFG.TC/LAB REPORT	P	V	V	
		HYDRO TEST	NA	LEAKAGE	100%	NO LEAKAGE	NO LEAKAGE	MFG. TC/IR	P	V/W	V	REFER NOTE 4
2.1.3	FLANGES FOR TANKS	CHEMICAL & PHY PROPERTIES	MA	CHEM & PHY TEST	1/HT BATCH	ASTM A 182 GR. F 304	ASTM A 182 GR. F 304	MGF.TC/LAB REPORT	P	V	V	
2.2	**IN PROCESS**											
2.2.1	DISHED ENDS	DIMENSIONS	MA	MEASUREMENT WITH TEMPLATE	100%	APPD.DWG.(BY BHEL)	APPD.DWG.(BY BHEL)	MFG.TC./LAB REPORT	P	V	V	
		SURFACE DEFECTS ON WELDMENTS		DP TEST	100%	ASTM E 165	NO SURFACE DEFECTS	MFG.TC	P	V	V	
2.3	**FINAL ASSEMBLY FOR TANKS:**	DIMENSIONS &	MA	MEASUREMENT	100%	APPD.DWG.(BY BHEL)	APPD.DWG.(BY BHEL)	MFG.TC/INSP REPORT	P	W	W	TO BE OFFERED ALONG WITH FINAL SKID ASSEMBLY INSPECTION.
		ORIENTATION	MA	VISUAL		APPD.DWG.(BY BHEL)	APPD.DWG.(BY BHEL)	MFG.TC/INSP REPORT	P	W	W	
2.3.1		LEAKAGE	MA	WATER FILL FOR 2 HR	100%	N.A.	NO LEAKAGE	MFG.TC/INSP. REPORT	P	W	W	
3.0	**STIRRER :**											
3.1	RAW MATERIAL FOR SHAFT	CHEM.& PHY. PROPERTIES	MA	CHEM &.PHY TEST	1/BAR	ASTM A 479 GR.TP 304	ASTM A 479 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		IGC TEST	MA	IGC TEST	1/HT BATCH	ASTM A 262 PR.'E'	ASTM A 262 PR.'E'	MFG.TC/LAB REPORT				
3.2	IMPELLER	CHEMICAL PROP.	MA	CHEMICAL TEST	1/PLATE	ASTM A 240 GR.TP 316	ASTM A 240 GR.TP 316	MFG.TC/LAB REPORT	P	V	V	
3.3	COMPLETE STIRRER UNIT WITH MOTOR	PERFORMANCE IN WATER FILLED TANK										
		- VIBRATION	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		- WOBBLING	MA	VISUAL	100%	NO WOBBLING	NO WOBBLING	MFG.TC	P	V	V	
		- POWER CONSUMPTION/ CURRENT DRAWN	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
4.0	**MOTORS:**	ROUTINE TEST	MA	MFG. TC	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		TYPE TEST	MA	MFG. TC	1/ SIMILAR FRAME SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		DEGREE OF PROTECTION	MA	MFG. TC	1/ SIMILAR FRAME SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	

MANUFACTURER/ SUB CONTRACTOR

MAIN SUPPLIER--BHEL

SIGNATURE

**** LEGEND :**

M : MANUFACUTRER/SUB-CONTRACTOR/SUB-VENDOR
B : BHEL/ NOMINATED INSPECTION AGENCY
"P" PERFORM, **"W"** WITNESS, AND **"V"** VERIFICATION
R: CUSTOMER

SIGNATURE OF APPROVAL BY CUSTOMER

THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-445-154-A001

ANNEXURE-I

		MANUFACTURER'S NAME & ADDRESS :		**QUALITY PLAN**				**PROJECT**	1 x 660 MW SAGARDIGHI TPS UNIT V PHASE - III				
				ITEM: CHEMICAL DOSING SYSTEM		**QP.NO :** **REV. :** 0							
				SUB - SYSTEM :		**DATE :**		**PACKAGE**	CHEMICAL DOSING SYSTEM				
				CHEMICAL DOSING SYSTEM		**PAGE :** 2 OF 4		**CONTRACT NO.**					
								MAIN SUPPLIER	BHEL/PEM, NOIDA				
S.NO.	**COMPONENTS/ OPERATION**	**CHARACTERISTICS CHECKED**	**CATEGORY**	**TYPE/ METHOD CHECK**	**EXTENT OF CHECK**	**REFERENCE DOCUMENT**	**ACCEPTANCE NORMS**	**FORMAT OF RECORDS**	**AGENCY****			**REMARKS**	
									M	**B**	**R**		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**	
5.0	**METERING PUMP:**												
5.1	**RAW MATERIAL :**												
5.1.1	WETTED PARTS	CHEM & PHY. PROPERTIES	MA	CHEM. & PHY. TEST	1/BAR	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V		
		SURFACE TEST	MI	UT ON BAR>25 MM DIA	100%	ASTM A 388	REF. NOTE # 1	MFG.TC/LAB REPORT	P	V	V		
				DP ON M/C SURFACE	100%	ASME - E - 165	NO SURFACE DEFECTS	MFG.TC/LAB REPORT	P	V	V		
5.2	**FINAL INSPECTION**												
5.2.1	PUMP WITH MOTOR	LINEARITY	MA	PERFORMANCE	100%	API 675	API 675	INSPECTION REPORT	P	W	V	SHALL BE TESTED WITH EITHER JOB MOTOR OR SHOP MOTOR OF SIMILAR FRAME SIZE	
		STEADY STATE ACCURACY	MA	SHOP TEST	100%	API 675	API 675	INSPECTION REPORT	P	W	V		
		REPEATABILITY	MA	SHOP TEST	100%	API 675	API 675	INSPECTION REPORT	P	W	V		
		POWER DRAWN @ 100% STROKE	MA	MEASURED AT WORK	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	INSPECTION REPORT	P	W	V		
		LEAKAGE	MA	HYDRO TEST	100%	@1.5X DESIGN PRESSURE	NO LEAKAGE	INSPECTION REPORT	P	W	V		
		DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	V		
		NOISE	MA	MEASUREMENT	100%	--	< 85 dbA AT 1 M RADIUS	INSPECTION REPORT	P	W	V		
		VIBRATION	MA	MEASUREMENT	100%	--	≤45 MICRONS (PEAK TO PEAK)	INSPECTION REPORT	P	W	V		
7.0	**PRESSURE RELIEF VALVE**	SET & RESET PRESSURE.	MA	PERFORMANCE	100%	BHEL APPD.DATA SHEET & API RP-520	BHEL APPD.DATA SHEET & API RP-520	MFG. TC	P	V	V		
		DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG. TC	P	V	V		
		LEAKAGE DURING PERFORMANCE TEST	MA	VISUAL	100%	NO LEAKAGE	NO LEAKAGE	MFG. TC	P	V	V		
8	**VALVES (GATE, GLOBE & NRV)**												
8.1	**RAW MATERIAL :**												
8.1.1	BODY, BONNET COVER	CHEM.& PHY PROPERTIES	MA	CHEM.& PHY TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC/LAB REPORT	P	V	V		
		HEAT TREATMENT	MA	HEAT TREATMENT	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC/LAB REPORT	P	V	V		
8.1.2	TRIM MATERIAL	CHEM.& PHY PROPERTIES	MA	CHEM.& PHY TEST	1/BAR/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC/LAB REPORT	P	V	V		
8.2	**ASSEMBLY**												
		LEAKAGE (BODY & SEAT)		HYDRO TEST	100%	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG TC	P	V	V		
		LEAKAGE (SEAT)		PNEUMATIC TEST	100%	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG TC	P	V	V		
		DIMENSIONS		MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG TC	P	V	V		

MANUFACTURER/ SUB CONTRACTOR | **MAIN SUPPLIER--BHEL**

SIGNATURE

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R: CUSTOMER
"P" PERFORM, **"W"** WITNESS, AND **"V"** VERIFICATION

SIGNATURE OF APPROVAL BY CUSTOMER

THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-445-154-A001

ANNEXURE-I

BHEL	MANUFACTURER'S NAME & ADDRESS :		QUALITY PLAN ITEM: CHEMICAL DOSING SYSTEM SUB - SYSTEM : CHEMICAL DOSING SYSTEM		QP.NO : REV. : 0 DATE : PAGE : 3 OF 4		PROJECT : 1 x 660 MW SAGARDIGHI TPS UNIT V PHASE - III PACKAGE : CHEMICAL DOSING SYSTEM CONTRACT NO. MAIN SUPPLIER : BHEL/PEM, NOIDA					
S.NO	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY** M	AGENCY** B	AGENCY** R	
1	2	3	4	5	6	7	8	9	10			11
9.0	**FITTING/FLANGES FOR PIPING:**											
9.1	RAW MATERIAL	CHEM.& PHY PRPERTIES	MA	CHEM.& PHY TEST	1/HT BATCH	ASTM A 182 GR.TP 304	ASTM A 182 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		HEAT TREATMENT	MA	HEAT TREATMENT	100%	ASTM A 182 GR.TP 304	ASTM A 182 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		IGC TEST	MI	IGC TEST	1/HT BATCH	ASTM A 262 PR. 'E'	ASTM A 262 PR. 'E'	MFG.TC/LAB REPORT	P	V	V	
9.2	FINAL INSPECTION	DIMENSIONS	NA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG/ ANSI B 16.11/16.5	BHEL APPD.DATA SHEET/DWG/ ANSI B 16.11/16.5	MFG.TC	P	V	V	
10.0	**STRAINERS :**											
10.1	RAW MATERIAL FOR BODY	PHY.& CHEM. PROPERTIES	MA	PHY. & CHEM.TEST	1/BAR/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TCLAB REPORT	P	V	V	
10.2	SCREEN	CHEMICAL	MA	CHEMICAL	1/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
		MESH SIZE	MA	MEASUREMENT	1/SIZE	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
10.3	FINAL INSPECTION	DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		LEAKAGE		HYDRO TEST	1	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG.TC	P	V	V	
11.0	**PIPE (SEAMLESS)**											
11.1	MATERIAL	CHEMICAL	MA	CHEMICAL	1/HT BATCH/SIZE	ASTM A 312 GR.TP 304	ASTM A 312 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		MECHANICAL TEST	MA	MECHANICAL TEST	1/HT BATCH/SIZE	ASTM A 312 GR.TP 304	ASTM A 312 GR.TP 304	MFG.TC/LAB REPORT	P	V	V	
		MICRO STRUCTURE	MI	GRAINS STRUCTURE	1/HT BATCH/SIZE	FOR HEAT TREATMENT	FOR HEAT TREATMENT	MFG.TC/LAB REPORT	P	V	V	IDENTIFICATION BY BHEL. REFER NOTE 4.
		IGC TEST	MI	IGC TEST	1/HT BATCH/SIZE	ASTM A 262 PR 'E'	ASTM A 262 PR 'E'	MFG.TC/LAB REPORT	P	V	V	
		HYDRO TEST	MA	LEAKAGE	100%	NO LEAKAGE	NO LEAKAGE	MFG.TC/IR	P	V/W	V	
12.0	**LEVEL GAUGE :**											
12.1	RAW MATERIAL	CHEM.PROPERTIES	MA	CHEM.TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MGF.TC/LAB REPORT	P	V	V	
12.2	FINAL INSPECTION	DIMENSION	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		LEAKAGE	MA	HYDRO TEST	100%	BHEL APPD.DATA SHEET	NO LEAKAGE	MFG.TC	P	V	V	
13.0	**PRESSURE & DP GAUGE**											
13.1	MAT. FOR WETTED PARTS & BOUR	CHEM.PROPERTIES	MA	CHEM.TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
13.2	FINAL INSPECTION	DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG.TC/LAB REPORT				
13.3	PERFORMANCE	ACCURACY & OVERLOAD PROTECTION	MA	CALIBRATION	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG. TC	P	V	V	
14.0	**SWITCHES(LEVEL, PRESURE & DP) & TRANSMITTERS (LEVEL, PRESSURE & DP):**											INSTRUMENTS AS APPLICABLE FOR THE MODULE ORDERED SHALL BE CONSIDERED.
14.1	MAT. FOR WETTED PARTS	CHEM.PROPERTIES	MA	CHEM.TEST	1/HT BATCH	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	
14.2	PERFORMANCE	FUNCTIONAL	MA	CALIBRATION & VISUAL	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		IR-HV-IR		ELECTRICAL	100%	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC	P	V	V	
		DIMENSIONS		MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG.TC	P	V	V	
		DEGREE OF PROTECTION	MI	VERIFICATION OF TYPE TEST CERT	TYPE TEST	BHEL APPD.DATA SHEET	BHEL APPD.DATA SHEET	MFG.TC/LAB REPORT	P	V	V	

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MANUFACTURER/ SUB CONTRACTOR	MAIN SUPPLIER--BHEL	
SIGNATURE		SIGNATURE OF APPROVAL BY CUSTOMER

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ANNEXURE-I

BHEL	MANUFACTURER'S NAME & ADDRESS :		QUALITY PLAN ITEM: CHEMICAL DOSING SYSTEM SUB - SYSTEM : CHEMICAL DOSING SYSTEM		QP.NO : REV. : 0 DATE : PAGE : 4 OF 4		PROJECT: 1 x 660 MW SAGARDIGHI TPS UNIT V PHASE - III PACKAGE: CHEMICAL DOSING SYSTEM CONTRACT NO. MAIN SUPPLIER: BHEL/PEM, NOIDA					
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY** M	AGENCY** B	AGENCY** R	REMARKS
1	2	3	4	5	6	7	8	9	10			11
15.0	**CONTROL PANEL :**	DIMENSIONS	MA	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	CONTOL PANEL TEST TO BE OFFERED ALONG WITH FINAL SKID ASSEMBLY.
		CONTINUITY, IR-HV-IR	MA	ELECTRICAL	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		VERIFICATION OF MAKE	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		RATING OF COMPONENTS	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		PAINT SHADES, THICKNESS	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		ADHESION	MA		100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		DEGREE OF PROTECTION	MI	VERIFICATION OF TYPE TEST CERTIFICATE	TYPE TEST	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	MFG.TC/LAB REPORT	P	V	W	
16.0	**COMPLETE SKID ASSEMBLY:**	DIMENSIONS & ORIENTATION	CR	MEASUREMENT	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		LEAKAGE, CHECK ON WELDMENTS		VISUAL & HYDRO TEST	100%	DISCH.PIPING - 1.5 x DISCH PR. OF PUMP	NO LEAKAGE	INSPECTION REPORT	P	W	W	
		FUNCTIONAL TEST FOR INTERLOCKS	MA	VISUAL	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
	PMI Test for SS	GRADE CONFIRMATION	MA	CHEM.TEST	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/DWG	INSPECTION REPORT	P	W	W	
		PAINTING	MA	VISUAL & MEASUREMENT	100%	BHEL APPD PAINTING SCHEME	APPD DWG/PAINTING	INSPECTION REPORT	P	W	W	

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) CHEMICAL DOSING SKID VENDOR SHALL BE SELECTED FROM CUSTOMER APPROVED SOURCES. ALL THE BOUGHT OUT ITEMS OF THE CHEMICAL DOSING VENDOR SHALL BE PROCURED FROM BHEL APPROVED SOURCES.

NOTE- 3) ALL VENDOR DRAWINGS/DATASHEETS SHALL BE APPROVED BY BHEL. ONLY MANUFACTURING QP(PREPARED IN LINE WITH THIS STANDARD QP) OF THE VENDOR SHALL BE FORWARDED FOR CUSTOMER APPROVAL. ALL THE BHEL APPROVED DOCUMENTS SHALL BE FURNISHED TO CUSTOMER FOR INFORMATION/RECORDS ALONG WITH O&M MANUAL. COPY OF THE SAME SHALL ALSO BE FURNISHED TO INSPECTION AGENCY DURING INSPECTION.

NOTE 4) 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 5) FOR RAW MATERIAL (BARS/PIPES/CASTINGS/FORGINGS) WHERE HEAT TREATMENT ARE CARRIED OUT BY MATERIAL PRODUCERS ON BULK QUANTITIES, THEIR TEST CERTIFICATE SHALL BE REVIEWED (EXCEPT TIME TEMPERATURE CHART)

NOTE 6) 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

MANUFACTURER/ SUB CONTRACTOR	MAIN SUPPLIER--BHEL	** LEGEND : **M** : MANUFACUTRER/SUB-CONTRACTOR/SUB-VENDOR **B** : BHEL/NOMINATED INSPECTION AGENCY R: CUSTOMER		
SIGNATURE		**"P"** PERFORM, **"W"** WITNESS, AND **"V"** VERIFICATION		SIGNATURE OF APPROVAL BY CUSTOMER

THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-445-154-A001

ANNEXURE II: SUB VENDORS LIST

SUB VENDOR LIST - MECHANICAL

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	**TANKS/DISSOLVING BASKETS/WATER SEAL/CO2 ABSORBER/ BREATHER**	SELF MAKE OF MAIN VENDOR		
2.	**METERING PUMPS**	VK PUMPS	NASIK	
		MILTON ROY INDIA	CHENNAI	
		SWELLORE	AHMEDABAD	
		POSITIVE METERING PUMPS	NASIK	
		METACHEM	MUMBAI	
3.	**AGITATOR**	REMI PEOCESS PLANT & M/C	MUMBAI	
		FIBRE & FIBRE	MUMBAI / SILVASA	
		CEECONS	CHENNAI	
		STANDARD ENGINEERS	MUMBAI	
4.	**BALL VALVE (MANUAL /PNEUMATIC/ ELECTRIC) CLASS 150**	A.V. VALVES LTD	AGRA	
		AKAY INDUSTRIES PVT.LTD.	DHARWAD	
		BELGAUM AQUA VALVES PVT. LTD.	BELGAUN	
		ASIAN INDUSTRIAL VALVES & INSTRUMENTS.	CHENNAI	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		DEMBLA VALVES LTD.	THANE	
		M/S GM ENGINEERING	RAJKOT	
		HAWA VALVES (INDIA) PVT. LTD.	NAVI MUMBAI	
		INTERVALVE (INDIA) LTD.	PUNE	
		LEADER VALVES LTD.	JALANDHAR	
		MICROFINISH VALVES PVT LTD.	HUBLI	
		NILON VALVES PRIVATE LIMITED	AHMEDABAD	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		UNIFLOW	CHENNAI	
		VALTECH INDUSTRIES	MUMBAI	
		VAAS AUTOMATION PVT. LTD.	NEW DELHI	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
5.	**DIAPHRAGM VALVE (MANUAL / PNEUMATIC) CLASS 150**	WEIR BDK	HUBLI	
		CRANE FLOW PROCESS	SATARA	
		PROCON	MUMBAI	
		MAJESTIC VALVES (LABLINE)	-	
		HAWA ENGINEERS	AHMEDABAD	
6.	**DUAL PLATE CHECK**	ADVANCE VALVES PVT. LTD.	NOIDA	

	VALVES	FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	1. DUAL PLATE CHECK VALVE CI - CLASS 150 & UP TO 600NB, 2. DUAL PLATE CHECK VALVE CCS - CLASS 150 & UP TO 500NB
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CI ,CCS & STAINLESS STEEL SPRING ASSISTED DUAL PLATE CHECK VALVES UPTO 700 NB AND 150 CLASS RATING.
7.	**Y-TYPE STRAINER / STRAINER (WATER SERVICE)**	OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		GRAND PRIX	NEW DELHI	
		JAYPEE	NEW DELHI	
		GREAVES COTTON	MUMBAI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI / NOIDA	
		FILTERATION ENGINEERS (I) PVT. LTD	MUMBAI	
		FLUIDNYE	-	
		SUNGOV ENGINEERING PVT. LTD.	DELHI	
		GRAND PRIX	FARIDABAD	
		JAYPEE INDUSTRIES PVT. LTD.	DELHI	
		BHATIA ENGINEERING CO.	DELHI	
8.	**SS PIPES / TUBES**	APEX TUBES	BEHROR (ALWAR)	
		RATNAMANI	CHATTRAL	
		REMI	TARAPUR	
		PRAKASH STEELAGE	-	
9.	**SAFETY SHOWER**	UNICARE	-	
		MOHAN INDUSTRIES	-	
		SUPER SAFETY SERVICES	-	
10.	**STROKE CONTROLLER**	V K PUMPS	NASIK	
		METACHEM	MUMBAI	
		SWELORE	AHMEDABAD	
		MILTON ROY INDIA	CHENNAI	
11.	**SAFETY VALVES/RELIEF VALVES**	METACHEM	MUMBAI	
		KEYSTONE	BARODA	
		V K PUMPS	NASIK	
		MILTON ROY	CHENNAI	
12.	**STEEL GATE/GLOBE/NR**	A.V. VALVES LTD	AGRA	

	VALVES	ATAM VALVES PVT. LTD.	JALANDHAR	(1) CARBON STEEL GATE VALVES & NON RETURN VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 300 NB (#150) (2) CARBON STEEL GLOBE VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 200 NB (#150)
		FLUIDLINE VALVES COMPANY PVT.LTD.	KAUSHAMBI	
		M/S GM ENGINEERING	RAJKOT	
		INTERVALVE (INDIA) LTD.	PUNE	A) STEEL GATE VALVES: UPTO 50NB, #800 AND 65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C)SUPPLIER NOT REGISTERED FOR NR VALVES
		LEADER VALVES LTD.	JALANDHAR	
		NITON VALVE INDUSTRIES PVT LTD	MUMBAI	
		NSSL LIMITED.	NAGPUR	
		STEEL STRONG VALVES (I) PVT. LTD.	NAVI MUMBAI	LIMITED TO RANGES & CLASSES AS AVAILABE IN VD FILE.
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CC/CSS-GATE-BBT-UPTO600NB CL UPTO300,GATE-PSBT UPTO250NB CL 1500,GLV-BBT-UPTO300NB CL UPTO600,SCNRV-BBT-UPTO600NB CL UPTO150,SCNRV-BBT-UPTO300NB CL 300,SCNRV-PSBT-UPTO150NB CL UPTO900
		VALTECH INDUSTRIES	MUMBAI	CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE-GV/150/900, GV/300/400, GV/600/300, GV/GLV/NRV/900/250, GLV/300/300, GLV/150/350, SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.

		V.K. VALVES PVT. LTD.,	JALANDHAR	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
13.	**FITTINGS (CS/SS)**	M.S. FITTINGS	KOLKATA	
		METAL LLOYDS	MUMBAI	
		TRUE FORGE	FARIDABAD	
		TUBE PRODUCTS	BARODA	
		NL HAZRA	KOLKATA	
		GUJRAT INFRA PIPES	BARODA	
		EDWARDS	USA	
		PIPEFIT ENGINEERS	BARODA	
		SIDDARTH & GAUTAM	FARIDABAD	
		EBY	MUMBAI	
14.	**FLANGES (SS/CS)**	PRADEEP METALS LTD	MUMBAI	
		TUBE PRODUCT INCOROPORATION	BARODA	
		MS FITTINGS	KOLKATA	
		HAWA ENGINEERING	-	
		ALIANCE PIPE & PLANGES	KOLKATA	
		JAI AMBE	MUMBAI	
15.	**PAINT**			
		BERGER PAINTS INDIA LTD		
		GOODLASS NEROLAC		
		JENSON & NICHOLSON (I) LTD		
		CDC CARBOLINE (I) LTD.		
		SHALIMAR PAINTS LTD.		
		ADDISON PAINTS LTD		
		GRAND POLYCOAT		
		BOMBAY PAINTS		
		HEMPLE PAINTS (SINGAPORE)		
		JOTUN PAINTS		
16.	**MOTORISED ACTUATOR**	ROTARK	-	
		AUMA	-	
		LIMITORK	-	

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

   BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

2. DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.

3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

SUB VENDOR LIST ELECTRICAL

SUB-VENDOR LIST

The list of approved make of the LT Motors are as mentioned below:

S.No.	LIST OF LT MOTORS
1.	BHARAT BIJLEE LTD.
2.	CROMPTON GREAVES
3.	ASEA BROWN BOVERI
4.	KIRLOSKAR ELECTRIC CO LTD.
5.	NGEF
6.	SIEMENS
7.	MARATHON
8.	GE-POWER
9.	RAJINDRA ELECT INDUSTRIES
10.	LAXMI HYDRAULICS PVT. LTD

NOTES:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL AND CUSTOMER.

2. BIDDER TO PROPOSE SUB-VENDORS WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

3. DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.

4. THE INSPECTION CATEGORY SHALL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/ CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

SUB VENDOR LIST C&I

Sl. No.	Item Description	Vendor Name	
		3	IEC
76	MOOSE CONDUCTOR	1	HINDUSTAN VIDYUT PRODUCTS LTD., HARYANA
		2	GUPTA POWER INFRASTRUCTURE LTD., BHUBANESWAR
		3	HIREN ALUMINIUM Ltd., SILVASSA DADRA & NAGAR HAVELI
77	ALUMINIUM TUBE	1	HINDALCO INDUSTRIES LIMITED
		2	JINDAL ALUMINIUM LIMITED
		3	BALCO
78	STRUCTURE HARDWARE	1	DEEPAK FASTNERS LTD
		2	NAVEEN METAL INDUSTRIES, KOLKATA
		3	NEW INDIA ENGINEERING CORPORATION
79	LUGS	1	UNIVERSAL MACHINES
		2	COMET
		3	MAHAVEER ENGINEERING
		4	DOWELLS
		5	SUNIL & CO. PVT. LTD.
80	FAST BUST TRANSFER	1	AARTECH SOLONICS LTD, MP
		2	ABB
81	RAIL POLE	1	SAIL
		2	RINL
		3	TATA
82	FRP JUNCTION BOXES/ JUNCTION BOXES (POWER/CONTROL), LIGHTING JB	1	SCHNEIDER
		2	CONTROL DEVICE
		3	SWITCHING CIRCUIT
		4	JASPER ENGINEERS
		5	BAJAJ ELECTRICALS
		6	AJMERA
		7	S B EIEC. EENGINEERING CORP. Ltd
		8	PYROTECH
		9	ENGG. CONSTRUCTION CORP.
		10	L&T
83	LOCAL STARTER PANEL, LOCAL CONTROL PANEL, LIGHTING PANEL, ACELP, DCELP	1	PYROTECH
		2	L&T
		3	CONTROL DEVICE
		4	SCHNEIDER
84	LIGHTING WIRE	1	ISI MARK

Sl. No.	Item Description	Vendor Name	
85	ACTUATOR	1	AUMA
		2	LIMITORQUE
86	CABLE for ROLLED -E-CHAIN	1	IGUS
87	CABLE GLAND	1	SUNIL & COMPANY
		2	ARUP ENGG. & FOUNDRY WORKS
		3	COMMET BRASS PRODUCTS
		4	ELECTROMAC INDUSTRIES
		5	BALIGA LIGHTING EQPT.
88	BAY CONTROL UNIT	1	ALSTOM
		2	SIEMENS
		3	ABB
89	TRANSFORMER BUSHING	1	ABB
		2	AREVA
		3	ALSTOM
		4	BHEL
90	EARTH LEAKAGE CB	1	SCHNEIDER
		2	L&T
		3	SIEMENS
		4	ABB
91	EARTH LEAKAGE RELAY [ELR] ALONG WITH CBCT	1	AREVA
		2	PRO'KDEVICES
92	PUSH BUTTON	1	BCH
		2	L&T
		3	SCHNEIDER
		4	SIEMENS
		5	TECKNIC CONTROL
		6	GE – POWER
		7	ABB
93	RELAYS (OTHER THAN INTERPOSING & NUMERICAL RELAYS)	1	ABB
		2	AREVA
		3	SIEMENS
		4	GE – POWER
		5	ALSTOM
94	ENERGY MANAGEMENT SYSTEM	1	SCHNEIDER
		2	SECURE

Sl. No.	Item Description	Vendor Name	
	CONTROL & INSTRUMENTATION SYSTEM VENDORS		
1	DISTRIBUTED CONTROL SYSTEM	1	ABB
		2	HONEYWELL
		3	EMERSON
		4	VALMET (FORMERLY METSO)
2	PLC (Programmable Logic Controller)	1	ROCKWELL AUTOMATION INDIA LTD.
		2	GE
		3	SCHNEIDER ELECTRIC INDIA PVT.LTD.
3	DIGITAL INDICATOR	1	ABB
		2	GOSSEN / CAMILLE BAUER / METRAWATT
		3	YOKOGAWA
4	VERTICAL MOVING COIL INDICATOR	1	ABB
		2	GOSSEN
		3	CAMILLE BAUER
		4	METRAWATT
		5	YOKOGAWA
5	TRANSDUCERS	1	SIEMENS
		2	ABB
		3	CAMILLEBAUER
		4	ELSTER
		5	PYROTECH
		6	SOUTHERN TRANSDUCERS
		7	ADEPT
6	LARGE VIDEO SCREEN	1	BARCO
		2	PLANAR
7	PC	1	DELL
8	TFT MONITOR	1	DELL
		2	HP
		3	IBM-LENOVO
9	DOT MATRIX PRINTERS	1	EPSON
		2	TVS
10	PRINTERS (LASER)	1	HP
		2	IBM
11	COMPUTER FURNITURE	1	ADARSH CONTROLS
		2	COSMOS MEDIA
		3	FEATHER LITE
		4	GODREJ
		5	OTS

Sl. No.	Item Description	Vendor Name	
		6	PYROTECH
12	CONTROL PANEL/RACK	1	PYROTECH
		2	RITTAL
13	PRESSURE GAUGES	1	A. N. INSTRUMENTS PVT. LTD.
		2	ASHCROFT INDIA
		3	GENERAL INSTRUMENTS CONSORTIUM
		4	MANOMETER (INDIA) PVT.LTD
		5	WIKA
		6	FORBES MARSHALL LTD.
		7	GLUCK (INDIA) MFG.CO.
		8	WAAREE INDUSTRIES
		9	BUDENBERG GAUGE CO. LTD.
14	PRESSURE SWITCHES	1	ASHCROFT INDIA
		2	INDFOS INDUSTRIES LTD.
		3	SOR INC.
		4	SWITZER INSTRUMENT CO.
		5	TRAFAG-INDIA
		6	DELTA CONTROLS LTD.
15	ELECTRONIC TRANSMITTER	1	EMERSON PROCESS
		2	HONEYWELL
		3	YOKOGAWA
		4	FUJI
16	TEMPERATURE GAUGE	1	A. N INSTRUMENTS PVT. LTD.
		2	ASHCROFT INDIA
		3	GENERAL INSTRUMENTS CONSORTIUM
		4	GOA THERMOSTATIC INSTUMENTS
		5	WIKA
		6	FORBES MARSHALL
		7	WAREE
17	TEMPERATURE SWITCH	1	GENERAL INSTRUMENTS CONSORTIUM
		2	INDFOS INDUSTRIES LTD.
		3	SWITZER INSTRUMENT CO.
		4	AN INSTRUMENTS
18	TEMPERATURE ELEMENT	1	DETRIVE
		2	GENERAL INSTRUMENS CONSORTIUM

Sl. No.	Item Description	Vendor Name	
		3	INDUSTRIAL INSTRUMENTS
		4	PYRO ELEC INSTRUMENTS GOA P. LTD.
		5	TEMPSENS INSTRUMENTS (I) PVT. LTD.
19	ROTA METER	1	EUREKA
		2	FLUIDYNE INSTREMENTS
		3	IEPL
		4	PLACKA INSTRUMENTS INDIA PVT. LTD.
		5	TRAC
20	SIGHT FLOW INDICATOR	1	CHEMTROLS SAMIL
		2	LEVCON INSTRUMENTS PVT. LTD.
		3	V.AUTOMAT & INSTRUMENTS PVT LTD.
		4	FORBES MARSHALL LTD.
21	FLOW SWITCH	1	GENERAL INSTRUMENTS CONSORTIUM
		2	KROHNE MARSHALL
		3	SWITZER INSTRUMENT CO.
22	IMPACT HEAD TYPE ELEMENT	1	DETRIECH / EMERSON PROCESS
		2	MIDWEST
		3	STARMECH
		4	SWITZER INSTRUMENT CO.
		5	VERIS INC.
23	LEVEL GAUGE	1	CHEMTROLS ENGG. (P) LTD.
		2	LEVCON INSTRUMENTS (P) LTD.
		3	S. B. ELECTRO-MECHANICALS PVT. LTD.
		4	V. AUTOMAT & INSTRUMENTS PVT. LTD.
		5	DK INSTRUMENTS
		6	SIGMA INSTRUMENTS COMPANY
24	LEVEL SWITCH (FLOAT TYPE)	1	CHEMTROLS
		2	MAGNETROL INTERNATIONAL NV
		3	DK INSTRUMENTS
		4	LEVCON INSTRUMENTS P LTD.
25	LEVEL SWITCH (CONDUCTIVITY TYPE)	1	LEVEL STATE, UK
		2	SOLARTON/MOBREY, UK
		3	YARWAY
26	LEVEL SWITCH	1	ENDRESS + HAUSER

Sl. No.	Item Description	Vendor Name	
	(CAPACITANCE TYPE)	2	DK INSRTUMENTS
27	LEVEL SWITCH (DISPLACEMENT TYPE)	1	DRESSER VALVES INDIA LTD.
		2	CHEMTROLS
		3	DK INSRTUMENTS
		4	ECKARDT
28	LEVEL TRANSMITTER (ULTRASONIC TYPE)	1	EMERSON PROCESS
		2	ENDRESS + HAUSER
		3	SIEMENS MIL TRONICS
		4	VEGA
29	LEVEL TRANSMITTER (RADAR Type)	1	ENDRESS + HAUSER
		2	VEGA
30	BUNKER/SILO LEVEL 3D MONITORING (ULTRASONIC TYPE)	1	E & H
		2	SIEMENS
		3	VEGA-GERMANY
31	VIBRATION MONITORING SYSTEM /TURBINE SUPERVISORY MONITORING SYSTEM	1	GE (for BENTLY NEVADA SYSTEM)
		2	MEGGIT
		3	SHINKAWA, JAPAN
32	MERCURY MONITORING	1	DURAG GMBH AND CO KG
		2	SICK
		3	SHINKAWA
33	Dust Density Monitor	1	CODEL INTERNATIONAL LTD.
		2	DURAG GMBH AND CO KG
		3	LAND INSTRUMENTS INTERNATIONAL
		4	SICK GMBH
34	CO Analyzer (in situ type)	1	CODEL INTERNATIONAL LTD.
		2	LAND INSTRUMENTS INTERNATIONAL
		3	SICK GMBH
35	Oxygen Analyzer (Zirconia Probe type)	1	EMERSON PROCESS MANAGEMENT
36	SO_2-NOx/CO/CO_2 Analyzer(Insitu Type)	2	CODEL INTERNATIONAL LTD
		3	PROCAL
		4	SICK GMBH
37	SWAS system (with selected analysers from Rosemount Analytical / Hack Ultra-France, Orion – USA, Hach-USA. ABB – UK, Polymetron-France/Zeltwegger -Analyticals)	1	ABB LTD.
		2	EMERSON PROCESS MANAGEMENT INDIA PVT.
		3	FORBES MARSHALL
38	DUST MONITOR	1	SIEMENS MILLTRONICS

Sl. No.	Item Description	Vendor Name	
		2	FILTER SENSE
		3	BIN MASTER
39	PULSE JET CONTROLLER	1	SWITCHING CIRCUIT
		2	ADVANCE CONCEPT
		3	VOLTCRAFT
		4	SQUARE M
		5	MICRO SYSTEM
40	AIR FILTER REGULATOR	1	JRU INSTRUMENTS (Formerly PLACKA)
		2	SHAVO NORGREN (INDIA) PVT. LTD.
41	ELECTRO PNEUMATIC CONTROLLER	1	MTL INDIA PVT. LTD.
		2	WATSON SMITH LTD.
		3	FAIRCHILD
42	SMART POSITIONER	1	EMERSON PROCESS MANAGEMENT
		2	SIEMENS
		3	ABB
43	SOLENOID VALVE	1	ASCO (I) LTD.
		2	ROTEX AUTOMATION LTD.
		3	NUCON INDUSTRIES PVT LTD
44	FEP INSULATED CABLE (For TG control)	1	DELTON CABLES
		2	HABIA CABLES
		3	LAPP CABLES
		4	LEONI KERPEN
		5	TEMPENS INSTRUMENTS (I) PVT. LTD.
		6	THERMOELECTRIC
45	PTFE INSULATED CABLES (For TG control)	1	ADVANCE CABLES TECHNOLOGIES
		2	DELTON CABLES
		3	FLUTEF INDUSTRIES
		4	RELIANCE INDUSTEIES
		5	RJ INDUSTRIAL CORPORATION
		6	TEMPSENS INSTRUMENTS (I) PVT. LTD
		7	TOSHNIWAL CABLES PRIVATE LTD
		8	UNIVERSAL CABLES LIMITED
46	INSTRUMENTATION CONTROL CABLE/ COMPENSATING CABLE / THERMOCOUPLE EXTENSION CABLES	1	ADVANCE CABLES TECHNOLOGIES
		2	CORDS CABLE INDUSTRIES PVT. LTD.
		3	DELTON CABLES LTD.
		4	HAVIA CABLES
		5	KEI INDUSTRIES LTD.
		6	KERPEN CABELS

Sl. No.	Item Description	Vendor Name	
53	PUBLIC ADRESSING SYSTEM (ANALOG SYSTEM)	1	BOSCH SECURITY SYSTEMS
	PUBLIC ADRESSING SYSTEM (IP ADDRESSABLE)	2	STENTOFONE (from ZENITAL GROUP)
		3	INDUSTRONIC
		4	COMMEND
54	EPABX	1	ABB INDIA PVT. LTD.
		2	BPL TELECOM PVT. LTD.
		3	CROMPTON GREAVES LTD.
		4	HCL INFINET LTD.
		5	SIEMENS LTD.
		6	ABC INDIA PVT LTD
55	CCTV System	1	BOSCH
		2	HONEYWELL
		3	PELCO
56	LIE/LIR	1	CHEMIN CONTROLS
		2	ELECTRONICS CORP. OF INDIA LTD.
		3	PYROTECH
		4	FORBES MARSHAL
		5	INSTRUMENTATION LIMITED
		6	PRAMMEN INDUSTRIES
57	CONDENSATE POTS	1	FLOWTECH
		2	INSTRUMENTATION LIMITED
		3	PRECISION ENGG INDUSTRIES
		4	BALDOTA VALVE AND FITTING CO. PVT LTD.
		5	METPRESS ENGINEERING WORKS
		6	MICROPRECISION
58	IMPULSE PIPES	1	BHARAT HEAVY ELECTRICALS LTD.
		2	INDIA SEAMLESS METAL TUBES LTD. (only for CS Pipes)
		3	JINDAL SAW PIPES LTD.
		4	MAHARASHTRA SEAMLESS (only for CS Pipes)
		5	MANNESMANN AG
		6	SUMITOMO CORPORATION
		7	TPS TECHNITUBE ROHREN WERKE GMBH
		8	TROUVAY CAUVIN GULF E.C. DUBAI
		9	BALDOTA VALVE AND FITTING CO. PVT. LTD.

Sl. No.	Item Description	Vendor Name	
		10	BHARAT HEAVY ELECTRICALS LTD.
		11	EXCEL HYDRO – PHEUMATICS PVT. LTD.
		12	INSTRUMENTATION LTD.
		13	METPRESS ENGINEERING WORKS
		14	MAHALAKSHMI SEAMLESS
		15	RATNAMANI METALS & TUBES LTD.
59	INSTRUMENT VALVES / MANIFOLDS	1	BHARAT HEAVY ELECTRICALS LTD.
		2	BALDOTA VALVE AND FITTING CO PVT LTD.
		3	INSTRUMENTATION LIMITED
		4	METPRESS ENGINEERING WORKS
		5	EXCEL HYDRO-PNEUMATICS PVT. LTD.
		6	METPRESS ENGINEERING WORKS
		7	FLOWTECH
60	COMPRESSION FITTINGS	1	PARKER HANNIFIN
		2	PRECISION ENGG INDUSTRIES
		3	TROUVAY & CAUVIN
		4	HOKE (TECHNICAL PARTS CO. MUMBAI)
		5	SWAGELOCK
		6	METPRESS ENGINEERING WORKS
61	SOCKET WELD FITTINGS	1	EXCEL HYDRO-PNEUMATICS PVT. LTD.
		2	METPRESS ENGINEERING WORKS
		3	V.K. INDUSTRIES
		4	VIKAS INDUSTRIAL PRODUCTS
		5	BALDOTA VALVE AND FITTING CO PVT LTD.
		6	FLOWTECH
	FIRE DETECTION AND HYDRANT SYSTEM VENDORS		
1	HYDRANT VALVES	1	SHAH BHOGILAL
		2	SUKAN
		3	NEWAGE
		4	VENUS
		5	WINCO
2	FIRE HOSES	1	NEWAGE
		2	CHATTARIA RUBBER
3	WATER MONITOR & WATER-	1	SHAH BHOGILAL

PACKAGE WISE REGISTERED SUPPLIER LIST (PERMANENT CATEGORY) AS ON 9/4/2021 1:51:12 PM

Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address
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
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
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
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
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 :
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-
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
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
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
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
145-10000-A	TEMPERATURE 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
145-10000-A	TEMPERATURE 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
145-10000-A	TEMPERATURE 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-
145-10000-A	TEMPERATURE 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 :
145-10000-A	TEMPERATURE 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
145-10000-A	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincode : 403525 Email : gtilworks@pyro-electric.in	Works-1 >Mrs Saanvi Naik BICHOLIM, BICHOLIM-GOA INDIA Phone- 9595855152 FAX : Pincode : 403 529 Email : saanvi.naik@thermostatic.in
145-10000-A	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,	Works-1->Mr. S.G. Dixit D2/5, Mapusa Industrial Estate, -Mapusa-GOA INDIA Phone- 09326054551 FAX : 0832-2262331 Pincode : 403 507 Email : sumukh@goainstruments.com
145-10000-A	TEMPERATURE 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
145-10000-A	TEMPERATURE 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
145-11000-A	LEVEL GAUGE	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com	
145-11000-A	LEVEL GAUGE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	Works-1->Mr. Bharat Kumar/ Mr. Sasi Kumar Plot No. 92B & 93B,Sec-V, IMTManesar -GURGAON-HARYANA INDIA Phone- 0124-4366000 TO 9 FAX : 0124-2290884 Pincode : 122002 Email : bharat@blissanand .com
145-11000-A	LEVEL GAUGE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	Works-1->R Gopinath 27 Nahur Udyog Industrial Premises,M.M.Malviya Road, Mulund(-MUMBAI-MAHARASHTRA INDIA Phone- +912225918567 FAX : +912225918566 Pincode : 400080 Email : sales@sigmainstruments.co.in

277014/2024/PS-PEM-WSE

PACKAGE WISE REGISTERED SUPPLIER LIST (PERMANENT CATEGORY) AS ON 9/4/2021 1:51:12 PM

Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address
145-13000-A	TEMP. ELEMENT	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
145-13000-A	TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	320, TV INDUSTIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI Phone- 24934125,24938403 Pincode : 400025 Email : trivtech@vsnl.com	Works-1->Mr. A.D.Solomon J-14, MIDC, TARAPORE, BOISER STN., -THANE-MAHARASHTRA India Phone- FAX : Pincode : Email : trivtech@vsnl.com
145-13000-A	TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.	Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema,Mahim Mumbai Phone- 09322664709 Pincode : 400016 Email : ramk@giconindia.com	Works-1->Mr. Raghavendra M. Kulkarni Survey No. 250A/B, Post-Mangaon,Tal.- Kudal, Dist.- Sindhudurg, --MAHARASHTRA India Phone- 09322664709 FAX : 022-24455026 Pincode : 416519 Email : ramk@giconindia.com
145-13000-A	TEMP. ELEMENT	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
145-13000-A	TEMP. ELEMENT	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	M. D. BICHU/R. M. BICHU G.B, HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA Phone- 9326114601 Pincode : 403507 Email : priyanka.marketing@pyro-electric.in	Works-1->A A KULKARNI/ VINOD C G PLOT NO. 71,BICHOLIM INDUSTRIAL ESTATE -BICHOLIM-GOA INDIA Phone- 9326114409 FAX : 91 832 2363381 Pincode : 403529 Email : pyroworks@pyro-electric.in
145-13000-A	TEMP. ELEMENT	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-
145-13000-A	TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,	Works-1->Mr. S.G. Dixit D2/5, Mapusa Industrial Estate, -Mapusa-GOA INDIA Phone- 09326054551 FAX : 0832-2262331 Pincode : 403 507 Email : sumukh@goainstruments.com
145-13000-A	TEMP. ELEMENT	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
145-13000-A	TEMP. ELEMENT	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
145-13000-A	TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com	Works-1->Mr. S.D Deval B-188A ROAD NO.5 ,M.I.A -UDAIPUR-RAJASTHAN INDIA Phone- 9352501530 FAX : 0294-3057750 Pincode : 313003 Email : deval@tempsens.com
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
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	
145-14000-A	TRANSMITTERS	ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com	
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
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
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
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
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
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
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
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. S L Sadani Others 104 - 115,Electronic Complex - Indore-MADHYA PRADESH INDIA Phone- 0731-4081307 FAX : Pincode : 452010 Email : sales@nivocontrols.com;sadanis@nivocontrols.com

277014/2024/PS-PEM-WSE

PACKAGE WISE REGISTERED SUPPLIER LIST (PERMANENT CATEGORY) AS ON 9/4/2021 1:51:12 PM

Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address
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 :
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
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	
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	
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
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
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
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
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
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
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	
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
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	
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
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
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
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	
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 :
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
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
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-

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PACKAGE WISE REGISTERED SUPPLIER LIST (PERMANENT CATEGORY) AS ON 9/4/2021 1:51:12 PM

Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address
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	
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
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
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
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
145-24000-A	LOCAL CONTROL PANELS	INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	47, CHAKALA ROAD, ANDHERI(EAST), MUMBAI Phone- 28344494,28221532 Pincode : 400099 Email : indconapp@vsnl.com	
145-24000-A	LOCAL CONTROL PANELS	PROCON INSTRUMENTATION PVT. LTD.	1H, SHAKTI TOWERS, 766, ANNA SALAI, CHENNAI Phone- 28266041,2824142 Pincode : 600022 Email : procond1@nda.vsnl.net.in	
145-24000-A	LOCAL CONTROL PANELS	C and S ELECTRIC LTD.	222, OKHLA INDUSTRIAL ESTATE, PHASE-II, NEW DELHI Phone- 9871799447 Pincode : 110020 Email : panel.marketing@cselectric.co.in	
145-24000-A	LOCAL CONTROL PANELS	PYROTECH ELECTRONICS PVT. LTD	F-16 A, Road No. - 3 M.I.A.,Madri UDAIPUR Phone- 2492122,31,34 Pincode : 313003 Email : pyrotech@pyrotechindia.com	

NOTES:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL AND CUSTOMER.

