



UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

1X660 MW UPRVUNL PANKI TPS, EXTENSION

TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & STORAGE SYSTEM

ANNEXURE - V

(MANDATORY SPARES LIST)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

CHAPTER 9 : MANDATORY SPARES

1.0 SPARES

The Bidder shall include in his scope of supply all the necessary Mandatory spares, start up and commissioning spares and recommended spares and indicate these in the relevant schedules of the Bid Form and Price Schedules. The general requirements pertaining to the supply of these spares is given below:-

1.1 MANDATORY SPARES

- a) The list of mandatory spares considered essential by the Employer is indicated in Volume - II. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares shall be deemed to be included in the contract price. The bidder shall furnish the population per unit of each item in the Bid Forms and Price Schedules.

Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.

- b) The Employer reserves the right to buy any or all the mandatory spares parts.
- c) The prices of mandatory spares indicated by the Bidder in the Bid Proposal sheets shall be used for bid evaluation purposes.
- d) 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 equipments.
- e) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise.

1.2 RECOMMENDED SPARES

- a) In addition to the spare parts mentioned above, the contractor shall also provide a list of recommended spares for 3 years of normal operation of the plant and indicate the list and total prices in relevant schedule of the Bid Form and Price Schedules. The Employer reserves the right to buy any or all of the recommended spares. The recommended spares shall be delivered at project site at least two months before the scheduled date of initial operation of first unit. However, the spares shall not be dispatched before the dispatch of the main equipment.
- b) Price of recommended spares will not be used for evaluation of the bids. The price of these spars will remain valid up to 6 months after placement of Notification of Award for the main equipment. However, the Contractor shall be liable to provide necessary justification for the quoted prices for these spares as desired by the Employer.

1.3 START-UP & COMMISSIONING SPARES

Start-up and commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used

till the plant is handed over to the employer shall come under this category. The Contractor shall provide for an adequate stock of such start up and commissioning spares to be brought by him to the site for the plant erection and commissioning. They must be available at site before the equipments are energized. The unused spares, if any, should be removed from there only after the issue of Taking Over certificate. All start up spares which remain unused at the time shall remain the property of the Contractor.

- 1.4 The Bidder shall include in his scope of supply all the necessary Mandatory spares, start up and commissioning spares and recommended spares and indicate these in the relevant schedules of the Bid Form and Price Schedules. The general requirements pertaining to the supply of these spars is given below.
- 1.5 The Contractor shall indicate the service expectancy period for the spares parts (both mandatory and recommended) under normal operating conditions before replacement is necessary.
- 1.6 All spares supplied under this contract shall be strictly inter changeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desecrator packs as necessary.
- 1.7 All the spares (both recommended and mandatory) shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.
- 1.8 The contractor will provide Employer with cross-sectional drawings, catalogues, assembly drawings and other relevant documents so as to enable the Employer to identify and finalize order for recommended spares.
- 1.9 Each spares part shall be clearly marked or labeled on the outside of the packing with its description. When more than one spares 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 purposes of identification.
- 1.10 All cases, containers or other packages are to be opened for such examination as may be considered necessary by the Employer.
- 1.11 The contractor will provide the Employer with all the addresses and particulars of his sub suppliers while placing the order on vendors for items/components/equipments covered under the contract and will further ensure with his vendors that the Employer, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.
- 1.12 The Contractor shall warrant that all spares supplied will be new and in accordance with the contract Documents and will be free from defects in design, material and workmanship.
- 1.13 In addition to the recommended spares listed by the contractor, if the employer further identifies certain particular items of spares, the contractor shall submit the prices and delivery quotation for such spares within 30 days of receipt of such request with a validity period of 6 months for consideration by the Employer and placement of order for additional spares if the Employer so desires.

- 1.14 The Contractor shall guarantee the long term availability of spares to the Employer for the full life of the equipment covered under the contract. The Contractor shall guarantee that before going out of production of spares parts of the equipment covered under the Contract, He shall give the Employer at least 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to sub-contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his sub contractors, Contractor will provide the Employers, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equivalent makes required by the Employer for the purpose of manufacture / procurement of such items.

GENERAL NOTE:

- 1.0 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.
- 2.0 Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed and the break up for these shall be furnished in the bid.
- 3.0 In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed as per the list from Volume - II.
- 4.0 **Identification:**
Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

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15.00 AUXILIARY WATER SYSTEM

Service Water Pumps, CW blow down pumps, Air pre-heater wash water pumps, DM makeup pumps, AC & Ventilation System makeup pumps (as the case may be)

i)	Impeller	:	1 No of each type & size.
ii)	Shafts	:	1 No of each type & size.
iii)	Shaft Sleeve	:	1 Set of each type & size.
iv)	Casing and impeller Wearing rings	:	2 Sets of each type & size.
v)	Bearings for Pumps	:	2 Sets of each type & size.
vi)	Motor Bearings	:	1 Set of each type & size.
vii)	Thrust Bearings	:	2 Sets of each type & size.
viii)	Sleeve nuts & Bearings	:	1 Set of each type & size.
ix)	Gland Packing	:	2 Sets of each type & size.
ix)	Fastners	:	1 Set of each type & size.
xi)	Complete Coupling (Pump & Motors)	:	1 Sets of each type & size.
xii)	Mechanical Seal	:	1 Set of each type & size.

16.00 FUEL OIL HANDLING SYSTEM

	ITEM	QUANTITY
1.10	Strainer elements	
	a. Drain Pumps	1 no.
	b. LDO unloading pumps	1 no.
	c. HFO unloading pumps	2 no.
1.2	Relief valve complete assembly	
	a. LDO unloading pumps	1 no.
	b. HFO unloading pumps	2 no.
	c. Pressure reducing station	1 no.
1.3	Floor Coil Heater	
	a. H.F.O. Storage tanks	15% of total length of coil for one (1) no. H.F.O. storage tank
	b. Oil water separator pit	15% of total length of coil
1.4	Bearings of	
	a. LDO unloading pumps	1 set
	b. HFO unloading pumps	2 set
	c. Drain Pumps	1 set
1.5	Rotor Assembly (Complete cartridge assembly)	
	a. LDO unloading pumps	1 no.
	b. HFO unloading pumps	2 set
	c. Drain Pumps	1 no.
1.6	Coupling Bolts with nuts, washer and bushed for LDO unloading pumps	1 set for each size of coupling
1.7	Coupling Bolts with nuts, washer and bushed for HFO unloading pumps	2 set for each size of coupling
1.8	Wearing Rings	1 set for each type of pump
1.9	Gland Packing (if applicable)	1 set for each type of pump
1.10	Mechanical seal Assembly (if applicable)	2 sets each for LDO/4 set for HFO unloading cum transfer pump
1.11	Shaft Sleeve	1 set for each type of pump

1.12	Valves (Each type and size)	a. 1 number, where the total quantity of a particular type and size of valve is less than or equal to 10.
		b. 2 numbers, where the total quantity of a particular type and size of valve is less than 40 but more than 10.
		c. 10% of total quantity (to nearest whole number) of a particular type and size of