2. BIDDER TO PROPOSE SUB-VENDORS WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

3. DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.

4. THE INSPECTION CATEGORY SHALL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/ CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

ANNEXURE III:

DRAWING DOCUMENTS DISTRIBUTION PROCEDURE

DRAWING DOCUMNTS DISTRIBUTION SCHEDULE

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

Note:

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

    - P&IDs.
    - GA & Foundation Drawing
    - Local Control Panel/ Junction Box Wiring Diagram

ANNEXURE IV: PAINTING SPECIFICATION

SECTION-XI

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 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 / Sa2½	:	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 C222-2000	:	Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings.

j)	IS 13213 : 2000	:	Polyurethane Full Gloss Enamel (Two pack)
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.

3.00.00 **GENERAL REQUIREMENTS**

3.01.00 The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.

3.02.00 The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.

3.03.00 The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.

3.04.00 The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.

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

3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.

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

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

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

3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.

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

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

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

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

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

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

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

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

3.19.00 All insulated piping shall have aluminium sheet jacketing.

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

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

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

All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be

applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.

4.02.00 **Surface Preparation**

4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting up to SSPC SP10/NACE2/Sa2½ level to get "near white metal" surface before applying the primer.

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

4.03.00 **Painting**

4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves shall be as follows :

a) Surface preparation shall be done by means of sand blasting, which shall conform to SSPC SP10/NACE 2/Sa2½ Standard.

b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.

c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.

d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.

e) Total DFT of paint system shall not be less than 300 microns.

4.03.02 Specification for application of paints for external surfaces protection of steel pipes and fittings which are buried underground / laid inside a Hume Pipe & or submerged Under Water and laid under Pipe Trenches (in road/rail/pipe or trench crossings) shall be as follows :

a) Surface preparation by means of sand blasting and shall conforms to SSPC SP10/NACE2/ Sa2½.

b) External surface of the pipe, fittings, specialties etc. handling raw water/ clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 1500 micron including primer coat.

4.03.03 Specification for application of paints for internal surface protection of large diameter pipes, if any, shall be as follows :

a) Surface preparation by means of sand blasting which shall conforms to SSPC SP10/NACE2/Sa2½ standard.

b) All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.

c) Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.

d) The minimum dry film thickness (DFT) of internal lining shall be 500 micron.

4.03.04 Specification for application of paints for protection of internal surfaces of DM Water Storage Tank(s) shall be as follows :

a) Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.

b) Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.

c) Total thickness of primer and paint should not be less than 500 microns.

4.03.05 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.

4.03.06 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.

4.03.07 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

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

5.00.00 COATING PROCEDURE AND APPLICATION

5.01.00 Surface preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 /

NACE 2 / Sa2½ of ISO 8501 (near white metal)

a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.

b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 **Application of Epoxy Coating**

a) Coating shall be applied when

i) When the pipe surface temperature shall be at least 3°C above dew point temperature.

ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater that
50°C.

b) Material preparation shall be in accordance with manufacturer's recommendations.

c) Application of epoxy coating system :

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

5.03.00 **Application of PU Coating**

a) PU coating shall be applied when the pipe surface temperature at least 3°C above dew point temperature (when R.H is more than 85%).

b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 **TEST REQUIREMENTS**

6.01.00 **Measurement of dry film thickness**

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

6.01.01 **Apparatus / Instrument**

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

6.01.02 **Procedures**

a) **Number of measurements**

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

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

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

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

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

Area measurement must be within specified range.

6.02.00 **Electrical Inspection (Holiday) Test**

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

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

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

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

Testing Voltage V = 7900 √T ± 10 percent where T is the average coating thickness in mm.

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

6.03.00 **Adhesion Pull off Test**

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

6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:

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

6.03.02 **Prepare the test surface**

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

6.03.03 **Prepare Dolly (Test Pull Stub)**

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

6.03.04 **Select an adhesive**

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

6.03.05 **Attach the dolly to the surface**

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

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

c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.

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

6.03.06 **Adhesion Test Procedure**

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

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

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

d) Firmly hold the base of the instrument in one hand and rotate the 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.

6.04.00 **Coating Repair**

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

6.04.01 **Surface Preparation**

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

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

6.04.03 **Coating Application**

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

6.04.04 Repair Inspection:

Repaired portion shall be electrically inspected using a holiday detector.

6.05.00 **Welded Field Joints**

6.05.01 **Preparation**

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

6.05.02 **Electrical Inspection**

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

7.00.00 **INFORMATION/DATA REQUIRED**

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

ANNEXURE V: MANDATORY SPARES LIST

	TITLE: **1 X 660 MW SAGARDIGHI TPS UNIT NO. 5, PHASE III**	**SPECIFICATION NO.: PE-TS-445-154-A001**	
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	**SUB-SECTION:** IA	
		REV. NO.: 00	**DATE:** 30.11.2021

ANNEXURE - V

MANDATORY SPARES LIST

MANDATORY SPARES FOR OXYGEN DOSING SYSTEM		
S. No.	**ITEM**	**QUANTITY**
1.0	**MECH. ITEMS**	
1.1	Piston Ring (Guide Ring)	1 set (one set means complete replacement required for each type & Duty of Pump)
1.2	Piston (Plunger)	1 set (one set means complete replacement required for each type & Duty of Pump)
1.3	Seals and other Wear out Part	1 set (one set means complete replacement required for each type & Duty of Pump)
1.4	Complete Set of Bearings	1 set (one set means complete replacement required for each type & Duty of Pump)
1.5	Crank Shaft	1 set (one set means complete replacement required for each type & Duty of Pump)
1.6	Cross Head	1No. for each type and Duty of Pump
1.7	Cross head guide bush	3Nos. for each type and Duty of Pump
1.8	Connecting Rod Plate	1 set (one set means complete replacement required for each type & Duty of Pump)
1.9	Complete Set of Valves	10% (rounded off to the next higher integer) of the total quantity used for each type and Size or Minimum 1No. whichever is higher
1.10	Pump Discharge NRV	1 No. for each type & Duty of Pump
1.11	Strainer	2 Nos. for each type and size
2.0	**ELECTRICAL ITEMS**	
2.1	415 Volt Motor	
2.1.1	Motor of each type and rating ~~(Note: motors covered in mechanical spare items need not to be included here again)~~ 10% of the installed quantity or minimum 1 number whichever be higher.	10% of the installed quantity or minimum 1 number whichever be higher
2.1.2	End Shield Cover Driving & Non-Driving End	1 set for each type and rating of Motor
2.1.3	Heaters	2 sets for each type and rating of motor
2.1.4	Bearings (DE and NDE) for each type and rating of motor	2 sets
2.1.5	Cooling Fan for all type and rating of LT motors	One (1) set
2.1.6	Dust seals and gaskets for each type of motors	Dust seals and gaskets for each type of motors
2.1.7	Motor Terminal Block	1 no. for each type and rating of Motor
2.1.8	Complete Set of Coupling	1 set for each type and rating
3.0	**C&I ITEMS**	
3.1	**ELECTRONIC TRANSMITTERS**	

3.1.1	Pressure	1 (One) no. complete set for each type and model/ range used in the system.
3.1.2	Level	1 (One) no. complete set for each type and model/ range used in the system.
3.1.3	Differential Pressure	1 (One) no. complete set for each type and model/ range used in the system.
3.2	**GUAGES**	
3.2.1	Pressure Gauge	10% of total nos. used in the system or minimum 1 (one) no. whichever is more for each type and range.
3.2.2	Differential Pressure Gauge	10% of total nos. used in the system or minimum 1 (one) no. whichever is more for each type and range.
3.2.3	Magnetic Level Gauge	10% of total nos. used in the system or minimum 1 (one) no. whichever is more for each type and range
3.3	**Erection Hardware**	
3.3.1	Transmitter's Manifold	10% of total nos. used in the system or minimum 2 (Two) nos. whichever is more for each type, rating/ model and size used in the system.
3.3.2	Impulse Line Root/Source valve	10% of total nos. used in the system or minimum 2 (Two) nos. whichever is more for each type, rating/ model and size used in the system.
3.3.3	Impulse Line Isolation valve	10% of total nos. used in the system or minimum 4 (four) nos. whichever is more for each type, rating/ model and size used in the system.
3.3.4	Impulse Line Drain valve	10% of total nos. used in the system or minimum 4 (four) nos. whichever is more for each type, rating/ model and size used in the system.
3.3.5	Impulse Line fittings	10% of total nos. used in the system or minimum 4 (four) nos. whichever is more for each type, rating/ model and size used in the system.
3.3.6	Impulse Pipe	Each type/ size 25 Nos.
3.3.7	Copper/ SS Tube	Each type/ size 100 meters.
3.3.8	Fittings for Copper/SS Tube	Each type/ size 100 nos.

Notes: -

i) Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by the bidder shall be the specified percentage (%) of the total population of the plant. In case the quality so calculated happens to be a fraction, the same shall be rounded off to next higher whole number.

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

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

iv) In case, mandatory spares are not applicable as per equipment / item selected, bidder has to provide equivalent mandatory spare as per for selected equipment / item in line with list of mandatory spares.

The vendor warrants:

1. That all spares supplied will be new and in accordance with the contract document and will be free from defects in design, material and workmanship and shall further guarantee as under:

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

3. The long term availability of spares to the BHEL and the customer for the full life of the equipment covered under the contract and that before going out of production of spare parts of the equipment covered under the contract, vendor and his sub-vendors shall give the BHEL and the customer at least 24 (Twenty-Four) months advance notice so that the latter may order his bulk requirements of spares, if he so desires. The same provision will also be applicable to the sub-vendors. Further, in case of discontinuance of manufacture of any spares by the vendors or his sub-vendors the vendors and his sub-vendors, will provide the BHEL and the customer, 2 (two) years in advance, with full manufacturing drawings, material specifications and technical information required by the BHEL and the customer for the purpose of manufacture of such items and also the right to manufacture such spares for their own requirements.

4. Further in case of discontinuance of supply of spares by the vendors or his sub-vendors, the vendor will provide the BHEL and the customer with full information for replacement of such spares with other equivalent makes, if so required by the BHEL and the customer.

5. Notwithstanding the above, the vendor shall be responsible for supply of spares for the lifetime of the package at reasonable prices. The prices of all future requirements of spares shall be derived from the corresponding ex-works price at which the orders for such spares have been placed by the BHEL and the customer as a part of the mandatory or long term or any other kind of spares. The base indices for calculating ex-works price shall be commissioning of last equipment under main contract.

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

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

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

	TITLE: 1 X 660 MW SAGARDIGHI TPS UNIT NO. 5, PHASE - III	SPECIFICATION NO. PE-TS-445-154-A001
		SECTION I
		SUB SECTION - I A
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	REV.NO. 0 DATE: 30.11.2021

ANNEXURE VI:

LIST OF ERECTION & COMMISSIONING SPARES

LIST OF COMMISSIONING SPARES

SL. NO.	ITEM DESCRIPTION	Quantity per skid (no.)	Total Nos.
1.0	**HYDRAZINE DOSING SYSTEM**		
1.1	Oil Seals for drive end.	4	4
1.2	Gaskets for drive end	4	4
1.3	Guide ring for plunger.	4	4
1.4	Teflon rings for valve/s.	8	8
1.5	Level gauge glass	2	2
1.6	Back up fuse	3	3
1.7	Pilot lamp	2	2
1.8	Push Button	2	2
1.9	Control fuse	2	2
1.10	Bulb for Annunciation	4	4
2.0	**AMMONIA DOSING SYSTEM**		
2.1	Oil Seals for drive end.	4	4
2.2	Gaskets for drive end	4	4
2.3	Guide ring for plunger.	4	4
2.4	Teflon rings for valves.	8	8
2.5	Level gauge glass	2	2
2.6	Back up fuse	3	3
2.7	Pilot lamp	2	2
2.8	Push Button	2	2
2.9	Control fuse	2	2
2.10	Bulb for Annunciation	4	4
3.0	**NaOH DOSING SYSTEM**		
3.1	Oil Seals for drive end.	4	4
3.2	Gaskets for drive end	4	4
3.3	Guide ring for plunger.	4	4
3.4	Teflon rings for valve/s.	8	8
3.5	Level gauge glass	2	2
3.6	Back up fuse	3	3
3.7	Pilot lamp	2	2
3.8	Push Button	2	2
3.9	Control fuse	2	2
3.10	Bulb for Annunciation	4	4

Notes: -

- Any other commissioning spare/ special tools and tackles required for the commissioning of the bidder's chemical dosing skids shall be in bidder's scope and same shall be supplied by bidder as part of his base offer and the same shall be mentioned specifically by the bidder in the un-priced schedule.
- All the commissioning spares provided shall be strictly of the same make and specification of the items it shall replace and shall be perfectly interchangeable.
- All the commissioning spares shall be separately packed and properly marked for easy identification at site.

ANNEXURE VII

DRAWING / DOCUMENTS SUBMISSION SCHEDULE

DRAWING/ DOCUMENTS SUBMISSION SCHEDULE

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

For the Drawings/ Documents Distribution procedure, please refer Annexure-III. The submission of soft copy or hard copy of the drawing/document whichever is later will be considered as final date of submission of the drawing/ documents. 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 further note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. Engineering meeting shall be held fort nightly, for which the bidder shall depute his concerned engineer along with project manager to BHEL PEM office or at customer office. The meeting can also be held at site.

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

S. No.	Drawing/ document No.	Drawing/ document Title	Timelines in days
1.	PE-V0-445-154-A001	P&I DIAGRAM FOR CHEMICAL DOSING SYSTEM	1st submission by vendor 10 days from PO date. BHEL comments/ Approval 5 days , Vendor Resubmission within 5 days.
2.	PE-V0-445-154-A004	TECHNICAL DATA SHEET-CHEMICAL DOSING SYSTEM	
3.	PE-V0-445-154-A005	GA DRAWING & FOUNDATION DETAILS	
4.	PE-V0-445-154-A004	LOCAL CONTROL PANEL (INCLUDING WIRING DIAGRAM, LOGIC DIAGRAM AND FIELD TERMINATION DETAILS) - CDS	
5.	PE-V0-445-154-A003	QAP FOR CHEMICAL DOSING SYSTEM	
6.	PE-V0-445-154-A007	O&M MANUAL FOR CHEMICAL DOSING SYSTEM	75

NOTES: -

- Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account.
- 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.

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

ANNEXURE VIII:

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

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

Check List for Operation & Maintenance Manual

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

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

5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipment along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipment.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair, Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/ calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres, Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				

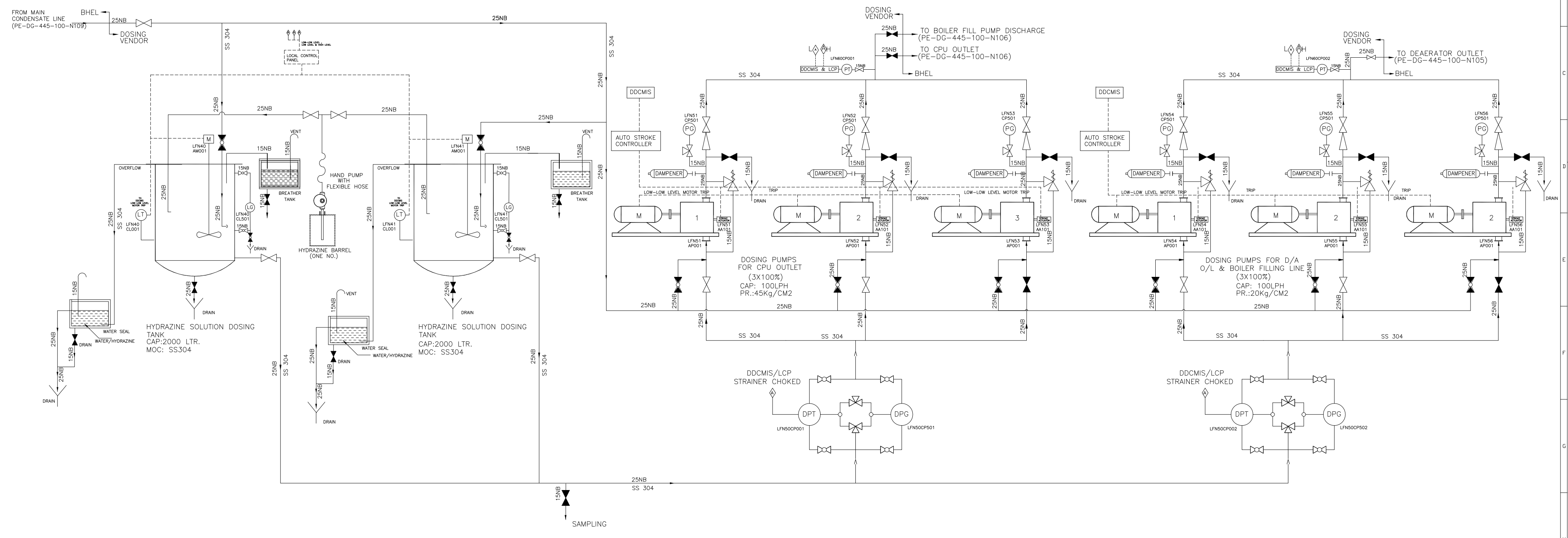
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	**Statutory and other specific requirements considerations.**				
8.0	**List of reference documents**				
9.0	**Binding as per requirement**				

	TITLE: 1 X 660 MW SAGARDIGHI TPS UNIT NO. 5, PHASE - III	SPECIFICATION NO. PE-TS-445-154-A001
		SECTION I
		SUB SECTION - I A
	TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM	REV.NO. 0 DATE: 30.11.2021

P&IDs FOR CHEMICAL DOSING SYSTEM

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



LEGEND

	GATE VALVE NORMALLY OPEN
	GATE VALVE NORMALLY CLOSED
	NON RETURN VALVE
	GLOBE VALVE NORMALLY OPEN
	PRESSURE RELIEF VALVE
	THREE WAY VALVE (TYPICAL)
	VENT TO ATMOSPHERE
	FUNNEL
PG	PRESSURE GAUGE
LG	LEVEL GAUGE (MAGNETIC TYPE WITH COLOUR CHANGING FLAPPER)
M	MOTOR OPERATED (AC)
	GLOBE VALVE NORMALLY CLOSED
LT	LEVEL TRANSMITTER (ULTRA SONIC TYPE,SMART WITH HART COMPATIBLE) ALONGWITH INDICATOR/CONTROLLER HAVING MINIMUM TWO NOS. OF CONFIGURABLE RELAY CONTACTS.
	DUPLEX FILTER
A	ALARM
I	INTERLOCK

NOTES:-

1. DOSING SYSTEM SHALL BE SKID MOUNTED.
2. ALL DRAINS SHALL BE CONNECTED AT ONE POINT ON SKID.
3. FOR CAPACITY OF THE TANKS AND PUMPS PLEASE REFER DATASHEET -A
4. ONE NO. BARREL & ONE NO. HAND PUMP SHALL BE SUPPLIED WITH THE SKID.

1X660 MW SAGARDIGHI THERMAL POWER STATION, UNIT NO. 5

OWNER: The West Bengal Power Development Corporation Limited (A Government of West Bengal Enterprise)

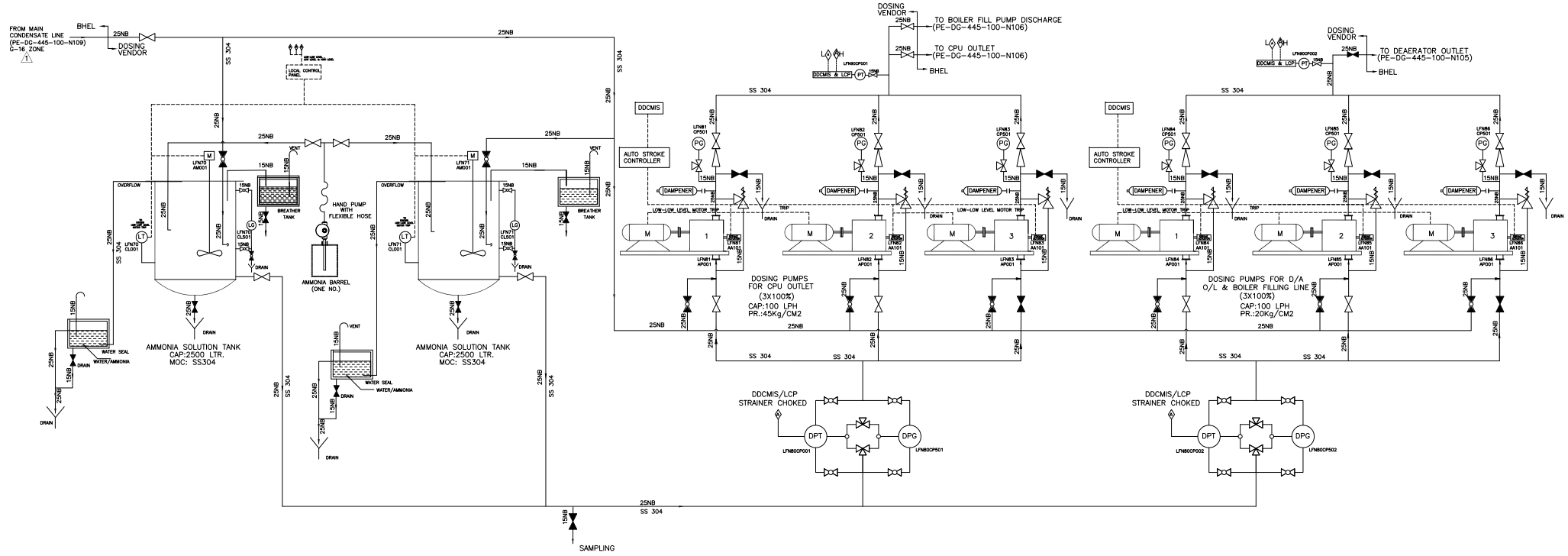
OWNER'S CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

JOB NO. 445
STATUS CONTRACT
DISTRIBUTION

TITLE P & ID FOR HYDRAZINE DOSING SYSTEM

DRAWING NO. PE-DG-445-154-A002
REV. 0
SIZE-A0



LEGEND

	GATE VALVE NORMALLY OPEN
	GATE VALVE NORMALLY CLOSED
	NON RETURN VALVE
	GLOBE VALVE NORMALLY OPEN
	PRESSURE RELIEF VALVE
	THREE WAY VALVE (TYPICAL)
	VENT TO ATMOSPHERE
	FUNNEL
PG	PRESSURE GAUGE
LG	LEVEL GAUGE (MAGNETIC TYPE WITH COLOUR CHANGING FLAPPER)
M	MOTOR OPERATED (AC)
	GLOBE VALVE NORMALLY CLOSED
LT	LEVEL TRANSMITTER (ULTRA SONIC TYPE,SMART WITH HART COMPATIBLE) ALONGWITH INDICATOR/CONTROLLER HAVING MINIMUM TWO NOS. OF CONFIGURABLE RELAY CONTACTS.
	DUPLEX FILTER
	ALARM
	INTERLOCK

NOTES: –

1. DOSING SYSTEM SHALL BE SKID MOUNTED.
2. ALL DRAINS SHALL BE CONNECTED AT ONE POINT ON SKID.
3. FOR CAPACITY OF THE TANKS AND PUMPS PLEASE REFER DATASHEET –A
4. ONE NO. BARREL & ONE NO. HAND PUMP SHALL BE SUPPLIED WITH THE SKID.

REV.	DATE	ALTD	CHD	APPD

1X660 MW SAGARDIGHI THERMAL POWER STATION, UNIT NO. 5

OWNER: The West Bengal Power Development Corporation Limited (A Government of West Bengal Enterprise)

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

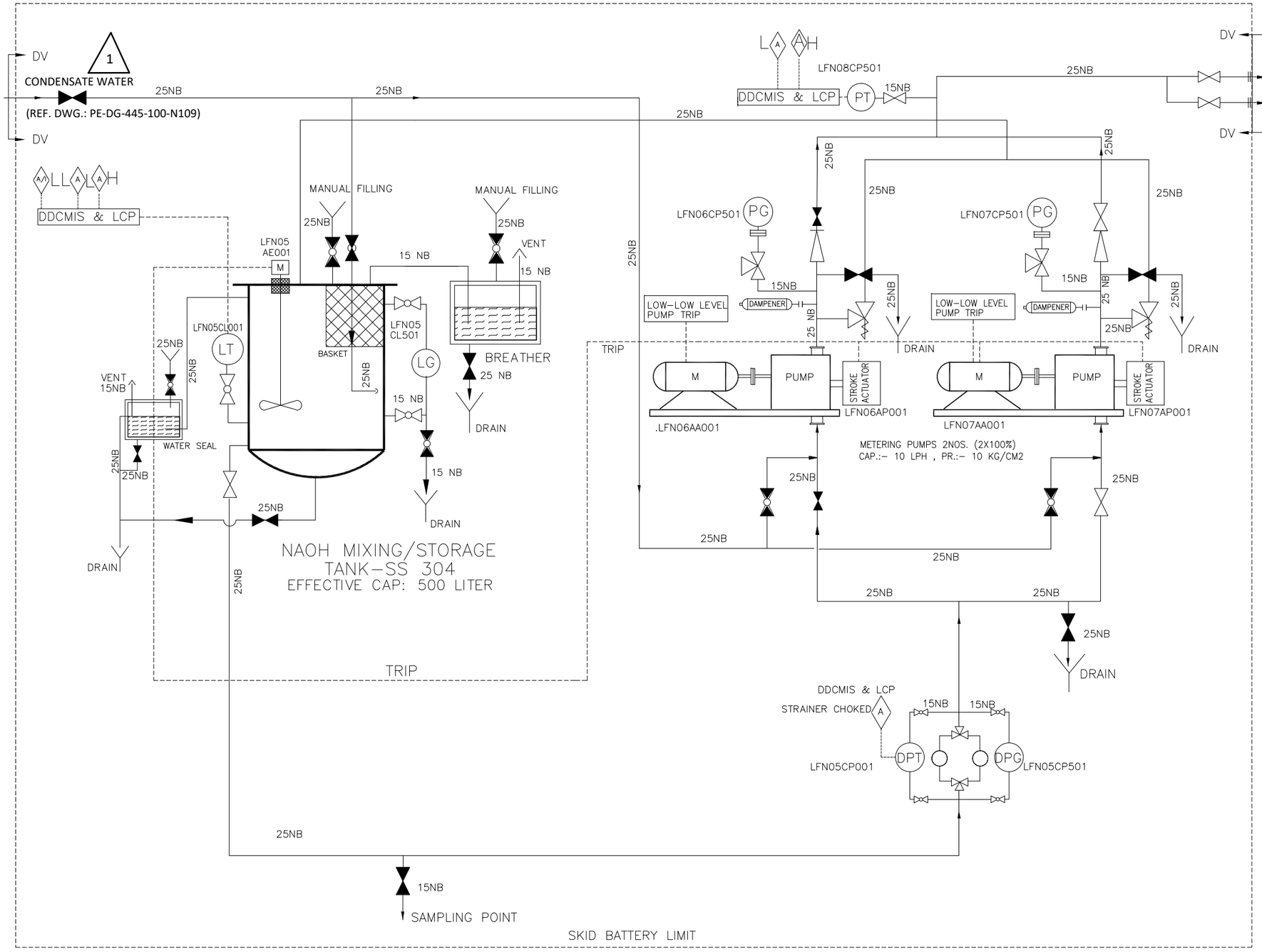
BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

JOB NO. 445
STATUS CONTRACT
DISTRIBUTION

DEPT CODE	NAME	SIGN	DATE
DRN	RK		31-08-2015
DESN	RK		31-08-2015
CHD	AKS		31-08-2015
APPD	SB		31-08-2015

TITLE: P & ID FOR AMMONIA DOSING SYSTEM

DRAWING NO: PE-DG-445-154-A001
SCALE: SCALE
SHEET
REV. 0
SIZE-A0



DV: DOSING VENDOR

	LEGEND
	METERING PUMP
	PUMP MOTOR
	GATE VALVE NORMALLY OPEN
	GATE VALVE NORMALLY CLOSED
	NON RETURN VALVE
	GLOBE VALVE NORMALLY OPEN
	PRESSURE RELIEF VALVE
	MULTI VALVE MANIFOLD
	VENT TO ATMOSPHERE
	FUNNEL
PG	PRESSURE GAUGE
LG	LEVEL GAUGE
M	STIRRER MOTOR
	GLOBE VALVE NORMALLY CLOSED
LT	LEVEL TRANSMITTER
	DUPLEX STRAINER
DPT	DIFFERENTIAL PRESSURE TRANSMITTER
DPG	DIFFERENTIAL PRESSURE GAUGE
PT	PRESSURE TRANSMITTER
	STIRRER
	CHEMICAL SEAL DIAPHRAGM
A	ALARM
	INTERLOCK
	STUFFING BOX

NOTES:-

1 THE DOSING SYSTEM INCLUDING ITS LOCAL CONTROL PANEL SHALL BE SKID MOUNTED.
2 ALL DRAINS SHALL BE CONNECTED VIA FUNNELS TO MAIN DRAIN HEADER AND TERMINATED AT ONE POINT ON SKID.
3. COUNTER FLANGES SHALL BE PROVIDED AT SKID INLET & OUTLET TERMINAL POINTS.

1X660 MW SAGARDIGHI THERMAL POWER STATION, UNIT NO. 5

OWNER: The West Bengal Power Development Corporation Limited (A Government of West Bengal Enterprise)

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

BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

JOB NO. 445
STATUS CONTRACT
DISTRIBUTION

DEPT CODE	DSN	NAME	SIGN	DATE
M	DESN	MA		11-08-2021
	CHD	AKS		11-08-2021
	APPD	SB		11-08-2021

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD

TITLE: P & ID FOR NAOH DOSING SYSTEM

DRAWING NO. PE-DG-445-154-A003
SHEET
REV. 00
SIZE-A0

DATA SHEET-A

S. NO	DESCRIPTION	HYDRAZINE DOSING	AMMONIA DOSING	NaOH DOSING
1.0	**No. of skid(s) per unit**	One (1)	One (1)	One (1)
2.0	**Solution Dosing Tank:**			
2.1	No. of tanks per skid	Two (2 x 100%)	Two (2 x 100%)	One (1 x 100%)
2.2	Capacity in litres (eff.)	2000	2500	500
2.3	Type	Vertical Cylindrical, Bottom Dished end.	Vertical Cylindrical, Bottom Dished end.	Vertical Cylindrical, Bottom Dished end.
2.4	Material of the tank	SS-304	SS-304	SS-304
2.5	Thickness	3 mm	3 mm	6 mm
2.6	Motorised Stirrer	Propeller type with slow speed reduction gear unit		
2.7	Dissolving basket	NA	NA	Provided(50Mesh BS)
2.8	MOC -Dissolving basket	NA	NA	SS 316
2.9	MOC of stirrer	SS 304	SS 304	SS 304
2.10	Design Standard	IS 803/ API 650	IS 803/ API 650	IS 803/ API 650
2.11	Min. freeboard (mm)	300	300	300
3.0	**Metering pumps:**			
3.1	Medium to be handled	Hydrazine solution	Ammonia solution	NaOH solution
3.2	Type of pump	--------Positive displacement (Plunger type) metering pump----------		
3.3	Make of pump	As per approved sub vendor list		
3.4	Nos. of pump-motor assembly	Six (6) [Three (3) nos. for outlet of Condensate Polisher & Three (3) nos. for Deaerator outlet]		Two (2 x 100%)
3.5	Capacity	0-100 LPH	0-100 LPH	0-10 LPH
3.6	Discharge pressure	45 Kg/Cm^2 (g) for CEP discharge & boiler fill pump discharge and 20 Kg/cm^2 for D/A outlet.		10 Kg/Cm^2 (g)
3.7	All Wetted parts of pumps	SS-304	SS-304	SS-304
3.8	Applicable standard	API 675	API 675	API 675
3.9	Type of stroke control	Local manual, remote manual & remote auto	Local manual, remote manual & remote auto	Local manual & automatic
3.10	Connection at suction, Position	1″ ANSI B16.5 #150, bottom	1″ ANSI B16.5 #150, bottom	1″ ANSI B16.5 #150, bottom
3.11	Connection at discharge, Position	1″ ANSI B16.5 #300, top	1″ ANSI B16.5 #300, top	1″ ANSI B16.5 #300, top
3.12	Suction condition	Flooded	Flooded	Flooded
3.13	Type of casing	Foot mounted	Foot mounted	Foot mounted
5.0	**Strainers:**			
5.1	No. of strainers	Two	Two	One
5.2	Type	Duplex type	Duplex type	Duplex type
5.3	Material of screen	SS-304	SS-304	SS-304
5.4	Mesh Size	50 (BS)	50 (BS)	50 (BS)
6.0	**Main, Drain & Overflow Piping:**			
6.1	Material	ASTM A 312 GR TP	ASTM A 312 GR TP	ASTM A 312 GR TP

		304 SCH. 40	304 SCH. 40	304 SCH. 40
6.2	Diameter	25 NB	25 NB	25 NB
7.0	**Sampling & Vent Pipe:**			
7.1	Material	ASTM A 312 GR TP 304 SCH. 40	ASTM A 312 GR TP 304 SCH. 40	ASTM A 312 GR TP 304 SCH. 40
7.2	Diameter	15 NB	15 NB	15 NB
8.0	**Main Drain Header:**			
8.1	Material	ASTM A 312 GR TP 304 SCH. 40	ASTM A 312 GR TP 304 SCH. 40	ASTM A 312 GR TP 304 SCH. 40
8.2	Diameter	40 NB	40 NB	40 NB
9.0	**Valves:**			
9.1.00	**Gate & Globe valves**	The following parameters are applicable for all three systems.		
9.1.01	Body, Bonnet, Stem	ASTM A182 Gr. TP 304. Material for Stem shall be SS 316.		
9.1.02	Design standard	ANSI B 16.34/API 602 for gate valves, BS 5352 for globe valve		
9.1.03	Test standard	API 598		
9.1.04	Size	As per P&ID		
9.1.05	End Connections	SW ANSI B 16.11		
9.1.06	Rating	Class ASA 800		
9.1.07	Valve operation	Manual		
9.2.00	**Check valves/ NRV**			
9.2.01	Body, cover, disc/piston	ASTM A182 Gr. TP 30		
9.2.02	Design standard	ANSI B 16.34/API 602		
9.2.03	Test standard	API 598/MSS-SP-61		
9.2.04	Size	25 NB		
9.2.05	End Connections	SW ANSI B 16.11		
9.2.06	Rating	Class ASA 800		
9.2.07	Valve operation	Manual		
9.3.00	**Pressure relief valve (PRV)**			
9.3.01	Body, bonnet, disc, nozzle	ASTM A182 Gr. TP 316		
9.3.02	Valve discharges to	Dosing tank		
9.3.03	Back pressure	Constant		
9.3.04	Set pressure	50 Kg/Cm^2 for CEP discharge & 22 Kg/Cm^2 for D/A outlet.		12 Kg/Cm^2
9.3.05	Inlet Connections	25 NB, Flanged, ANSI B16.5, 300#		
9.3.06	Outlet Connections	25 NB, Flanged, ANSI B16.5, 150#		
10.0	**Fittings**	Forged steel to A182 F304, Dimension to ANSI B 16.11 socket weld ends.		
11.0	**Flanges (pump suction/ pump discharge)**	------ANSI B 16.5 CL 150 / ANSI B 16.5 CL 300 ------		
12.0	**Structural steel**	IS 2062	IS 2062	IS 2062
13.0	**Barrel and Barrel pump**	One no. each	One no. each	NA
14.0	**Step ladder with**	IS 2062	IS 2062	IS 2062

	platform			
15.0	**Nut & Bolt**	ASTM A-193 Gr B7 and ASTM A-194 Gr. 2H respectively.	ASTM A-193 Gr B7 and ASTM A-194 Gr. 2H respectively.	ASTM A-193 Gr B7 and ASTM A-194 Gr. 2H respectively.

SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

	TITLE:	SPECIFICATION NO.
BHEL	**TECHNICAL SPECIFICATION FOR CHEMICAL DOSING SYSTEM** **SAGARDIGHI THERMAL POWER PROJECT 1 X 660 MW UNIT NO. 5, PHASE-III**	VOLUME NO. : **II-B** SECTION: **C** REV NO. : **00** DATE: 21.08.2021 SHEET: 1 OF 1

SPECIFIC TECHNICAL REQUIREMENT: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

The equipment and services to be provided by bidder under this specification shall be as detailed here below but shall not be limited to the following:

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 bidder without any extra charge shall provide the same.
c) Supply of mandatory spares as specified in the specifications of mechanical equipment's.
d) Electrical load requirement for **Chemical Dosing System.**
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 including GA drg, data sheet as per required format, quality plans, calculations, test reports, test certificates, operation and maintenance manuals, characteristic curves, wiring diagrams/schemes etc. shall be furnished as specified at contract stage. All documents shall be subject to customer / BHEL approval without any commercial implications to BHEL.
h) The sub-vendor list for various electrical items is subject to BHEL/Customer approval without any commercial implications.
i) Motors shall meet minimum requirement of Electric motor specification.
j) All routine tests and type tests reports as per applicable standards shall be furnished at contract stage.
k) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
l) 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 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical / quality assurance requirements stipulated 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.

4.0 LIST OF ENCLOSURES

4.1 Electrical scope between BHEL & vendor
4.2 Load Data Format. (Annexure –II)
4.3 BHEL Cable listing format (Annexure–III) & Explanatory notes for filling up cable list
4.4 Technical specification – Specification for Electric Motors/Actuators, Cables, & Erection – Cabling, Grounding and Lightning Protection System & Cable Tray Dwg.
4.5 Datasheets & quality plan for motors & General technical requirements for LV Motors

ANNEXURE-I

REV : 0 DATE : 11.03.2015

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

PACKAGE : CHEMICAL DOSING SYSTEM
SCOPE OF VENDOR: SUPPLY
PROJECT: **SAGARDIGHI THERMAL POWER PROJECT, 1 x 660 MW UNIT NO. 5, PHASE – III**

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.
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.

ANNEXURE-I

REV : 0 DATE : 11.03.2015

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

PACKAGE : CHEMICAL DOSING SYSTEM
SCOPE OF VENDOR: SUPPLY
PROJECT: **SAGARDIGHI THERMAL POWER PROJECT, 1 x 660 MW UNIT NO. 5, PHASE – III**

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)

LOAD DATA (ELECTRICAL)	JOB NO.	445	ORIGINATING AGENCY		PEM (ELECTRICAL)	
	PROJECT TITLE	SAGARDIGHI THERMAL POWER PROJECT, 1x 660 MW UNIT NO. 5, PHASE – III	NAME		DATA FILLED UP ON	
	SYSTEM	CHEMICAL DOSING SYSTEM	SIGN.		DATA ENTERED ON	
	DEPTT. / SECTION	MAUX	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

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
    a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
    b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
    f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
    g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
|	|	|	|
Cable Voltage Code (see B below)	No. of cores (e.g. 01,03,3H, 07)	Cable code (See C below)	Cable size (e.g. 035,185,2.5, 0.5)

(A) SYSTEM VOLTAGE CODES:
(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:
A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C&I)

Specific Technical Requirements (C&I):

1) LP CHEMICAL DOSING SYSTEM shall be controlled from DCS through operator work stations located in central control room (in BHEL Scope). Also refer the enclosed standard block diagram available under section "Signal Exchange Between Drives & DCS (DCP)" for further information. The operation and control philosophy of LP chemical dosing system shall be as per design memorandum given elsewhere in the specification.

2) Local panel required for the operation shall be in bidder's scope.

3) The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire chemical dosing system. The requirements given are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of Customer shall prevail without any commercial implication.

4) The instrumentation to be provided for Chemical dosing system shall be as per the technical specification document / drawings wherever provided for the respective systems as a minimum requirement for bidding purpose. However, for completeness of the system and its associated equipment, Bidder shall also provide all the necessary instruments to the process requirement even if not indicated in the given technical Specification document /drawings. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any technical, commercial and delivery implication to BHEL.

5) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

6) In case of any conflict and repetition of clauses in the specification, the more stringent requirements as per interpretation of BHEL shall prevail without any commercial implication.

7) Electrical Actuators with integral starter shall be provided for all on/off and inching type valves along with necessary interface units for linking to corresponding Control System as applicable, typical Hook-up diagram of drives is included for reference. Non-contact type electronic 2-wire position transmitters shall be provided for all inching type motorised valves. The detailed specification is attached elsewhere in the specification.

8) The solenoid valves shall have limit switches for open/close feedback.

9) All the instruments/drives shall be terminated on local control panel (LCP) in field.

10) All the instruments/drives shall be terminated on JBs/Panels in field. JBs/Panels shall be in Bidder's scope. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable.

11) RTD's shall be of duplex type. Both the elements of duplex temperature sensors shall be terminated to junction boxes. Temperature measurement shall have up scale / down scale drive to protect from process upset in case of sensor failure. For RTDs ring - tong type lugs shall be used at Junction Boxes

12) Level transmitter for level measurements in the tanks shall be Ultrasonic type.

13) Diaphragm seals with pressure/ differential measurements shall be provided for corrosive/viscous/solid bearing/slurry type fluid applications whether explicitly indicated in the tender p&id or not.

14) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible.

15) Bidder to provide input/output list, drives list, termination details, recommended control logics / write-up etc. The list of documents to be submitted after award of contract is to be referred by bidder.

16) All field instruments enclosure shall be IP65. Local panel/cabinet enclosure shall be IP 55, unless otherwise specified. Electronics located outside control room shall be tropicalized and enclosed in dust & weatherproof cabinets (IP-65/67) suitable for the environment.

17) Components of instruments, control devices, accessories, piping etc. which contact steam, condensate or boiler feed water shall be manufactured from copper-free materials.

18) Primary sensor redundancy for Control/measurement shall be decided as per following general criteria:

a. Critical controls & respective measurements, measurements required for protection of auxiliaries & for major CLCS- Triple redundant.
b. Non-critical but important control & measurements and measurements required for other CLCS & OLCS- Dual redundant.

19) All the instruments/ sensors/transmitters/switches meant for redundant applications shall have completely separate and independent impulse pipes/ root valves etc. No redundant instrument shall share a single process tapping. There will be separate and independent tapping for every individual instrument.

20) Double root valve shall be provided for all pressure tapings where the line pressure is 40kg/cm2 and above. Single root valve for below 40Kg /sq. cm.

21) Bidder to comply with codes and standards as mentioned in the specification.

22) Instrument installation shall be as per the attached "Standard Hook-up diagram of instrument." However, any instrument/ analyser installation not covered in the same shall be subject to Customer and BHEL approval during detailed engineering.

23) Bidder shall provide erection hardware as per installation drawings.

24) Bidder to provide mandatory spares as per mandatory spares list attached elsewhere in the specification.

25) Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication. The make/model of various instruments/items/systems shall be as per Customer/BHEL approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

26) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system.

27) Two nos feeders of 415 V AC power supply shall be provided by BHEL at a single point, Vendor shall provide feeder with auto changeover facility with indication. Bidder to include necessary power distribution board in his scope. Any power supply for panel, instruments etc and any other supply like 24 V DC, 110 V AC etc. for alarm annunciator, Auto Stroke Controller etc. shall be derived from these two feeders by the bidder. Any power supply other than the above, if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Bidder to submit the power requirement along with the bid.

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

29) Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification.

30) Number of pairs to be selected for Screen /Control cable (Size : 0.5 mm2)
a) F-Type: 2P/4P/8P/12P
b) G-Type: 2P/4P/8P/12P

31) Number of cores to be selected for Control cable (Size: 2.5 mm2):
a) 3 Core
b) 5 Core
c) 12 Core

32) Any part/module of the C&I system which are not listed under recommended spares shall be deemed as having life expectancy not less than the expected life of the plant i.e. 30 years.

33) Instrument ranges shall be selected to have the normal reading, preferably between 50% and 70% of full scale for linear parameters and 70% to 80% 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.

34) 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.

35) The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of only deviation, a No deviation certificate is to be furnished.

36) In addition to requirements specified here, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification.

37) All the outdoor field instruments such as analysers/transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack so that the equipments are protected against rain/ sunlight etc. Site fabricated racks are not accepted.

38) Control & Instrumentation equipment shall be guaranteed against manufacturing defect for at least two (2) years from the date of handing over to Owner.

SECTION – II

GENERAL TECHNICAL REQUIREMENTS

SUB-SECTION IIA - GENERAL TECHNICAL REQUIREMENTS (MECH.)
SUB-SECTION IIB - GENERAL TECHNICAL REQUIREMENTS (ELEC.)
SUB-SECTION IIC - GENERAL TECHNICAL REQUIREMENTS (C&I)

SECTION- IIA

GENERAL TECHNICAL REQUIREMENTS (MECH.)

1.0 SCOPE

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), supervision of E&C, mandatory spares along with spares for erection, start-up and commissioning as required, forwarding, proper packing, shipment and delivery at site for 1 x 660 MW SAGARDIGHI TPS UNIT –V, PHASE – III, Chemical Dosing System complete with all accessories for the total scope as specified.

2.0 DESIGN PHILOSOPHY:

Chemical dosing systems have been designed to dose required quantity of chemicals to maintain the quality of boiler feed water. Chemicals are dosed both in low-pressure side of feed water cycle as well as in DMCW system.

3.0 LOW PRESSURE CHEMICAL DOSING:

3.1 AMMONIA DOSING SYSTEM:

(Refer drawing no. PE-DG-445-154-A001)

Condensate water should have proper pH (8.2-8.5) in order to protect the system from corrosion. In order to control the same dosing of dilute solution of Ammonia is done at CEP discharge after CPU. Though provision has been kept to dose ammonia at deaerator outlet and boiler fill pumps discharge also but dosing shall be done at one place at a time only. For this purpose, one (1) no. skid mounted ammonia dosing system shall be provided. The dosing skid shall comprise of the following:

3.1.1 AMMONIA SOLUTION DOSING TANK (2 X 100%)

A dilute solution is prepared in the solution dosing tanks using condensate (from CEP discharge & DM water from Cycle make-up pump discharge) and is uniformly mixed by a motorized stirrer. The tanks are provided with breather with vent, motorized agitator, level gauge, level transmitter & overflow drain with sealing arrangement. The solution is then dosed to the required point with the help of dosing pumps.

3.1.2 AMMONIA DOSING PUMPS (total 6 nos.)

Three nos. (3 x 100%) for CEP discharge/ boiler fill pumps discharge & three nos. (3 X 100%) for D/A outlet dosing point, positive displacement plunger type dosing pumps (electrically operated, auto adjusted) with motor, relief valves shall be provided. A duplex strainer common for three pumps each for CEP discharge & D/A outlet, with Differential Pressure Transmitter (DPT) and Differential Pressure Gauge (DPG) shall be provided. The pumps shall also be provided with a pressure gauge in the individual discharge line and a pressure transmitter at common discharge line.

3.1.3 AMMONIA BARREL (1 no.) & BARREL PUMP (1 no.)

One (1) no. ammonia barrel of 100-liter capacity with one manual barrel pump [ammonia dispensing pump (1 x 100%) complete with flexible hose and couplings for transferring Ammonia from drum at ground level to solution dosing tank shall be provided.

3.1.4 ASSOCIATED PIPING, VALVES ETC:

As indicated in the drawing enclosed, to make the system complete, all associated piping & valves shall be provided. All piping in the skid shall be ASTM 312 Gr. TP 304 (seamless) SCH. 40, pipe size: 40/25/15 Nb. Valve material shall be SS-304, ASA 800 rating. All valves shall be manually operated. Drains from tanks & pipes shall be inter-connected to a common drain header and terminated at the dosing skid itself. Level gauge drain shall not be connected to main drain header since quantity of liquid is very small and occurrence of such cases is rare. The same may be manually disposed of. As flow in drains is not continuous & of very small quantity the same shall be led to plant drain.

3.1.5 FLUSHING

Condensate water shall be used for flushing the tank, dosing pumps and dosing lines shown in P&I drawing.

3.2 HYDRAZINE DOSING SYSTEM:
(Refer drawing no. PE-DG-445-154-A002)

Residual oxygen present in feed water can be detrimental to feed cycle equipment's. In order to control the same continuous dosing of dilute solution of hydrazine is done at deaerator outlet (BFP suctions) only. Though provision has been kept to dose hydrazine at CEP discharge after CPU and boiler fill pumps discharge also, but dosing shall be done at one place at a time. For this purpose, one (1) no. skid mounted Hydrazine dosing system shall be provided. Dosing system shall mainly comprise of the following:

3.2.1 HYDRAZINE SOLUTION DOSING TANK (2 X 100%)

A dilute solution is prepared in the solution dosing tanks using condensate (from CEP discharge/ DM water from Cycle Water Make Up pump discharge) and is uniformly mixed by a motorized stirrer. The tanks are provided with breather with vent, motorized agitator, level gauge, level transmitter & overflow drain with sealing arrangement. The solution is then dosed to the required point with the help of dosing pumps.

3.2.2 HYDRAZINE DOSING PUMPS (total 6 nos.)

Three nos. (3 x 100%) for CEP discharge & three nos. (3 X 100%) for D/A outlet dosing point, positive displacement plunger type dosing pumps (electrically operated, auto adjusted) with motor, relief valves shall be provided. A duplex strainer common for three pumps each for CEP discharge & D/A outlet, with Differential Pressure Transmitter (DPT) and Differential Pressure Gauge (DPG) shall be provided. The pumps shall also be provided with a pressure gauge in the individual discharge line and a pressure transmitter at common discharge line.

3.2.3 HYDRAZINE BARREL (1 no.) & BARREL PUMP (1 no.)

One (1) no. hydrazine barrel of barrel of 100-liter capacity with one manual barrel pump [Hydrazine dispensing pump (1x100%)] complete with flexible hose and couplings for transferring hydrazine from drum at ground level to preparation cum metering tank shall be provided.

3.2.4 ASSOCIATED PIPING, VALVES ETC:

As indicated in the drawing enclosed, to make the system complete, all associated piping & valves shall be provided. All piping in the skid shall be ASTM 312 Gr. TP 304 (seamless) SCH. 40, pipe sizes: 40/ 25/ 15 Nb. Valve material shall be SS-304, ASA 800 rating. All valves shall be manually operated. Drains from tanks & pipes shall be inter-connected to a common drain header and terminated at the dosing skid itself. Level gauge drain shall not be connected to main drain header since quantity of liquid is very small and occurrence of such cases is rare. The same may be manually disposed of. As flow in drains is not continuous & of very small quantity the same shall be led to plant drain.

4.2.5 FLUSHING

Condensate water shall be used for flushing the tank, dosing pumps and dosing lines shown in P&I drawing.

3.3 NaOH DOSING SYSTEM (1 no.):
(Refer drawing no. PE-DG-445-154-A003)

Sodium Hydroxide (NaOH) dosing system is provided to dose NaOH solution in Equipment cooling water lines/ DMCW overhead tank to increase pH up to 9.5. The sodium hydroxide dosing is done in the DMCW cycle during the initial fill and for the compensation of cooling water for any leakage during normal run. The dilute 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 starting the motorized agitator locally from LCP and remotely from DCS. The dosing is done manually from LCP and also from DCS as per requirements of desired pH in DMCW 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 skid shall consist of following:

3.3.1 NaOH SOLUTION PREPARATION CUM STORAGE TANK (1 no.)

One (1) no. NaOH solution preparation cum storage tank complete with motorized agitator, CO_2 absorber, dissolving basket, level gauge, level transmitter, vent, overflow with water seal & drain shall be provided.

3.3.2 NaOH DOSING PUMPS (total 2 nos.)

Two numbers (2 X 100%) positive displacement plunger type metering pumps (electrically operated, auto adjusted) with relief valves shall be provided.

The stroke of the pumps shall be adjustable from 0 to 100% even when the pump is in operation so as to achieve a step-less variation of capacity over the specified range of operation.

A duplex strainer (common for both pumps) shall be provided in the suction line of the pump with Differential Pressure Transmitter (DPT) and Differential Pressure Gauge (DPG). The pump shall also be provided with a pressure gauge in the individual discharge line and a pressure transmitter at common discharge line.

3.3.3 ASSOCIATED PIPING, VALVES ETC:

As indicated in the drawing enclosed, to make the system complete, all associated piping & valves shall be provided. All piping in the skid shall be ASTM 312 Gr. TP 304 (seamless) SCH. 40, Line size: 40/25/15 Nb. Valve material shall be SS-304, ASA 800 rating. All valves shall be manually operated.

Drains from tanks & pipes shall be inter-connected to a common drain header and terminated at the dosing skid itself. Level gauge drain shall not be connected to main drain header since quantity of liquid is very small and occurrence of such cases is rare. The same may be manually disposed of. As flow in drains is not continuous & of very small quantity thus shall be led to plant drain.

3.3.4 PARAMETERS FOR NaOH DOSING:

Major parameters of the equipment as calculated & provided in the system are mentioned in enclosed Datasheet - A.

3.3.5 FLUSHING

Condensate Water shall be used for flushing the tank, dosing pumps and dosing lines shown in P&I drawing.

3.4 CONTROL & INSTRUMENTATION

The control of all dosing systems shall be realized in DDCMIS including ON/ OFF command of the individual pumps and stirrers. All controls, fault indicators/ alarms, interlocks, logics shall be implemented in DDCMIS. Separate local control panel shall be provided for each of the above said system.

Each solution tank shall be provided with magnetic type level gauge with colour changing flapper and graduated scale

The starter of all the motors shall be clubbed with main plant MCC. Power to all pumps, agitators etc. shall be fed from MCC. DDCMIS commands shall extend to MCC.

A local panel comprising of ‘START’ push button, 'STOP' push button along with ‘ON/ OFF/ TRIP’ indication, local/ remote indication, stroke position indicator, raise/ lower push button for stroke position and local annunciation shall be provided for local operation. The 'START' push button and ‘STOP’ push button shall be routed to DDCMIS.

The ON/ OFF operation of all motorized stirrers and pumps shall also be provided in DDCMIS with local ON, OFF facility.

Local controller shall be hooked up with DDCMIS for remote manual and automatic control of the dosing system.

The auto stroke controllers of each pump shall be provided in the local panel. The stroke position & adjustment will be done from DDCMIS and the stroke controller shall be suitable for accepting 4-20 mA DC signals. The pumps shall be provided with 24 V DC, 2- wire LVDT Type Position feedback transmitter to generate 4-20 mA DC signals to indicate stroke position in DDCMIS & Local panel.

The Local/ Remote selection switch (soft) shall be provided in DDCMIS and its indication shall be provided in LCP. LCP shall be located on the dosing skid.

a) 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.

b) Following conditions to be ensured before starting a stirrer:
   i) Level in the tank adequate.
   ii) MCC not disturbed.

c) Following conditions to be ensured before starting a pump:
   i) Level in the tank adequate.
   ii) MCC not disturbed.
   iii) Duplex strainer- not choked.

d) Following shall be provided on LCP:
   i) ON/ OFF/ Fault- Lamp Indications for all drives (pumps & agitator).
   ii) Operation ‘Local selected’/ operation ‘Remote selected’- Lamp Indication, common for all drives.
   iii) Pump- Start/ Stop & Agitator-Start/ Stop – Push Buttons.
   iv) Auto stoke controller.
   v) Stoke position indicator (may be a part of controller).
   vi) Local LED based annunciation driven by DDCMIS.

e) Following fault indications with alarm annunciations shall be provided on LCP:
   i) Low level in the dosing/ mixing cum storage tank.
   ii) Low-low level in the dosing/ mixing cum storage tank.
   iii) High level in the dosing/ mixing cum storage tank.
   iv) High-high level in dosing/ mixing cum storage tank.
   v) High pressure at pump discharge header.
   vi) Low pressure at pump discharge header.
   vii) Strainer choked.
   viii) Dosing pump-1- tripped.
   ix) Dosing pump-2- tripped.
   x) Dosing pump-3- tripped.
   xi) Stirrer motor—tripped.

SIGNAL EXCHANGE

f) Following signals shall be wired from DDCMIS to LCP. These shall be 24V DC powered signals. (PF contacts are not used to avoid the higher voltage LCP power supply reaching DDCMIS while contact interrogation).
   i) Operation local selected.
   ii) Operation remote selected.
   iii) Pump- 1/ 2 & stirrer (ON/ OFF/ FAULT).
   iv) Process conditions.
   v) Pump- 1/2 stroke length demand signal (4-20 mA).

g) Following signals shall be wired from LCP to DDCMIS. Binary signals shall be P.F. contacts.
   i) All field signals.
   ii) START/ STOP–PB commands for all drive (pumps & agitator).

iii) Pump- 1/ 2 stroke length feedback signal (4-20 mA).

h) Signal Exchange between DDCMIS & MCC shall be as per applicable Drive Control Philosophy i.e.
   i) START & STOP command from DDCMIS to MCC.
   ii) ON, OFF, & MCC Disturbed feedback from MCC to DDCMIS.

i) Signal Exchange between LCP & MCC shall be
   i) EMERGENCY STOP-PB for all drives (pumps & agitators) shall also be wired directly to MCC.

SECTION- IIB

GENERAL TECHNICAL REQUIREMENTS (ELECTRICAL)

SECTION - II

A.C. & D.C. MOTORS

1.00.00 SCOPE

1.01.00 This specification covers the general requirements of the electric motors for plant auxiliary equipment except for special application like crane, lift, submersible pump etc., motors for which are covered in individual equipment specifications.

1.02.00 Motors 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.

2.00.00 STANDARDS

2.01.00 All 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.

3.00.00 SERVICE CONDITIONS

3.01.00 The motors will 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 of this specification.

3.03.00 For motor installed outdoor and exposed to direct sun rays, 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.

4.01.02 All 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.

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

IE3

4.01.04 All LT motor shall conform to minimum efficiency performance standards (MEPS) of IE2 mentioned in IS: 12615. All HT motors shall have efficiency and power factor higher than 90% and 0.83 respectively.

4.01.05 The motor name-plate rating at 50°C 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 (If applicable)

4.02.01 Inverter duty motors are designed according to the requirements of IEC/TS-60034 part17 & 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 coordinated 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**

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.

5.02.00 **Starting Requirements**

5.02.01 Motor shall be designed for direct on line starting at full voltage. Starting current at rated voltage for LT motors shall be 6 times of full load current plus IS tolerance. For 3.3KV and 11KV motor except BFP, starting current shall be maximum 6 times of full load current inclusive IS tolerance. For Boiler feed pump motor, starting current shall be limited to 4.5times of full load current plus IS tolerance.

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 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals without exceeding acceptable winding temperature.

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.

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 The motor may be subjected to 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 upto 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 Enclosures for the motor and the cable box shall conform to the degree of protection IP-55 unless otherwise specified.

6.01.02 Motors like circulating water pumps of large output ratings, 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.

6.01.03 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv. as detailed below:

a) Fuel Oil area : Group IIB
b) Hydrogen generation plant area : Group IIC (or Group-I, Div-II as per NEC or Class-1, Gr-B, Div-II as per NEMA/IEC60034)

Separate Canopy shall be provided for LT motors located in outdoor or semi-outdoor area.

6.02.00 **Cooling**

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

6.02.02 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.

6.03.00 **Winding and Insulation**

6.03.01 All insulated winding shall be of copper.

6.03.02 HT 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.

6.03.03 LT motors shall have Class F or higher insulation with temperature limited to 120ºC.

6.04.00 **Tropical Protection**

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

6.04.02 All fittings and hardware shall be corrosion resistant.

6.05.00 **Bearings**

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

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

6.06.00 **Noise & Vibration**

6.06.01 Noise level shall not exceed 85 db (A) except for BFP motor for which the maximum limit shall be 90 db (A).

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

6.07.00 **Motor Terminal Box**

6.07.01 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.

6.07.02 Terminal box shall be capable of being turned 360^{o} in steps of 90^{o}, unless otherwise approved.

6.07.03 Terminal box for all LT motors shall be diagonally split type and shall have the same degree of protection as motor.

6.07.04 The terminal box shall have sufficient space inside for termination /connection of suitable sized HT 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.

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

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

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

6.07.08 For HT 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.

6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match Owner's cable. All threads shall be ISO metric thread only.

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

6.08.00 **Grounding**

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

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

Motor above 90 kW	50 x 6 mm GI Flat
Motor above 30 kW upto 90 kW	35 x 6 mm GI Flat
Motor above 5 kW upto 30 kW	25 x 3 mm GI Flat
Motor upto 5 kW	8 SWG GI Wire

The above sizes shall be superseded by different sizes if so indicated in the relevant clause of the General Electrical Specification.

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

6.09.00 **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 ^{o}C under rated condition and method of measurement.
b. Degree of protection.
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 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 phase 50 Hz 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 HT 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 Each bearing of HT shall be provided with minimum 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^{o}C.

7.04.00 Indicator/Switch

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

a) HT 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 0.5 A at 220V D.C. and 5A at 240V A.C.

7.05.00 Current Transformer for Differential Protection

7.05.01 Motor above 1000 kW shall be provided with three differential current transformers (PS class) mounted over the neutral leads within the enclosure. Matching three (3) numbers PS class CTs shall be mounted on the switchgear end.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.

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 motor (power) terminal box.

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

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they will 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 eye bolt 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. The paint shade shall be as specified in the Annexure.

8.00.00 TESTS

8.01.00 Upon completion, each HT & LT motor shall be subject to routine tests as per Schedule-C of Section -I. 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 despatch of the motors from works.

8.03.00 The following type test reports shall be submitted for each type and rating of HT 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.

8.03.04 The following type tests shall be performed on a representative sample of 11000V and 3300V motor of each type & rating, even if type test certificates of these tests are submitted by the Bidder for Purchaser's approval:

a. Measurement of stator resistance (and rotor resistance on slip ring motors).

b. No load test at rated voltage to determine voltage, current, power input and speeds.

c. Locked rotor reading of voltage, current, power input and values of torque of motor.

d. Full load test to determine efficiency, power factor and slip.

e. Temperature rise test. During heat run test, bearing temperature, Winding temperature, core temperature, coolant flow and its temperature shall be recorded. In case temperature rise test is carried at any load other than rated load, specific approval for test procedure and method has to be obtained.

f. Momentary overload test.

g. Test for noise level of motor.

9.00.00 SPARE

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

10.00.00 DRAWINGS, DATA & MANUALS

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

10.01.00 Along with the bid

a) List of the motors
b) Individual motor data sheet as per Annexures
c) Scheme & write up on forced lubrication system, if any.
d) Type test report

10.02.00 After Award of Contract for Information (I)/ Approval (A)

a) Dimensional General Arrangement drawing (I)
b) Foundation Plan & Loading (I)
c) Cable end box details.(I)
d) Space requirement for rotor removal (I)
e) Thermal withstands curves hot & cold (I)
f) Starting and speed torque characteristics at 80%, 100% & 110% voltage (A)
g) Complete motor data sheet (A)
h) Erection & Maintenance Manual (I)

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11 kV, 3 Ø/, 3W, 50 Hz Non-effectively earthed Fault level 40 KA symm. for 3 second.	Motors above 1500 kW
H.T. Supply	3.3 kV, 3 Ø/, 3W, 50 Hz Non-effectively earthed Fault level 40 KA symm. for 3 second.	Motors above 160kW upto 1500 kW.
L.T. Supply	415V, 3 Ø/, 3W, 50 Hz Effectively earthed Fault level 50 KA symm. for 1 seconds.	Motors above 200W upto 160 kW
	240V, 1 Ø/, 2W, 50 Hz Effectively earthed	Motors below 200W Lighting, space heating, A.C. control protective devices
D.C. Supply	220V, 2W, unearthed Fault level 25* KA for 1 second (Min.)	D.C. alarm, control protective devices

* However actual value shall be substantiated by the bidder through calculation.

2.0 RANGE OF VARIATION

A.C. Supply

Voltage : ±10%

Frequency : ±5%

Combined Volt & frequency : 10% (absolute sum)

D.C. Supply

Voltage : 190 to 240 Volt

3.0 Paint Shade : RAL 7032

	TITLE	SPECIFICATION NO.
BHEL	LV MOTOR DATA SHEET – C SAGARDIGHI THERMAL POWER PROJECT 1 x 660 MW UNIT NO. 5, PHASE – III	VOLUME II B SECTION D REV NO. 00 DATE 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	

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

	TITLE	SPECIFICATION NO.
BHEL	LV MOTOR DATA SHEET – C SAGARDIGHI THERMAL POWER PROJECT 1 x 660 MW UNIT NO. 5, PHASE – III	VOLUME II B SECTION D REV NO. 00 DATE SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
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					
			SEAL	REV.	
NAME	SIGNATURE	DATE			

BHEL	**GENERAL TECHNICAL REQUIREMENTs** **FOR** **LV MOTORS**	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : **II-B**
		SECTION : **D**
		REV NO. : **00** DATE : 29/08/2005
		SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

BHEL	**GENERAL TECHNICAL REQUIREMENTs** **FOR** **LV MOTORS**	SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : **II-B** SECTION : **D** REV NO. : **00** DATE : 29/08/2005 SHEET : 1 OF 4

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**

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.

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. 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	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1 & NOTE-2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 of 2

		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR**, CR:** CRITICAL
D: DOCUMENTATION

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

SECTION - IV

CABLES

1.00.00 SCOPE OF SUPPLY

1.01.00 Cables shall be furnished in accordance with this specification and the following annexures :-

a. HV. Power Cables : Annexure A

b. LV. Power Cables : Annexure B

c. Control Cables : Annexure C

1.02.00 Other cables including special cables, fire survival cables if any, which are necessary as per proven engineering practice for satisfactory & trouble free operation of the entire cable system of the main plant shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and sub-systems.

1.03.00 Special tools and tackle.

1.04.00 All relevant drawings, data and instruction manuals.

2.00.00 CODES AND STANDARDS

2.01.00 All cable and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.01.01 Cable and material 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.

2.01.02 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 DESIGN CRITERIA

3.01.00 The Cables will be used for connection of power and control circuits of the auxiliary electrical systems.

3.02.00 Cables will be generally laid on ladder type trays or drawn through rigid PVC/GI /HDPE pipe/conduits or directly buried in ground depending on layout requirement.

3.03.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard or this specification which one is more stringent.

3.04.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.

3.05.00 The outer sheath of power and control cables shall have rodent and termite repulsion treatment.

3.06.00 Core identification for multicore cable shall be provided by colour coding.

3.07.00 For 3.3KV and above rating cables shall be dry cured in pressurized nitrogen atmosphere.

3.08.00 The allowable voltage drop at terminal of the connected equipment shall be maximum 2.5% at full load while choosing the conductor size and calculations shall be submitted for purchaser's approval. In case of squirrel cage induction motors, the cable size shall be so chosen that the motor terminal voltage does not fall below 80% of the rated voltage, at the time of starting.

3.09.00 Cable selection criteria

1> In cable sizing the following are to be taken into consideration.

a. Short circuit current and duration
b. Continuous current.
c. Installation conditions.
d. Voltage drop under normal running and starting condition.
e. Fault contribution of motor and expected time up to which motor contribution persists

2> Apart from above, consideration shall also be given to limit the cable to some standard sizes instead of using too many types.

3> The standard cable sizes, capacities, derating factors, etc. as given in IS will be generally followed.

a) For breaker protected circuits minimum size will be determined by short circuit rating.

b) For motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly following a second. For fuse protected circuit, the conductor size will depend on full load current subject to voltage drop not exceeding 2.5%.

4> For practical purposes, the minimum size chosen is as below:
a) Aluminium : 16 Sq. mm.
b) Copper : 2.5 Sq. mm.
All drives of small rating where terminations with 16 Sq. mm. cables are not feasible, shall have copper cable.

5> All control cables shall be 2.5 Sq. mm. copper cable.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 H.V. Power Cables

The type and quantity shall be furnished as indicated in Annexure -A

4.02.00 L.V. Power Cables

The type and quantity shall be furnished as indicated in Annexure -B

4.03.00 Control Cables

The type and quantity shall be furnished as indicated in Annexure -C

4.04.00 Separate cables for each type of following services / functions as applicable shall be used for each feeder. Same multicore cable using different services and different voltage class/grade shall not be acceptable:

a) Power.
b) Control, interlock and indication.
c) Metering and measuring.
d) Alarm and annunciation.
e) C.T. Cables.
f) V.T. Cables.

4.05.00 Double/ multi run cable termination at motor end shall be avoided.

4.06.00 Drum Length & Tolerance

The cables shall be supplied in non-returnable packing steel drum for HV power cables, wooden drums for LV power and control cables, each containing minimum 500 meters length of larger sizes of cable unless specifically asked for. For smaller sizes of cables, each drum shall contain 1000 meters length of cable. Allowable tolerance on individual drum length is ±5%.

4.07.00 Total Quantity Variation

Total supplied quantity shall not vary by more than ± 2-1/2% of total quantity for ordered length for all types of cables.

4.08.00 Non-Standard Length

Owner shall not accept any non-standard lengths of the total ordered quantity. Cable lengths shall not be less than 500 meters in any case.

4.09.00 Cable identification

Cable identification shall be provided by embossing on every meter on the outer sheath the following:

a) Manufacturer's name or trade mark

b) Voltage grade

c) Year of manufacture

d) Type of insulation, e.g. XLPE/PVC etc.

e) No. of core and size of cables.

f) Type of improved fire performance, e.g. FR/FR-LSH

g) IS number

4.10.00 Packing

4.10.01 Cables shall be supplied in non-returnable drums. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage.

4.10.02 Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment.

4.10.03 The cable drums should carry the following details in printed form:

a) Manufacturer's name or trade make

b) Type of cable & voltage grade

c) Year of manufacture

d) Type of insulation e.g. XLPE

e) No. of core and size of cables

f) Cable code

g) Length of cable on drum

h) No. of length on drum, if more than one

i) Direction of rotation, by arrow

j) Approx. gross mass.

k) IS number and ISI mark

4.11.00 Joints and Terminations

Materials of construction for a joint/termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations shall have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements.

5.00.00 TESTS

5.01.00 Shop Tests

The Cables shall be subject to shop tests in accordance relevant IS/IEC standards to prove the design and general qualities of the Cables as below: -

5.01.01 Routine tests on each drum of cables.

5.01.02 Acceptance tests on drums chosen at random on each type, size and batch for acceptance of the lot.

5.01.03 Type tests on each type of cable, size and batch inclusive of measurement of armour D.C. resistance of power cables.

5.02.00 Additional Tests

Following additional acceptance tests shall also be performed on each type of cables having outer sheath with improved fire performance (category C1, Type FR/ Category C2, Type FRLSH):

5.02.01 Oxygen index test (for both C1 & C2)

The Oxygen index shall not be less than 29

5.02.02 Temperature Index Test (for both C1 & C2)

The measured value of temperature index shall be 21 at a temperature of 250°C

5.02.03 Flame Retardance test on single cable and on bunched cables (for both C1 & C2)

After the test, there should be no visible damages on the test specimen within 300mm from its upper end.

After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly.

5.02.04 Halogen acid gas evolution test (for category C2).

The level of HCL evolved shall not exceed 20 per cent by weight

5.02.05 Smoke density test (for category C2)

The cables shall meet the requirements of light transmission of minimum 40% after the test.

5.02.06 test for specific optical density of smoke (for category C2)
(to be considered later)

5.02.07 Test for rodent & termite repulsion property

The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.

5.03.00 Test Witness

Tests shall be performed in presence of Owner's representative if so desired by the Owner. The Contractor shall give at least thirty (30) days' advance notice of the date when the tests are to be carried out.

5.04.00 Test Certificates

5.04.01 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner.

5.04.02 Test reports shall be completed with all details and shall also contain IS specified limit values, wherever applicable, to facilitate review

5.04.03 The cables shall be dispatched from works only after receipt of Owner's written approval of the test reports.

6.00.00 SPECIAL TOOLS & TACKLE

6.01.00 A set of special tools & tackle which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied. These special tools and tackles shall include but not limited to:

a.	Splice-cum-insulation remover for control cable	:	10 Nos
b.	Hand operated compression tools with a set of dies for different cable sizes	:	4 Nos. + 4 Sets of dies for each size of cables
c.	Hydraulically operated Compression tools with a set of dies for different cable sizes	:	4 Nos. + 4 Sets of dies for each size of cables
d.	Wire-wrap gun with accessories for 0.5 Sq. mm. instrumentation cables	:	10 Nos

e. Maxi-terminal connection gun with accessories for 0.5 Sq. mm. instrumentation cables : 10 Nos

6.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

7.00.00 DRAWINGS, DATA & MANUALS

7.01.00 Drawings, Data & Manuals shall be submitted with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in this specification for approval & subsequent distribution after the issue of Letter of Intent.

7.02.00 To be submitted with the Bid :

a. Manufacturer's catalogues giving cable construction details and characteristics.

b. Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.

c. Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables.

d. Type test reports on H.V. power cable.

7.03.00 To be submitted for Information (I) / Approval (A)

7.03.01 Guaranteed Technical Particulars(A)

7.03.02 Quality assurance plan.(A)

7.03.03 Shop Test reports(A)

7.03.04 Instruction manuals(I)

The manual shall clearly indicate method of laying, termination, check-ups and tests to be carried out before commissioning.

7.03.05 Any other relevant drawing or data necessary for satisfactory installation operation and maintenance (I) or as required by purchaser.

7.04.00 The Owner may review the documents marked (I) if thought necessary. The contractor shall note that the approval of drawings & documents by the Owner does not relieve him of his contractual obligation.

7.05.00 The bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, information, etc required to fully describe the cable are to be submitted with the bid.

7.06.00 All drawings shall be prepared by using AutoCAD and documents shall be generated using Electronic version. The paper copy of the drawings &

document shall be submitted for approval & reference. All final drawings and documents shall be submitted in CD in AutoCAD 2000 and MS office format as applicable for Owner's future reference.

Annexure-A

H.V. POWER CABLE

1.0 3300/3300V & 11000/11000V (i.e. un-earthed grade) 90ºC continuous rating under normal condition and 250°C under short circuit condition, XLPE heavy duty power cable suitable for use in 3300V and 11000 V non effectively earthed system conforming to following requirement and in line with IS 7098, IS 8130 & IS 5831 and IS 3975.

1.1	Conductor	:	Stranded and compacted aluminium conductor of grade H2 and class 2 conforming to IS:8130.
1.2	Conductor Screen	:	Extruded semi-conducting compound.
1.3	Insulation	:	Extruded cross linked polyethylene (XLPE) conforming to IS-7098(Part-2)
1.4	Insulation Screen	:	Extruded semi-conducting compound with a layer of non-magnetic metallic tape. For single core armoured cables, the armouring shall constitute the metallic part of screening. The semi-conducting tape shall be easily strippable. (Applicable for cables above 3300V/3300V)
1.5	Core Identification	:	By coloured strips applied on cores or by numerals.
1.6	Inner Sheath	:	Extruded PVC compound conforming to type ST2 of IS:5831 for three core cables. Filler shall be of same material as of inner sheath i.e. ST2. Single core cables shall have no inner sheath.
1.7	Armour	:	Galvanised single round steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminum single round wire conforming to H4 grade for single core cables.
1.8	Overall Sheath	:	Extruded FRLS PVC compound conforming to type ST2 of IS:5831. Category — Type C2 — FRLSH (Fire Retardant Low smoke and halogen evolution)
1.9	Drum		Conforming to IS-10418 (Steel Drum)

Annexure-B

LV POWER CABLE

1.0 1100 V grade, 90º C continuous rating under normal condition and 250°C under short circuit condition rating, XLPE heavy duty, power cable conforming to following requirement and in line with IS 7098. IS 8130 & IS 5831 and IS 3975.

1.1	Conductor	:	Stranded and compacted plain aluminium of grade H2 for cable sizes above 2.5 mm2and class 2 stranded high conductivity annealed plain copper for cable sizes upto 2.5 mm2 conforming to IS:8130.
1.2	Insulation	:	Extruded cross-linked polyethylene (XLPE) conforming to IS:7098(Part-3)
1.3	Core Identification	:	By color coding
1.4	Inner Sheath	:	Extruded PVC compound conforming to type ST2 of IS:5831 for multicore cable. Single core cables shall have no inner sheath.
1.5	Armour	:	Galvanised single round steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminium single round wire conforming to H4 grade for single core cables.
1.6	Overall Sheath	:	Extruded FRLS PVC compound conforming to type ST2 of IS:5831. having improved fire performance category and type as stated below. Category — Type C2 — FRLSH (Fire Retardant Low smoke and halogen evolution)
1.7	Drum		Conforming to IS-10418(Wooden Drum)

Annexure-C

CONTROL CABLES

1.0 1100 V grade 70ºC continuous rating under normal condition and 160°C under short circuit condition rating PVC Control cable (YWY) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.

1.1	Conductor	:	Stranded non-compacted and circular, high conductivity annealed plain copper, generally conforming to IS:8130.
1.2	Insulation	:	Extruded PVC compound conforming to type A of IS : 5831.
1.3	Core Identification	:	By color coding and numbering at interval of 100mm or less
1.4	Inner Sheath	:	Extruded PVC compound conforming to type ST1 of IS:5831 for multi-core cables. Filler shall be of same material as of inner sheath i.e. ST1. Single core cables shall have no inner sheath.
1.5	Armour:	:	Galvanised single round steel wire for twin and Multi-core cables.
1.6	Overall Sheath	:	Extruded PVC compound conforming to type ST1 of IS 5831 having improved fire performance category and type as stated below.

Category	Type
C2	FRLSH (Fire Retardant Low smoke and halogen evolution)

1.7 Drum : Conforming to IS-10418 (Wooden Drum)

Annexure-D

STANDARD CABLE SIZES

Sl. No.	Cable Size	Conductor	Insulation
1.0	**H. T. CABLES**		
1.1	1 core 630 Sq. mm. (3.3/3.3 KV & 11/11KV (UE)	AL	XLPE (FRLSH)
1.2	3 core 185 Sq. mm. (3.3/3.3 KV & 11/11KV (UE)	AL	XLPE (FRLSH)
1.3	3 core 240 Sq. mm. (3.3/3.3 KV & 11/11KV (UE)	AL	XLPE (FRLSH)
1.4	3 core 300 Sq. mm. (3.3/3.3 KV & 11/11KV (UE)	AL	XLPE (FRLSH)
1.6	1 core 70 Sq. mm. (3.3/3.3 KV & 11/11KV (UE)	AL	XLPE (FRLSH)
2.0	**L. T. POWER CABLES**		
2.1	3 core 2.5 Sq. mm.	Cu	XLPE (FRLSH)
2.2	3 core 6 Sq. mm.	Cu	XLPE (FRLSH)
2.3	2 core 16 Sq. mm.	Cu	XLPE (FRLSH)
2.4	2 core 16 Sq. mm.	AL	XLPE (FRLSH)
2.5	3 core 16 Sq. mm.	AL	XLPE (FRLSH)
2.6	4 core 16 Sq. mm.	AL	XLPE (FRLSH)
2.7	3 core 25 Sq. mm.	AL	XLPE (FRLSH)
2.8	2 core 35 Sq. mm.	AL	XLPE (FRLSH)
2.9	3 core 35 Sq. mm.	AL	XLPE (FRLSH)
2.10	4 core 35 Sq. mm.	AL	XLPE (FRLSH)
2.11	3 core 50 Sq. mm.	AL	XLPE (FRLSH)
2.12	4 core 70 Sq. mm.	AL	XLPE (FRLSH)
2.13	3 core 95 Sq. mm.	AL	XLPE (FRLSH)

Sl. No.	Cable Size	Conductor	Insulation
2.14	$3^1/_2$ core 95 Sq. mm.	AL	XLPE (FRLSH)
2.15	3 core 150 Sq. mm.	AL	XLPE (FRLSH)
2.16	3 core 185 Sq. mm.	AL	XLPE (FRLSH)
2.17	$3^1/_2$ core 185 Sq. mm.	AL	XLPE (FRLSH)
2.18	3 core 240 Sq. mm.	AL	XLPE (FRLSH)
2.19	$3^1/_2$ core 240 Sq. mm.	AL	XLPE (FRLSH)
2.20	3 core 300 Sq. mm.	AL	XLPE (FRLSH)
2.21	$3^1/_2$ core 300 Sq. mm.	AL	XLPE (FRLSH)
2.22	1 core 630 Sq. mm.	AL	XLPE (FRLSH)
3.0	CONTROL CABLE		
3.1	2 core 2.5 Sq. mm.	Cu.	PVC (FRLSH)
3.2	3 core 2.5 Sq. mm.	Cu.	PVC (FRLSH)
3.3	5 core 2.5 Sq. mm.	Cu.	PVC (FRLSH)
3.4	7 core 2.5 Sq. mm.	Cu.	PVC (FRLSH)
3.5	9 core 2.5 Sq. mm		PVC (FRLSH)
3.6	12 core 2.5 Sq. mm.	Cu.	PVC (FRLSH)
4.0	CABLES FOR ELECTRONIC EQUIPMENT GROUNDING		
4.1	1 core 35 Sq. mm.	Cu.	XLPE (FRLSH)
4.2	1 core 150 Sq. mm.	Cu.	XLPE (FRLSH)

Annexure-E

FS POWER & CONTROL CABLE

1.1KV GRADE COPPER CONDUCTOR FS POWER CABLES

1100 V, copper conductor, heat resisting insulation, extruded inner sheath of low smoke and very low halogen content fire resisting material (for multi-core), single layer of copper wire armour for single core/ single layer of round galvanised steel wire for multicore, outer sheath of low smoke and very low halogen content fire resistant material, suitable for minimum temperature of 950 deg.C (Cat-C) for 3 hours. The cables shall be in compliance with BS 6387.

1.1KV GRADE COPPER CONDUCTOR FS CONTROL CABLES

1100 V, copper conductor, heat resisting insulation, extruded inner sheath of low smoke and very low halogen content fire resisting material (for multi-core), single layer of copper wire armour for single core/ single layer of round galvanised steel wire for multicore, outer sheath of low smoke and very low halogen content fire resistant material, suitable for minimum temperature of 950 deg.C (Cat-C) for 3 hours. The cables shall be in compliance with BS 6387.

[Note : For instrumentation signaling purpose, pair cable with screen on both inner sheath & outer sheath shall be used. For details refer section – VI of Vol.-IIE.]

SECTION - VII

ERECTION - CABLING, GROUNDING AND LIGHTNING PROTECTION SYSTEM

1.00.00 SCOPE OF WORK

1.01.00 The scope of work covers complete and efficient design, supply, erection, testing and commissioning of cabling, electrical grounding and lightning protection system for the entire plant.

1.01.01 Area-wise, the scope shall broadly cover, but not be limited to :

A. Main Power House Building
B. Boiler area, ESP stack
C. Transformer yard, CHP, AHP, FGD area.
D. All auxiliary areas/ buildings (including electrical rooms of respective buildings) and structures of balance of plant (BOP) systems as details in the Lead Specification.
E. Overhead interplant cable trestle and pipe cum cable trestle.

1.01.02 Equipment-wise, the scope of work related to cabling, electrical grounding and lightning protection shall cover all electrical equipment as described in different Sections of the Specification.

1.02.00 Scope of work shall also include all civil and structural works (except cable trenches/tunnels and major equipment foundations) necessary for installation of cabling, electrical grounding and lightning protection system.

2.00.00 SCOPE OF SUPPLY & SERVICES

2.01.00 Scope of Supply

Scope of supply shall include but not be limited to the followings

2.01.01 Transportation to site in properly packed condition of all materials and miscellaneous items required to complete the erection work under this specification.

2.01.02 These materials and miscellaneous items shall include but not be limited to the following:

a) Galvanized steel rigid/flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanized sheet steel junction boxes, cable fixing clamps, nuts & bolts, etc. as required.

b) Cable trays, Fittings and Accessories

c) Cable termination and jointing kits as necessary.

d) All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.

e) Mild steel rods for main ground mat, grounding electrode, column & structure grounding, risers etc.

Mild steel rod for vertical air terminals,

Materials for electronic grounding,

Galvanized steel flats for horizontal air terminals, for down conductors and for large equipment grounding

Galvanized wire (8 SWG) for small equipment grounding.

f) Fire-proof cable penetration sealing system,

g) Fire retardant cable coating system.

h) Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work of Cabling, Grounding and Lightning Protection Systems shall be deemed to be included in the scope of this specification and shall be furnished by the Contractor without any extra charge to the Purchaser.

2.02.00 Scope of Services

The scope of Cabling, Grounding and Lightning Protection Systems includes but is not limited to the following:

2.02.01 Furnishing of all erection tools and tackles, testing equipment, implements, supplies, hardware and transport for timely and efficient execution of the erection work.

2.02.02 Erection work shall be performed with respect to all the equipment/materials mentioned under ‘Scope of Supply’.

2.02.03 Erection work shall also be performed with respect to the following items:

a) Cable trays and accessories

a) Power cables

b) Cables laid directly buried in ground

c) Control, instrument and special cables

3.00.00 GENERAL REQUIREMENTS

3.01.00 Codes and Standards

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.

3.02.00 Erection Schedule

3.02.01 The Bidder shall agree to adhere to the Owner's Erection Schedule if such a schedule is attached with the Specification. Alternatively, in case the target completion dates alone are indicated, the Bidder shall furnish detailed erection schedules (starting from zero date) with separate 'S' curves for Cabling, Grounding and Lightning Protection works.

3.02.02 The erection schedule, as approved by the OE shall be strictly followed by the contractor. If the work is held-up for any reason, attributable to him or not, the same shall be brought immediately to the notice of the OE.

4.00.00 DESIGN CRITERIA

4.01.00 Grounding System

4.01.01 Grounding work shall be carried out in compliance to the following standards/codes. All standards, specifications and codes of practice (COP) referred to herein shall be the latest editions including all amendments and revisions as on the date of opening of bid. In case of conflict between the specification and those standards/codes referred to herein, the former shall prevail:

a)	Indian Electricity rules	
b)	National Electrical Code	
c)	Recommended practice for hot-dip galvanizing of iron and steel	IS 2629
d)	Method of testing uniformity of coating on zinc coated articles	IS 2633
e)	COP for earthing	IS 3043
f)	Methods for determination of mass of zinc coating on zinc coated iron and steel articles	IS 6745
g)	IEEE guide for safety in AC substation grounding	IEEE 80
h)	IEEE recommended practice for grounding of industrial and commercial power systems	IEEE 142
i)	IEEE recommended practice for determining the electric power station ground potential rise and induced voltage from a power fault	IEEE 367
j)	IEEE guide for instrumentation and control equipment grounding in generating stations	IEEE 1050

4.01.02 Basic design criteria are delineated below:

a) The station grounding system shall be an interconnected network of MS conductor and MS ground rods. The system shall (a) provide safety to personnel from contact of dangerous potential caused by ground fault, (b) ensure sufficient grounding current for effective relaying and (c) stabilize circuit potential with respect to ground.

b) The station grounding system shall be designed in compliance with the IEEE- 80/ IEEE- 665 considering fault current of 50kA for 1 sec. and shall be subject to approval of the Owner.

c) Actual soil resistivity measurement shall be carried out at proposed site during dry season.

d) The surface resistivity shall be considered as 3000 Ohm-meter for gravel and 1000 Ohm-meter for concrete.

e) Major items of equipment, such as generator, switchgear, transformer, motor, relay panels and control panels etc shall have integral ground buses or connection points which shall be connected to the underground grid.

f) Electronic panels and equipment, where required, shall be grounded utilizing an insulated ground wire connected in accordance with the manufacturer's recommendations. Where practical, electronics ground loops shall be avoided. Where this is not practical, isolation transformers shall be furnished. All indoor and outdoor electrical equipment and associated non-current carrying system, metal works, support structures, buildings columns, fence, neutrals, masts, arrestors, etc shall be connected to the plant ground system.

g) Instrumentation cable screens shall be single point bonded to the instrument earth network to minimize the effects of electrical interference.

h) For Signal/case/intrinsically safe signal, grounding of control room instruments, separate earth pit not connected to main ground grid shall be used. Control cabinets shall be connected to this separate earth pit.

i) A grounding conductor (steel wire armour in case of cables with outer sheath) shall be routed parallel to all power conductors operating above 240 volts.

j) All ground wires installed in conduits shall be uninsulated.

k) Embedded grounding grid made of GI flat at basement/grade slab as well as upper floor/suspended slabs shall be provided.

l) In addition mild steel ground pads at different locations i.e. on wall/floor/ceiling inside the buildings/tunnels/trenches shall be provided. These pads will be in turn connected to below ground level earth mat through galvanized steel flat or riser. Each ground pad shall have provision for connection of at least two GI flats.

m) Treated earth pit shall be provided for system earthing at locations where generator and transformer neutrals are grounded. Two pits shall be provided for each neutral.

n) Dedicated treated earth pit shall be provided for lightning protection system.

o) Clean earthing for instrumentation shall be provided with dedicated earthing system and separate treated earth pits below the main control room, feed water pump house in turbine house etc.

p) Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.

In order to meet the above design criteria, ground grid mesh will be provided for the main plant complex, viz., switchyard, transformer yard adjacent to power house building, power house building and boiler area up to stack, auxiliary buildings, etc. All electrical equipment, non-current carrying metal parts, structures, building steel, lightning protection system, generator/transformer neutrals will be connected to this station ground grid.

4.01.03 Other major design aspects that are to be considered for grounding system are given below:

1. Ground Grid Conductor

i) Ground grid conductor of mild steel rod shall be used.

ii) The minimum conductor section is determined on the basis of ground fault current. This section is then increased by an allowance to account for the soil corrosion loss of 0.3 mm per year over the design life of 30 years. However, the minimum size shall be 1x40 mm dia mild steel conductor.

2. Underground Grid

i) The ground grid mesh is designed to keep the touch and step voltages within safe limits as per recommendation of IEEE 80 & IEEE665.

ii) The ground grid conductors will be buried in earth at a minimum depth of 1000 mm. The length of ground conductors below earth will be sufficient to ensure a ground resistance less than 0.5 ohm.

iii) The ground grid conductor will be so laid as to provide short and direct connection to building steel and major electrical equipment.

iv) Ground rods shall be provided at the points where system neutrals/lightning protections are connected to the ground grid.

v) All ground grid conductor connections will be welded type.

vi) Main Plant ground grid shall be connected with the other auxiliary building /area ground grid at least at two (2) points.

vii) For test pits, the electrode will be 100 mm dia. Heavy duty C.I. pipe with perforations. Electrodes installed in test pits will have disconnecting facilities

3. Above-ground Connections

i) Galvanized steel flats shall be used for all connections above earth.

ii) Inside building, ground conductors will be run for each floor supported on building steel and/or cable trays. These ground conductors in turn will be connected to the station ground grid through riser (at least two) coming up along building columns/cable shafts.

iii) Two separate and distinct ground connections will be provided for each electrical equipment in compliance with I.E. Rules.

iv) All connections above ground will be welded type except connection to equipment/structures which shall be bolted type.

4. Equipment Ground Lead

Equipment ground connections will be sized to carry the available ground fault current. Considerations shall also be given to mechanical ruggedness of the connections and to limit the number of sizes.

5. Electronic Equipment Grounding

i) Internal ground connection of electronic panels shall be insulated from the enclosure, frame, and chassis are to be terminated to an insulated ground bus.

ii) Insulated ground bus of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar.

iii) All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

iv) Electronic equipment and systems, metal enclosures of all electronic panels shall be connected to a grounding system with which is isolated and separate from the electrical equipment grounding system.

4.01.04 The minimum conductor sizes for connection of various equipment and structures shall be as given in the attached Notes and Details for Grounding & Lightning Protection Systems.

4.01.05 Entire erection of grounding work shall be carried out in such a way as to be capable of withstanding the intended services of carrying full short circuit level currents to ground mat without any damage / deformation.

4.02.00 Lightning Protection System

4.02.01 Lightning protection work shall be carried out in compliance to the following standards/codes. All standards, specifications and codes of practice (COP) referred to herein shall be the latest editions including all amendments and revisions as on the date of opening of bid. In case of conflict between the specification and those standards/codes referred to herein, the former shall prevail:

a)	Indian Electricity rules	
b)	National Electrical Code	
c)	COP for the protection of building and allied structures against lightning	IS 2309
d)	Recommended practice for hot-dip galvanizing of iron and steel	IS 2629
e)	Method of testing uniformity of coating on zinc coated articles	IS 2633
g)	Methods for determination of mass of zinc coating on zinc coated iron and steel articles	IS 6745
k)	IEEE guide for instrumentation and control equipment grounding in generating stations	IEEE 1050

4.02.02 Basic design criteria are delineated below:

a) The main purposes of the lightning protection system shall be (a) to provide protection to structures from lightning strokes and (b) to provide a low resistance-conducting path to lightning discharge.

b) Lightning protection shall be provided for Power House building, auxiliary building of CHP, AHP, FGD etc. and other structures.

c) Lightning protection will also be provided for building/ structures where the overall rise factor exceeds 10^{-6} as per IS: 2309.

d) For metal structures which are electrically continuous down to the ground level, no lightning protection is required except adequate grounding connections.

4.02.03 Other major design aspects that are to be considered for grounding system are given below:

a) Air termination network with down conductors and earthing electrodes will be provided on the basis of IS Code of Practice.

b) Vertical air terminals shall be of 20mm dia galvanized steel rod on the structure/building (except for chimney).

c) Horizontal air termination of 75x10 mm GS flat conductor on the roof of the installation shall be so laid out that no part of the roof will be more than 9 meters from the nearest conductor.

d) Shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 Degrees.

e) Down conductors of 75x10 mm GS Flat for all installations except for conveyor gallery will run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground. It shall be 25x3 mm GS flat for conveyor gallery.

f) An earth electrode of size 40 mm. diameter 3 metre long MS will be provided at the connection point of the down conductor with the station ground.

g) All connections will be of welded type.

h) Risers (for Lightning protection) shall be of 1x40 (minimum) mm dia. MS rod from underground mat to minimum 300 mm above grade level/concrete floor level.

i) Shielding mast shall be provided at the top of steel columns cap plates of power house building.

j) All other ancillary items in connection with the work described above shall be furnished to complete the work irrespective of whether such items may have been specifically mentioned or not.

4.02.04 All materials and accessories to be supplied by the Bidder shall be brand new ones of reputed make.

4.02.05 Necessary drawings, data sheets and Technical leaflets for each piece of shop produced/fabricated items.

4.03.00 Cabling System

4.03.01 Cabling work shall be carried out in compliance to the following standards/codes. All standards, specifications and codes of practice (COP) referred to herein shall be the latest editions including all amendments and revisions as on the date of opening of bid. In case of conflict between the specification and those standards/codes referred to herein, the former shall prevail:

a)	Indian Electricity rules	
b)	National Electrical Code	
c)	Steel tubes, tubulars and other steel fittings	IS 1239
d)	COP for installation & maintenance of power cables upto and including 33kV rating	IS 1255
e)	Degree of protection provided by enclosures for low voltage switchgear & control gear	IS 2147
f)	Recommended practice for hot-dip galvanizing of iron and steel	IS 2629
g)	Method of testing uniformity of coating on zinc coated articles	IS 2633
h)	Flexible steel conduits for electrical wiring	IS 3480
i)	Cable Glands	BS 6121 / EN 50262
i)	Methods for determination of mass of zinc coating on zinc coated iron and steel articles	IS 6745
j)	Compression type tubular in-line connectors for aluminium conductors of insulated cables	IS 8309
k)	Conduits for electrical installation	IS 9537
l)	Joints & terminations for polymeric cables for working voltages from 3.3kV upto & including 33kV : performance requirements & type tests	IS 13573
m)	Conduit systems for electrical and communication installation	IS 14930

4.03.02 Erection of cabling work shall be carried out in such a way as to provide a reliable and assured electric power supply system to all station auxiliaries.

4.03.03 Cable routing will be done on unit basis as far as possible.

4.03.04 Cables will generally be laid on cable trays, cable trench, cable rack, overhead supported from building steel/structures or cable bridge/cable trestle. Cables shall be run in concrete trenches in transformer yard and in those electrical rooms at ground level, which are without any spreader room below. However cable trench shall be avoided as far as possible in outdoor areas. Cables shall not be buried directly in ground unless explicitly permitted in some areas.

All cable trestle shall be provided with walkway by the side of cable tray for maintenance. Walkway shall have hand railing with 1200 mm minimum height.

4.03.05 Cables will generally be laid on cable trays, cable trench, cable rack, overhead supported from building steel/structures or cable bridge/cable trestle. Cables shall be run in concrete trenches in transformer yard and in those electrical rooms at ground level, which are without any spreader room below.

4.03.06 Cable trench shall be avoided in boiler area and in outdoor areas as far as practicable. Cable shall be laid on cable trays along overhead pipe bridges. Where such overhead pipe bridges are not available, overhead pipe trestles are to be erected for taking the cable racks/trays. Cables buried directly in ground are not acceptable.

4.03.06 In indoor mechanical equipment areas like pump houses, overhead cable trays shall generally be used.

4.03.07 For underground crossing of railways, road, etc. additional protection shall be provided in form of Hume pipe or concrete encased rigid steel conduits (duct bank).

4.03.08 A.C. and D.C. circuit will not be run in same cable. Further, separately fused circuit will run in separate cables.

For Instrumentation cabling system, Bidder shall refer VOL-IIE, Section I of General Technical Requirement Under "C&I Cabling".

4.03.09 Cables for redundant equipment system shall be run in separate trays, as far as possible.

4.03.11 Erection of cabling work shall be executed keeping in view all necessities and requirements of fire fighting codes for Generating Stations having an adverse industrial environment.

4.03.12 Suitable embedded steel inserts shall be provided on wall/floor/ ceiling surfaces for welding of cable tray bracket in order to make the cable tray system withstand, in addition to normal tray cable loadings, horizontal/vertical accelerations due to seismic forces for indoor trays and also wind load for outdoor trays such as on Boiler platforms.

4.03.13 Erection work to be carried out under this specification shall conform to the ‘Notes and Details for Cabling System’ given in Annexure-A and the drawings attached to this specification.

5.00.00 SPECIFIC REQUIREMENTS - SUPPLY

5.01.00 Equipment and Material

5.01.01 Equipment and material shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.

5.01.02 All accessories, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

5.01.03 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

5.02.00 Conduits and Accessories

5.02.01 The contractor shall provide and install all conduits, mild steel pipes, flexible conduits, rigid PVC pipes, etc. complete with accessories like tees, bends, adopters, locknuts, pull boxes, conduit plugs, caps, etc as required for the cabling work. Conduits shall be furnished in standard length of 5 metres, threaded at both ends.

5.02.02 Conduits diameter upto and including 25mm size shall be of 16 SWG and conduits above 25 mm diameter shall be of 14 SWG. Minimum diameter of conduits shall be 20 mm.

5.02.03 Conduits shall be made of hot-dip galvanized steel with an organic corrosion resistant ID coating. In chemical handling areas, battery room, etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion. Conduits, fittings & accessories shall have ISI mark.

5.02.04 For sizes above 63 mm, hot dip galvanized - both on inside and outside - steel pipes with necessary fittings & accessories shall be provided and installed by the contractor. The pipes and fittings shall be of heavy duty class with relevant ISI mark.

5.02.05 Flexible conduits complying to relevant IS and made with bright, cold-rolled, annealed and electro-galvanized mild steel strips shall be used between embedded conduits/pipes and the motor terminals. It shall also be used between fixed conduit and any equipment with vibration or equipment requiring regular removal.

5.02.06 Non-metallic conduits made of HDPE outer jacket with friction-reducing permanent internal lining shall generally be used for control & instrumentation cables in some areas where cable trays do not exist and where the runs are

straight ones Necessary fittings & accessories as may be required for the installation shall also be provided.

5.03.00 Junction Box

5.03.01 Technical requirement for both non-metallic type and galvanized steel Junction Boxes are given below. Unless the choice is specifically mentioned in the General / Lead Electrical Specification or elsewhere in the tender document, galvanized steel Junction Boxes shall be offered.

Non-metallic Junction Boxes:

a) Material of the Junction Boxes shall be halogen-free and silicon-free, glass fibre-reinforced polycarbonate for outdoor use and/or for cable sizes more than 50 sq.mm. Material shall be ABS/ polycarbonate for indoor use and/or for cable sizes upto 50 sq. mm. Junction boxes for use with fire-survival cables shall be of Duro-plast / powder-coated metal.

b) Material of all non-metallic junction boxes shall be fire retardant and self-extinguishing in accordance with UL 94 V0. It should be tested at Glow Wire test for 960º C.

c) Boxes shall be suitable for continuous operation at an ambient temperature range of -10º C to +80º C.

d) The impact strength of polycarbonate enclosures/boards i.e. the degree of protection against mechanical shock load shall be in accordance with EN 50298-98 for IK 08 (5 Joule).

e) Degree of protection shall be IP 66 to EN 60529. Junction boxes shall have integrally embedded gaskets made of Polyurethane.

f) Allowing a minimum of 20% spare terminals after complete termination, the terminal board for control and instrumentation JBs shall have 6 /12 / 24 / 36 / 48 ways.

g) Doors shall have stainless steel quick fastening screws.

h) The boxes shall be complete with all brackets/fasteners as required for installation on walls, columns and structure.

5.03.03 Steel Junction Boxes

a. Junction boxes with IP 55 (for Indoor) / IP 65 (for Outdoor) degree of protection, shall comprise of a rectangular parallelepiped case hinged door with Handle constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the box shall be arranged to slope towards the rear of the box. Gland plate shall be 3mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of

adequate strength and rigidity, hot dip galvanized as per relevant IS with epoxy powder coating paint RAL 7032 with min painting thickness 80 micron and suitable for mounting on wall, column, structures etc. The boxes shall be complete with M8 earthing stud and all brackets/fasteners as required for installation.

b) No. of Ways: 6 / 12 / 24 / 36 / 48 with 20% spare terminals after termination.

c) All outdoor JBs shall be similar but with a canopy at the top.

d) Doors shall be hinged and lockable and shall be made of the same material as the case. The doors shall have industrial heavy-duty hinges. The doors shall be easily but firmly lockable with quick release fastener.

e) The junction boxes shall have the following indelible markings:

i) Circuit nos. on top by white-stenciled paint at site.

ii) Circuit nos. with ferrules (inside) as per approved drawing.

iii) Danger sign in case of 415V circuit.

5.04.00 Terminals

5.04.01 Multiway terminal blocks of approved type, complete with screws, nuts; washers and marking strips shall be furnished for connection of incoming/outgoing wires.

5.04.02 Each control cable terminal shall be suitable for connection of 2 nos. 2.5 sq.mm. stranded copper conductors without any damage to the conductor or looseness of conductors.

5.05.00 Cable Termination & Straight through Joints

5.05.01 Bidder shall supply cable termination and jointing kits in requisite quantity for H.T. Power Cables, L.T. Power, Control Cables, Instrumentation Cables, etc. along with all accessories & consumables required for making termination and joints complete. Those shall be of proven design and make which have already been extensively used and type tested.

5.05.02 Components shall be pre-moulded type, taped type or heat-shrinkable type. 11kV 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 cables supplied/erected.

5.07.00 Cable Lugs

Cable lugs shall be suitable for termination of different cross-sections of H.T./L.T./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.

5.09.00 Cable Clamps and Straps

5.09.01 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.

5.09.02 Cable clamps required for multicore cables on vertical run shall be made up of 25x3mm size aluminium strip. For clamping the multicore cables, self-locking, de-interlocking type fire-resistant nylon clamps/straps of sufficient strength shall be used.

5.10.00 Consumables and Hardware

5.10.01 The Contractor shall furnish all erection materials, hardware and consumables required to complete the installation.

5.10.02 The materials shall include but not be limited to the following:

Consumables : Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials, etc.

Hardware : Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims, etc.

5.10.03 Supply of cement, sand, stone, etc. required for the execution of the contract shall be the responsibility of the Contractor.

5.11.00 Testing Equipment

5.11.01 The major testing equipment that are required to be provided by the Contractor are listed below:

a) Insulation Tests

i) Power operated Meggar - 1 KV and 10 KV grade

ii) Hand operated Meggar - 1 KV grade

b) Hand driven earth Resistance Meggar, range 0-1/3/30 ohms.

c) High potential testing set - roller mounted type

d) Tong testers of suitable ranges.

e) Contact resistance measuring set for micro-ohms.

f) Torque wrench of various sizes.

g) Multimeters, test lamp, field telephone with buzzer set, different gauges, etc.

5.11.02 The list of equipment is indicative only. Any other test equipment required will be arranged by the Contractor.

6.00.00 METHODS AND WORKMANSHIP

6.01.00 All work shall be installed in a first class, neat workmanlike manner by mechanics/ electricians skilled in the trade involved.

6.02.00 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

6.03.00 All details on installation shall be electrically and mechanically correct.

6.04.00 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

7.00.00 INSTALLATION

7.01.00 General

7.01.01 Installation work shall be carried out in accordance with good engineering practices and also as per manufacturer's instructions/ recommendations where the same are available.

7.01.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

7.01.03 Cable installation work shall mean erection of cable trays/racks, supports, hangers, junction boxes, conduits, laying of cables either in ground or on trays inside trenches tunnels/overhead trays in conduits, etc. dressing and clamping, jointing and termination inclusive of supply of necessary jointing/ termination kits, lugs, glands, ferrules, tapes, etc. and other accessories, grounding of cable armour. In case of direct laying in ground, all excavation work, necessary back-filling, supply of bricks and protective concrete slabs, removal of excess earth shall be part of the installation work.

7.01.04 Grounding installation work shall mean erection, jointing/ brazing/ welding, connection and painting, testing of ground conductors including supply of necessary steel/copper.

7.01.05 Lightning protection system installation work shall mean erection, jointing, welding, connection and painting, testing of air termination network, down conductors, shielding masts, connection to ground grid, electrodes, risers, horizontal conductors, etc. of lightning protection system.

7.02.00 Cable Trays

7.02.01 Pre-fabricated cable trays and accessories shall be assembled & erected at site. Adequate spaces will be provided to facilitate installation of cable system and to allow routine inspection and modification after installation.

7.02.02 Cable trays either inside concrete trenches or inside buildings and racks inside cable shafts shall be aligned and leveled properly. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings.

7.02.03 As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.

7.02.04 The cable trays shall be supported in general at a span of exceeding 1.25 metres horizontally and 1.0 metre vertically.

7.02.05 Sufficient spacing not less than 250 mm shall be provided between trays and maintained to permit adequate access, for installing & maintaining the cables.

7.02.06 Complete cable tray support structure after installation shall be inspected/ tested for welding strength, straightness, accuracy, use of proper sizes and compliance to drawings.

7.02.07 Complete cable tray and accessory installation work shall be inspected/tested for proper alignment, leveling, use of proper accessories, high quality workmanship, etc.

7.02.08 The Contractor shall remove the RCC/steel trench covers whenever required and shall again place the same in their positions after the erection work in the particular area is completed or when further work is not likely to be taken up for some time.

7.02.09 Whenever any pipe/conduit/cable tray emerges out or enters into a building care should be taken to ensure that no water enters into the building.

7.02.10 Cable trays in areas subject to excessive coal dust, oil spillage, mechanical damage or accessible to personal contact shall be provided with raised sheet metal tray covers, installed on upper tray in horizontal run and front in vertical run.

7.02.11 Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way.

7.02.12 Cable tray/conduit system will be so designed as to accommodate maximum pulling tension and minimum bending radius of cable.

7.02.13 Cable tray/conduit system will be constructed to prevent drainage of water into equipment or building.

7.02.14 Cable tray/conduit system shall be electrically continuous and grounded.

7.02.15 Different voltage grade cables will be laid in separate trays when trays are run in tier formation. Power cables will normally be on top trays and control/instrumentation cable on bottom trays.

7.03.00 Cable and Conduits

7.03.01 The Contractor shall install, terminate and connect up all cable and conduits as per drawings and cable schedules.

7.03.02 The drawings shall be strictly followed except where obvious interference occurs. In such cases, the routing shall be changed as directed and/or approved by the Engineer.

7.03.03 Approximate lengths of cable and conduit runs will be shown by the contractor in the cable schedule for guidance only. Before commencement of work the Contractor shall take actual measurements and prepare his own cable-cutting schedule to reduce wastage to a minimum.

7.03.04 The Contractor shall also maintain and submit when requested, a record of cable insulation value when drawn from store, after laying, before and after termination/jointing.

7.03.05 Where direct heat radiation exists, heat isolating barriers, shall be adopted for cabling system.

7.03.06 Cabling/wiring in offices, laboratories, control rooms etc. shall be taken through concealed G.I. or rigid PVC pipes as directed by the owner's Engineer.

7.03.07 At certain places where hazardous fumes/gasses may cause fire to the cables, cable trenches after installation of cables shall be sand filled.

7.04.00 Conduit and Accessories

7.04.01 Conduit/pipes shall be used only in short lengths in certain areas where required and/or as directed by the Engineer.

7.04.02 The Contractor shall furnish all conduits complete with accessories as required.

7.04.03 Conduits shall be flexible type in general. However, rigid type steel conduit if required shall also be supplied by the Contractor.

7.04.04 Except for inside an enclosure wherever the cable enters or leaves the conduit, the conduit end shall be sealed by suitable sealing compound, having fire withstand capability.

7.04.05 The entire metallic conduit system, when embedded or exposed shall be electrically continuous and grounded.

7.04.06 Where it is possible for water or other liquids to enter conduits, sloping of conduit runs and drainage of flow points shall be considered.

7.04.07 Pull boxes will be installed between termination points where required to facilitate cable pulling, but at a maximum interval of 30 meters.

7.04.08 Conduits shall be firmly fastened within 900 mm of each junction box/pull box/cabinet/fitting, etc. Conduits shall be supported at least every 2000 mm.

7.05.00 Cables: Storage and Handling

7.05.01 Cable drums shall be stored on hard and well-drained surface so that they may not sink. In no case shall the drum be stored on the flat, i.e., with flange horizontal.

7.05.02 Rolling of drums shall be avoided as far as practicable, for short distance, the drums may be rolled provided they are rolled slowly and in proper direction as

marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cable.

7.05.03 For unreeling the cable, the drum shall be mounted on jacks or on cable wheel. The spindle shall be strong enough to carry the weight without bending. The drum shall be rolled on the spindle slowly so that the cable should come out over the drum and not below the drum.

7.05.04 While laying cable, cable rollers shall be used at an interval of 2000 mm. The cables shall be pushed over the roller by a gang of people positioned in between rollers over a suitable distance. Care shall be taken so that kinks and twists or any mechanical damage does not occur in cables. Only approved cable pulling grips or other devices shall be used. Cables shall not be dragged on ground or along structure while laying out from cable drums. Cable shall not be pulled from the end without having intermediate pushing arrangement. Bending radius of the cable during installation shall not be less than what is specified by the manufacturer.

7.05.05 Empty cable drums shall be returned to the Owner.

7.06.00 Cable Laying

7.06.01 Cable shall generally be installed in ladder type prefabricated trays except for some short run in rigid/flexible conduit for protection or crossings.

7.06.02 Cables laid on trays and risers shall be neatly dressed and clamped with self-locking type fire resistant nylon ties at an interval of 750 mm. for horizontal and vertical runs, in case of both power, control and instrumentation cables.

7.06.03 Single core power cables for 3 Ph. AC circuits shall be laid in trefoil formation and suitably clamped with self-locking type fire resistant nylon ties at an interval of 750 mm.

7.06.04 L.T. multicore power cables with cross-sectional area of 95 sq.mm and above and all H.T. multicore power cables and shall be clamped individually by self-locking type fire resistant nylon ties.

7.06.05 L.T. power cables of cross sectional area less than 95 sq.mm and all control and Instrumentation cables shall be clamped in bunches with self-locking type fire resistant nylon ties. The number of cable in one bunch shall not exceed eight (8).

7.06.06 Prior to laying of cables inside the indoor and outdoor trenches, the contractor shall properly clean the trenches.

7.06.07 In outdoor areas, buried cables shall be laid and covered with sand/riddled earth and protected from damage by bricks at sides and precast slab at top.

7.06.08 When buried cables cross road/railway track, adequate protection shall be provided in the form of hume/galvanised iron pipes laid at a minimum depth of 1 meter below ground.

7.07.00 Cable Tags & Markers

7.07.01 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedules. Cables and conduits shall be tagged at their entrance, bends, every 30.0M and exit from any equipment, junction box. When a cable/conduit passes through a wall, tags shall be fitted on both sides of the wall.

7.07.02 The tags shall be of aluminium with the number punched on it and securely attached to the cable by not less than two turns of 16 SWG G.I. wire. For single core cable the wire shall be of non-magnetic material.

7.07.03 Location of cable joints, if any, shall be clearly indicated with cable marker with an additional inscription 'cable-joint'.

7.07.04 Contractor shall furnish and install all tags and markers stated above.

7.07.05 For buried cable, the marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change of direction.

7.08.00 Cable Termination and Connection

7.08.01 Termination and connection of cables shall be done strictly in accordance with manufacturer's instruction, drawings and/or as directed by the Engineer.

7.08.02 Work shall include all clamping, fitting, fixing, soldering, tapping, compound filling, cable jointing, crimping, shorting and grounding as required for the complete job. All equipment required for all such operations shall be of Contractor's procurement. Furnishing of all consumable materials such as soldering material, electrical tape, sealing material as well as cable jointing kits shall be included in the offer.

7.08.04 Cable joint kits for all cables shall be supplied by Contractor under this specification. Responsibility for proper termination shall lie on the contractor. Guarantee for termination shall also have to be given by Contractor.

7.08.05 The equipment will be generally provided with blank bottom plates for cable/conduit entry and cable end box for power cables.

7.08.06 The Contractor shall perform all drilling, cutting on the blank plate and any minor modification work required to complete the job.

7.08.07 If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires major modification, the same shall be carried out by the contractor.

7.08.08 Control/instrumentation cable cores entering control panel/ switchgear/ MCC, etc. shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.

7.08.09 The Contractor shall put ferrules on all control cable cores in all junction boxes and at all terminations. The ferrules shall carry terminal numbers as per drawings. All ferrules shall be coloured, plastic & interlocked type.

7.08.10 Spare cores shall be similarly ferruled, crimped with lug and taped on the ends. Spare cores shall be ferruled with individual cable number.

7.08.11 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.

7.08.12 All cable entry points shall be properly sealed and made vermin and dust proof. Unusual opening, if any, shall be effectively closed. Sealing work shall be carried out with approved sealing compound having fire withstand capability for at least three hours.

7.08.13 Strips and special tools like manually or pneumatically driven gun/pistol for termi-point/equivalent connection shall be supplied by the Contractor.

7.09.00 Cable Joints

7.09.01 Cable shall be installed without joints as far as practicable.

7.09.02 If however jointing becomes necessary, it shall be made only by qualified cable jointer and strictly in accordance with manufacturer's recommendation.

7.10.00 Grounding

7.10.01 If supply and laying of the underground mat is included in the scope of the Contractor, the Contractor will plan and organize works to lay the grounding mat in the same sequence in which the building and equipment foundation is being done.

7.10.02 Underground mat will be made of mild steel rods laid underground in length and breadth of the area at a depth of minimum 1 metre below grade level. All crossings and straight run shall be arc welded for good electrical continuity. Ground conductors, when crossing underground trenches, directly laid underground pipe and equipment foundation, if any, shall be at least 300 mm below the bottom elevation of such trenches/pipes as shown in the relevant drawing.

7.10.03 Contractor shall carryout the interconnection among various peripheral earthing grids/mats, steel structures, lightning protection system as well as grounding of all electrical equipment, etc. The grounding work shall be carried out as per provisions of I.E. rules, Indian standards and Annexure-E: Notes & Details for Grounding & Lightning Protection System.

7.10.04 Grounding shall be done by conductors of adequate sizes (size shall be selected by the bidder with supporting calculation, if not specified) and the same shall be connected to the risers of main ground mat.

7.10.05 For fabricated cable trays, a separate ground conductor (50x6 mm G.S. flat) shall run along the entire length of each route of cable tray being suitably clamped on the cable tray. Individual cable trays of each section shall be connected to above ground conductor through 50x6 mm G.S. flat to maintain continuity of ground path.

7.10.06 All ground conductor connections shall be made by electric arc welding/ brazing unless otherwise specified. Ground connections shall be made from nearest available station ground grid risers. The rods/connection shall be coated with cold galvanizing /weather resistance anti corrosive paints.

7.10.07 All ground conductors shall be painted black for easy identification.

7.10.08 Equipment ground connections, after being checked and tested by the Engineer, shall be coated with anti-corrosive paint.

7.10.09 Whether specifically shown or not in Project drawings, all conduits, trays, cable armour and cable end box, electrical equipment such as motors, switchboards, panels, cabinets, junction boxes, lockout switches, fittings, fixtures, etc. shall be effectively grounded.

7.10.10 If there is no provision to ground the L.T. transformer neutral at transformer end, to make an effectively earthed 415V system the neutral bus of all 415V distribution boards shall be connected to ground grid at two different and distinct points.

7.10.11 Ground Electrode

Ground electrodes are to be fabricated and driven into the ground by the side of mat conductor. All connections to the conductors shall be done by are wilding process.

7.10.12 Risers

Risers are required for connecting the equipment and structures with the ground mat. These will be 1x40 mm dia (minimum) M.S. rod. laid from ground mat to above ground level properly clamped or supported along the outer edge of the concrete foundation. Connection to the ground mat shall be done by arc welding and the other end is to be kept free at least 300 mm above grade level/concrete floor level unless otherwise shown.

7.10.13 Column Grounding

All columns are required to be grounded by 1x40 mm dia (minimum) M.S. rod from ground mat. Laying, supporting along with foundation, connecting at ground mat are within the scope of this specification. At least 300 mm length

of the above rods shall be left free above the grade level/concrete floor level for connection with columns.

7.10.14 Electronic Equipment Grounding

Internal ground connection of electronic panels shall be insulated from the enclosure, frame, chasis and to be terminated to an insulated ground bus.

Insulated ground bus of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar.

All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

Electronic equipment and systems, metal enclosures of all electronic panels shall be connected to a grounding system with which is isolated and separate from the electrical equipment grounding system. Separate Earth pit shall be made by 3M X 3M MS Rod.

7.11.00 Painting

Contractor shall paint steel fabrications at site with two (2) coats of red oxide primer and two (2) coats of battleship grey (shade no. 632 of IS:5) synthetic enamel paint. In case a different kind of primer or a finish shade is mentioned in the Lead/General Specification due to especially corrosive atmosphere, the same shall be followed.

7.12.00 Galvanizing

Galvanizing shall be uniform, clean, smooth, continuous and free from acid spots. Should the galvanizing of the samples be found defective, the entire batch of steel has to be re-galvanized, at Contractor's cost. The amount of zinc deposit shall not be less than 610 grams per square metre of surface area. Additionally, the thickness of the zinc deposit at any spot shall not be less than 75 microns. The Owner reserves the right to measure the thickness of zinc deposit by appropriate instrument and reject any component which shows thickness of zinc at any location less than 75 microns.

7.13.00 Excavation and Back Filling

7.13.01 Contractor shall perform all excavation and backfilling to the original level with good consolidation as required for buried cable and ground connections. Sheeting and shoring shall be done as necessary for protection of the work.

7.13.02 Contractor shall make his own arrangements for pumping out any water that may be accumulated in the excavation.

7.14.00 Steel Fabrication

7.14.01 All racks, trays, supports, hangers & brackets wherever necessary shall be fabricated by the Contractor.

7.14.02 Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edge and burns so as not to cause any damage to personnel or cables.

7.15.00 Cleaning up of Work Site

7.15.01 The Contractor shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage or drive ways.

7.15.02 Upon completion of work, the Contractor shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

8.00.00 TESTS

8.01.00 Shop Tests

8.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works.

8.01.02 Tests on panels/junction boxes shall include:

a) Wiring continuity tests.
b) High voltage and insulation tests.
c) Operational tests.

8.02.00 Site Tests

8.02.01 Contractor shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit.

8.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

8.02.03 All power cables after installation and prior to connections shall be subjected to High Potential tests. Also the insulation resistance values shall be measured both before and after Hipot test for comparison. The leakage current shall also be measured during the Hipot test at site.

Cable cores shall be tested for :
a) Physical damage
b) Continuity
c) Correctness of connections as per relevant wiring diagram
d) Insulation resistance to earth
e) Insulation resistance between conductors

f) Proper earth connections of cable glands, cable boxes, cable armour, screens etc.

8.02.04 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

8.03.00 Test Certificates

8.03.01 Type test certificate on any equipment, if so desired by the Owner, 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 the Bid

9.01.01 Make, type and catalogue number of different electrical items and accessories along with technical leaflets, data sheets etc.

9.01.02 Typical General arrangement drawings showing constructional features, fixing arrangement of pre-fabricated cable trays.

9.01.03 Bill of Materials for cable trays and accessories, conduits & accessories.

9.01.04 Layout of Grounding system & lightning protection system showing connection and other details along with backup design calculations and detailed write up.

9.01.05 Bill of materials for grounding and lightning protection system.

9.01.06 Drawing showing details of equipment grounding.

9.02.00 To be submitted after Award of Contract

9.02.01 Make, type & catalogue number of cable termination kits, joints & accessories.

9.02.02 Detail dimensional drawings showing constructional features, grounding, fixing arrangement etc.

9.02.03 Bill of Materials for Pre-fabricated cable tray and accessories, Conduits & accessories.

9.02.04 Dimensional G.A. drawings and data sheets for different equipment and items supplied under this specification.

9.02.05 Layout drawing of Grounding system and Lightning protection system showing connection details along with backup design calculation and detailed write up.

9.02.06 Bill of material for grounding system and lightning protection system.

9.02.07 Drawing showing details of equipment grounding system.

Annexure-A

DETAILS FOR FIRE-PROOF CABLE PENETRATION SEALING SYSTEM

1.00.00 General

1.01.00 The Fire proof sealing, fire stop system and fire protection coating system are required to prevent spreading of fire from one place to other place (or one zone to other zone) through the openings in wall / floor, cables laid in trays / racks and openings below Electrical Switchgear, MCC, DB,/ Cabinets, Panels etc.

1.02.00 The fire-proof cable penetration (FPCP) sealing system shall conform to the requirement of BS: 476 Part 20 (latest edition with all amendments).

2.00.00 Scope of Work

The scope of work includes but is not limited to the following items of supply and installation:

i) Fire Stops in wall and floors

ii) Fire stops below switchgear, MCC, Switchboards, DBs, junction boxes / panels / cabinets, etc. which are floor mounted type

iii) Fire retardant coating to be applied for installed cables

iv) Fire proof barrier walls

v) Fire proof doors

vi) Minor civil and structural works for installation of the entire work

vii) Necessary erection materials, consumables and sundry items to complete the work for satisfactory and trouble free operation

viii) Any special tools & tackles

ix) Conducting the type test of fire proof sealing system in presence of Owner's Engineers

x) All relevant Drawings, Data sheets and instruction manuals

3.00.00 Design Criteria

3.01.00 Fire Proof Cable Penetration Sealing System

The material / components used for fire-proof sealing (FPCP) system shall be provided to meet the following requirements:

i) The product shall be age tested for not less than 30 years.

ii) Shall be free from shrinkage or cracking; should achieve smoke and gas tightness during fire and should be modifiable.

iii) Not to generate toxic or corrosive gas and cause harm to the personnel handling the system.

iv) Prohibition of production of acid or alkali during gas generation.

v) Shall be repellant to pest / rodent / termite.

vi) Expansion co-efficient - very low which is to be comparable with masonry concrete.

vii) Not soluble / reactive to acid, water, alkali.

viii) Thermal conductivity - low.

ix) The material in contact with the cables in the FPCP sealing system shall be compatible with the material used for outer sheath of cables.

x) It should not have any adverse effect on the cables and should not alter the current carrying capacity of the cables.

xi) Retrofit in design to accommodate not less than 15% more addition of cables depending upon the size of cables, physically and chemically stable.

xii) Capable of withstanding vibrations, drop-loads, foot traffics, mechanical loads, etc.

xiii) The sealing system shall maintain its integrity and perform satisfactorily even after

a. Remaining in water for a long time.

b. Accelerated thermal aging.

c. Sustaining vibrations.

xiv) The design and construction of FPCP sealing system shall specifically take into account the fact that under seismic disturbances, normal load, short circuit and fire conditions, the cable / cable trays will be subject to movement, expansion and oscillation and this shall not result in any damage or cause dislocation of the FPCP sealing system or the material constituting the FPCP sealing System.

xv) Non-hygroscopic, non-inflammable and shall not get affected over a period of time due to humidity, moisture and ozone etc. and should not

contain volatile solvents which may cause a fire hazard during application.

xvi) The fire sealing system to be installed at floor openings below C&I panels, control panels/boards etc. in Central Electrical Room, Central Control Room, Central Electronic Room shall have a fire rating of not less than two (2) hours. The fire sealing system to be installed at all other places like the rest of the wall and floor crossings of cables/cable trays, openings below Switchgears/Boards etc. shall have a fire rating of one (1) hour. The system shall be stable after application of water jet in the exposed side in order to extinguish fire.

3.02.00 Fire Protection coating to be applied on installed cables:

A. The cables shall be coated with fire protection material of 2 mm dry thickness at the strategic locations as follows so as to limit the spread of fire:

i) At fire stops in walls and floors on either side upto 500 mm length.

ii) At fire stop below Electrical Switchgears/ MCCs/ Panels/ Cabins, etc. on one side coating of 500 mm length, i.e., on the cable vault side / cable trench side.

iii) Length of 500 mm on all sides of the junction/crossing of cabling work in open cable routes/ cable trench.

iv) In fire risk areas and where specified at suitable intervals as decided upon side conditions in open cable routes.

v) Where necessary and specified at site intervals along cable routes in cable trenches.

vi) The coating shall be applied evenly on the cables only.

B. The fire protection coating shall have the following properties/composition:

i) Asbestos-free, non-volatile, not eatable by vermin, harmless and non-irritant to human skin.

ii) Not affecting the current carrying capacity of the cables and the properties of the installed cables.

iii) It shall delay fire damage to cables and prevent flame spreading meeting the requirement of IEC - 332.

iv) Coating material shall show no signs of cracking and peeling when the coated cable is bent to the radius of minimum 12 times the diameter of the maximum size cable at 180°C.

v) The limiting oxygen index of the material shall not be less than 60% as per ASTMD - 2863.

vi) Life expectancy equivalent to the cable installations.

3.03.00 The various openings in the cable vault, vertical, horizontal raceways of cables penetrating walls, floors and the bottom of Electrical switchgears, MCCs, distribution boards, Cabinets, Panels shall be provided with fire stop systems. Cables passing through the openings at various locations are laid on various tiers of the cable trays/ racks in the bunch formation. Bidder shall visit the site to assess and get acquainted with the type of cable installation where fire stops and fire protection coating are to be provided. In case steel frames are required to be fabricated and fixed in the openings, the fabrication of frame & fixing of the same shall have to be done by the Contractor without any extra cost. The necessary steel section for fabrication of frames shall be supplied by the Contractor without any extra cost. Any civil works required to be done in the openings shall be carried out by the Bidder. Bidder shall also include one set of tools & accessories required for addition or removal of cables after the seal is made.

3.04.00 The bidder shall quote the unit rates for provision of supply, installation, testing & commissioning of the fire proof seals as given in the specification. Bidder is requested to quote the unit rates per square metre (i.e., area) basis of the area of the fire sealing material.

4.00.00 Type Test on Penetration Seals

4.01.00 The type tests for fire proof/ penetration seal for floor and wall opening/ fire stop system for bottom of electrical switchgear/ MCC/ panel base are as under:

i) Fire rating test

ii) Hose Stream test

iii) Accelerated aging test

iv) Fire rating test on the penetration seal system built out of accelerated aged components followed by hose stream test

v) Temp. rise test for cable in the fire stop

vi) Water absorption test followed by fire rating test

vii) Flame Resistance test for fire retardant coating material

viii) Anti-rodent test

4.02.00 Fire Rating Test

This test shall be carried out to prove the guaranteed power rating duration of the system in respect of stability, integrity and insulation characteristics of the complete system. The penetration seal system as a whole conforming to ASTM 814 and as per BS:476 Part-8 shall be built with the necessary component. The fire test shall be built with the necessary component.

The test specimen of the penetration seal built with 9-10 nos. armoured cables of various sizes passing through the seal shall be fitted to the gas fired furnace and shall form the upper most face of the furnace. The gas fired furnace shall have provision to achieve standard time temperature characteristics for fire tests as mentioned in BS-476 Part-8, according to which the temperature required to be maintained are as under:

Heating time (minute)	30	90	120	150	180	210	240
Furnace temp (°C)	821	886	1029	1062	1090	1113	1133

The pressure inside the furnace at the time of test shall be more than 2 mm water gauge. The penetration shall be subjected to fire test with surface exposed to controlled fire in the furnace conforming to time / temperature characteristics as mentioned above. During the test, temperatures of both the faces of the penetration seal i.e. one which is exposed to fire and the other unexposed, shall be measured by calibrated thermocouples after regular interval of 5 minutes. At least 3 thermocouples shall be provided for temperature measurement of each face.

4.03.00 The results at the end of the tests shall be interpreted or failure criteria as under:

i) The system is deemed to have failed to maintain stability if there is a total collapse of the penetration seal.

ii) In case cracks are seen on the face of the penetration seal or cracks through the seal system through which the flame / or gas can pass, the system is deemed to have failed to maintain integrity. The development of crack is characterized by ignition cotton wool held near the seal on the unexposed surface at a distance of about 30 mm from the aperture.

iii) In case the mean temperature rise of unexposed surface of seal exceeds 140°C above the initial temperature or temperature of unexposed surface exceeds 180°C, the system shall deemed to have failed in respect of insulation characteristics.

iv) Temperature measurement on the unexposed side of the penetration seal specimen shall be measured by the thermocouple on the surface of penetrating items and on fire stop material in accordance with ATME-814/UL 1479 at a distance of 25 mm from fire stop material and penetration items respectively.

4.04.00 Hose Stream Test:

The intention of the hose stream test is to ascertain whether the penetration seal assembly maintains its stability on application of water jet after withstanding the fire for 3 hours i.e. the guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for carrying out the fire rating test. The penetration seal system shall be subjected to the action of hose stream at the nozzle pressure of 30 psi supplied for a duration of 1.5 sec./ sq.ft.. of exposed area. The hose stream shall be applied with 1.1/ 8" dia. nozzle at a perpendicular distance of approximately 17 ft. from the centre of the assembly on a line approximately 270 deg. from the line normal to the centre for the test assembly. The water stream shall be applied within 4 minutes and 30 seconds after completion of fire rating test.

However, this period shall not exceed more than 10 minutes in case of practical difficulties experienced by testing stations. The application of water stream shall be maintained throughout the test duration and shall traverse the complete fire stop system.

The fire stop assembly is deemed to have passed the hose stream test successfully if no through projection of water is noticed on the unexposed surface of the seal. Further on completion of hose stream test, the appearance of the penetration seal system shall not alter substantially indicating thereby that the stability of the system has been maintained.

4.05.00 Accelerated aging test

The intention of accelerated aging test is to ascertain whether the artificial aging of the systems and components thereof results into change in the mechanical properties or in the form. In order to simulate aging, artificial aging shall be resorted to.

For the purpose of subjecting the penetrations seal system components to accelerated aging, the system / components shall be stored for 336 hours in air furnace where the temperature of the inside air, shall be maintained at 100° C. However, for system components in pliable form, system component shall be stored for 448 hours in air furnace where temp. of air inside the furnace shall be maintained at 75° C. It is assumed that the changes occurring during test period would roughly correspond to the effect on aging over a period of about 40 years.

After completion of 336 hours / 448 hours, the mechanical properties such as tensile strength element, elongation and hardness of the material (as may be applicable) shall be tested. These results shall be compared with corresponding values before subjecting to accelerated aging test.

The change in the form of system / components shall also be compared with the form before the tests to ascertain whether the system / components thereof have undergone any permanent change.

In case the mechanical properties before and after the accelerated aging do not indicate substantial change, the system shall be deemed to have passed the accelerated aging test. Similarly the variation in the form of the system components at the end of the test shall not indicate permanent deformation which is likely to affect the ceiling properties of the system.

4.06.00 Fire Rating test After Accelerated Aging:

Intention to this test is to ascertain whether the penetration seal built out of components already subjected to accelerated aging still passes the fire rating test for guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for fire rating test mentioned above. The assembly or the penetration seal shall be carried out with the components which were subjected to accelerated aging test based on the test procedure mentioned above. In case there is a problem of co-ordination with the test station, the prototype assembly may be subjected to aging in manufacturer's works under the conditions mentioned above and live fire test should be carried out at manufacturer's works in presence of Owner's representative.

In live fire test, the temperature of fire shall be of the order of 1000° C at the end of 3 hours. The test shall be carried out at atmospheric pressure.

The interpretation of test results for failure shall be similar to those mentioned under fire rating test/live fire test above.

4.07.00 Temperature rise test for cable in the fire stop:

This test shall be carried out to ascertain whether due to inadequate dissipation of heat at the location of fire stop, the temperature of cable conductor or outer sheath in contact with the fire stop, rises beyond the acceptable limits due to which whether any derating is required for cables.

Fire stop systems shall be erected with, at least 8-10 armoured cables, specially power cables. While laying the cable through penetration seal, thermocouple shall be placed on the outer surface of cable in contact with the fire stop system. The location shall be selected where there exists possibility of inadequate dissipation of heat from cables to the atmosphere due to fire stop components. Two thermocouples shall also be located on the two surfaces of the fire penetration seal system. Similarly thermocouples shall also be placed on the other surface of cables where there exists contact of free air without any obstruction so as to enable adequate nature cooling.

In case the temperature of outer surface of the cable in contact or inside the fire stop system does not exceed 75° C, it is inferred that no derating of cable is required for cable when used in conjunction with the particular fire stop system.

Test shall be repeated with reduced current till the temperature of cable outer surface in contact with fire stop system is limited to 75°C. The rate of the current so guaranteed by the cable manufacturer as free air rating shall be the derating factor.

4.08.00 Water Absorption Test:

The test specimen shall be immersed in fresh clean water at a temp. of 20°C. The test specimen must be separated from the bottom and sides of the soak tank by at least 10 mm and it shall be covered by approximately 25 mm of water. At the end of the 24 hours soak period, the specimen shall be removed from the water and moped up with a damp cloth.

Fire rating test after water absorption is to ascertain whether the penetration seal subjected to water absorption still passes the fire rating test for guaranteed fire rating duration.

Test apparatus for this test shall be similar to the one used for fire rating test. In case there is problem of coordination with test stations, the prototype assembly may be subject to water absorption test at manufacturer's works followed by live fire test which should be carried out at manufacturer's works in presence of Owner's representative. In line fire test, the temperature of furnace shall be of the order of 1000°C at the end of 3 hours. The test shall be carried out at atmospheric pressure.

4.09.00 Flame Resistance Test for fire Retardant Coating Material:

Sample strips shall be of ½ " wide, 12" long and approximately 70 mills in thick (without any reinforcement). Each strip shall be held vertically (clamped at the top) in a natural gas burner flame, (blue cone of flame touching bottom edge of sample) for 10 minutes. The flame shall then be removed and observation shall be recorded. In case, any flaming of the samples should cease after the removal of gas burner. White charred length of the sample should not exceed 1 & ½".

4.10.00 Anti-Rodent Test:

Physical tests:

a) This test shall be carried out to ascertain the anti-rodent properties of the components of the Fire proof sealing system.

b) This test shall be carried out at approved test station performing sealing system tests on pharmaceutical products. The complete Fire Proof sealing system shall be subjected to attack of inspect / vermin such as rate for about 20 days.

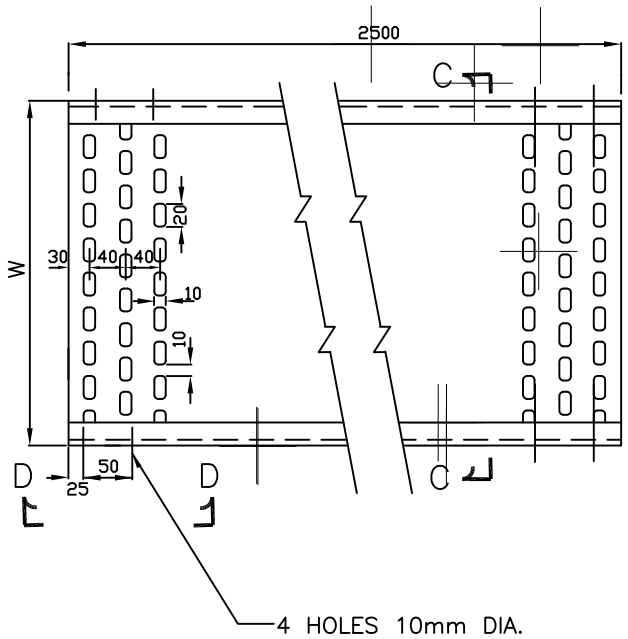
c) At the end of the test condition of the surface of Fire Proof sealing system the test material shall be compared with the surface condition before commencement of the test. The fire stop shall be deemed to have passed this test in case no marks of growth are seen on the surface.

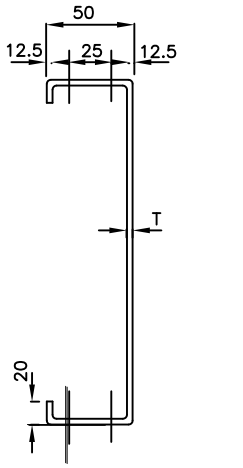
5.00.00 Test Certificates

5.01.00 Certified copies of all tests carried out at works and at site shall be furnished in requisite number of copies.

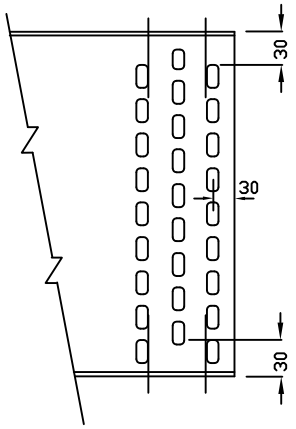
5.02.00 Test reports shall be complete with all details and shall also contain limit valves specified in the relevant standards, wherever applicable, to facilitate review of Test Report/ Certificates.

5.03.00 The fire proof sealing system shall be installed only after receipt of approval of the test reports.

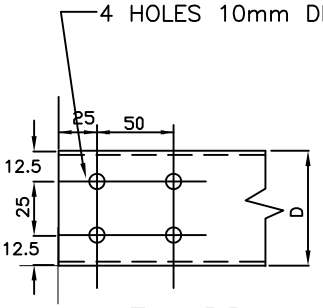




SECTION–CC
(100/50 TRAYS)



ARRANGEMENT OF
PERFORATIONS



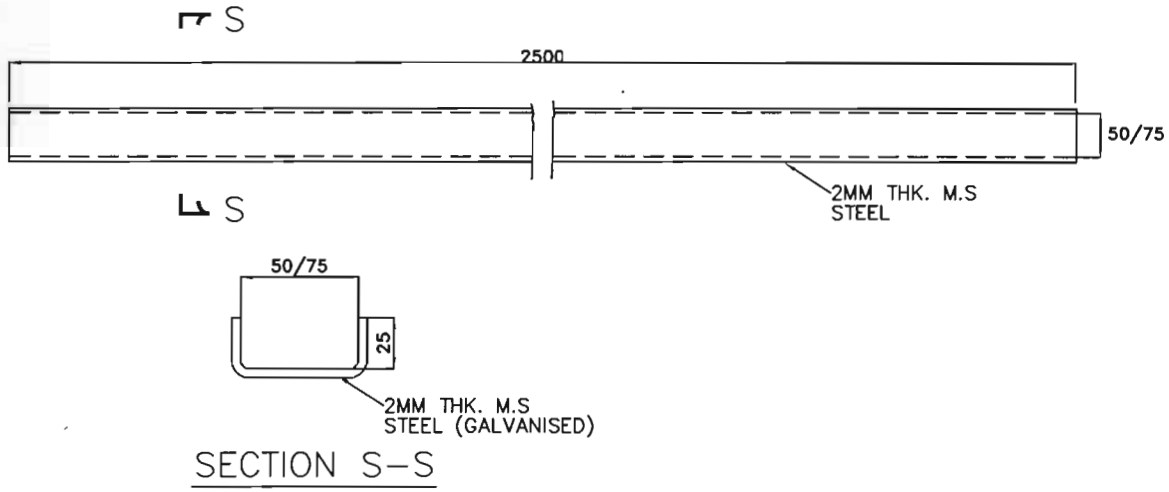
VIEW–DD
(100,50W TRAYS)

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

PERFORATED TYPE TRAY

BHEL	TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	

277014/2024/PS-PEM-WSF



SECTION S–S

CABLE TROUGHS

TYPICAL DETAILS OF
CABLE TRAY AND ACCESSORIES

SECTION- IIC

GENERAL TECHNICAL REQUIREMENTS (C&I)

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR LP CHEMICAL DOSING SYSTEM	

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0. The quantity of instruments for auxiliary system shall be as per tender P &ID, wherever provided, for the respective system as a minimum for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe &reliable operation of plant, bidder shall supply the same without any price and delivery implication to BHEL.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg / Cm2. The contacts of equipment mounted instruments; sensors, switches etc. for external connection including spare contacts shall be wired out to suitably located junction boxes.

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

2.09.00 Chemical Dosing System

2.09.01 The dosing pumps start/ stop control shall be from plant DCS except for storage, transfer and preparation of solution. ON/OFF command facility from DCS for individual pump shall be envisaged.

2.09.02 Each dosing pump shall be provided with diaphragm seal, snubber, glycerin filled type pressure gauge of proper range on discharge piping with isolation

valves, fittings etc. Each solution tank shall be provided with magnetic type level gauge with colour changing flapper and graduated scale. Except for very proprietary nature application no Level switch shall be used in the system. level transmitters shall be provided for deriving switching function in DCS for low-level alarm and interlock. The chemical feed system shall be operated and adjusted from the local panel and as well as from the station DCS in Unit Control Room.

2.09.03 For each system Local Control Panel (LCP) comprising of 'START' push button and 'EMERGENCY STOP' push button along with 'ON/OFF' indication shall also be provided for local operation. The auto stroke controllers of each pump shall be provided in the local panel. Dosing rate shall be controlled from DCS through 4-20 mA signals for stroke adjustment of the positive displacement pumps or any other means of dozing rate adjustment which will be based on the SWAS measurements in feed water when selected for AUTO operation. In addition to remote AUTO stroke adjustment, provision shall be kept for local as well as remote adjustment in Manual mode. Required final control element with accessories shall be provided for this purpose. Use of resistance type feedback mechanism for position indication shall be avoided. The ON/OFF operation facility for motorized stirrer shall also be provided from DCS & LCP.

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2.09.04 Following DO (digital Output) & AO(Analog Output) signals shall be wired between DCS & LCP.

1. START–PB commands for all drives (pumps & agitator)
2. Process conditions
3. Pump & stirrer (ON/OFF/DISTURBANCE)
4. Pump stroke length demand signal (4-20 mA)

2.09.05 Following DI(digital Input) & AI(Analog Input) signals shall be wired between DCS & LCP.

1. All field signals
2. Operation local selected
3. Operation remote selected
4. Pump & stirrer (ON/OFF/DISTURBANCE)
5. Pump stroke length feedback signal (4-20 mA)

2.09.06 All the field instruments i.e. level transmitter, pressure transmitter etc. & stroke actuator shall be interfaced with DCS through LCP.

2.09.07 Necessary & suitable instrumentation as required to achieve the operation philosophy as indicated in Volume IIB/Section -IV of this specification and as illustrated here-in & in relevant tender flow diagram shall be provided as minimum requirement.

2.05.00 **Electrical Work**

Bidder need to note that 2 nos. (1+1) supply feeders of 415V, 3 phase, 3 wire AC system shall be provided for each skid. Complete skid including changeover between feeders \starters \LCP \interlocks \protection devices \any other supply etc. shall be in bidder's scope only. Skid complete with internal cabling and earthing need to be supplied by Bidder. Supply and erection of electrical items (power/control cables, cabling materials, local push button station & earthing) external to skid shall also be included. Any other equipment /materials required for completeness of all electrical work (though not mentioned specifically) is in bidder's scope.

i) Necessary electric motors for all motor driven equipment along with couplings, reduction gears and all other accessories as required for the complete Chemical Feed Systems.

ii) Local Emergency Stop Push Button Stations with for unidirectional & bi-directional motors as specified for the complete Chemical Feed Systems.

iii) Control Panels each with all accessories as follows:

   a) START – STOP Push Buttons, ON-OFF Indicating Lamps along with other devices / accessories specified elsewhere in this document. Auto-Manual selector switches (as determined by operational requirement) for all drives/equipment of Chemical Feed Systems shall be provided in the control panel.

   b) For all motors of rating 30 KW and above ammeter shall be provided in the Control Panel.

   c) Trip alarm annunciation for all motors shall be provided in the Control Panel.

iv) Special cables, if any.

v) Grounding of skid mounting equipment and skid grounding.

vi) All structures, steel attachments embedded components etc. as required for complete electrical work.

2.06.00 **Instrumentation and Control**

i. The dosing pumps start/ stop control shall be from plant DCS except for storage, transfer and preparation of solution. ON/OFF command facility from DCS for individual pump shall be envisaged.

ii. For each system Local Control Panel (LCP) comprising of 'START' push button and 'EMERGENCY STOP' push button along with 'ON/OFF' indication shall also be provided for local operation. The auto stroke controllers of each pump shall be provided in the local panel. The stroke position & adjustment will be done from DCS as well as LCP and the stroke controller shall be suitable for accepting 4-20 mA DC signals. The pumps shall be provided with Position feedback transmitter with 4-20 mA DC indication of stroke position in DCS & LCP. The ON/OFF operation facility for motorized stirrer shall be provided from LCP also.

iii. Following signals shall be wired from DCS to LCP.

1. Operation local selected
2. Operation remote selected
3. Pump & stirrer (ON/OFF/DISTURBANCE)
4. Process conditions (as per clause 5 above)
5. Pump stroke length demand signal (4-20 mA)

iv. Following signals shall be wired from LCP to DCS.

- All field signals
- START–PB commands for all drives (pumps & agitator)
- Pump stroke length feedback signal (4-20 mA)

v. All the field instruments i.e. level transmitter, pressure transmitter etc. & stroke actuator shall be interfaced with DCS through LCP.

For details on C&I Specification refer Vol II-E

6.00.00 **PLANT OPERATION AND CONTROL**

6.01.00 For each of Chemical Feed Systems, operation and control philosophies are envisaged as follows:

a) It is intended to control chemical dosing system from DDCMIS, including ON/ OFF command of individual dosing pumps & agitator motors, stroke/ feed rate adjustment.

b) However, Bidder shall provide local pre-wired control panel complete with the following:

i) Start / Stop push buttons for pumps and agitator motors

ii) Indicating lamps

iii) Local controller with local / remote selection, stroke position indicator and rise/ lower push buttons for stroke position variation. Local controller shall be hooked up with DDCMIS for remote manual and automatic control of the dosing system.

iv) Local annunciation

6.02.00 The starter of each motor shall be with main plant MCC.

6.03.00 Bidder shall supply all necessary instrumentation and control for satisfactory operation of the chemical dosing system. Each dosing pump shall be provided with diaphragm seal & glycerin filled type pressure gauge of proper range on discharge piping with isolation valves, fittings etc. Each solution tank shall be provided with magnetic type level gauge with colour changing flapper and graduated scale. Level gauge shall have level transmitter with 4-20 mA DC output for remote monitoring of data. Level switch shall be provided for low level alarm and interlock. Non-contact type position feedback mechanism shall be provided in the drive actuator for position indication and control.

6.04.00 The control philosophies for low-pressure Hydrazine Dosing Pumps are as follows:

Following inter-locks shall be provided:

i) At low level in the tank:

a) Dosing pump shall be tripped.

b) Agitator shall be tripped.

ii) A group alarm shall be provided in the DDCMIS (in the Main Control Room) for the following conditions :

a) Low level in the tank.

b) Pump & Agitator trip due to low level in the tank.

c) Pump trip due to over load.

iii) Starting & stopping of dosing pumps is envisaged through DDCMIS &Local Control Panel (LCP).

Dosing rate is adjusted from LCP / remote DDCMIS through 4-20 mA signal in addition to local manual adjustment provisions for stroke adjustment of the positive displacement dosing pumps based on the measurement of dissolved oxygen at Deaerator outlet when selected for remote operation.

Following annunciations shall be provided in local control panel:

a) High level in tank.

b) Low level in tank.

c) Dosing pump motor tripped.

d) Stirrer motor tripped.

LCP shall be located on the dosing skid. Local emergency stop shall be provided on the LCP as well.

6.05.00 The control philosophies of low-pressure Ammonia Dosing Pumps are as follows:

Following inter-locks shall be provided:

i) At low level in the tank:

a) Dosing pump shall be tripped.

b) Agitator shall be tripped.

ii) A group alarm shall be provided in the DDCMIS (located in Main Control Room) for the following conditions:

a) Low level in the tank.

b) Pump & Agitator trip due to low level in the tank.

c) Pump trip due to over load.

iii) Starting & stopping of dosing pumps is envisaged through DDCMIS & local control panel (LCP).

Dosing rate is adjusted from LCP / remote DDCMIS through 4-20 mA signal in addition to local manual adjustment provisions for stroke adjustment of the positive displacement dosing pumps based on the measurement of pH of feed water when selected for remote operation.

Following annunciations shall be provided in local control panel:

a) High level in tank.

b) Low level in tank.

c) Dosing pump motor tripped.

d) Stirrer motor tripped.

LCP shall be located on the dosing skid. Local emergency stop shall be provided on the LCP as well.

6.06.00 Sodium Hydroxide Solution shall be dosed by gravity.

Following inter-locks shall be provided:

i) At low level in the tank:

a) Agitator shall be tripped.

ii) A group alarm shall be provided in the DDCMIS (located in Main Control Room) for the following conditions:

a) Low level in tank

b) Agitator trip due to low level in the tank.

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR LP CHEMICAL DOSING SYSTEM	

SPECIFICATION FOR
MOTORISED VALVE ACTUATOR

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	DOCUMENT NO.: PE-ID-445-145-I902	
		VOLUME II B	
		SECTION D	
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		SHEET 1 OF 5	

Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL*	* PROJECT	1 X 660 MW SAGARDIGHI STPP		
	OFFER REFERENCE			
	* TAG NO SERVICE			
	* DUTY	☐ ON / OFF ☐ INCHING		
	* LINE SIZE (inlet/outlet) MATERIAL			
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG GLOBE ☐ BUTTERFLY		
	* OPENING / CLOSING TIME			
	* WORKING PRESSURE			
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP OF -20 to70 DEG O AND RELATIVE HUMIDITY OF 0-95%IN HOT HUMID AND TROPICAL ATMOSPHERE AND HIGHLY POLLUTED AT PLACES OF COAL DUST AND FLY DUST		
	VALVE SEAT TEST PRESS	BIDDER TO SPEOIFY		
	REQUIRED VALVE TORQUE	BIDDER TQ SPECIFY		
	AOTUATOR RATED TORQUE	BIDDER TO SPEOIFY		
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED WEATHER PROOF DUST TIGHT SUITABLE FOR OUTDOOR USE WITHOUT CANOPY NEMA6/IP 68		
	MEOHANIOAL POSITION INDIOATOR	TO BE PROVIDED FOR 0-100% TRAVEL		
	BEARINGS	DOUBLE SHIELDED GREASE LUBRIOATED ANTI-FRICTION		
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS) SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED		
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE FOR ISOLATING SERVIOE THREE SUCCESSIVE OPEN-OLOSE OPERATIONS OR 15 MINS WHIOHEVER IS HIGHER **FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM as per IEC60034-1**		
HANDWHEEL as per standard EN 12570:2000	* REQUIRED	■ YES ☐ NO		
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED		
	*TO DISENGAGE AUTOMATIOALLY DURING MOTOR OPERATION.			
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPEOIFY		
	MOTOR MAKE / MODEL / TYPE / RATING (KW) (REFER NOTE NO 6 & 7)	BIDDER TO SPEOIFY		
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- NCLUSIVE OF **I.S.** TOLERANCE		
	ACTUATOR APPLICABLE WIRING DIAGRAM	■ ENCLOSED (BIDDER TO CONFIRM) A ■ DRG NO 3-V-MISC-24227 R00 B ☐ DRG NO 3-V-MISC-24550 R00 C ☐ DRG NO 3-V-MISC-24283 R00 D, ☐ DRG NO 4-V-MISC-90271 R11 E ☐ For Thyristor based Integral starter Bidder/Vendor to furnish wiring diagram		
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐ ■TO BE DECIDED DURING DETAILED ENGINEERING		
	PAINT TYPE	☐ ENAMEL ■ EPOXY CONFIRMING TO CORROSION CATEGORY C5-I		
	SHAFT RPM	BIDDER TO SPEOIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		

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Data Sheet A & B

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	
	@ PWR SUPP TO MTR / STARTER	415V 3PH AC	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V	
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 67 ■ P 68 ☐ FLAME PROOF	
	@MOTOR BEARING WITH 2 EARTH TERMINALS	DOUBLE SHIELDED GREASE LUBRICATED ANTI FRICTION	
	@ INSULATION CLASS	CLASS-F TEMP RISE LIMITED TO CLASS-B	
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos ,1 IN EACH PHASE)	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED (THERMISTOR PTC)	
INTEGRAL STARTER	INTEGRAL STARTER	■REQUIRED ☐ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	■ CONTACTORS ☐ THYRISTORS	
	TYPE	■ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)	
	IF SMART (REFER BELOW POINT a – h)		
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐.....	
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC	
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED	
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐.....	
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP	
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED	
	STEP DOWN CONT TRANSFORMER	■ REQUIRED	
	OPEN / CLOSE PB	■REQUIRED ☐ NOT REQUIRED	
	STOP PB	■ REQUIRED ☐ NOT REQUIRED	
	NDICATING LAMPS	■ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S	■REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	■REQUIRED ☐ NOT REQUIRED	
	NTEGRAL STARTER DISTURBED SIGNAL(Refer Note 14)	REQUIRED MOTOR THERMOSTSTTRIP O/L RELAY OPTD, CONT /POWER SUPPLY FAILED, S/S IN LOCAL/REMOTE/OFF MODE TORQUE SWITCH OPEN/CLOSE CUT OFF/STOP PB OPTD, VALVE JAMMED ETC)	
	ACTION ON LOSS OF EXTERNAL ELECTRIC POWER	■STAYPUT ■ FAIL SAFE TO BE DECIDED DURING DETAILED ENGINEERING	
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter) **DATASHEET & WIRING DIAGRAM OF ISOLATION DEVICE TO BE PROVIDED**	TYPE OF ISOLATING DEVICE	■ INTERPOSING RELAY ☐ OPTO COUPLER TO BE DECIDED DURING DETAILED ENGINEERING	
	QUANTITY	☐ 2 NOs ■ 3 NOs	
	DRIVING VOLTAGE	■ 20.5 – 24V DC ☐ _____V DC	
	DRIVING CURRENT	■ 125mA MAX ☐ _____mA MAX	
	LOAD RESISTANCE	■ > 192 ohms - <25 k ohms ☐ > _____ohms - < _____ohms	

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Data Sheet A & B

	DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
TORQUE SWITCH (Not Applicable for Smart Actuator) **(SS Refer Notes)**	MFR & MODEL NO	BIDDER TO SPECIFY	
	OPEN / CLOSE	■1 No ❑2Nos / ■1 No ☐2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0 5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
LIMIT SWITCH (Not Applicable for Smart Actuator) **(SS Refer Notes)**	MFR & MODEL NO	BIDDER TO SPECIFY	
	OPEN INT CLOSE	☐1 No ■2 Nos / 2 Nos (ADJ) / ❑1 No ■2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0 5A 220V DC	
	ACCURACY	2% OF SET VALUE	
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications**)	■ REQUIRED ❑ NOT REQUIRED	
	MFR & MODEL NO	BIDDER TO SPECIFY	
	TYPE	❑ ELECTRQNIC (2 WIRE) R/I CONVERTER ■ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	■ 24V DC ☐	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC 1 PH ,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T B	@ ■ IP 68 @☐	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET	❑ REQUIRED ■ NOT REQUIRED	
	NO OF PINS REQUIRED(TO BE CHECKED AS PER SIGNALS IN DRIVE CONTROL PHILOSOPHY)		
	NOS OF PLUG & SOCKET	☐ 1 Nos for ON/OFF ☐ 2 NOS (for inching duty) ❑ OTHER (TO BE SPECIFIED INLINE WITH DRIVE CONTROL PHILOSOPHY)	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE ----------	
	@ SPACE HEATER CABLE GLAND	SIZE ----------	
	CONTROL CABLE GLANDS-1	CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 1P X 1.5 SQMM	
	CONTROL CABLE GLANDS-2	CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 8P X 0.5 SQMM	
	CONTROL CABLE GLANDS-3 (Additional for inching duty)	CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 2P X 0.5 SQMM	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg

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Data Sheet A & B

DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

NOTES

1. **SCOPE** DESIGN MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY

2. **CODES & STANDARDS** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH
IS-9334, IS-2147 IS-2148, IS-325, IS-2959 IS-4691 IS-4722 IEC 60947-5-1 AND EN 15714-3 2010 OR LATEST VERSION

3 TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG C FOR AMBIENT TEMPERATURE OF 50 DEG C

4 CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED

5 THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE

6 THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING

7. THE MOTOR SHALL BE CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE 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

8. N ADDITION TO ABOVE REQUIREMENTS FOR LIMIT/TORQUE SWITCH, **MECHANICAL END STOP** WITH ACCURACY OF 2% SHALL BE SUPPLIED

9 IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR

10 LOCAL POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL

11 CONTROL WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ MM

12 ENDURANCE RATED TORQUE RANGE SHOULD BE BASED ON ISO 5211 ISO5210

13 TAG PLATE SHALL BE CONFIRMING TO STANDARD BS-15714

14 THE ACTUATORS SHALL BE DESIGNED TO BE SELF-LOCKING UPON LOSS OF POWER MOTOR SHALL BE DESIGNED TO CLOSE IN 30 SECS FROM FULL OPEN POSITION AND SHALL HAVE ADEQUATE CAPACITY TO OPEN AND CLOSE UNDER FULL UNBALANCED DESIGN PRESSURE

15 AUTOMATIC PHASE CORRECTION FACILITY AND POTENTIAL FREE CONTACT FOR ANNUNCIATION OF POWER FAILURE SHALL BE PROVIDED

16 LIMIT SWITCHES SHALL BE SILVER PLATED WITH HIGH CONDUCTIVITY AND NON-CORROSIVE TYPE CONTACT RATING SHALL BE SUFFICIENT TO MEET THE REQUIREMENT OF CONTROL SYSTEM SUBJECT TO A MINIMUM OF 60 V, 6 VA RATING PROTECTION CLASS SHALL BE IP67

17 THE TERMINAL BOX SHALL BE WEATHER PROOF WITH REMOVABLE FRONT COVER & CABLE GLANDS FOR CABLE CONNECTION IT SHALL BE SUITABLE FOR 2.5 SQ MM COPPER CONDUCTOR

18 ACTUATOR SHALL ATTAIN FULL SPEED OPERATIONS BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT)

19. ** **VALVES WITH 10 DEGREE/20DEGREE FEEDBACK REQUIREMENT FOR APPLICATIONS SUCH AS CW/ACW/PLANT WATER SYSTEM SHALL BE CONSIDERED AS INCHING DUTY VALVES. ACCORDINGLY, POSITION FEED BACK TRANSMITTER, PLUG & SOCKET REQUIREMENT SHALL BE CONSIDERED.**

$$ **TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.**

	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME	ANJALI RAMAN	VIPUL KUMAR VERMA	SURESH CHAND SHARMA	NAME
SIGNATURE				SIGNATURE
DATE	27 03 2020	27 03 2020	27 03 2020	DATE

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY) @ BE FILLED BY ES

277014/2024/PS-PEM-WSE

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Data Sheet A & B

DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

ADDITONAL NOTES FOR SAGARDIGHI PROJECT:

- TEST WITNESS: TESTS SHALL BE PERFORMED IN THE PRESENCE OF OWNER/PURCHASER'S REPRESENTATIVE SO DESIRED BY THE OWNER/ PURCHASER. THE CONTRACTOR SHALL GIVE AT LEAST FIFTEEN (15) DAYS ADVANCE NOTICE OF THE DATE WHEN THE TESTS ARE TO BE CARRIED OUT.

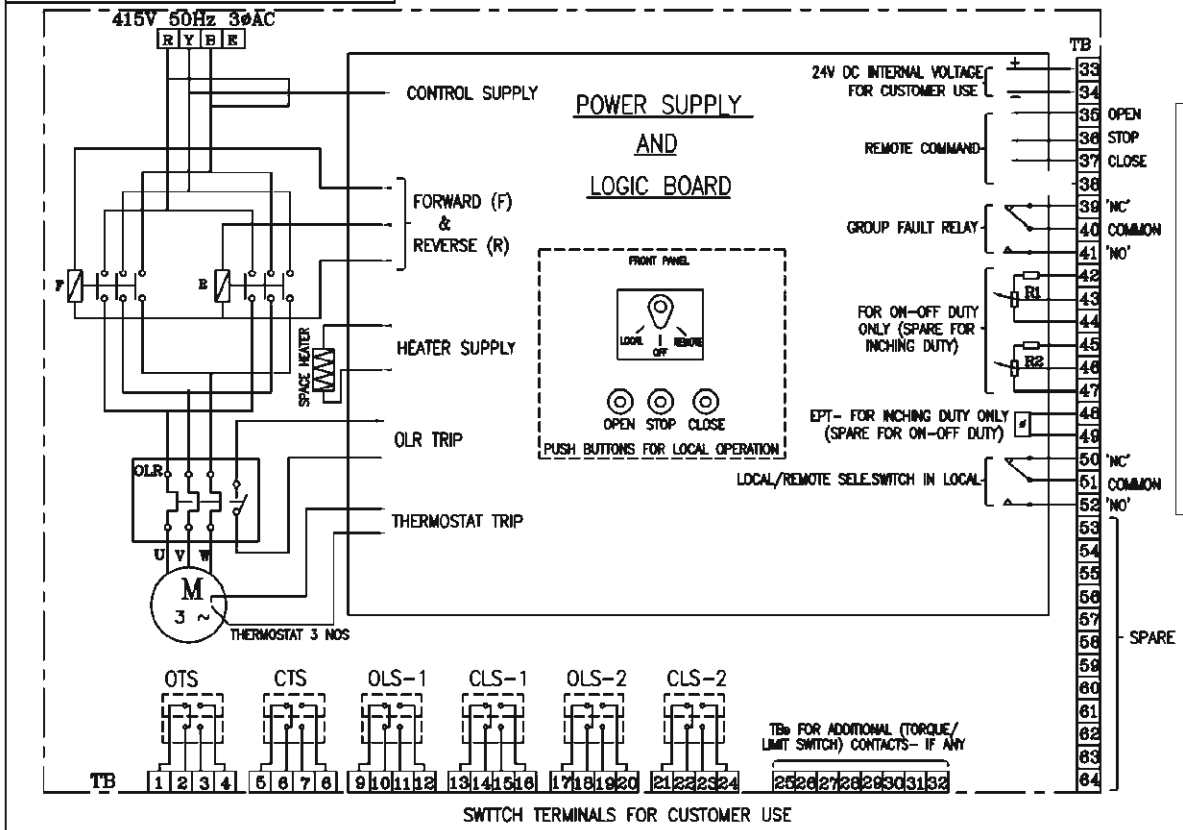
- ADVANCE NOTICE SHALL BE GIVEN TO THE OWNER AS AGREED IN THE CONTRACT, PRIOR TO THE STAGE OF MANUFACTURE BEING REACHED, AND THE PIECE OF PLANT MUST BE HELD AT THIS STAGE UNTIL THE OWNER HAS INSPECTED THE PIECE, OR HAS ADVISED IN WRITING THAT INSPECTION IS WAIVED, IF HAVING CONSULTED THE OWNER AND GIVEN REASONABLE NOTICE IN WRITING OF THE DATE ON WHICH THE PIECE OF PLANT WILL BE AVAILABLE FOR INSPECTION, THE OWNER DOES NOT ATTEND, THE SUCCESSFUL BIDDER MAY PROCEED WITH MANUFACTURE HAVING FORWARDED TO THE OWNER DULY CERTIFIED COPIES OF HIS OWN INSPECTION AND TEST RESULTS.

- ACTUATOR SHALL ATTAIN FULL SPEED OPERATIONS BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT)

- A SPACE HEATER SHALL BE INCLUDED IN THE LIMIT SWITCH COMPARTMENT SUITABLE FOR 240V, 1 PHASE, 50 HZ SUPPLY.

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.

DRAWING NO. 3-V-MISC-24227



SWITCH TERMINALS FOR CUSTOMER USE

Separate wire (no common wire) to be used for signal exchange between DCS and actuator. Additionally, separate TBs are to be used at actuator end. Please refer attached dwg 12A05-DWG-I0021 for the same.

CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	

SWITCH: TERMINAL NO. | FULL OPEN | a | INTERMEDIATE | b | FULL CLOSE

VALVE POSITION

——— INDICATES CONTACT CLOSED

- - - - - - INDICATES CONTACT OPEN

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	♯

♯ – CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

* – BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

NOTE:-

1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE. ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
2. CTS – TORQUE SWITCHES FOR CW ROTATION (CLOSE)
3. OTS – TORQUE SWITCHES FOR CCW ROTATION (OPEN)
4. OLS-1, OLS-2 – LIMITSWITCHES FOR POSITION OPEN
5. CLS-1, CLS-2 – LIMITSWITCHES FOR POSITION CLOSE
6. EPT – ELECTRONIC POSITION TRAMSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
7. R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M – MOTOR 3ø 415V 50 Hz AC SUPPLY

REV	DATE	ALTERED
		CHD & APPD

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

BHARAT HEAVY ELECTRICALS LTD., UNIT: HIGH PRESSURE BOILER PLANT. TIRUCHIRAPALLI-620014. 365-121

	NAME	SIGN	DATE	NO.OF VAR
DRN	N.P.ESWAR	N.P	07.10.04	
CHD	D.DINAKARAN	D.D	07.10.04	
APPD	K.ARUNACHALAM	K.A	07.10.04	

DEPT VL | CODE | SCALE | WEIGHT (KG). | REFERENCE INFORMATIONS | NO. OF SHEETS

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER

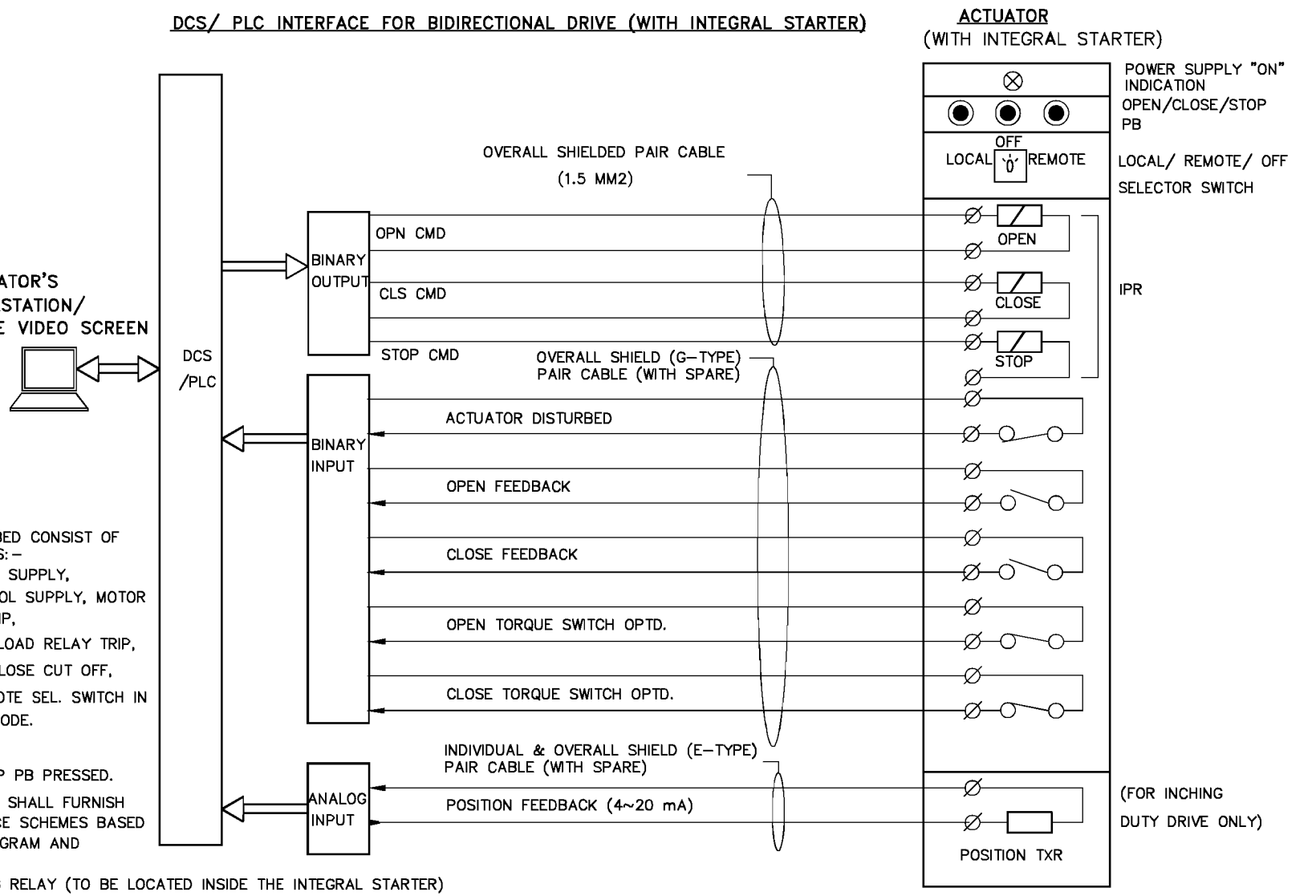
CARD CODE: U 01

DRAWING NO.: 3-V-MISC-24227

REV: 0

Size A3

DCS/ PLC INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)



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. DCS /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

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	11.08.18
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL DRIVE INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA
SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL- 12A05 | SCALE : NIL
DWG. NO. 12A05-DWG-I-0021 (SHEET 1 OF 6) | REV. 0

12A05-DWG-I-0021-R-0-SHT-1-5 11-08-18

A3 (9-96) [420x297]

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 standard, which ensures equal or better quality, may be accepted. In such case the seller shall provide details of how his standards comply with the Buyer's requirement and duly certified copies of the English version of the standard adopted shall be submitted.

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 coal 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 as per IEC-60034-1, whichever is longer.

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.

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 operations 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, self locking features, clutch, hand wheel, position indicator & transmitter, in-built thermostat for over load protection, space heater and internal wiring.

6.01.02 The actuator enclosure shall be totally enclosed, 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.

6.01.05 All motorized actuators shall be Smart Type and shall be furnished with Integral Starter mounted on the actuator and compatible with DCS/PLC. The Integral Starter shall be complete with:

1. One (1) triple pole breaker
2. One (1) no. reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC aux. contacts for each contactor.
3. One (1) no. Remote- Local selector switch
4. CLOSE-STOP-OPEN oil tight push buttons with indication lights. STOP push button shall be latchable type.
5. 415 / 240 V control transformer with primary and secondary fuses.

These actuators shall have diagnostic feature with valve checking facility from remote.

6.02.00 **Motor**

6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class F insulation and weatherproof IPW-55 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 Open / Close command termination logic with position and torque limit switch positioner circuitry shall be suitably built in a PCB inside the actuator.

a) For binary drive, open/close/stop command and 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.

Interface with the control system shall be through hardwired signal only. Interposing relays provided (with coil burden 2.5 VA) in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system.

b) 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

c) Open/close command termination logic shall be suitably built inside actuator.

6.03.04 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.

6.03.05 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.

6.04.00 **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 (applicable for inching services only)**

The actuator shall have:

6.05.01 One (1) built-in local position indicator for 0-100% travel.

6.05.02 One (1) no. transducer (4-20 ma) for remote position indicator for 0-100 % travel

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 conductors.

7.00.00 **TEST**

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.

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR LP CHEMICAL DOSING SYSTEM	

SPECIFICATION FOR FIELD INSTRUMENTS & CONTROL PANEL

SECTION-VI

TECHNICAL SPECIFICATION

CONTROL AND INSTRUMENTATION SYSTEMS

1.00.00 FIELD INSTRUMENTS

This section provides general guidelines for field instruments and equipment to be supplied under this specification. All measuring instruments/equipment and subsystems 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.

i) HART management system shall be integral feature of the DDCMIS and shall be provided for centralised configuration, maintenance, diagnostics & record-keeping for all electronic transmitters.

ii) Bidder shall provide following facilities as a minimum through software:

a) Constant scanning to monitor faults of changes to instrument configuration.

b) Owner-defined and standard calibration and configuration procedures for all transmitters.

c) Constant signal data collection facilities to maintain continuously updated records.

d) Automatic tracking of configuration changes made in the field, such as may be introduced by hand-held communicator. All configuration function associated with hand-held communicators shall be available in the system.

e) Event and log reports on screen as well as on printer.

f) Any addition/deletion of transmitter will be reported on printer and logged in hard disk.

1.01.00 PRESSURE TRANSMITTER

01.	Type	:	Microprocessor based Smart, HART protocol compatible
02.	Transmission	:	2 - Wire

03.	Output Signal	:	Simultaneous transmission of digital and 4-20 mA DC signal.
04.	Signal Processing	:	Silicon solid state electronic circuitry
05.	Sensor type	:	Capsule / Diaphragm
06.	Element material	:	AISI-316 or better
07.	Static Pressure	:	150 % of maximum span continuously, without affecting the calibration.
08.	Turn-down ratio	:	10 : 1 for vacuum/very low pressure application ; 30 : 1 minimum for other applications.
09.	Span and Zero	:	Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span
10.	Enclosure Class	:	Weather proof as per IP-65 with durable corrosion resistant epoxy coating (Explosion proof for NEC Class-1, Division 1 area wherever required)
11.	Output Indicator	:	Backlit LCD type
12.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
13.	Body	:	Forged Carbon Steel (SS for DM Water & corrisve service).
14.	Power supply	:	16 - 48 Volts D.C.
15.	Load	:	500 Ohms (min.) at 24 Volts D.C.
16.	Ambient Temperature	:	0 - 50^{O}C
17.	Performance :		
i)	Accuracy	:	$\pm$ 0.075% of Span or better
ii)	Repeatability	:	$\pm$ 0.05% of Span or better
iii)	Response time	:	100 msec or better
iv)	Stability	:	$\pm$ 0.1% of Calibrated Span for 6 months up to 70 Kg/cm2 and $\pm$ 0.25% of Calibrated Span for more than 70 Kg/cm2
v)	Zero and span drift	:	$\pm$ 0.015% per deg. C at max span and 0.11% per deg. C at min span
18.	Sealing/Isolation	:	Extended diaphragm with 5 meters SS armored capillary for corrosive, viscous and dirty fluid applications. Material for separator

diaphragm shall be as per application. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application

19. Diagnostics : Self indicating feature

20. Accessories :
a) Universal mounting bracket suitable for 2" pipe mounting.
b) High tensile carbon steel U- bolts.
c) Installation accessories as per relevant installation drawing.
d) Syphons for steam and hot water services.
e) ½" NPT 2-valve stainless steel manifold for pressure transmitters constructed from SS316 bar stock. In case it becomes necessary to use a DP transmitter for gauge pressure measurement then a 2-valve manifold should be used in place of 5-valve manifold.
f) Companion flange with nuts, bolts and gaskets.
g) Hand held configurator kit for calibration of Smart Transmitter.

1.02.00 Differential Pressure Transmitter

01. Type : Microprocessor based Smart, HART protocol compatible

02. Transmission : 2-Wire

03. Output signal : Simultaneous transmission of digital and 4-20 mA DC signal.

04. Signal Processing Unit : Silicon solid-state electronic circuitry

05. Sensor type : Capsule/Diaphragm

06. Element material : AISI-316 (Stainless Steel) or better

07. Static Pressure/

Overload Pressure		:	Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy
08.	Turn-down ratio	:	10 :1for vacuum/very low pressure application; 30 : 1 minimum for other applications.
09.	Span and Zero	:	Locally adjustable, non-interacting
10.	Enclosure class	:	Weather proof as per IP-65 with durable corrosion resistant epoxy coating (Explosion proof for NEC Class-1, Division 1 area wherever required))
11.	Zero suppression / elevation	:	At least 100% of Span
12.	Output Indicator	:	Backlit LCD type
13.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
14.	Body	:	Forged Carbon Steel (SS for DM Water)
15.	Ambient temperature	:	0 - 50^{O} C
16.	Power supply	:	16 - 48 Volts DC
17.	Load	:	500 Ohms (min.) at 24 Volts DC
18.	Performance :-		
i)	Accuracy	:	±0.2 % of span or better
ii)	Repeatability	:	± 0.05 % of span or better
iii)	Response time	:	100 msec or better
iv)	Stability	:	± 0.1% of Calibrated Span for 6 months up to 70 Kg/cm2
v)	Zero and span drift	:	± 0.015% per deg. C at max span and 0.11% per deg. C at min span
19.	Sealing/Isolation	:	Extended diaphragm with 5 meters. SS armored capillary for corrosive, viscous and dirty fluid applications. Material for separator diaphragm, depending on application.
20.	Diagnostics	:	Self indicating feature
21.	Accessories	:	a) Universal mounting bracket suitable for2" pipe mounting.

b) High tensile carbon steel U-bolts.

c) Installation accessories as per relevant installation drawing.

d) Syphons for steam and hot water services.

e) ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock.

f) Companion flange with nuts, bolts and gaskets.

g) Hand held configurator kit for calibration of Smart Transmitter.

1.02.00 DISPLACER TYPE LEVEL TRANSMITTERS

01.	Type		:	SMART
02.	Stages of operation		:	Continuous
03.	Material -			
	i)	Displacer	:	AISI 316 SS
	ii)	Suspension wire	:	AISI 316 SS
	iii)	Torque tube housing	:	Carbon steel or SS as per application
	iv)	Torque tube	:	Inconel
	v)	Displacer chamber	:	Carbon steel or SS as per process application
	vi)	Transmitter Housing	:	Die cast aluminium or better
04.	Power supply		:	16-48 Volts D.C.
05.	Transmission		:	2-wire
06.	Output Signal		:	Simultaneous transmission of digital and 4-20 mA DC signal. Standard HART protocol.
07.	Signal processing		:	Solid-state electronic circuitry
08.	Static / overload pressure		:	Maximum static pressure without permanent deformation or loss of accuracy.
09.	Turn-down ratio		:	10 : 1 or better

10.	Zero & Span	:	Easily accessible (local zero & span adjustment and non-interactive type)
11.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12.	Output Indicator	:	Yes, Backlit LCD type
13.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
14.	Ambient Temperature	:	0 - 50^{O}C
15.	Load Impedance	:	500 Ohms at 24 Volts (minimum)
16.	Process Connection	:	2" Companion flange with nuts, bolts and gaskets
17.	Performance -		
	Accuracy	:	± 0.2% of span or better
18.	Accessories	:	a) Counter Flange, nuts, bolts, gaskets etc. b) Weights for 5 point calibration of instruments. c) Vent and drain plugs d) Special calibration tool/configurator,if any.
19.	Preferred Features	:	a) Test plug connection and cutout terminals physically separated from other electronics. b) Electronic Damping facility (adjustable).

1.03.00 MASS FLOW METER

A. Sensor

01.	Measuring Principle	:	Coriolis Mass flow.
02.	Primary Element	:	Flow Tube of 316SS or better
03.	Temperature Control For Heating	:	To be provided for heavy fuel oil application. Heating arrangement shall be integral.
04.	Process Connection	:	Flanged and rating as per process requirement.
05.	Drain	:	Self-draining facility

1.06.00 Rotameter

01.	Type	:	Online upto 2" and Bypass above 2" line size"
02.	Metering tube	:	Borosilicate glass
03.	Float	:	AISI 316-SS unless the process fluid demands some other material.
04.	Body MOC	:	SS as per fluid condition.
05.	Scale	:	Aluminium Graduated - Engraved black on white background.
06.	Process connection	:	Flanged to line size or threaded for connection size ½" or less.
07.	Accuracy	:	± 2% of full scale detection or better for on-line type and ±4% of full-scale detection or better for by-pass type.
08.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
09.	Accessories	:	Slip-on orifice plate of 316-SS and taps of / SS as per application. Applicable SS Isolation valves and SS Range Orifice - for bypass type rotameters.
10.	Housing protection class	:	IP- 65.

1.07.00 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..
05.	Bezel Material	:	SS 304.
06.	Socket Material	:	SS 316
07.	Enclosure	:	IP-65.
08.	Dial Size	:	150 mm

09.	Scale	:	Black lettering on white background in 270 Deg. arc.
10.	Window	:	Shatterproof glass
11.	Range Selection	:	Normal process pressure – 50 ~ 70 % of range (approximately).
12.	Over-range Protection	:	125% of maximum range by internal stop. External stop at zero
13.	Adjustment	:	Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment. External zero adjustment for glycerine filled gauges.
14.	Element Connection	:	Argon welding
15.	Process Connection	:	1/2" NPT(M) Bottom connection for local mounting, back connection for panel mounting.
16.	Performance	:	Accuracy of $\pm$ 1.0 % of span or better.
17.	Operating ambient temperature	:	0 - 50^{O}C
18.	Safety Feature	:	Blow out disc./diaphragm at the back
19.	Accessories	:	a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge. b) Stainless steel Diaphragm chemical seals for corrosive, viscous and solid-bearing or slurry type process fluids. diaphragm chemical seal shall be provided with the following: 1) Top chamber : SS 304 2) Bottom Chamber: SS 316 3) Sealing fluid: Silicon DC 200 4) Diaphragm: SS 316 c) 3-way SS gauge cock/ 2-Valve SS-316 barstock manifold for pressure gauges with 1/2" NPT process connection..

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

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

f) Syphons for steam and hot water services.

	20.	Applicable standard	:	IS-3624 / 1996 , EN-837-1
	21.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

1.08.00 Temperature Gauge

	01.	Type	:	Inert gas filled remote mounting system.
	02.	Sensing Element Material	:	Bourdon - AISI-316 SS
	03.	Capillary Armoring	:	Stainless steel flexible
	04.	Movement Material	:	AISI 304 SS
	05.	Bulb / Stem Diameter	:	12 mm
	06.	Bulb / Stem Material	:	AISI 316
	07.	Capillary	:	Stainless Steel
	08.	Thermometer connection to well	:	½" NPT
	09.	Case Material	:	Stainless steel
	10.	Dial Size	:	150 mm in general (100 mm for SWAS gauges)
	11.	Scale	:	Black lettering on white background in 270 Deg. arc.
	12.	Mounting	:	Surface/Panel
	13.	Over range Protection	:	125 % of range or more
	14.	Instrument connection	:	Bottom connection for local mounting and back connection for panel mounting.

15.	Range	:	Normal temperature – 50 ~ 70% of range approximately.
16.	Zero adjuster	:	Micrometer screw adjustable from front.
17.	Window	:	Shatterproof glass.
18.	Accuracy	:	± 1 % or better
19.	Enclosure Class	:	IP-65
20.	Capillary	:	5 meters (local)/15.0 meters (local panel) - armoured stainless steel
21.	Compensation	:	Capillary and Case Compensation
22.	Accessories	:	a) Forged/barstock SS316 thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of thermowell: 1) SS 316: in general 2) Inconel: For flue gas application 3) Tungsten carbide: For coal mill application b) Installation accessories as required.
23.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

1.09.00 Thermocouples

01.	Type	:	a) Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.) / Type-E (Chromel Constantan) [As per application] b) Duplex (Triplex incase of turbine/Generator/excitor bearing temperature may be used) c) Ungrounded
02.	Wire gauge	:	16 AWG for Type-K, 24 AWG for Type-R
03.	Standard	:	ANSI-MC 96.1.
04.	Protecting Tube :-		
i)	O.D.	:	8 mm
ii)	Material	:	316-SS Seamless
iii)	Filling	:	Magnesium Oxide (Purity above 99.4%)

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

1.10.00 Passing condition of various drain valves shall be monitored by measuring drain pipe metal temperature at the downstream of the drain valves. Also Drum, SH, RH metal temperature measurement shall be provided. Necessary thermocouples shall be provided as per the following specification.

01.	Measuring medium	:	Metal temperature
02.	Metal of thermocouple element	:	Chromel-Alumel Type-K
03.	Type of thermocouple ungrounded type.	:	Duplex with separate hot junctions,
04.	Insulation	:	Mineral insulation Magnesium Oxide
05.	Thermocouple wirer gauge	:	16 AWG
06.	Protective Sheath	:	SS 321
07.	Protective Sheath Dia	:	8 mm O.D.
08.	Characteristics of thermocouple	:	Special limits of error as in ANSI MC 96.01.1975
09.	Mounting Accessories	:	1/2" BSP SS sliding end connector, weld pad, weld on clamps of heat resistant steel SS 310.
10.	Cold end sealing	:	SS pot seal with colour coded PTFE headed sleeve insulated flexible tails. Sealing compound - Epoxy resin
11.	Minimum Bending Radius	:	30 mm
12.	Length of T/C	:	30 mtrs. (minimum)

1.11.00 Resistance Temperature Detector

01.	Type	:	Platinum (Duplex), Ungrounded
02.	Resistance	:	100 ohm at $0^{O}C$
03.	Base	:	Wound on ceramic (anti-inductive)
04.	Wiring	:	3 /4 Wire

05. Protecting Tube :-

i)	O.D.	:	8 mm
ii)	Material	:	SS-316, Seamless
iii)	Filling	:	Magnesium oxide (Purity above 99.4%).

06. Response time : a) < 20 seconds for measurement.

b) < 10 seconds for control.

07. Calibration : DIN 43760

08. Accuracy : ± 0.5% of range

09. Head :

i) Type : IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area)

ii) Material : Die cast aluminum or better

iii) Terminal blocks : Nickel plated Brass-screw type / silver plated

iv) Cable connection : ½" NPT gland and grommet.

v) Others : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shal be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells"

10. 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) Barstock thermowell of stepless tapered design as per ASME PTC19.3 code.

Process connection M33x2 (M) in general or 11/2"flanged for flue gas/Furnace/air etc. application.

Material of construction of thermowell:

1) SS 316: in general

2) Inconel: For flue gas application

3) Tungsten carbide: For coal mill application.

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

1.12.00 Pressure Switch

01.	Type	:	i) Piston for high pressure application (above 40 bar) ii) Bellow /Diaphragm for low pressure application (below 40 bar)
02.	Sensing element material	:	AISI SS-316. All other wetted part SS316.
03.	Case Material	:	Die-cast aluminum alloy with neoprene gasket.
04.	Setter Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.
05.	Over range	:	150 % of maximum pressure
06.	Adjustments	:	a) Internal Set Point b) Differential adjustment
07.	End Connection	:	1/2" NPT (M) bottom connected
08.	Switch configuration	:	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.	Elect connection	:	Plug in socket
13.	Enclosure Class	:	IP-65 weather and dust proof (Explosion proof for NEC Class-1, Division 1 area).
14.	Performance	:	a) Repeatbility $\pm$ 0.5% of full range b) Accuracy of Setting Indication of $\pm$ 1.5%
15.	Ambient temperature	:	0 – 50^{O}C

1.15.00 Level Switch

01.	Type	:	External cage float operated. Magnetically coupled.
02.	Float Material	:	AISI-316 stainless steel or better
03.	Other wetted parts	:	AISI-316 stainless steel or better
04.	External Cage	:	Carbon steel / Stainless steel or better as per process requirements, welded type / flanged

construction. Cage pressure rating shall equal or exceed the rating of the main vessel.

05.	External cage mounting	:	Side-Side.
06.	External cage connection	:	25 NB socket welded.
07.	Switch housing	:	Epoxy coated die-cast aluminum alloy with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
08.	Type of switch configuration	:	2 SPDT (two nos.)
09.	Contact rating	:	5A, 240V/AC, 0.25A, 220V DC
10.	Accessories	:	a) Counter flange, nuts & bolts, suitable gasket etc. b) Steel globe type drain valve. c) ½"NPT cable gland d) Stainless steel alpha-numeric engraved for service and tag. e) Globe drain valve
11.	Preferred feature	:	Switch operating point marked on cage
12.	Mounting	:	On standpipe

1.16.00 Conductivity Type Level Switch

01.	Type	:	Conductivity discrimination.
02.	Application	:	Drain pots viz. on CRH line
03.	Mounting	:	Flanged – on external cage.
04.	Probe MOC	:	Stainless steel with high purity ceramic.
05.	Probe rating	:	> Maximum design pressure of vessel.
06.	Input	:	Four independent channel with selectable switching threshold for water conductivity.
07.	Relay Output	:	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.

	08.	Contact type & rating	:	2SPDT or 1 DPDT @ 5A 30V DC.
	09.	Local Display	:	Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.
	10.	Power supply	:	Dual 240V AC, 50 Hz, 1Ph UPS supply.
	11.	Enclosure	:	IP–65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).
	12.	Accessories	:	a) PTFE cable from probe to electronics b) Mounting accessories c) External cage d) Washer & gasket
	13	Test pressure	:	Two times rated pressure
	14.	Elect connection	:	Plug in socket

1.17.00 Capacitance Type Level Switch

	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.	Ambient temperature	:	0-60ºC.
	08.	Mounting	:	Top Mounting
	09.	Supply voltage	:	240V AC, 50 Hz, 1Ph UPS supply/ 24V DC

	10.	Relay output	:	2 SPDT
	11.	Contact rating	:	5A min. at 240V AC on resistive load
	12.	Response time	:	100 msec or better
	13.	Elect connection	:	Plug in socket
	14.	Accessories	:	Counter flange, cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.

1.18.00 RF Type Level Switch

	Sensing Probe		:	
	01.	Type	:	Rigid
	02.	Material	:	SS-316
	03.	Mounting	:	Threaded
	04.	Probe Head Housing	:	Cast Aluminium
	05.	Protection	:	IP-66
		Electronic Controller	:	
	01.	Supply Voltage	:	240V AC (UPS)
	02.	Relay Output	:	2 nos. SPDT
	03.	Contact Rating	:	240V AC,5A/ 220V DC, 0.25A
	04.	Housing Material	:	Cast Aluminium
	05.	Protection	:	IP-65
	06.	Local LED Indication	:	Power On, Alarm Level, Probe Healthy
	07.	Switching Repeatability	:	±0.5%
	08.	Accessories	:	Coaxial cable probe connection to controller ½"NPT Cable Gland

1.19.00 Ultrasonic Level Switch

	01.	Principle of operation	:	Ultrasonic contact level technology
	02.	Input Power	:	24V DC/ 240V AC

	03.	Output Contact	:	2 SPDT (240V AC, 5A/ 220V DC, 0.25A)
	04.	Switch Mounting	:	Integral
	05.	Sensor Material	:	SS-316
	06.	Enclosure	:	Cast Aluminium (IP-65)
	07.	Process Connection	:	2" Flanged
	08.	Repeatability	:	2 mm
	09.	Power supply	:	240V AC, 50 Hz, 1Ph UPS supply/ 24V DC
	10.	Cable connection	:	½" NPT with cable gland
	11.	Accessories	:	Cable gland, cable, companion flange, bolts & nuts, gaskets etc. along with all mounting hardware

1.20.00 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	:	240V AC, 50 Hz, 1Ph UPS supply/ 24V DC
	10.	Signal Output	:	4-20 mA DC (isolated) - 500 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- 0 to 50° C and Sensor 0 to 80° 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.

1.21.00 Conductivity Type E lectronic Level Indicator

01.	Type	:	Conductivity discrimination.
02.	Application	:	Separator drum Level .
03.	No. of Probes	:	As per manufacturer standard.
04.	Probe Mounting	:	Flanged – on standpipe.
05.	Probe MOC	:	Stainless steel with high purity ceramic.
06.	Probe rating	:	> Maximum design pressure of vessel.
07.	Input	:	Independent channel with selectable switching threshold for water conductivity.
08.	Relay Output	:	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
09.	Contact type & rating	:	2 SPDT or 1 DPDT @ 5A 30V DC.
10.	Current output	:	Isolated 4-20 mA DC
11.	Local Display	:	a) Coloured (Red & Green) LEDs for level. b) Flashing LEDs for fault.
12.	Remote Display	:	Red, Green & flashing yellow LEDs for steam, Water & Fault indication respectively.

	13.	Power supply	:	Dual 240V AC, 50 Hz, 1Ph UPS supply.
	14.	Enclosure	:	a) IP–65, corrosion resistant & wall mounting type for local electronics. b) IP-42 for remote indicator
	15.	Accessories	:	a) PTFE cable from probe to electronics b) Mounting accessories. c) Standpipe d) Washer & gaskets e) Double isolation valves on each connection, double drain valves & double vent valves with mechanical lock. f) ½" NPT cable gland
	16.	Test pressure	:	Two times design pressure

1.22.00 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 0-2.0 Kg / Sq. cm or 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.

1.23.00 SOLENOID VALVE

	01.	Operating Principle	:	Electromagnetic (noiseless)
	02.	Coil voltage rating	:	24V DC (in general) other 220V DC /240V AC /110V AC as required

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 proofing with nitrile (NBR) and polyurethane (PUR) material
10.	Ambient Temperature	:	0 - 50^{O} C
11.	Fluid Temperature	:	0-150^{O} C (approx.)
12.	Coil Enclosure	:	Stainless Steel
13.	Insulation	:	Class-H
14.	Coil Casing	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
15.	Response time	:	4-7msec
16.	Mounting	:	On pipe or on panel
17.	Cable Connection	:	½" NPT cable gland
18.	Accessories	:	Mounting brackets, nuts and bolts
19.	Special feature	:	(i) LED indication for power (ii) Double coil type for open & close operation of valve / damper. (iii) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity

1.24.00 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.	Number of Tapings	:	As required plus one additional pair of taps
04.	Diameter Ratio	:	Between 0.34 to 0.7

	05.	Thickness	:	3mm for main pipe of diameter upto 250mm, 6mm for main pipe of diameter above 250mm and 10mm for diameter above 500 mm
	06.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
	07.	Meter run pipe	:	Same as pipe material
1/2" SS316 globe	08.	Accessories	:	Flanges, gaskets, nuts & bolts, root valves ~~(1" 316 SS globe)~~ jack screw, meter run pipe, Drain & vent hole as per application etc.

NOTE: One flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.

1.25.00 FLOW NOZZLE

	01.	Application	:	High fluid velocity flow measurement
	02.	Design Standard	:	ASME PTC 19.5
	03.	Tapings	:	D and D/2 (Numbers as required plus one additional pair of taps)
	04.	Diameter Ratio	:	Between 0.4 and 0.7
	05.	Material	:	316 SS ~~(321 SS for high temperature)~~
	05.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
	06.	Meter run pipe	:	Same as pipe material
	07.	Accessories	:	Meter run pipe, nipples and root valves (1" 316 SS globe).(Inspection port assembly for nozzles used in plant performance purpose)

NOTE: One flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.

1.26.00 GAUGE GLASS

	01.	Type	:	Reflex
	02.	Glass	:	Toughened borosilicate. Resistant to mechanical and thermal shocks.
	03.	Body material	:	Carbon steel / stainless steel- As per process requirements (Flanged Connection)
	04.	Pressure rating	:	Twice the maximum working pressure

	05.	Temperature rating	:	300^{O} C
	06.	Bolts and nuts	:	Rust proof alloy steel
	07.	Accessories	:	Suitable ball check valves of SS-304/316 body, gaskets, companion flange etc.

1.27.00 LEVEL GAUGE (FLOAT & BOARD)

	01.	Type	:	Float and Board
	02.	Float & Tape MOC	:	AISI 316
	03.	Pulley and Pulley Housing material	:	SS 304
	04.	Guide wire	:	SS 316 Stainless steel
	05.	Accuracy	:	+/- 2 mm
	06.	Indication	:	Vertical dial
	07.	Rating	:	Twice the design pressure
	08.	Spring tension assembly	:	SS 304
	09.	Anchor plate	:	SS304
	10.	Calibrated scale board:		Aluminium with black graduation

Note: The measuring rope/tape shall be passed through conduits

1.28.00 POWER CYLINDERS (PNEUMATIC)

	01.	Mounting Type	:	a) Fixed position mounting (End mounting).
			:	b) Trunnion mounting
	02.	Control Signal	:	4-20 mA DC to smart positioner with HART protocol for modulating purposes. 24V/48VDC 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-65.

06.	Accessories (as required)	:	a)	Air lock relay
			b)	Hand wheel.
			c)	Air filter regulator with gauge.
			d)	Volume Booster.
			e)	Limit Switches.
			f)	Smart Positioner with integral I-P convertor, feedback position Transmitter (4-20 mA DC output),Input & Output pressure gauges, local keypad & display.
			g)	Solenoid Valve
			h)	Junction box with cable gland
07.	Fail-safe operation	:	Stay put for regulating duty.	
08.	Repeatability	:	Better than 0.5% of full travel.	
09.	Hysterisis	:	Less than ±1% of full travel	
10.	Operating Temp. limit	:	80^{O} C (min.)	

1.29.00 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

1.30.00 SMOKE DENSITY ANALYZER

01.	Type	:	Insitu dry visible light (through LED)
02.	Principle of		

13.	Enclosure Class	:	IP-65
14.	Interchangeability	:	Fully Interchangeable Transmitters
15	Accessories	:	Sampling System, cables, sensor holder, dessicant chambers, souble compression fittings, ¾" cable gland, mounting fixture etc.

1.37.00 DENSITY METER

01.	Operating Principle	:	Vibration Density measurement
02.	Wetted Part Material	:	SS-316L
03.	Case Material	:	Cast Aluminium
04.	Output	:	4~20 mA DC
05.	Electrical connection	:	½" NPT
06.	Enclosure Class	:	IP-65
07.	Local Display	:	Digital 5 digit, density display with temp. compensation
08.	Accuracy	:	±1.0 %
09.	Power Supply	:	240V AC (UPS)
10.	Location	:	At the discharge of Gipsum bleed pump in FGD system.

1.38.00 RADAR TYPE LEVEL MEASUREMENT

01.	Type	:	Radar based on Time Domain Reflectometry
02.	Antena	:	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.	Environmental temperature	:	0 – 50ºC
05.	Enclosure	:	Explosion proof /IP 65 as per application
06.	Cable Entry	:	½" NPT
07.	Calibration	:	a) Self calibration with internal reference b) Zero & Span calibration
08.	Programming	:	Handheld programmer & Local key pad
09.	Process Connection	:	Flanged /screwed

10	Transmitter Beam Angle	:	10 degree or less
11	Blocking distance	:	less than 300 mm
12.	Electronic Housing	:	Epoxy painted Die-Cast aluminium alloy
13.	Antenna / Flange assembly	:	316 SS or Hestalloy (as required)
14.	Output Indicator	:	Digital Integral Display (Backlit LCD/LED)
15.	Accuracy	:	5 mm or 0.1% of probe length
16.	Accessories	:	a) Programming tool kit b) Gasket

1.39.00 CHLORINE LEAK DETECTOR

01.	Type	:	Electrochemical
02.	Resolution	:	0.1 ppm
03.	Display Type	:	Digital Indicating Meter
04.	Operating Temperature	:	0~45°C
05.	Alarm Contacts	:	Dual Alarm setpoints (240V AC, 5A)
06.	Enclosure Class	:	IP-65
07.	Mounting	:	Wall mounting
08.	Power Supply	:	240V AC
09.	Output	:	4~20 mA DC (600 Ω load)

1.40.00 RESIDUAL CHLORINE ANALYZER

01.	Type	:	Amperometric
02.	Electrode	:	Platinum/ Gold and copper electrode shall be provided with cell cleaning system
03.	Display Type	:	LCD in Analyzer Panel
04.	Range	:	0 to 20.0 mg/L (ppm)
05.	Accuracy	:	2% or better . The measurement accuracy shall not be affected by presence of treatment chemicals as chromates,

phosphates, de-former highly polluted water, change in temperature etc.

06.	Sensitivity	:	0.01 mg/L
07.	Alarm Contacts	:	Dual Alarm setpoints (240V AC, 5A)
08.	Enclosure Class	:	IP-65
09.	Power Supply	:	240V AC
10.	Output	:	4~20 mA DC (600 Ω load)
11.	Calibration	:	Zero & Span adjustment. Final calibration adjustments of the analyzer to be done at site and duly verified bt titration. Temperature compensation range 0-50°C.
12.	Mounting	:	Field mounting conform to IP-65
13.	Accessories	:	Chemical reagents, sample drain, pumping system (if required) etc.

1.41.00 ELECTRIC TO PNEUMATIC (E/P) CONVERTERS

01.	Air Supply	:	1.5 kg/cm2
02.	Max. supply Pressure	:	7 kg/cm2
03.	Input Signal	:	4-20 mA DC (as required by the design of control system).
04.	Output Signal	:	0.2 to 1.0 kg/cm2
05.	Control Action	:	Air to Close, Air to Open and Fail freeze-field selecable
06.	Response Time	:	5 seconds for 0 to 90% output pressure
07.	Repeatibility	:	+/- 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.

1.42.00 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 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.	Repeatibility	:	+/- 0.3% of span or better
08.	Accuracy	:	+/- 0. 1% of span or better
09.	Communication	:	Hart protocol
10.	Power-up with position	:	< 150 ms or better control
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 ii) Self calibration with tunable response time iii) Online diagnostics iv) Pressure guages to be provided on positioner (I/P & O/P pressure)

1.43.00 MAGENETIC LEVEL INDICATOR

01.	TYPE	:	Magnetically coupled level indicator
02.	Display	:	Coloured flags
03.	Chamber material	:	Stainless steel
04.	Wetted part material	:	Stainless steel
05.	Process connection	:	Side Side Flanged
06.	Drain & Vent	:	Flanged
07.	Scale	:	Standard, Stainless steel
08.	Accessories	:	Counter flange, gaskets

1.44.00 FLOW SWITCH

01.	Type	:	Paddle /Piston/Disk
02.	Wetted part material	:	Stainless steel or Hastelloy for acidic application
03.	End connection Tee	:	i) Threaded upto 1" line size with integral ii) Flanged for line size > 1 ½"
04.	Enclosure material	:	Die cast aluminium
05.	Enclosure class	:	IP 65
06.	Switch configuration	:	2 SPDT
07.	Contact rating	:	240V AC 15A
08.	Repeatibility	:	2%
09.	Cable connection	:	½"NPTF

	Logging Facilities	:	Yes. Should be able to compute cumulative flow over intervals selectable by Owner i.e., daily, weekly, monthly etc. The data shall be stored in the memory of flow computer for access in future.
10.	Software features	:	Compensation for any cross path errors Programming, configuration, shall be possible from front panel.
11.	Diagnostics	:	False signal tolerance , power supply failure etc.
12.	Protection Class	:	IP-65 or better, Weather protection against direct sunlight, rain etc for Flow meter and suitable for Cooling water for Transducer.
13.	Accuracy	:	± 1%
14.	Electrical connection	:	Plug and socket
15.	Accessories	:	All mounting hardware required like clamping fixtures, mechanism to remove the transducers online, interconnecting cables etc. All weather canopy for protection from direct sunlight and direct rain. Material of all fittings shall be SS 316

g) Bidder shall submit certified flow calculation and differential pressure Vs. flow curves for each element for Owner's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Owner's approval.

2.00.00 NOT USED

3.00.00 CONTROL PANEL/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES.
(For electrical System's Meter and for synchronisation, bidder shall refer to Electrical volume of specification)

3.01.00 Digital Indicator (If requird)

01.	Type	:	Five and half digit LED seven-segment display with sign.
02.	Display Character	:	13.8 mm, RED (LED)
03.	Accuracy	:	0.1% of reading, ±2 digit

	04.	Input	:	4-20mA DC/1-5 V DC/ pulse (as applicable)
	05.	Mounting	:	Flush Panel
	06.	Power Supply	:	240V ±10%, 50 ±2.5 Hz

3.02.00 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 operation
	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

3.03.00 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 Operation
	10.	Lamp	:	LED with built-in resistors as required
	11.	Lamp Rating :-		
	a)	Voltage	:	240 V AC
	b)	Watt	:	2 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

3.04.00 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 operation
	10.	Construction	:	Aluminum shrouding
	11.	Connection	:	Screw terminals

	12.	Enclosure Class	:	IP-52
3.05.00	INDICATING LAMP			
	01.	Type	:	LED with built-in resistor
	02.	Face Dimension	:	32 x 32 mm (maximum)
	03.	Voltage	:	240 V AC
	04.	Watt	:	2.5 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
3.06.00	INDICATING METERS (A.C)			
	01.	Type	:	Rectifier type taut band
	02.	Face Dimension	:	96 x 96 mm
	03.	Scale	:	Radial arc of 240 Deg.
	04.	Accuracy	:	1.5% of full scale. ±0.5 Hz for frequency meter
	05.	Input	:	0-1/0-5A for current measurement, 0-240V for voltage measurement, 50 ± 2.5 Hz for Frequency measurement
	06.	Zero Adjustment	:	Screw on meter face
	07.	Enclosure	:	Shielded Case IP-52
	08.	Mounting	:	Flush Panel
	09.	End Scale Suppression	:	6 times the measuring range only for motor ammeters
3.06.01	INDICATING METERS (D.C)			
	01.	Type	:	Taut band moving coil
	02.	Face Dimension	:	96 x 96 mm

	03.	Scale	:	Radial arc of 240 Deg.
	04.	Accuracy	:	1.5% of full scale
	05.	Input	:	0-75 mA for current measurement. Direct reading for voltage measurement.
	06.	Zero Adjustment	:	Screw on meter face
	07.	Enclosure	:	Shielded case IP-52
	08.	Mounting	:	Flush Panel
	09.	End Scale		
		Suppression	:	2 times the measuring range only for motor ammeters.

3.07.00 AUXILIARY RELAY

	01.	Type	:	Plug-in type with base/DIN rail Mounted
	02.	Coil voltage	:	240 V AC/24V DC / 220V DC
	03.	Contact Configuration	:	2 NO & 2 NC (Minimum), additional contacts as per requirement
	04.	Contact rating	:	250V/5A (A.C/D.C.)
	05.	Operating range	:	80 to 110% of rated voltage
	06.	Insulation	:	2 KV for 1 minute between terminals & earth.
	07.	Mechanical life	:	20 million operations
	08.	Enclosure	:	Transparent cover
	09.	Connection	:	Screw terminals.
	10.	Mounting	:	Projection mounting inside panel /DIN rail Mounting

Note : Coil protection: diode/surge suppressor shall be provided

3.08.00 COUPLING RELAY

	01.	Type	:	Miniature plug-in type/ DIN rail Mounting
	02.	Coil voltage	:	24 V D.C. / 48 V DC or others as required.
	03.	Contact	:	2 NO & 2 NC (Minimum)-Additional contact as per requirement

04.	Contact rating	:	250 V/10A (A.C)/220V/2A (D.C)
05.	Operating range	:	70 to 110% of rated voltage.
06.	Insulation	:	2 KV for 1 minutes between terminal & earth.
07.	Mechanical life	:	20 million operations
08.	Coil protection	:	Diode
09.	Indication	:	Coil on LED
10.	Enclosure	:	Transparent cover
11.	Connection	:	Screw terminals.
12.	Mounting	:	Projection mounting inside panel / DIN rail mounting

5.00.00 CONTROL DESK / PANEL / RACK

5.00.01 Convenient and logical approach to operational interfaces shall be considered to enhance aesthetics in the overall view of the control room..

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

5.00.03 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.

5.00.04 Incoming power supply feeders shall be Redundant UPS Power supply feeders, so that a single failure shall not affect the operation of the unit. Required isolation & protection through MCB shall be provided in all cases. Alarm shall be provided against failure of a single power supply. Duplication/looping of Power supply feeders at the Panel terminal is not acceptable. Redundant UPS power supply feeders shall form Primary & Secondary power supply Bus and further power distribution shall be from these busbars.

5.00.05 Desk / panel shall be provided with interior illumination lampwith door switch, space heater with thermostat and 5A, 3 Pin receptacle with plug. Exhasut/cooling fans with fan failure alarm shall be provided.

5.00.06 Lamp, heater, exhaust fan and receptacle circuits shall be suitable for available AC supply and furnished with individual ON-OFF switch. The ON-OFF switch of the 3 pin receptacle circuit shall be Illuminating type.

5.00.07 Panel / Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm.

5.00.08 Panels / enclosure shall be provided with 20% spare terminals. In addition, the spare hot on rail mounted input output channels /modules shall be in fully wired & terminated condition for system cabinets.

5.00.09 Wire shall be routed/laid in the covered PVC cable trough/tray.

5.00.10 Nameplate

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.

5.02.00 BACK UP PANEL / ELECTRICAL PANEL

5.02.01 Back Up Panel shall be of free standing type vertical panel with doors at the back. Construction shall be made from sheet steel of thickness not less than 3mm with mosaic grid structure of approximate size 24 X 48 on the front surface. Grid shall be heat resistant, flame retardant, self extinguishing, shrinkage free, non reflecting type. Finish shall be mat type without flaring. Indicators /ammeters, conductivity type EWLI for seperator, electromatic safety valve controls etc. shall be mounted on the panel..

5.02.02 Electrical Panel construction & design shall be similar to back up panel. Required control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. alongwith associated mimic diagram shall be provided for manual synchronization of generator.

5.02.03 Crating of the panels shall protect against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.

5.03.00 CABINETS / ENCLOSURE / PANELS

01.	Material of construction	:	Cold rolled steel sheet
02.	Thickness of Sheet	:	a) 3.0 mm for faces supporting instruments / terminals. Mounting plate shall also be 3.0 mm. b) 2.0 mm for other sides inclusive of top.
03.	Construction	:	Welded throughout as per (metallic parts) approved National Standards.
04.	Panel height	:	2300 mm maximum
05.	i)Corners	:	7 mm inner radius
	ii) Dimensional Tolerances	:	a) In height & length - 3 mm b) In height between adjacent sections - 2 mm. c) Total for a group - 6 mm
06.	Doors	:	Double, recessed, turned back edges. Doors shall have 4 point IP Lock
i)	Thickness of Sheet	:	2 mm

ii)	Hinges	:	Stainless steel
iii)	Door latches	:	Three point type
iv)	Door gaskets	:	Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure.
v)	Opening of the doors	:	Outward. Door swing shall be Min. 110-120 Degree
vi)	Louvers	:	With removable wire mesh to ensure dust and vermin proof.
07.	Color of interior	:	Brilliant white (Approval shall be accorded by owner during detail engineering)
08.	Colour external	:	RAL 7032 (Approval shall be accorded by Owner during engineering)
09.	Painting	:	Epoxy powder coated or better. Minimum Paint thickness shall be 80-100 microns
10.	Gland plates	:	Removable 4 mm thick (bottom)
11.	Cable entry	:	Bottom
12.	Hardware	:	a) Anti vibration pad- 15 mm b) Predrilled base channel ISMC - 100 or equivalent for all sides. c) Lifting hook / Eye bolt d) Drawing pocket e) Door switch, lamps, thermostat, heaters and fans
13.	Enclosure Protection	:	As per environment condition of the area of installation. Refer to Section-I of Vol-IIE clause 6.16.00.

5.04.00 LOCAL INSTRUMENT RACKS & ENCLOSURE (EXCEPT OFFSITE/BOP AREAS)

Transmitters and switches located in the field shall be grouped together and shall be installed in the enclosure (Closed Transmitter Racks) in case of outdoor area such as Boiler area etc. and in Open Type Rack in case of

covered area. Racks shall be factory prefabricated & painted and complete with internal tubing, manifold, isolation valves, integral junction box with outside access door, illumination etc. Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging. Following requirements for LIE/LIR shall be met:

1) Not more than Six (6) Instruments shall be grouped in a single Rack/enclosure".

2) Racks shall be installed above the tapping points for air, flue gas and coal air mixture application where as for applications such as for water and steam, racks to be installed below the source point.

3) Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential and guage Pressure measurements such as flue gas, furnace and coal air mixture applications. Intermittent purging shall be adopted for Pressure measurements in air application or wherever required.

5.04.02 Open Type Transmitter Racks

a) Open type transmitter racks may be provided for mounting transmitters, switches, gauges, converters and other accessories in rooms, buildings and closed areas like the power house building.

b) The open type racks shall be shop fabricated. Transmitters, switches, converters and transducers of enclosure class IP-65 or better can be directly mounted on open racks. However, enclosures not conforming to the above protection standard shall have to be housed in enclosures conforming to IP-65 class prior to mounting them on open structures.

c) The following shall be provided for open type transmitter racks:

1. Rack shall be constructed from 6mm thick steel channel frame.
2. Canopy shall be of 3mm thick CRCA steel.
3. 2"NB Galvanised pipes shall be laid horizontally and supported at two end channels to mount transmitters/switches at accessible height.
4. Adequate support for Manifold, impulse pipe and cable tray to be provided and the same shall be adjustable.
5. Individual Instrument blowdown line shall be connected to the common blowdown drain header through regulating globe type blowdown valves. The common blowdown drain header shall be 2" NB ASTM A106, Sch-80 Gr. C installed at a slope of 1:25

d) For operational convenience, the open type racks shall be used for mounting pressure and temperature gauges and switches and the local operating stations for electrical drives in the vicinity. Gauges mounted in racks shall be bottom connected and secured by double lock nuts. All gauges shall be located within 1500 mm from the floor for easy readability.

e) The structural design shall be such that no item shall interfere with maintenance and removal of instrument, equipment and their accessories.

f) Service Power and Lighting

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

ii) Power supply for receptacles and lighting shall be arranged. Power supplies for miscellaneous devices shall be provided with MCB located within the rack JB. MCBs shall be mounted in blocks. MCB ratings will be given on electrical schematic diagrams. Nameplates

shall be furnished above the MCB blocks, identifying the devices being served.

g) Control Air

Same as for closed type transmitter rack. Refer 5.01.01 (j) above

h) Service Air

Same as for closed type transmitter rack. Refer 5.01.01 (k) above

i) Power Supplies

Same as for closed type transmitter rack. Refer 5.01.01(l) above

j) Equipment Installation

Contractor shall prepare rack fabrication and piping drawings indicating the layout of each instrument. The drawings shall clearly indicate Contractor's piping arrangement for the sharing of process connections between two or more instruments. Special attention shall be given in the piping layout to avoid air traps in liquid filled piping or water pockets in piping intended to be dry.

k) Impulse Piping / Tubing

Same as for closed type transmitter rack. Refer 5.01.01 (n) above

l) Instrument Tubing

Same as for closed type transmitter rack. Refer 5.01.01 (o) above

5.04.03 Wiring of the Racks

a) A fully enclosed IP 65 type junction box shall be provided in each rack for housing the terminal blocks connectors, power supply fuses and other electrical accessories, as required.

b) Junction boxes for modular enclosures shall be fabricated externally on one end of each enclosure assembly to accept field wiring/cabling through the top or bottom of the junction box. A hinged door shall give access to the interior of the junction box.

c) All electrical connections between instruments and the junction box terminal blocks shall be made. In addition all utility wiring for lighting and service power shall be installed.

d) All wiring used within the enclosures shall conform to NEC /IEC standards. All wiring shall run though flexible or rigid conduits and shall be terminated at suitable terminal blocks. Sufficient clearance shall be provided for all control and instrument leads and all incoming

and outgoing leads shall be connected to terminal blocks suitably located for connecting external circuits.

e) High impedance circuits shall be connected using shielded or coaxial wire suitable for the service.

f) Conduits shall be supported properly at regular intervals with suitable conduit clamps.

g) Wire shall be neatly arranged and routed/laid in PVC trough/tray.

5.04.04 Junction Box

Junction boxes shall be of metallic construction.

a) Junction box shall be provided with front opening type cover. Junction box shall be of sheet steel construction with thickness not less than 2 mm. Junction box shall be complete with DIN rail mounted terminals, MCB, receptacles and earth bar. Earth bar shall be made of tinned copper of 25 X 6 MM size. Earth stud shall be furnished for safety grounding.

b) Terminals shall be screwless cage-clamp type and 20% spare terminals shall be furnished. Power terminals shall be screw type.

6.00.00 DESIGN CRITERIA

This section lays down the general design criteria to be adapted in designing the Control & Instrumentation system of the plant.

6.01.00 General Requirements

6.02.00 Instrumentation, control and automation devices and accessories shall be designed with the following considerations:

a) Stable in spite of temperature fluctuations.

b) Able to withstand high humidity.

c) Weather proof.

d) Dust proof.

e) Corrosion resistant.

f) Erosion resistant.

g) Able to withstand high vibration.

h) Easily accessible for operation & maintenance.

6.03.00 Parts subject to high pressure, temperature or other severe duty shall be of materials and construction suitable for the service conditions and long operating life.

6.04.00 Components of instruments, control devices, accessories, piping etc. which contact steam, condensate or boiler feed water shall be manufactured from copper-free materials.

6.05.00 Instrument Accuracy, Standard Scales and Ranges

6.05.01 Instrument Accuracy

Instruments shall meet the following general requirements.

a) Pressure measurement shall be linear with respect to the measured pressure.

b) Flow meter shall meet the specified accuracy criteria when operating between 25 and 100 % of full-scale flow. The accuracy 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 water specific gravity of 1.00.

d) Wherever the measured parameter is influenced by process pressure & temperature, required compressibility correction shall be introduced.

6.05.02 Instrument Scale Displays

a) All displays shall be in engineering units. Instrument scales displayed on screen will 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

6.05.03 Instrument Ranges

Instrument range shall be selected to have the normal reading, preferably between 50% and 70% of full scale for linear parameters and 70% to 80% 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.

6.08.02 Measurement & Channel Redundancy

To meet the failure and self checking criteria for the control system, measurement redundancy shall be provided for all the critical parameters. Throughout the control system, the security and validity of signals are to be ensured based on the following design principles.

a) Where a plant measurement is to be duplicated or triplicated such signals shall be separately fed to the different input modules.

b) Signals, after due security and validity checking by means of voting, averaging, median, difference monitoring or similar technique shall be used for control functions.

c) Where duplex measurements are used, provision shall be there for selecting any one as the duty signal. Continuous monitoring of Deviation between the signals shall be made in the system.

d) For binary and analog inputs required for protection of SG , TG and major auxiliaries whose non availability may result in loss of generation triple sensing devices shall be provided . Binary and analog inputs , which are required for protection of more than one equipment as well as protection signals for important auxiliaries and HT drives etc. triple sensing devices shall be provided .Also other binary and analog inputs required for CLCS dual sensing devices shall be provided . However,for those binary and analog inputs which are also required for protection in addition to CLCS, triple sensing devices shall be provided.

e) Measurement system, CLCS and OLCS shall all be configured with redundancy at processor modules,communication modules, data bus and power supply modules.Triple redundancy shall be followed as described elsewhere in the specification. All servers shall be dual redundant.

f) Both CLCS & OLCS shall be configured with Redundant I/O channels for each sensor/signals. Where redundant sensors are provided redundant I/O channels shall be provided for each sensors/signals.

g) Redundant sensors shall be provided for all control applications. For all major closed loop controls (CLCS) triple redundant sensors shall be provided. For other CLCS loops dual redundant sensors shall be provided.

h) Similarly for critical protection logic requirements triple redundant sensors for 2 out of 3 logic shall also be provided to avoid spurious tripping. For all other control application dual redundant sensors shall be provided. Dual and Triple redundant sensors shall also be provided as described elsewhere in the specification.

i) Signals shall be verified against cable failure / non coincidence monitoring for critical trip signals.

6.08.03 Redundancy in input / output modules

1. Redundancy

a) Redundancy in input / output modules for close loop control systems, open loop control system, protection, interlocking and sequential control shall be provided as follows:

i) Wherever redundant sensors are employed each sensor shall be wired to a separate input module so that even if one input module fails, the parameter will be available from the other input module.

ii) Redundancy in output module shall be provided for all HT (11KV & 3.3 KV) drives, critical LT drives and all modulating control drives so that any single failure of the output module shall not lead to the failure/disturbance of process. critical LT drives will be finalized by the owner at the time of Detail engineering.

iii) For BMS / FSSS and Turbine Trip system relevant sections elsewhere shall be referred. Refer clause nos. 4.29.02 and 4.30.01 of section -I for FSSS and Turbine trip redundancy.

iv) In addition to above, 20% wired input/output spare channel shall be provided for each I/O module.

2. Bidder to note that all I/O, Processor, network interface, communication modules etc., shall be sourced from their Original Principlal's works.

3. The system shall be provided with extensive diagnostic features so that a system failure can be diagnosed down to the module level giving location and nature of fault. Ease of maintenance and trouble shooting shall be a primary consideration in equipment selection.

4. The system shall provide inherently safe operation under all plant disturbances and component failures so that under no circumstances safety of the plant personnel nor equipment is zeopardized.. The DCS hardware shall be suitably sized to ensure that the implemented scheme meets the desired requirements. The Bidder through detailed calculations shall establish the adequacy of the system selected and demonstrate the same during shop testing and site testing.

6.08.04 Data highway Redundancy

There shall be Redundancy in the system for high reliability of communication. The redundant buses shall work continuously. All communication modules, bus couplers, bus interfaces etc. shall also be hot redundant.

Communication between the operator station and the functional groups of control microprocessors shall be by means of hot redundant data highways.

Redundancy failure shall also be indicated in operating station.

All soft links amongst DCS and various PLC / proprietary control systems shall be redundant bidirectional OPC link.

6.08.05 Redundancy for Power supply unit

All power supply feeders from UPS (in parallel mode having 50% load sharing) or 24 V DC system (in parallel mode having 50% load sharing) shall be redundant with auto changeover in each ACDB/DCDB panel. Any kind of bulk power supplies if used shall be redundant.

6.08.06 Redundancy in Operaotr Console

Operators' Consoles shall have fall back feature so that in case of failure of any console , its functions can be taken up in an adjacent console and LVS.

6.08.07 Design Of Enclosures

i) Design of outdoor enclosures shall be weather proof, dust-tight, drip-proof and shall take into account the environmental conditions.

ii) Enclosures shall be adequately sized so that the maximum permissible temperature rise above 50 Deg C ambient is 10 Deg C (maximum).

iii) Enclosures design shall also take into account greatest possible personnel safety.

6.09.00 Electrical Noise Control

6.09.01 Equipment furnished by Bidder shall incorporate necessary techniques to eliminate problems caused by electrical noise interferences and power line borne surges encountered in power plant environment. Equipment, which are vulnerable to electrical noise interference or surge shall be suitably immunized to eliminate possible problems.

6.09.02 Bidder shall be responsible for implementation of the shielding, input balancing, ripple filtration and grounding for field inputs to achieve installation with minimum noise coupling.

6.09.03 Radiated immunity test shall be in accordance to IEC 801.3.

6.10.00 Surge-Protection For Solid State Equipment

6.10.01 All solid-state equipment shall be able to withstand the surges inherent in a powerhouse environment. Equipment shall be designed to successfully withstand surges without damage to components and/or wiring on application of surge wave whose shape and characteristics are defined in ANSI publication C37.90-a (IEEE-472-1974) entitled "Guide for Surge Withstand Capability (SWC) Tests".

6.10.02 To immunize the system against surge, coupling free wheeling diodes, surge suppressors, opto / galvanic isolators shall be used as required.

6.11.00 Burn-In And Elevated Temperature Test

Solid-state equipment / system shall be certified to be tested for a minimum period of 168 hours continuously under power. Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies.

6.12.00 Elevated Temperature Test

a) During the first 48 hours the ambient temperature shall be maintained at 50^{0} C and the equipment shall be made to repeatedly perform operations it will be expected to perform in service with loads on various components being equal to those which will be experienced in actual service.

b) The 48 hours test period shall be continuous but shall be divided into four 12-hour segments. The power supply voltage during each 12 hours segment shall be nominal voltage for 11 hours; followed by 110 percent of nominal voltage for 30 minutes; followed by 90 percent of nominal voltage for 30 minutes.

c) During the elevated temperature test the cubicle doors shall be kept closed and inside temperature in the zone of highest heat dissipating

component /module shall be monitored. Temperature rise inside the cubicle shall not exceed 10 Deg.C above the ambient temperature of 50 Deg.C.

6.13.00 Burn in Test

The 48 hours elevated temperature test shall be followed by 168 hours of burn in test at normal operating temperature. This test shall also be conducted as per above procedure.

6.14.00 Panels, Cubicles and Enclosures

6.14.01 General

a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.

b) Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.

c) 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 CRCA steel for UCP / backup panel and other panels/cabinets shall be as described in Section VII of this volume of the specification. Panels and cabinets shall be of adequate strength to support mounted components during shipment

and to support a concentrated load of 100 Kilograms on their top after erection.

d) Panel /cabinet shall have eyebolt on top for lifting.

e) Mounting , wiring , powering of all items to be mounted / installed on desks irrespective of the source of procurement shall fall in the scope of erection of Bidder ,this shall include freeissue items furnished by Owner.

6.14.02 Surface Preparation and Painting

Sheet metal 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. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting.

b) Two spray coats of epoxy primer □urface shall be applied to all exterior and interior surfaces, each coat of primer □urface 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. The Min. Paint shade thickness at exterior & Interior shall be 80 to 100 Microns.The finish colors for exterior and interior surfaces shall conform to the following shades:

i) Exterior : RAL 7032

ii) Interior – Brilliant White (Preferred) / RAL 7032.

c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

6.14.03 Wiring

Wiring 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.

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) 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. Open-ended terminal lugs shall not be used.

d) Internal wiring shall 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 mili volt or micro volt shall be electrically and physically isolated from other AC and DC wiring.

f) All low-level signal cables shall be separately bundled from control cable.

g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall 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.

h) Shield wires shall be terminated on separately.

i) Common connections shall be limited to two wires per terminal. Looping of wires for power distribution in the panel to be avoided. Busbars to be provided for Power distribution".

j) 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 will not cause fatigue to the conductor.

k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. No wire shall be routed across the face or rear of any device in a manner, which will

impede the opening of covers or obstruct access to leads, terminals or devices.

l) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.

m) Panels /cabinets /desks shall be provided with removable gasketted cable gland plates and cable glands. Split type grommets shall be used for prefab cables.

n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.

o) Wire sizes used for internal wiring shall not be lower than the followings :

Control wiring (switches, pushbuttons etc.)	: 1.5 Sq.mm
Power supply /receptacle /illumination wiring	: 2.5 sq. mm or higher as per load

4-20mA DC current and low voltage signal upto 48V DC	: 0.5 Sq. mm

p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.

6.14.04 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) 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. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.

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 by means of insulated copper ground cable of required cross section with lug.

d) Circuits requiring grounding shall be individually and directly

connected to the panel ground bus.

e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.

f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure.

6.15.00 Panel / Cabinet/ Desk/ Enclosures / junction boxes & instruments Environmental Protections

a) Panels, cabinets, desks, distribution boxes, racks ,junction boxes, terminal boxes , instruments and all other field mounted equipment / enclosures shall suit the environmental condition of the area and shall not be inferior than the requirement indicated in the following table.

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

b) The construction of electrical enclosures located in areas subject to conditions classified in the National Electrical Code (NEC) as hazardous shall be of a type designated suitable for the environment in which they are located.

6.16.00 Terminal Blocks

a) Terminals shall be chromated galvanized DIN rail mounted screwless cage clamp type or maxi termi 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.

- High contact force, independent of conductor cross-section and large contact surface area.
- Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
- Inspection and maintenance free (resistant to thermal aging and vibration)
- 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 screwless 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.

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 20% spare wired terminals of spare IO channels.

h) Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.

i) 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.

j) Other requirements of the terminal blocks are as follows:

i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.

ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.

iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.

iv) It shall 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.

v) Where more than one connection to a terminal block is required, two tier terminals shall be used.

vi) The terminal blocks for Power, control and signal cable terminal block shall be seperate with seperate colour coding for ease in recognition..

7.00.00 METERING BASES AND CHART UNITS

The following system of units shall be followed for various displays and scales unless otherwise mentioned:

i)	Pressure	: Kg/cm^2
	Differential Pressure	: mm of H_2O column / Kg/cm^2
ii)	Draught	: mm of H_2O column
iii)	Vacuum	: Kg/cm^2 (abs)/mm of Hg column

iv)	Temperature	: Degree Celsius (^{O} C)
v)	Flow (Steam, Water)	: Tonnes / hr, M^3/Hr
vi)	Flow (Oil)	: M^3 / Hr, Liter/Hr
vii)	Flow Air	: Tonnes / hr / M^3 / Hr.
viii)	Density	: gms / c.c.
ix)	Level	: mm /%
x)	Conductivity	: Micro Siemens / cm
xi)	Gas Analyzer	: Percentage by weight or as specified in respective case.
xii)	Dissolved Oxygen / Silica / Sodium	: ppm /ppb

8.00.00 PROCESS CONNECTION & INSTRUMENT HOOK UP

8.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.

8.02.00 Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.

8.03.00 Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards.

10.00.00 ENVIRONMENTAL CONSIDERATIONS

C&I components shall operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. C&I system shall be designed considering all the operating conditions which may be encountered during installation and operation.

10.01.00 Temperature

10.01.01 Where the environmental extreme exceeds the capabilities of the selected system, Bidder shall take appropriate steps to control the environment.

10.02.00 Humidity

10.02.01 C&I system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor shall water be allowed to be admitted through conduit entering the cabinets from top or sides.

10.03.00 Atmospheric Contamination

10.03.01 Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO2 and other flue gas constituents in the coal fired plant are foreseen. This hazard shall be taken into design considerations.

10.04.00 Vibration

10.04.01 Design of the systems shall include features such as locking devices, anti vibration pads etc, to withstand vibration. In general, C&I equipment shall be installed away from the vibration zone.

10.05.00 Lightning

10.05.01 Protection against lightning shall be considered by providing proper grounding, metal oxide varistors, spark gap lightning arrestor, optical isolator and isolation transformer.

11.00.00 SECURITY

11.01.00 IP Door lock shall be provided in all Panels, Cabinets and Enclosures.

11.02.00 System mode key switch or password to prevent tampering of system program.

11.03.00 Redundant elements of the system shall not be exposed to the common hazards. For example routing of the redundant network cable through separate cable raceway, using separate cabinet / separate rack for redundant controller and redundant IO modules.

FORM NO. PEM-6666-0

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS –999- 145 –054A	
		VOLUME II B	
		SECTION D	
		REV. NO. 03	DATE : 16-09-2013
		SHEET 1	OF 6

1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site, supervision, erection, and commissioning at site of Local Panels required for control and monitoring of the Auxiliary Plant & Equipment.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 As a minimum requirement, the following standards shall be complied with:

a)	IS-6005 : 1998	:	Code of practice for phosphating of iron and steel.
b)	IS-5 : 2007	:	Colors for ready mixed paints and enamels.
c)	IS-1248:2003	:	Direct Acting Indicating Analog Elec Measuring Instruments.
d)	IS/IEC 60947:Part 1:2004	:	Low Voltage switchgear & control gear: Part-I (General Rules)
e)	IS-8828:1996	:	Circuit breaker for household and similar installations.
f)	IS-13947 (Part-I):1993	:	Low Voltage switchgear & control gear : Part-I (General Rules)
g)	ISA-18.1:1979	:	Annunciator Sequences and Specification
h)	NFPA-496:2003	:	Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps/LED cluster, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and stiffeners as necessary shall be provided.

3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel
Frame thickness: Not less than 3.0mm
Enclosure thickness: Not less than 3.0 mm for load bearing sections (Mounted with instruments)
2.0 mm for doors and Not less than 2.0 mm for others
Panel Height: Not less than 2365 mm (Refer data sheet-A (No. PES-145A-DS1-0)
Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at minimum three places. The door width shall not be more than 550mm.The doors shall be provided with suitable stiffeners to prevent buckling. The handle shall be on the right side of the door. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings / documents. Double door shall be provided with suitable glass windows, as per the requirement.

3.1.6 Suitable neoprene gasket shall be provided on all doors and removable covers. Suitable ventilation system along with louvers shall be provided at bottom and top of the doors covered with removable wire mesh.

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3.1.7 The class of protection shall be in accordance with IP-55 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).

3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.

3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.

3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.

No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.

3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.

3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm2 size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.

3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm2 to 2.5mm2 external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (20) percent spare terminal.

3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps / tube lights with shrouded cover of minimum 15W operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.

3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.

3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm2 size.

3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte

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Sheet / 2 mm Anodised Aluminium Plate. The inscription shall be with white letters on black background on traffolyte sheet. The labels shall be fixed by self tapping non-rusting screws.

3.1.18 Vendor shall furnish electric load and heat load list (in case panel is to be placed in ac environment) of each panel.

3.2 Hazardous Area Panel Requirement

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.

3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.

3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring devices

3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.

3.3.2 Alarm Annunciator System

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.

3.3.3 Relays

The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

3.3.4 Timers

The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.

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3.3.5 Control / Selector Switches

Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position / functions.

3.3.6 Push Buttons / Indicating Lights

The push buttons shall be momentary action self-resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate / inscription plate. Colour coding of push buttons shall be as under:

RED	Motor OFF / Valve CLOSE	YELLOW	Alarm acknowledge	Left Hand Side
GREEN	Motor ON / Valve OPEN	BLACK	Lamp test	Right Hand Side

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with LED cluster type lamp replaceable from front.

GREEN	Motor OFF / Valve CLOSED condition	AMBER	Motor tripped	Left Hand Side
RED	Motor ON / Valve OPEN condition	WHITE	Normal / healthy	Right Hand Side

3.3.7 Ammeters

Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type as called for in the data sheet-A (No. PES-145-54A-DS1-0). Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication

3.3.8 Miniature Circuit Breaker (MCB)

These shall be instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal trip feature for over current protection. The housing of MCB shall be made of non-ignitable, high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

3.3.9 Makes of various instruments / devices shall be as given below

1.	Alarm Annunciators	:	Procon / IIC
2.	Ammeters	:	AEP / IMP
3.	Control / Selector Switches	:	Alsthom / Kaycee / Siemens / L&T
4.	Push Buttons / Indicating Lamps	:	Siemens / L&T / Teknic / Alsthom
5.	Auxiliary Relays	:	Jyoti / Siemens / L&T / OEN
6.	Timers	:	L&T / Alsthom / Bhartiya Cutler Hammer
7.	MCBs	:	S&S Power Engg. / Indo Asian / MDS
8.	Terminal Blocks	:	Jyoti / Elmex

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 BHEL's standard Quality Plan for LCP is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.

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4.3 The vendor shall conduct the following tests as a minimum requirement:

4.3.1 Routine Tests

1. High Voltage (H.V.)
2. Insulation Resistance (I.R.)
3. Functional

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

5.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

1. Data Sheet no. PES-145A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract:

1. Data Shee No. PES-145A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs.

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrossion, incidental damage due

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to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Local Panels : Data sheet no. PES-145A-DS1-0
- Data sheet C for Local Panels : Data sheet no. PES-145A-DS2-0

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	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PES-145-054A	
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TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet A & B

			DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER			
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT	■3.0 mm(FOR FACES SUPPORTING INSTRUMENTS/TERMINALS)	
		OTHER	■ 2.0 mm (FOR OTHER SIDES AND TOP)	
		DOOR	■ 2.0 mm	
		HEIGHT	☐ 2365 mm for stand alone panels. (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
		OTHER	☐	
TECHNICAL	INPUT POWER SUPPLY *		☐ 240V 50 Hz AC ☐ 220V DC ☐ 415V 3 PHASE 3W ☐ 415V 3 PHASE 4W	
	NO. OF FEEDERS		☐ ONE ■ TWO	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____NOS. (AS REQUIRED)	
	PAINT TYPE		☐ EPOXY ENAMEL ■ EPOXY POWDER COATED OR BETTER (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
	PANEL COLOUR (EXTERNAL)		☐ LIGHT GREY (Shade 631 IS-5) ☐ OPALINE GREEN (Shade 275) . ■ RAL 7032 (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
	FINISH (EXTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL)		☐ WHITE ☐ CREAM ☐ OFF WHITE ■ BRILLIANT WHITE	
	FINISH (INTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	CLASS OF PROTECTION		☐ IP-42 (FOR INDOOR SERVICE) ■ IP-55 (FOR OUTDOOR SERVICE) ☐ ANY OTHER	
	CONTROL HARDWARE		■ RELAY BASED	
	FOUNDATION ARRANGEMENT		☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)			
	PANEL TYPE		☐ PRESSURISED ☐ UNPRESSURISED As per Requirement	
	CABLE GLAND		☐ DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT) *		☐ 1 Amp CT ☐ 4-20 mA	

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BHEL	**DATA SHEET FOR LOCAL PANELS**	SPECIFICATION NO.: PES-145-054A
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TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

* TO BE CO-ORDINATED WITH PEM ELECTRICAL

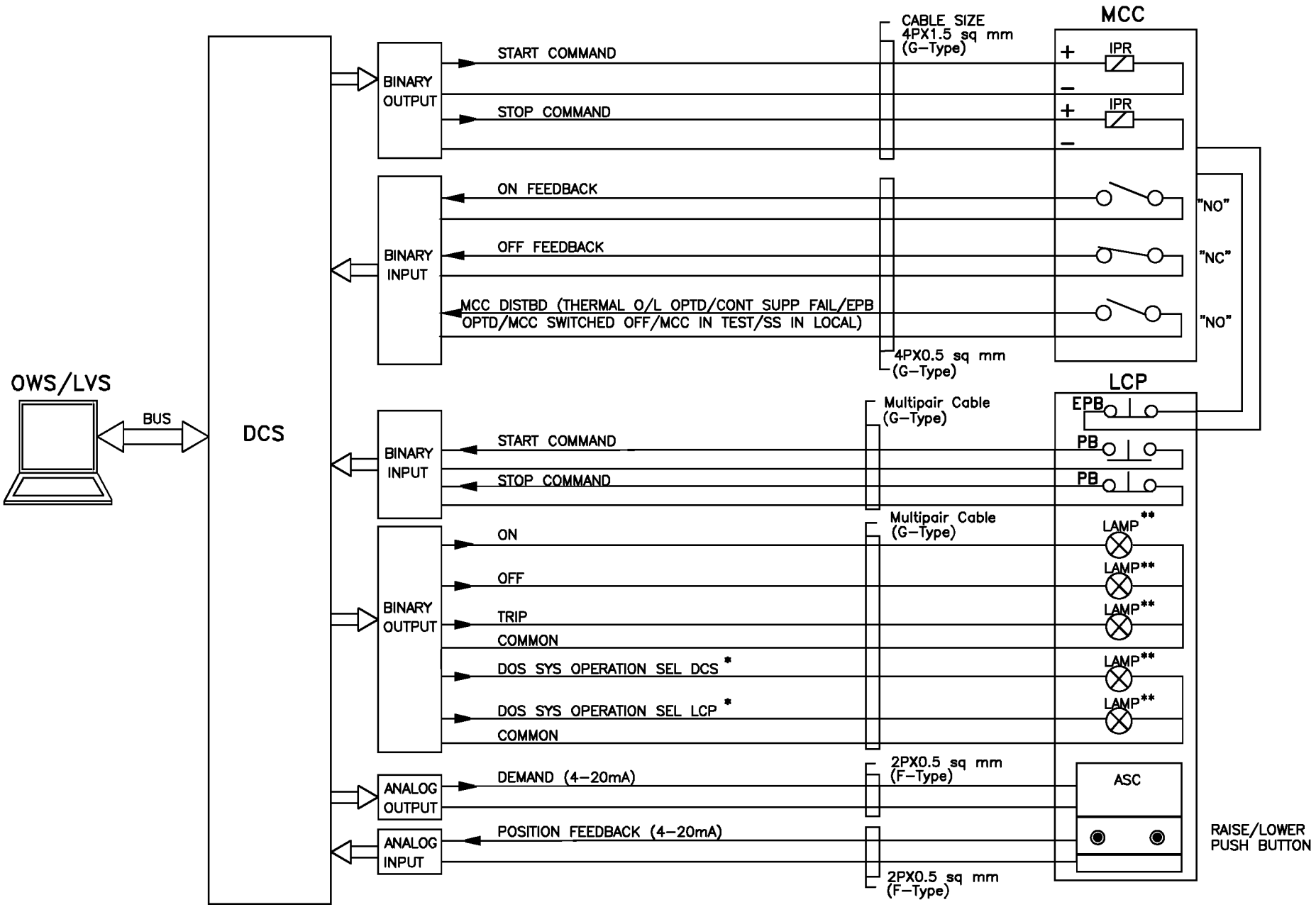
	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME				NAME:
SIGNATURE				SIGNATURE:
DATE				DATE:

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR LP CHEMICAL DOSING SYSTEM	

SIGNL EXCHANGE BETWEEN DRIVES & DCS

277014/2024/PS-PEM-WSE

DCS INTERFACE FOR LP CHEMICAL DOSING SYSTEM

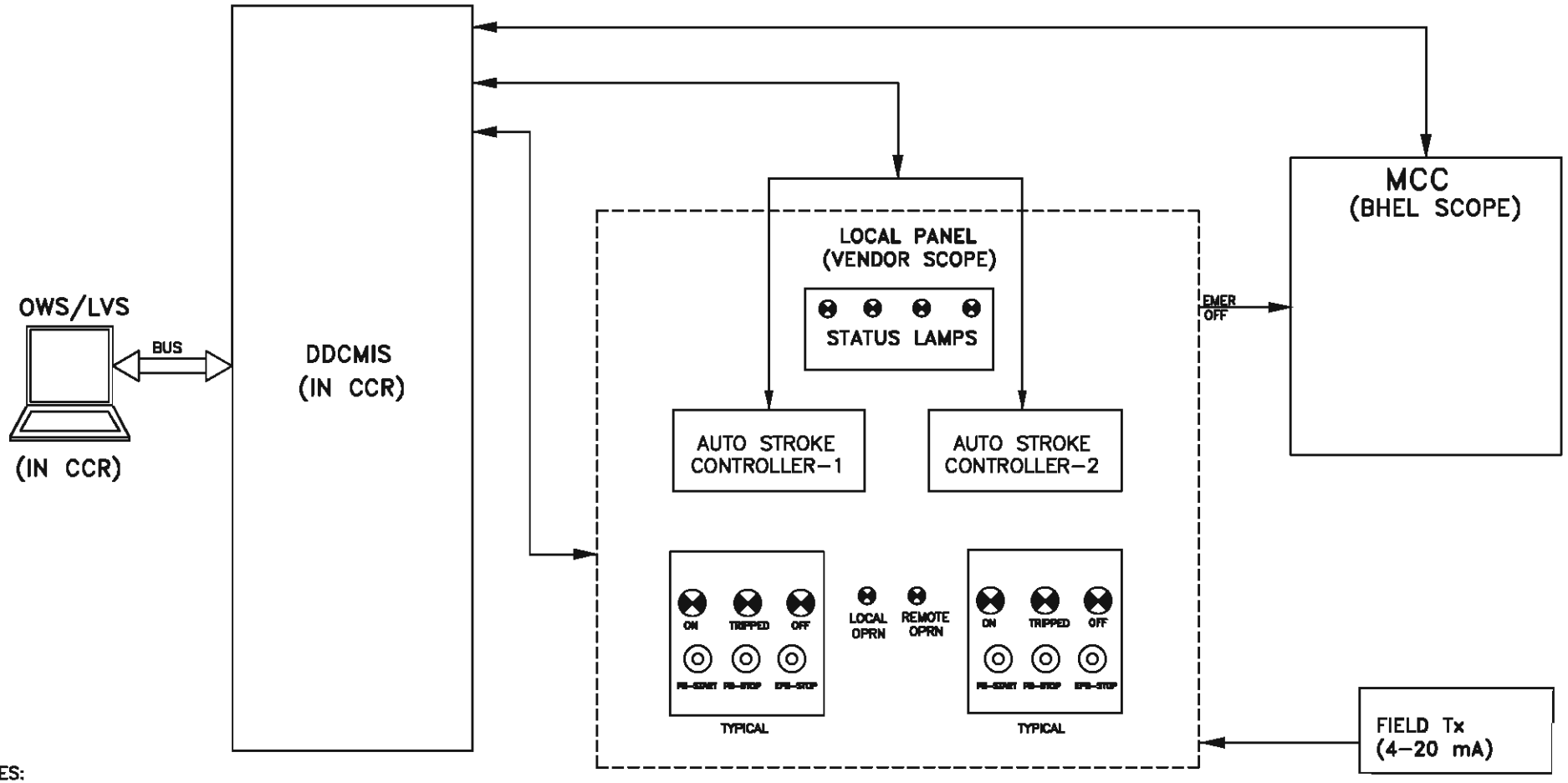


NOTE:–
INTERPOSING RELAYS (IPRs) TO BE SUPPLIED ALONG WITH MCC.
* COMMON SIGNAL FOR COMPLETE LP CHEMICAL DOSING SYSTEM
** ALL LAMPS ARE 24V DC DRIVEN.
THIS DRIVE INTERFACE IS INDICATIVE ONLY.

1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)

TITLE
DCS INTERFACE FOR LP CHEMICAL DOSING SYSTEM

STANDARD BLOCK INTERFACE DIAGRAM FOR LP DOSING SYSTEM (TYPICAL)



NOTES:

1. SIGNAL EXCHANGE BETWEEN DDCMIS & LP DOSING LOCAL PANEL SHALL BE AS PER CONTROL PHILOSOPHY.
2. FIELD INSTRUMENT SHALL BE TERMINATED IN LOCAL PANEL.
3. SIGNALS FOR INTERFACE TO/FROM DDCMIS ARE ALSO TERMINATED IN LOCAL PANEL.
4. A LOCAL PANEL COMPRISING OF 'START PB, 'STOP' PB ALONG WITH 'ON/ OFF/ TRIP' INDICATION, LOCAL/ REMOTE INDICATION, STROKE POSITION INDICATOR, RAISE/ LOWER PUSH BUTTON FOR STROKE POSITION AND LOCAL ANNUNCIATION SHALL BE PROVIDED BY BIDDER FOR LOCAL OPERATION.
5. AUTO STROKE CONTROLLER SHALL HAVE FACILITY OF STROKE LENGTH ADJUSTMENT THROUGH PUSH BUTTONS & 4–20mA SIGNALS.
6. THE LOCAL PANEL IS TYPICAL. SIMILAR PANELS SHALL BE APPLICABLE FOR A. HYDRAZINE DOSING SYS, B. AMMONIA DOSING SYS, C. NAOH DOSING SYS.

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		DATE	
	TITLE STANDARD BLOCK INTERFACE DIAGRAM FOR LP DOSING SYSTEM	REV.NO.	01
		SHT	3 OF 3

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR LP CHEMICAL DOSING SYSTEM	

INSTRUMENT CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY

11.03.00 Instrumentation Cable Interconnection and Termination Philosophy

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group JBs at strategic locations (where large concentration of signals are available, e.g. switchgear) is done and consequently cable with higher number of pairs are extensively used. JB's to be furnished under this specification shall be of 6/12/24/36/48 way. The material dimension and interior / exterior colour of JB's shall be subject to Owner's approval. The details of termination to be followed is mentioned in TABLE – 3 :

TABLE- 3

CABLE TERMINATION TO BE FOLLOWED

SL. NO	APPLICATION		TYPE OF TERMINATION		TYPE OF CABLE
	FROM (A)	TO (B)	END (A)	END (B)	
01.	Valves / Dampers Drive (Integral Junction Box)	Marshalling Cubicle / Local Group JB / Termination Control Cabinets / System Cabinets	Plug-in Connector	Post mounted Maxitermi / Cage Clamp type	G
02.	Transmitters, Process actuated switches to be mounted in LIE / LIR	Integral Junction Box of LIE / LIR	Plug-in Connector	Maxitermi / Cage Clamp (Rail mounted) type.	F, G
03.	RTD Heads	Local Junction Box	Plug-in Connector	Maxitermi / Cage Clamp (Rail mounted) type.	H
04.	Thermocouples	CJC Box	Manufacturer's standard	Screwed / Cage Clamp Type	A,B,C*
05.	Local Junction Box, CJC Box, Int. Junction Box of LIE / LIR / Group JB / MCC / Switchgear	Marshalling Cubicle / Local Group JB / Termination / Control Cabinets / System Cabinets	Maxitermi / Cage Clamp (Rail mounted) type.	Post mounted Maxitermi / Cage Clamp type	F, G
06.	Local Junction Box, MCC / Switchgear	Group JB	Maxitermi / Cage Clamp (Rail mounted) type.	Maxitermi / Cage Clamp (Rail mounted) type.	F, G
07.	Field mounted Instrument	Group JB	Maxitermi / Cage Clamp (Rail mounted) type.	Maxitermi / Cage Clamp (Rail mounted) type.	F, G
08.	Marshalling Cubicle /	Electronic System	Post mounted Maxitermi /	Post mounted Maxitermi /	F, G

SL. NO	APPLICATION		TYPE OF TERMINATION		TYPE OF CABLE
	FROM (A)	TO (B)	END (A)	END (B)	
	Termination Cabinet	Cabinet	Cage Clamp type.	Cage Clamp type.	
09.	UCP mounted equipments	Post mounted Maxitermi / Cage Clamp type	Post mounted Maxitermi / Cage Clamp type.	Plug in Connector / Cage Clamp type (rail mounted)	F, G (with connector at one end)
10.	DCS/ PLC Cabinets	PC, Printers etc.	Plug in connector	Plug in connector	Manufacturer Standard

NOTES :

01. For Sl. No. 05, 06, 07 & 08, normally 10% spare core shall be provided.

02. For analog signals individual pair shielding & overall shielding & for Binary signals only overall shielding of instrumentation cables shall be provided.

03 *For high temperature application only.

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR LP CHEMICAL DOSING SYSTEM	

ERECTION HARDWARE

12.00.00 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.

12.01.00 ELECTRICAL ACCESSORIES

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.

12.01.01 Junction Box

01.	Type of Enclosure	:	Dust tight & weatherproof conforming to IP 65
02.	Material	:	2 mm sheet steel
03.	Type of Cover	:	Solid Hinged Door with steel handle and IP lock
04.	Paint	:	631 IS 5 Epoxy Powder Coated
05.	Mounting	:	Surface
06.	Cable Entry	:	3 mm (min) Gland plate
07.	Gasket	:	Neoprene
08.	Grounding	:	Brass earth lug with green screw head External-2 nos , Internal-1no.M6.
09.	Number of Drain Holes	:	Two at bottom capped.
10.	Identification	:	Label for JB and Tags for cable
11.	Accessories	:	a) Rail mounted cage clamp type screwless terminals with markers b) Cable gland c) Ferrules d) Canopy at top

12.01.02 Cable Gland

01.	Type	:	Double compression
02.	Entry Thread	:	NPT
03.	Material	:	Brass
04.	Finish	:	Cadmium Plated.
05.	Protection	:	IP 65 or better

06. Accessories : Neoprene gasket, locknuts, reducers etc.

12.01.03 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

06. Height of the cable tray : 100 mm for 450mm and above width. (width cannot be less than 100 mm)

12.02.00 PROCESS HOOK UP ACCESSORIES & SPECIFICATION

Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for Owner's approval.

12.02.01 Specification for Process Hook Up Materials

PROCESS CONNECTION PIPING

SL. NO.	SYSTEM / LINE DESCRIPTION	PIPING CLASS	IMPULSE PIPING MATERIAL	SCHEDULE (SIZE)	MATERIALS FOR FITTING / VALVE BODY	VALVE STEM MATERIAL	RATING OF PIPING / FITTINGS	PRESS. CLASS OF VALVE
01.	MAIN STEAM / UPSTREAM OF HP BYPASS AND AUXILIARY STEAM PRESSURE REDUCING VALVE	A	ASTM-A335 GR. P-91/22 (NOTE-2)	XXS (½ INCH)	ASTM-A182 Gr. F-22	ASTM-A182 Gr. F-6a	9000 LB	3000 SPL
02.	BFP DISCHARGE / SUPERHEATER ATTEMPERATOR / SPRAY TO PRDS	B	ASTM-A106 GR. C	160 (½ INCH)	ASTM-A105	ASTM-A-182 GR. F6A	6000 LB	2500
03.	REHEATER ATTEMPERATOR	C	ASTM-A106 GR. C	160 (½ INCH)	ASTM-A105	ASTM-A-182 GR. F6A	6000 LB	1500

04.	HOT REHEAT / DOWN STREAM OF AUX. STEAM PRESSURE REDUCING VALVE UPTO DESUPER-HEATER / FLASH TANK DRAIN MANIFOLD	D	ASTM-A335 GR. P-91/22 (NOTE-2)	160 (½ INCH)	ASTM-A182 GR.F-22	ASTM-A182 Gr.F-6a	3000 LB	900
05.	COLD REHEAT UPTO TEE-OFF FOR HP BYPASS / EXTRACTION STEAM NO. 5 TO HPH	E	ASTM-A335 GR. P-22	80 (½ INCH)	ASTM-A182 GR.F-22	ASTM-A-182 GR. F6A	3000 LB	800
06.	COLD REHEAT DOWN-STEAM OF TEE-OFF (HP BYPASS)	F	ASTM-A106 GR. C	80 (½ INCH)	ASTM-A105	ASTM-A-182 GR. F6A	3000 LB	800
07.	BFP SUCTION / CONDENSATE SYSTEM / EXTRACTION TO LPH / EXTRACTION-4 TO BFP-T, DEAERATOR / AUXILIARY STEAM	G	ASTM-A106 GR. B	80 (½ INCH)	ASTM-A105	ASTM-A-182 GR. F6A	3000 LB	800
08.	AIR / FLUE GAS OUTSIDE FURNACE	M	ASTM-A106 GR. B/C	80 (¾ INCH)	ASTM-A105	ASTM-A-182 GR. F6A	3000 LB	800
09.	AIR / FLUE GAS INSIDE FURNACE	N	ASTM-A335 GR. P-22	80 (¾ INCH)	ASTM-A182 GR. F-22	ASTM-A-182 GR. F6A	3000 LB	800
10.	Purge Air	–	ASTM-A106 Gr. C	80 (3/4 inch)	ASTM-A 105 Gr. F-22	SS or better	3000 lb	800
11.	DM Cooling Water	–	ASTM A312 TP 316	40 (1/2 inch)	ASTM A182 F316	SS or better	3000 lb	800
12.	CW & ACW	–	ASTM-A106 Gr. C	80 (½ inch)	ASTM-A 105	SS or better	3000 lb	800

NOTE :

(1) RATING OF PIPING / FITTINGS / VALVES ETC. IS SUBJECTED TO THE DESIGN PRESSURE & TEMPERATURE DURING THE DETAILED ENGINEERING.

(2) IN CASE TEMPERATURE IS MORE THAN 540 DEG. C, THE MATERIAL SHALL BE P-91 ONLY.

12.02.02 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

12.02.03 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.

12.02.04 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

12.02.05 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

12.02.06 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

12.02.07 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.

12.02.08 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

12.02.09 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.

12.02.10 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

12.02.11 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/Cm2
	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

12.02.12 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

12.02.13 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

12.02.14 Instrument Valve Manifold

	01.	Type	:	a) Two valve manifold b) Five 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 Deg 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	:	i) Plugs for all ports

ii) Mounting Bracket , bolts , nuts

12.03.00 PNEUMATIC HOOK UP ACCESSORIES

12.03.01 Air Header

Technical Particulars :

			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

12.03.02 Seamless Stainless Steel Tube

01.	Reference	:	ASTM A-269 TP 31605
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

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR LP CHEMICAL DOSING SYSTEM	

QUALITY ASSURANCE PLAN/CHECK LIST

2.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured and tested at all the stages, as well as Services provided for erection, commissioning and testing shall be as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme and reviewed by by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Owner's representative for review. Schedule of finalisation of such quality plans will be finalised before award.

2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's Quality Control organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing.

2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site.

2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Consultant's approval without which manufacture shall not proceed. In these approved quality plans, Owner/Authorised representative/Consultant shall identify Customer Hold Points (CHP), test/checks which shall be carried out in presence of the Owner/Consultant/Owners Owner's Engineer or his Authorised Representative and beyond which the work will not proceed without consent of Owner/Authorised representative/Consultant in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised Representative/Consultant for acceptance and dispositioning.

2.05.00 The Bidder shall provide adequate notice to the Owner for inspection before the material is dispatched as per the provisions of the Contract. No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of

all previous tests/inspections by Owner's Owner's Engineer/Authorised representative, and duly authorised for despatch issuance of Material Despatch Clearance Certificate (MDCC).

2.06.00 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.

2.07.00 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.

2.08.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.

2.09.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Bidder's/Sub-Vendor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorised representative.

For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.

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.

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.

2.10.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination). Results of NDT shall be properly recorded and submitted for acceptance.

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.

2.11.00 All the Sub-Vendors proposed by the Bidder for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Bidder and finalised with the Owner shall be subject to Owner's review. Quality Plans of the successful Sub-Vendors shall be discussed, finalised and accepted by the Owner/Authorised representative and form part of the Purchase Order between the Bidder and the Sub-Vendor.

2.12.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Bidder and finalised with the Owner shall be furnished to the Owner for comments and subsequent acceptance before orders are placed.

Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their Sub-Vendor's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.

Quality audit/acceptance of the results of tests and inspection will not prejudice the right of the Owner to reject equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Bidder in earning satisfactory performance of equipment as per specification.

2.13.00 Quality requirements for main equipment shall equally apply for spares and replacement items.

2.14.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the acceptance of the Owner.

2.15.00 For quality assurance of all civil works refer to the specifications for civil works.

3.00.00 QUALITY ASSURANCE DOCUMENTS

3.01.00 The Bidder shall be required to submit two (2) copies and two (2) sets of microfilms of the following Quality Assurance documents within three (3) weeks after despatch of the equipment:

a) Material mill test reports on components as specified by the specification.

b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.

c) Non-destructive examination results /reports including radiography interpretation reports.

d) Factory tests results for testing required as per applicable codes and standards referred in the specification.

e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.

f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

g) Stress relief time temperature charts.

h) Inspection reports duly signed by QA personnel of the Owner and Bidder for the agreed inspection hold points. During the course of inspection, the following will also be recorded :

i) When some important repair work is involved to make the job acceptable.

ii) The repair work remains part of the accepted product quality.

i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

4.01.00 The Successful Bidder shall give the Owner’s Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Successful Bidder's account except for the expenses of the Inspector. The Owner’s Engineer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Successful Bidder may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports in six (6) copies.

4.02.00 The Owner’s Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Successful Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Successful Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Owner’s Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

4.03.00 When the factory tests have been completed at the Bidder's or sub-Vendor's works, the Owner/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Owner/ Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Owner/Inspector. Failure of the Owner/Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.

4.04.00 The Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

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

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

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

Note :

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

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

CHECK LIST FOR TRANSMITTER

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

Legend :

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

Note :

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

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

CHECK LIST FOR TEMPERATURE ELEMENT

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MODEL No./TAG No.						
	PROCESS CONNECTION						
2	STABILITY			P	W	V	
3	INSULATION RESISTANCE			P	W	V	
4	ENCLOSURE CLASS			P	W	V	
5	RESPONSE TIME			P	W	V	
7	ACCURACY			P	W	V	
8	HYDROSTATIC TEST			P	W	V	
9	ELECTRICAL CHARACTERISTIC OF SENSOR (CONTINUTY OF T/C WIRES & INSULATION RESISTANCE OF RTD LEADS w.r.t. BODY			P	W	V	
10	TEMP CURVES / CHARTS			P	V	V	
11	AMBIENT TEMP. EFFECT CHECK			P	W	V	
12	HV TEST			P	W	V	

Legend :

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

Note :

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

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

CHECK LIST FOR PRESSURE & DP GAUGE

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

Legend :

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

Note :

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

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

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR	ONE / LOT		P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

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

Note :

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

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR LP CHEMICAL DOSING SYSTEM	

TYPE TEST REQUIREMENT

13.00.00 TYPE TEST REQUIREMENTS

13.01.00 General Requirements

13.01.01 Contractor 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. A list of such tests are given for various equipment in table titled 'Type Test Requirement for C&I Systems' at the end of this sub-section. For the balance equipment instrument, type tests may be conducted as per manufacturers standard or if required by relevant standard.

13.01.02 Out of the tests listed, Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Owner or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.

13.01.03 For the rest, submission of type test results and certificate shall be acceptable provided:

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

b) There has been no change in the components from the offered equipment & tested equipment.

c) The test has been carried out as per the latest standards along with amendments as on the date of bid opening.

13.01.04 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 Bidder within the quoted price and no extra cost will be payable by Owner on this account

13.01.05 As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by Bidder or his authorized representative and the balance have to be approved by Owner.

13.01.06 The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.

13.01.07 For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Owner. 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.

13.01.08 Bidder shall indicate in his bid, the cost of the type test for each items only for which type tests are to be conducted specifically for this project.

13.02.00 Special Requirement for Solid State Equipments/ Systems

The minimum type tests reports, over and above the requirements of above clause which are to be submitted for each of the major C&I systems like SG-C&I system, TG- C&I system, Station - C&I system, Flame monitoring system, Coal feeders control and instrumentation system, Boiler flame analysis system, Turbine supervisory system, BFP Turbine supervisory instruments, Analyzer instruments, Vibration monitoring systems, etc. shall be as indicated below:

13.02.01 Surge Protections for Solid State Equipments/ Systems

All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and 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/ IEEE-472. 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 meets the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. 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, suitable class of IEC-255-4 which is equivalent to ANSI 37.90a/ IEEE-472 may also be adopted for SWC test.

13.02.02 Dry heat test as per IEC-68-2-2.

13.02.03 Damp heat test as per IEC-68-3.

13.02.04 Vibration test as per IEC-68-2-6.

13.02.05 Electrostatic discharge tests as per IEC 801-2 or equivalent.

13.02.06 Radio frequency immunity test as per IEC 801-6 or equivalent.

13.02.07 Electromagnetic immunity as per IEC 801-3 or equivalent.

Test listed at clause no. 13.02.05, 13.02.06 & 13.02.07 above are applicable for front end cards only as defined under clause no. 13.02.01 above.

14.00.00 SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR DCS AND OTHER SYSTEMS

14.00.01 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.

14.00.02 The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.

14.00.03 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.

13.03.00 Type Test Requirement for C&I Systems

SL. NO.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
01.	THERMOCOUPLES	DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
02.	RTD	AS PER STANDARD	IEC-751	NO	NO	
03.	C.J.C. BOX	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
		AMBIENT TEMP. EFFECT	APPROVED PROCEDURE	NO	YES	
04.	ELECTRONIC TRANSMITTER	AS PER STANDARD	BS-6447 / IEC-770	NO	YES	
05.	E/P CONVERTER	AS PER STANDARD	MFR. STANDARD	NO	YES	
06.	DUST EMISSION MONITOR	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
07.	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	VDE 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			

SL. NO.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
		• DIMENSIONAL CHECKS	IS 10810			
		• CROSS TALK				
		• MUTUAL CAPACITANCE	VDE 0472			
		• HV TEST	VDE 0472			
		• DRAIN WIRE CONTINUITY				
08.	PRESSURE GAUGE	• DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
		• TEMPERATURE INTERFERENCE TEST	IS-3624	NO	NO	
09.	TEMPERATURE GAUGE	DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
10.	PRESSURE & DIFFERENTIAL PRESSURE SWITCH	• DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
		• AS PER STANDARD	BS 6134	NO	NO	
11.	LEVEL SWITCH	DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
12.	CONDUCTIVITY LEVEL SWITCH	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
13.	CONTROL VALVES	CV TEST	ISA 75.02	YES	NO	
14.	FLOW NOZZLES & ORIFICE PLATE	CALIBRATION	ASME PTC, BS-1042	YES	NO	
15.	PLCs	ALL TESTS AS PER IEC-1131	IEC-1131			
16.	DCS					
	a) I/O MODULES	CMRR & NMRR VERIFICATION	Mfr. standard	NO	YES	
	b) OTHER MODULES	CMRR & NMRR VERIFICATION	Mfr. standard	NO	YES	
	c) CLCS SYSTEMS	MODEL TEST	Approved Procedure	YES	YES	
17.	LIE / LIR / JUNCTION BOX	DEGREE OF PROTECTION TEST	IS-2147	YES	YES	
18.	FLUE GAS O_2 ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
19.	FLUE GAS CO_2 ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR LP CHEMICAL DOSING SYSTEM	

APPLICABLE CODES AND STANDARDS

5.00.00 CODES AND STANDARDS

The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE , IS etc. Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall 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-255.4.

f) Printed circuit boards - IPC TM-650, IEC 326C.

g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973.

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)

k) Direct Acting Electrical Indicating Instruments - IS - 1248 - 1968

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) / IEC 60947 / IEC 60529

c) Protection Class for Enclosures , Cabinets Control Panels and Desks - IS 2147 1962

7) Apparatus, Enclosures and Installation Practices in Hazardous Area

a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978./ NFPA Article 500 , Vol.70-1984

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, 1982.

8) Sampling System

a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316.

b) Submerged helical coil heat exchangers for sample coolers -- ASTM D11-98.

c) Steam and water sampling ,conditioning and analysis in the power cycle - ASME PTC - 19.11

d) Standard methods of sampling system - ASTM D 1066-69

9) Annunciators

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

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

10) Interlocks, Protections

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

b) Surge withstand 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.

d) Turbine water damage prevention - ASME-TDP-1-1980.

e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.

f) Installation and operation of Pulverized fuel system - ANSI / NFPA 8503

g) Functional diagramming of Instrument and control systems - SAMA PMS 22.1

h) Digital interface for programmable instrumentation - ANSI / IEEE 488

11) Control Valves

a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972.

b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972.

c) Control Valve seat leakage – ANSI / FCI 70.2

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

e) Control Valve Capacity Test Procedure – ISA – S75.02

12) Process connection Piping and Tubing

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

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

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

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

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

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

g) Seamless Alloy Steel Pipe ASTM A 335 P22

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

i) Forged and Rolled alloy steel pipe flanges , forged fittings , valves and parts ASTM A - 182

j) Pipe fittings of wrought carbon steel and ally steel - ASTM A - 234

k) Composition bronze metal castings ASTM B - 62

l) Seamless copper tube , bright annealed ASTM B- 168

m) Valves flanged and butt welding ends ANSI B 16.34

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.

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

i)	Electrical Fast Transient	:	IEC-801.4
ii)	Surge Withstand	:	IEC-255.4
iii)	Radiated Electromagnetic Field	:	IEC-801.3
iv)	Electrostatic Discharge	:	IEC-801.2
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.

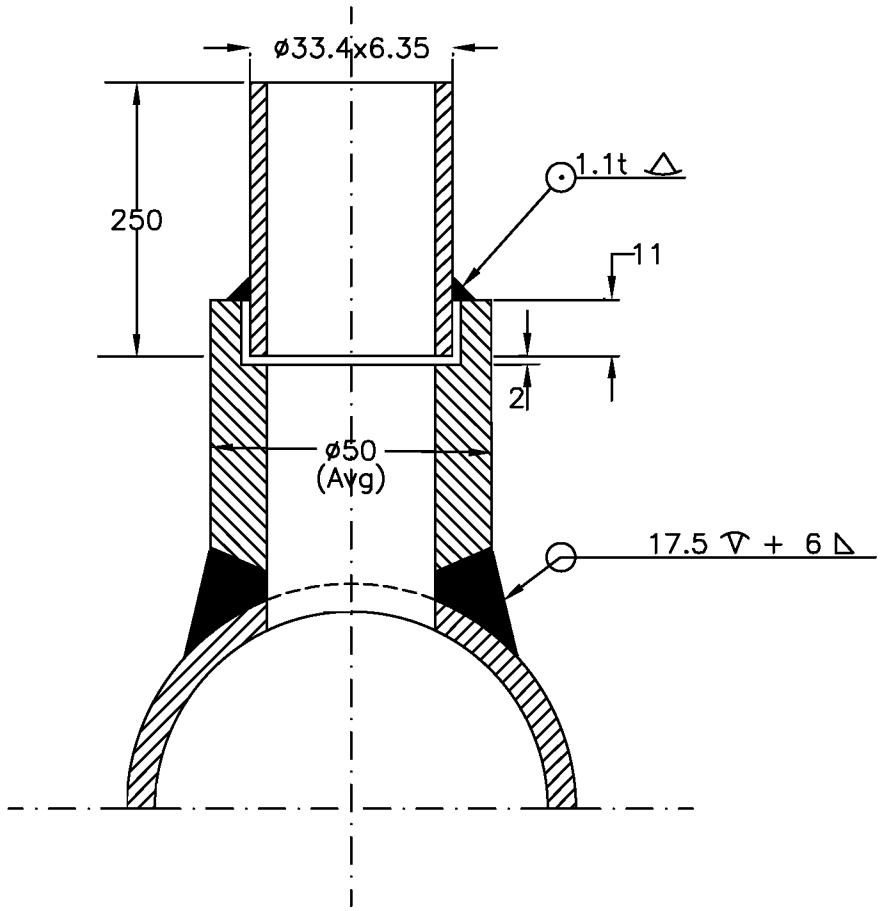
b) Galvanizing of carbon steel cable trays - ASTM A-386.

Codes and standards as described in different sub-sections of this specification shall also be followed .

Items such as thermowells, control valves, flow elements and other in line devices in high and medium pressure steam, feed water and similar services, which fall under the purview of Indian Boiler Regulation Act shall be either certified by IBR or shall be certified by authorities acceptable to IBR. It shall be responsibility of Bidder to obtain the necessary approval of the concerned Authority / Chief Inspector of Boilers for the design and design calculations, manufacturing and erection procedure as called for under the IBR Act for all items requiring such certification.

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR LP CHEMICAL DOSING SYSTEM	

INSTRUMENT STUB DETAIL



NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
6. STUB & NIPPLE SHALL HAVE IBR CERTIFICATION AS APPLICABLE, ACCORDING TO PROCESS DATA. 1

BHEL

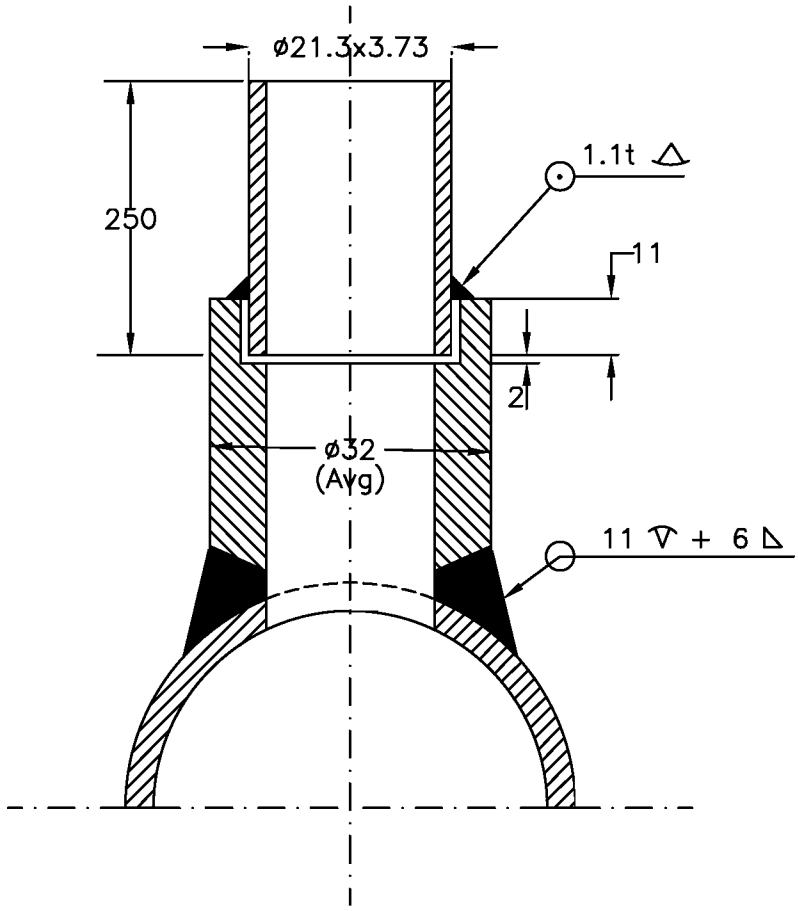
1

TITLE :

INSTRUMENT STUB DETAILS FOR PRESSURE MEASUREMENT

(60Kg/Cm2<PRESS≤455Kg/Cm2, TEMP≤425 DegC & Nb25, CLASS 6000#)
OR (PRESS≤455Kg/Cm2, 425DegC<TEMP≤500 DegC & Nb25, CLASS 6000#)

DRG. NO.
PE-DG-445-145-I101
REV. 01
SH. 3 OF 8 SHS.



NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
6. STUB & NIPPLE SHALL HAVE IBR CERTIFICATION AS APPLICABLE, ACCORDING TO PROCESS DATA. (1)

BHEL

TITLE :
INSTRUMENT STUB DETAILS
FOR PRESSURE MEASUREMENT
(PRESS < 60Kg/Cm2, TEMP < 425DegC & Nb15, CLASS 3000#)

DRG. NO.
PE-DG-445-145-I101
REV. 01
SH. 4 OF 8 SHS.

	1X660MW SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)	SECTION: C SUB SECTION : C&I
	C&I SPECIFICATION FOR LP CHEMICAL DOSING SYSTEM	

INSTRUMENT INSTALLATION & HOOKUP DIAGRAM

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-VI/CLAUSE NO. 12.02.00..

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

REVIEWED										
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

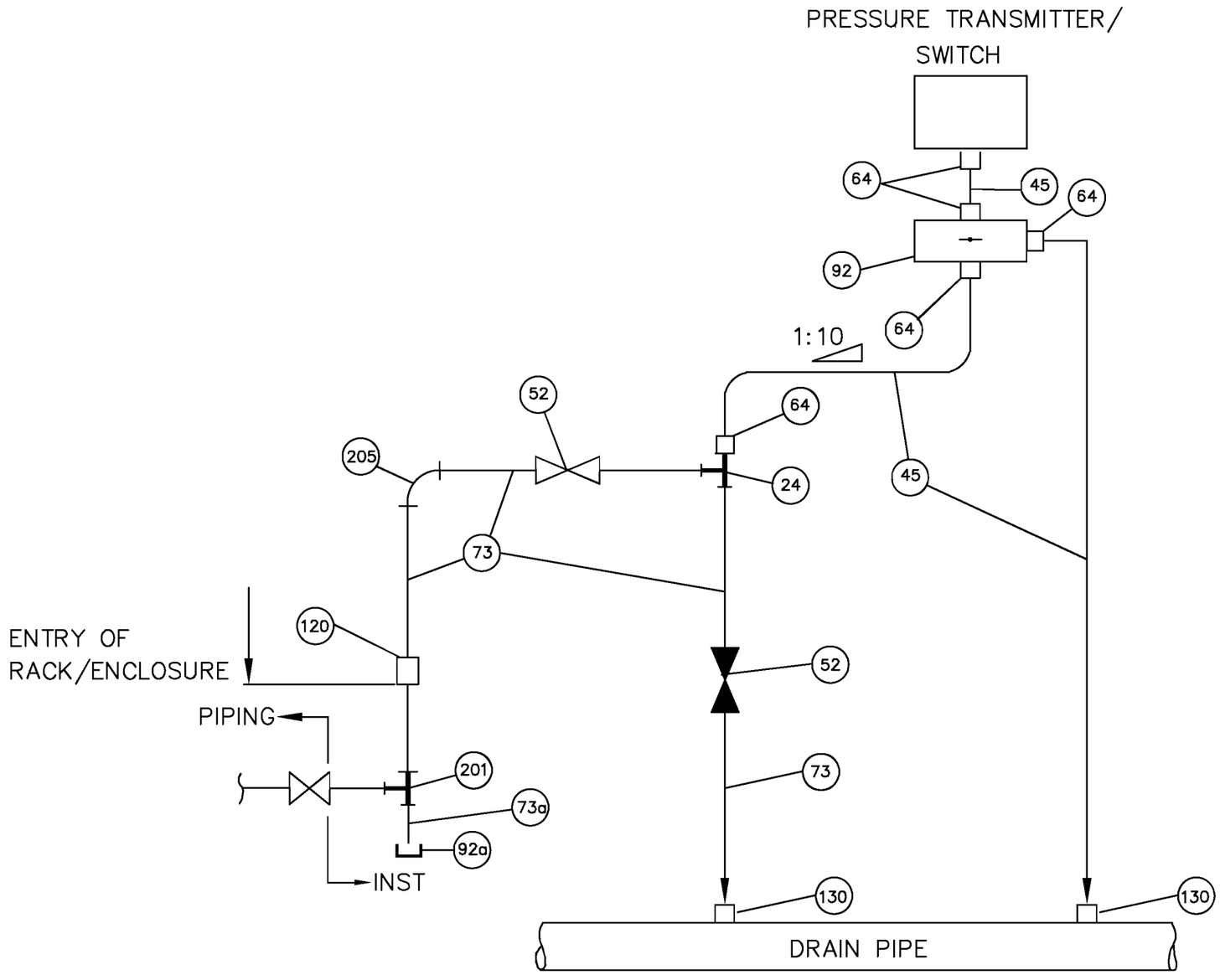
JOB NO. DCL- 12A05 | SCALE : NIL

DWG. NO. 12A05-DWG-I-0022 | REV. 0

D12A05-DWG-I-0022-R-0-SHT-3 OF 27 C 22.06.2017

A3 (9-96) [420x297]

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	2	GLOBE VALVE, 1/2" SW
64	5	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD
73	15	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	1	DRAIN PLUG, 1/2" NPT (M)
120	1	BULK HEAD UNION/COUPLING, 1/2" SW
130	2	HALF COUPLING, 1/2" SW
201	1	EQUAL TEE, 1/2" SW
205	2	90° ELBOW, 1/2" SW

SERVICE : CONDENSER PRESSURE ETC.

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL- 12A05 | SCALE : NIL

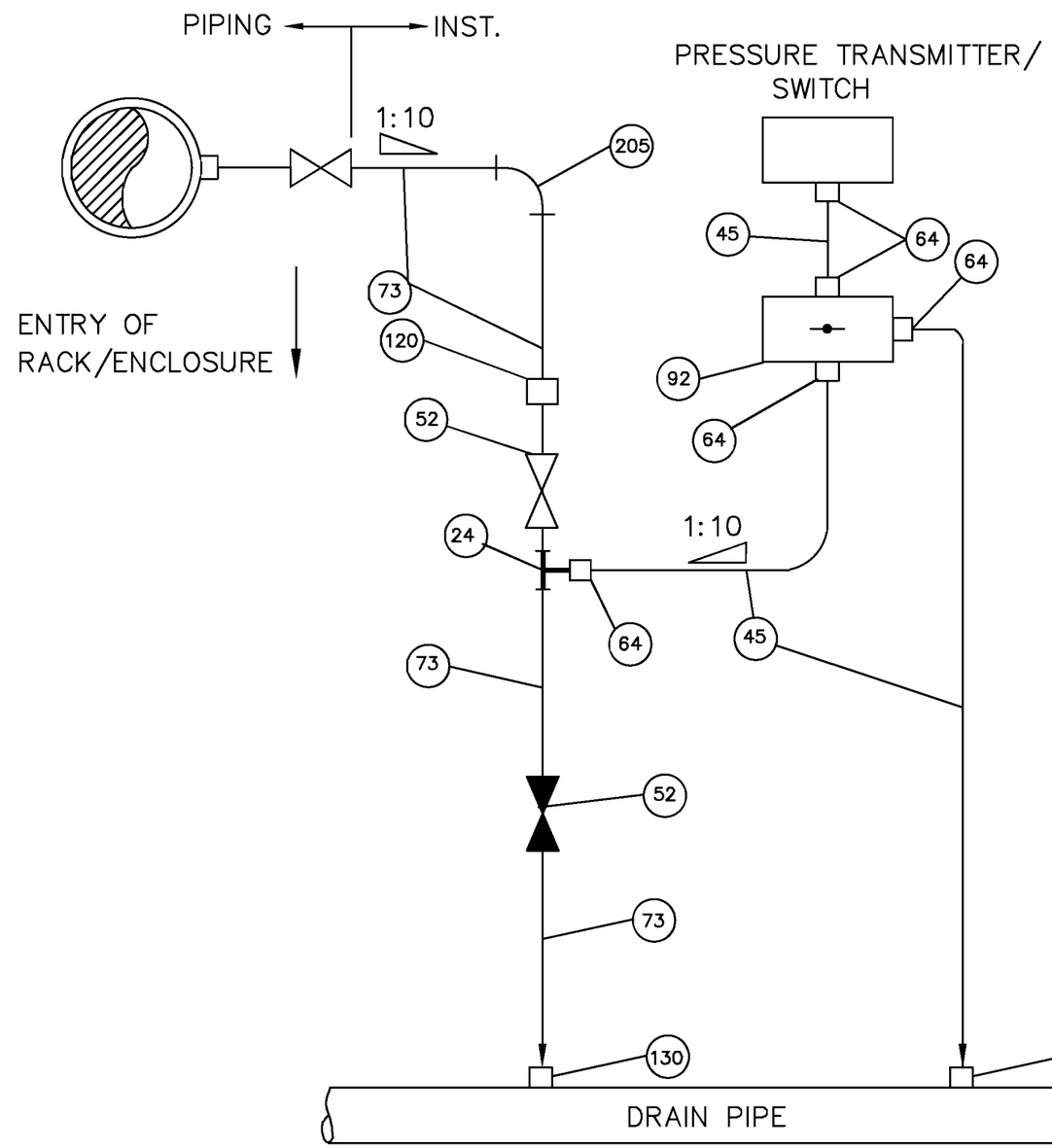
DWG. NO. 12A05-DWG-I-0022 | REV. 0

C 22.06.2017

D 12A05-DWG-I-0022-R-0-SHT-4 OF 27

A3 (9-96) [420x297]

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 : CONDENSATE, FEED WATER ETC.

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE–III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL– 12A05 | SCALE : NIL

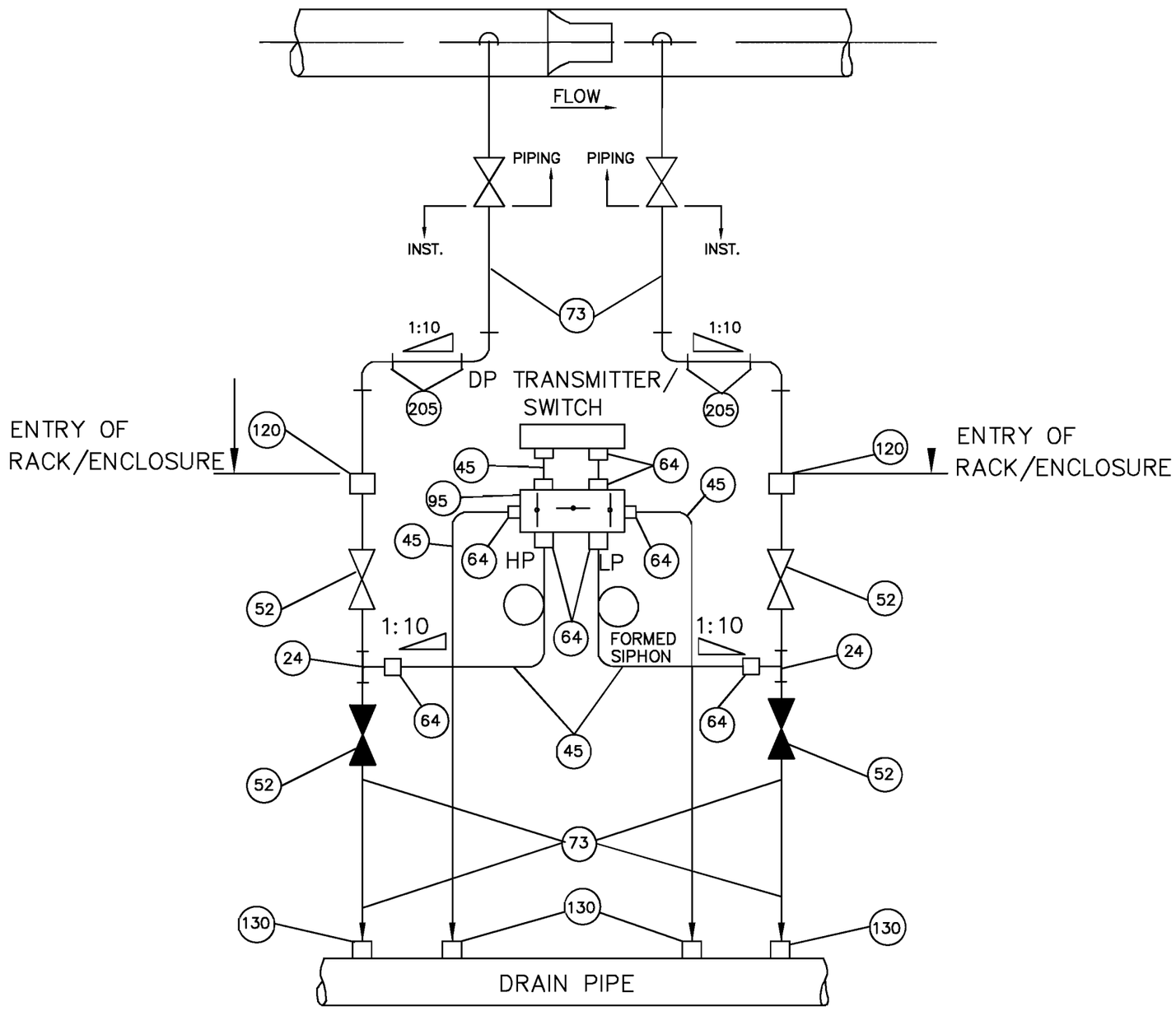
DWG. NO. 12A05–DWG–I–0022 | REV. 0

C 22.06.2017

D 12A05-DWG-I-0022-R-0-SHT-5 OF 27

A3 (9–96) [420x297]

DIFF. PRESS. TRANSMITTER/DIFF. PRESS. SWITCH MOUNTED BELOW SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	2	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	6 M	TUBE, 1/2" OD
52	4	GLOBE VALVE, 1/2" SW
64	10	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	30 M	IMPULSE PIPE, 15 NB
95	1	5 VALVE MANIFOLD, 1/2" NPT (F)
120	2	BULK–HEAD UNION, 1/2" SW
130	4	HALF COUPLING, 1/2" SW
205	4	90° ELBOW, 1/2" SW

SERVICE : CONDENSATE,FEED WATER ETC.

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE–III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL– 12A05 | SCALE : NIL

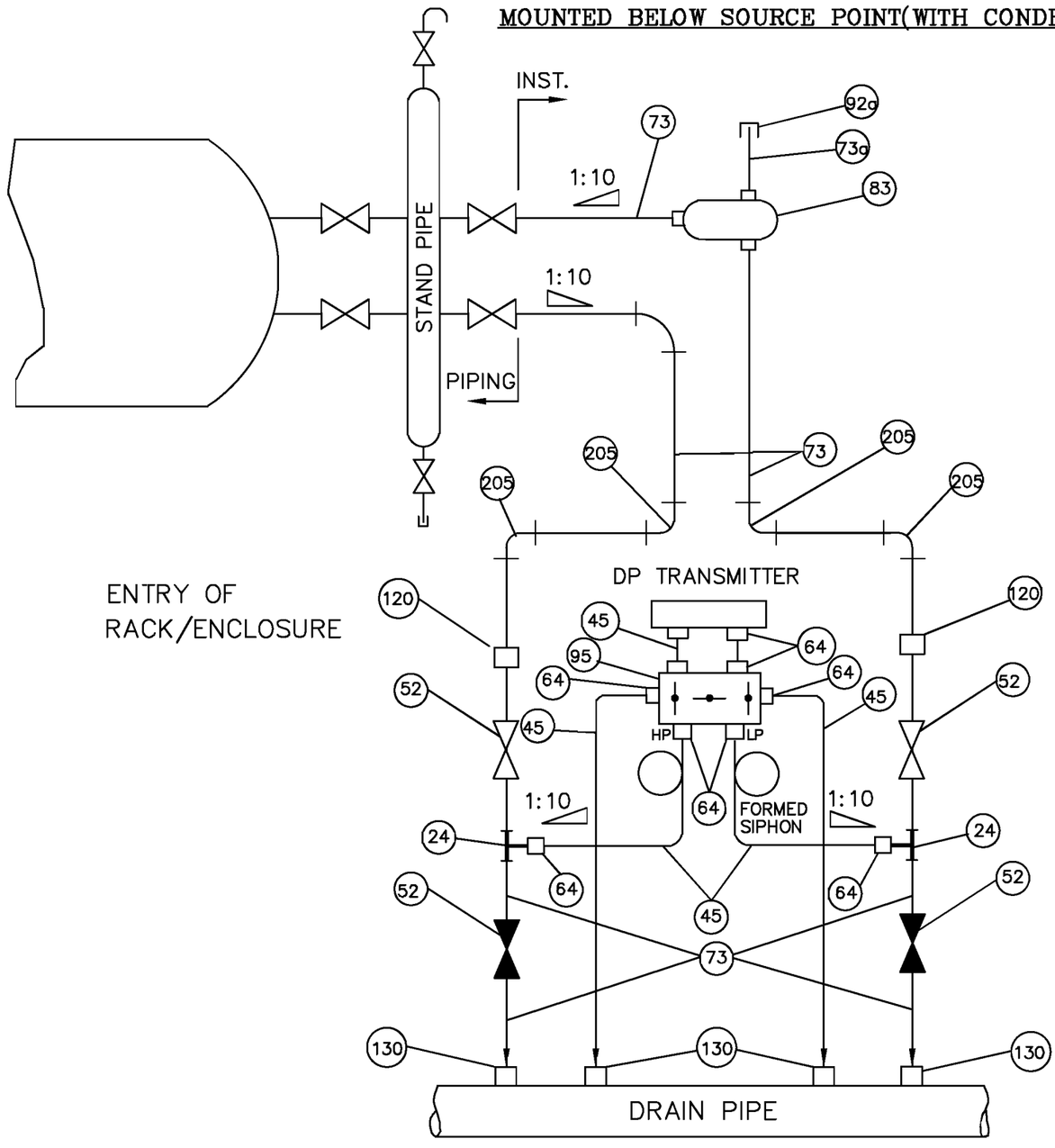
DWG. NO. 12A05–DWG–I–0022 | REV. 0

C 22.06.2017

D 12A05-DWG-I-0022-R-0-SHT-9 OF 27

A3 (9–96) [420x297]

DIFF.PRESS.TRANSMITTER (LEVEL)
MOUNTED BELOW SOURCE POINT(WITH CONDENSATE POT)



ENTRY OF RACK/ENCLOSURE

ENTRY OF RACK/ENCLOSURE

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	2	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	6 M	TUBE, 1/2" OD
52	4	GLOBE VALVE, 1/2" SW
64	8	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	30 M	IMPULSE PIPE, 15 NB
73a	1	NIPPLE, 1/2" SW X 1/2" NPT (F)
83	1	CONDENSATE POT, 1/2" SW
92a	1	VENT PLUG, 1/2" NPT (M)
95	1	5 VALVE MANIFOLD, 1/2" NPT (F)
120	2	BULK–HEAD UNION, 1/2" SW
130	4	HALF COUPLING, 1/2" SW
205	5	90° ELBOW, 1/2" SW

SERVICE : SEPARATOR, DEAERATOR, HEATERS

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017	
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE	

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE–III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

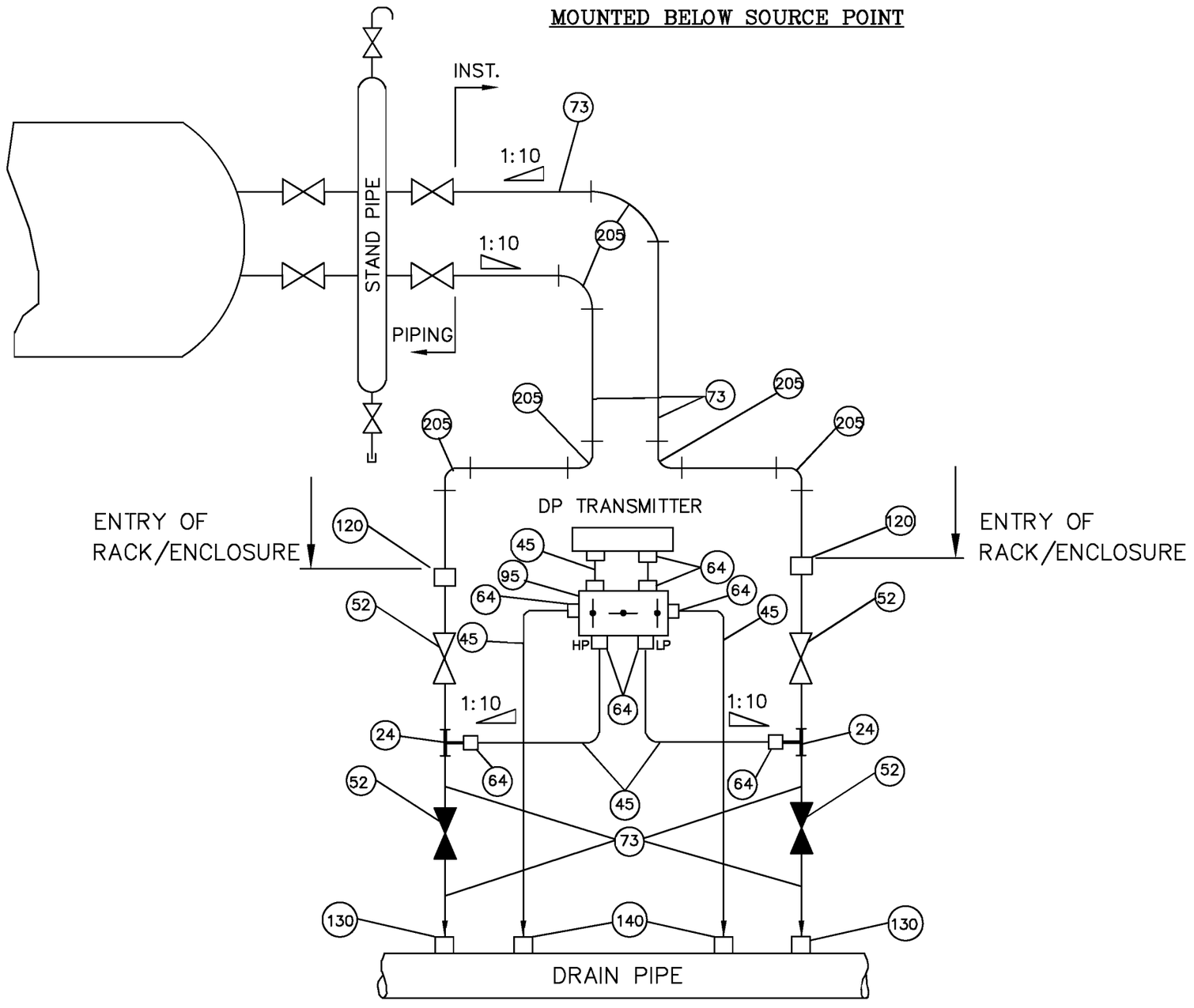
JOB NO. DCL– 12A05 | SCALE : NIL

DWG. NO. 12A05–DWG–I–0022 | REV. 0

D 12A05-DWG-I-0022-R-0-SHT-11 OF 27 C 22.06.2017

A3 (9–96) [420x297]

DIFF.PRESS.TRANSMITTER (LEVEL)
MOUNTED BELOW SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	2	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	6 M	TUBE, 1/2" OD
52	4	GLOBE VALVE, 1/2" SW
64	8	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	30 M	IMPULSE PIPE, 15 NB
95	1	5 VALVE MANIFOLD, 1/2" NPT (F)
120	2	BULK–HEAD UNION, 1/2" SW
130	4	HALF COUPLING, 1/2" SW
205	6	90° ELBOW, 1/2" SW

SERVICE : WATER

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE–III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL– 12A05 | SCALE : NIL

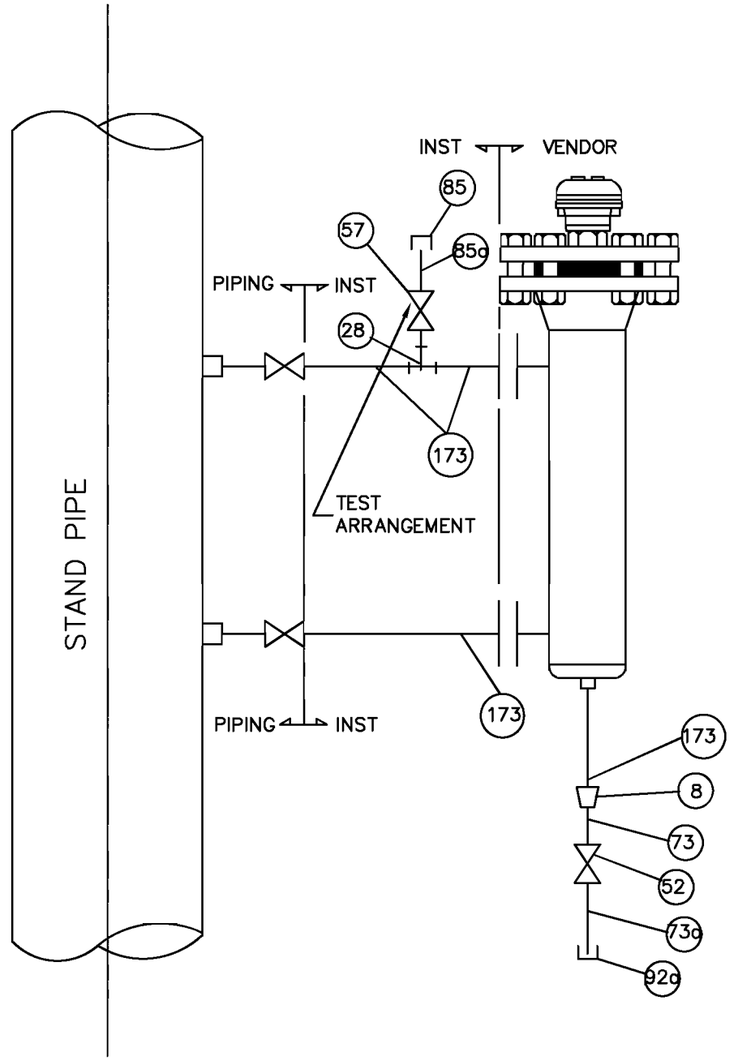
DWG. NO. 12A05–DWG–I–0022 | REV. 0

C 22.06.2017

D 12A05-DWG-I-0022-R-0-SHT-12 OF 27

A3 (9–96) [420x297]

FLOAT OPERATED LEVEL SWITCH



BILL OF MATERIALS		
ITEM NO	QTY/ INST	DESCRIPTION
8	1	REDUCER, 1" SW X 1/2" SW
28	1	EQUAL TEE, 1" SW
52	1	GLOBE VALVE, 1/2" SW
57	1	GLOBE VALVE, 1" SW
73	1 M	IMPULSE PIPE, 15 NB
73a	1	NIPPLE, 1/2" SW X 1/2" NPT (F)
85	1	PLUG, 1" NPT (M)
85a	1	NIPPLE, 1" SW X 1" NPT (F)
92a	1	DRAIN PLUG, 1/2" NPT (M)
173	1 M	IMPULSE PIPE, 25 NB

SERVICE : CONDENSATE

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE–III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL– 12A05 | SCALE : NIL

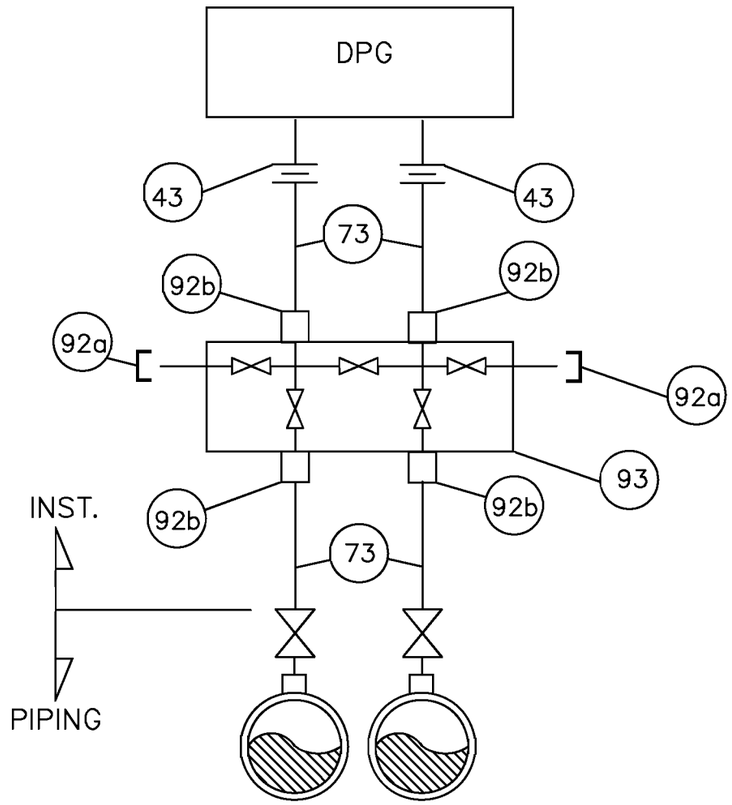
DWG. NO. 12A05–DWG–I–0022 | REV. 0

C 22.06.2017

D 12A05-DWG-I-0022-R-0-SHT-13 OF 27

A3 (9–96) [420x297]

DIFFERENTIAL PRESSURE GAUGE



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
43	2	THREE PIECE UNION, 1/2" SW X 1/2" NPT (F)
52	2	GLOBE VALVE, 1/2" SW
73	30 M	IMPULSE PIPE 15 NB
93	1	5 VALVE MANIFOLD, 1/2" NPT (F)
92a	2	VENT PLUG, 1/2" NPT (M)
92b	4	ADAPTOR, 1/2" SW X 1/2" NPT (M)

SERVICE : WATER, STEAM, AIR ETC.

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE–III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

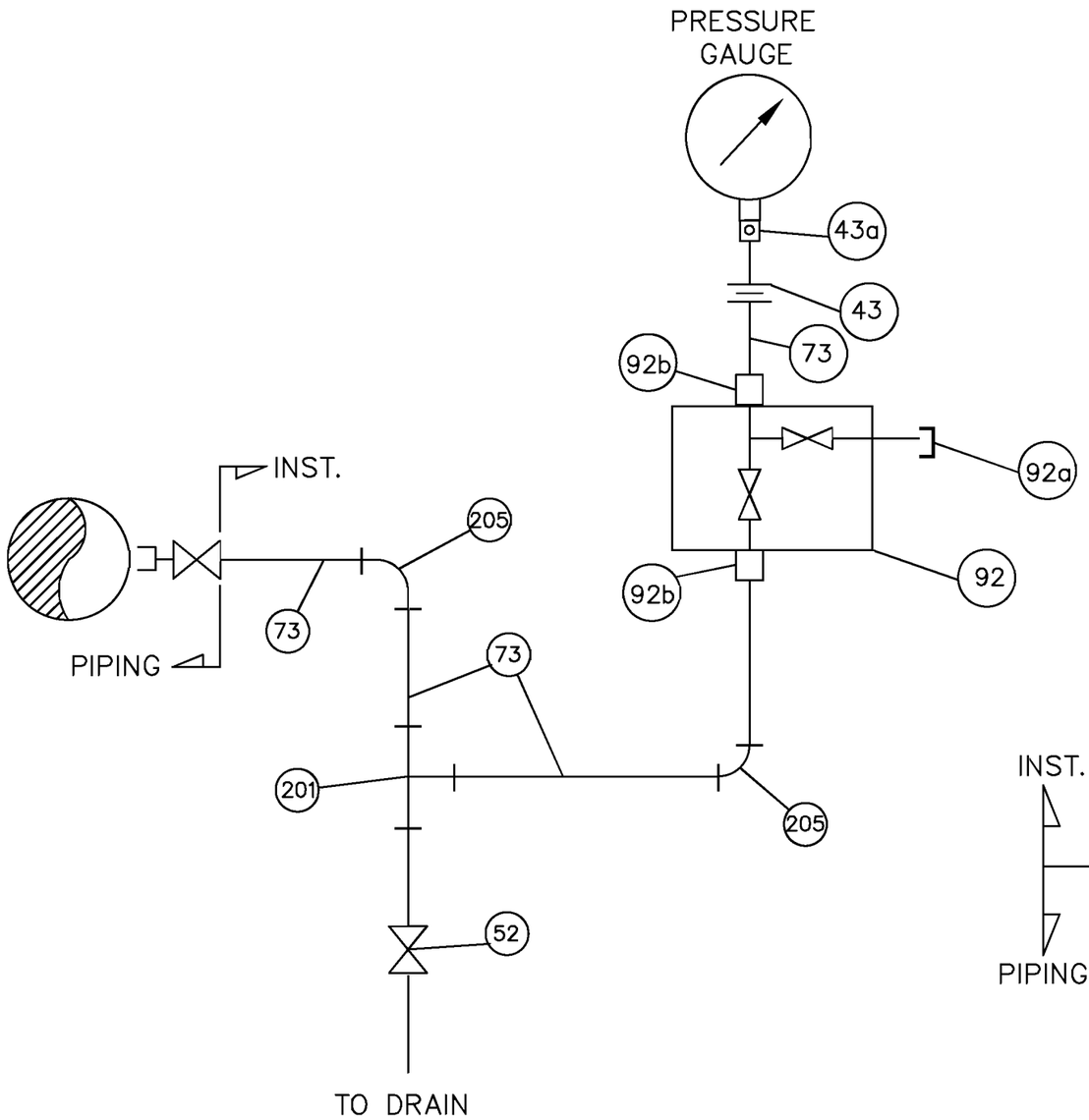
JOB NO. DCL– 12A05 | SCALE : NIL

DWG. NO. 12A05–DWG–I–0022 | REV. 0

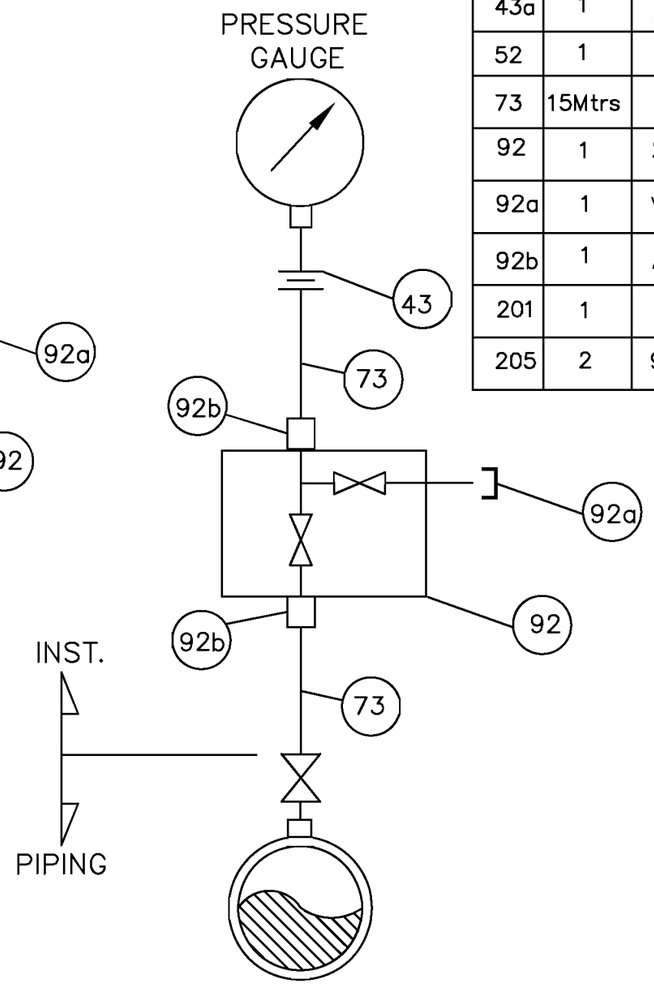
D12A05-DWG-I-0022-R-0-SHT-14 OF 27 C 22.06.2017

A3 (9–96) [420x297]

PRESSURE GAUGE



REMOTE MOUNTING



ON TAP MOUNTING

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, CONDENSATE ETC.

FOR TENDER PURPOSE ONLY

REVIEWED										
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

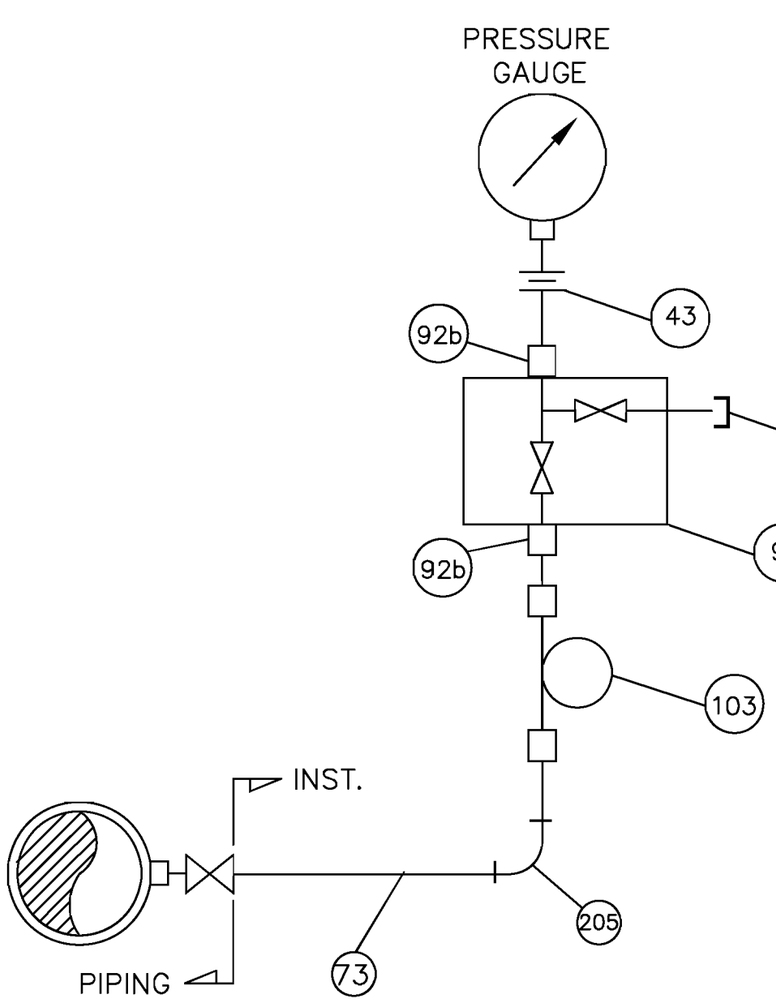
JOB NO. DCL– 12A05 | SCALE : NIL

DWG. NO. 12A05–DWG–I–0022 | REV. 0

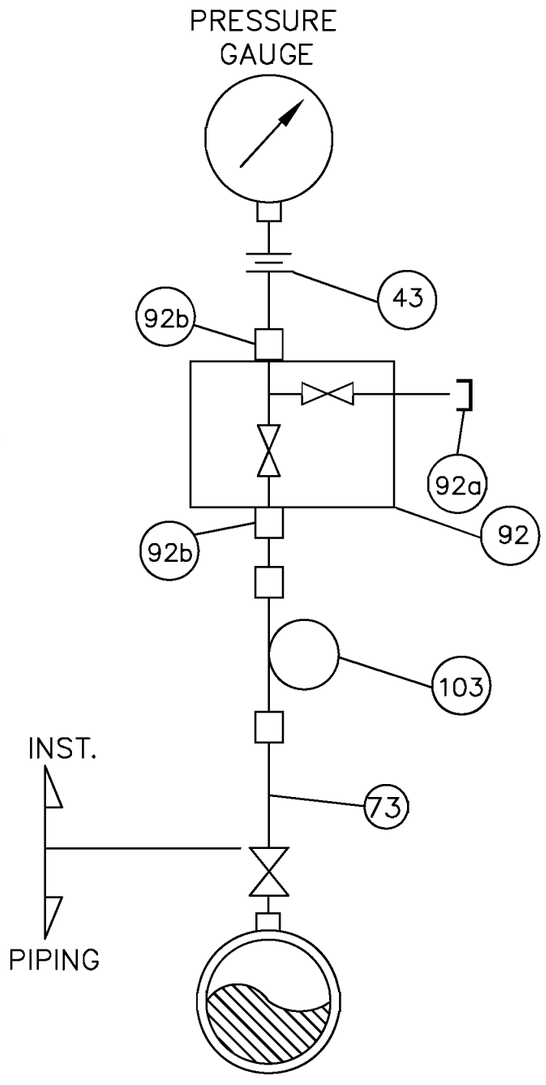
D 12A05-DWG-I-0022-R-0-SHT-15 OF 27 C 22.06.2017

A3 (9–96) [420x297]

PRESSURE GAUGE



REMOTE MOUNTING



ON TAP MOUNTING

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
43	1	THREE PIECE UNION, 1/2" SW X 1/2" NPT (F)
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)
103	1	SYPHON 1/2" SW
205	1	90° ELBOW 1/2" SW

SERVICE : STEAM, FEED WATER

FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE–III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL– 12A05 | SCALE : NIL

DWG. NO. 12A05–DWG–I–0022 | REV. 0

C 22.06.2017

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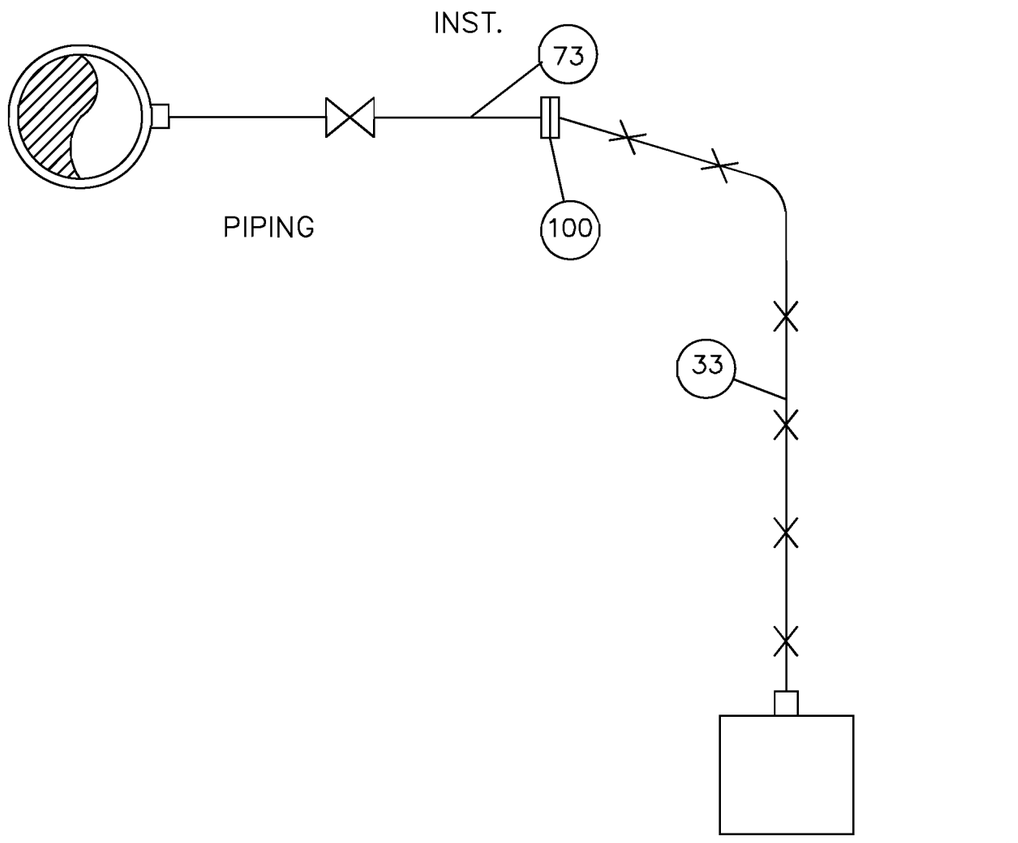
A3 (9–96) [420x297]

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

REVIEWED										
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL– 12A05 | SCALE : NIL

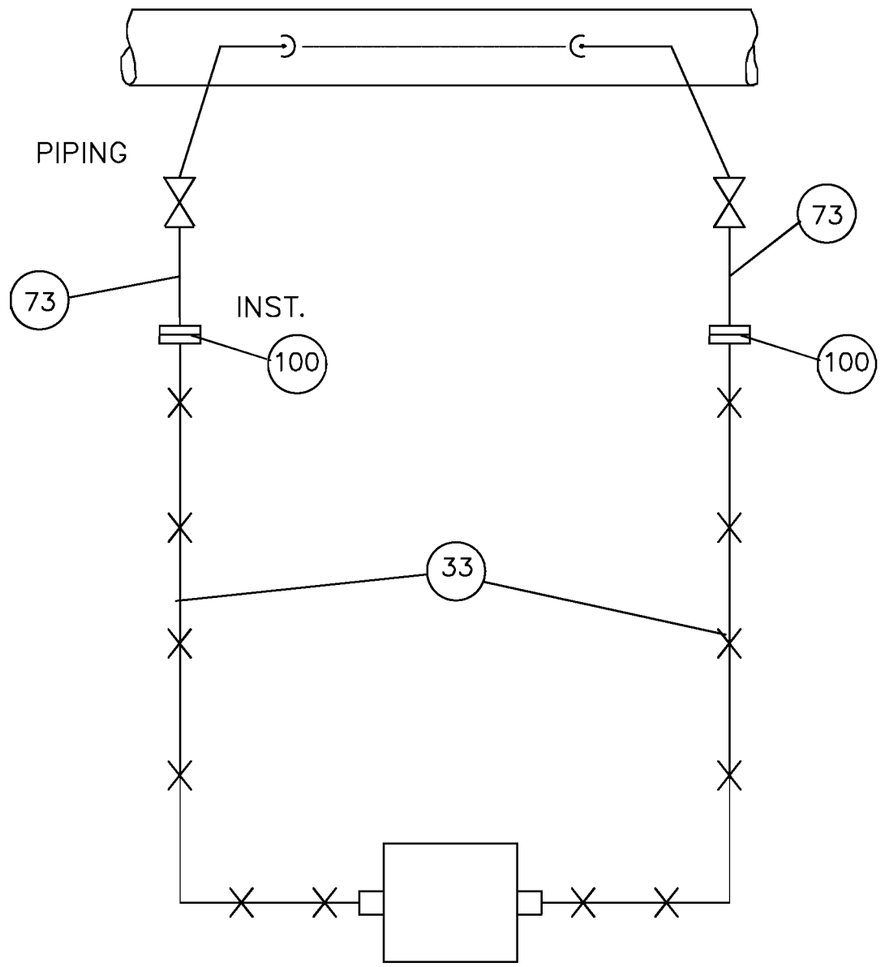
DWG. NO. 12A05–DWG–I–0022 | REV. 0

C 22.06.2017

D 12A05-DWG-I-0022-R-0-SHT-19 OF 27

A3 (9–96) [420x297]

DIFFERENTIAL PRESSURE TRANSMITTER/DIFFERENTIAL PRESSURE SWITCH



DIFFERENTIAL PRESSURE TRANSMITTER/
SWITCH/ GAUGE

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
33	A/R	SS ARMOURED CAPILLARY TUBE
73	2 M	IMPULSE PIPE, 15 NB
100	2	FLANGE ASSEMBLY TO SUIT 1/2" PIPE

SERVICE: CORROSIVE/ VISCOUS/SOLID BEARING OR SLURRY SERVICE

FOR TENDER PURPOSE ONLY

REVIEWED										
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	–	0	22.06.2017
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA

SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE–III
EXTN. UNITS # 5

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL– 12A05 | SCALE : NIL

DWG. NO. 12A05–DWG–I–0022 | REV. 0

C 22.06.2017

D 12A05-DWG-I-0022-R-0-SHT-20 OF 27

A3 (9–96) [420x297]

	TITLE: **1 X 660 MW SAGARDIGHI TPS UNIT NO. 5, PHASE III**	**SPECIFICATION NO.: PE-TS-445-154-A001**	
	TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM	**SUB-SECTION:** III	
		REV. NO.: 00	**DATE:** 30.11.2021

SECTION III

DOCUMENTS TO BE SUBMITTED BY BIDDER

277014/2024/PS-PEM-WSE

	TITLE: **1 X 660 MW SAGARDIGHI TPS UNIT NO. 5, PHASE III**	**SPECIFICATION NO.: PE-TS-445-154-A001**
	TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM	**SUB-SECTION:** III
		REV. NO.: 00 / **DATE:** 30.11.2021

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

Note: Bidder to furnish all the pre bid in the above indicated pre bid clarification format only. General Pre bid clarification will not be considered.

TITLE: 1 X 660 MW SAGARDIGHI TPS UNIT NO. 5, PHASE III	SPECIFICATION NO.: PE-TS-445-154-A001	
TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM	SUB-SECTION: III	
	REV. NO.: 00	DATE: 30.11.2021

COMPLIANCE CUM CONFIRMATION SCHEDULE

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

a.) 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.

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

c.) 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.

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

e.) 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.

f.) 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).

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

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

i.) Demonstration parameters shall stand valid till the satisfactory completion of demonstration test and its acceptance by BHEL/Customer.

	TITLE: 1 X 660 MW SAGARDIGHI TPS UNIT NO. 5, PHASE III	SPECIFICATION NO.: PE-TS-445-154-A001	
	TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM	SUB-SECTION: III	
		REV. NO.: 00	DATE: 30.11.2021

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.

THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-445-154-A001

SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWL

PROJECT:- 1 X 660 MW SAGARDIGHI TPS UNIT NO. 5, PHASE III

PACKAGE:- CHEMICAL DOSING SYSTEM

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

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

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

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

NOTES:

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

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

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

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

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

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

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

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

9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawl of deviation shall be taken as NIL.

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

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

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

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

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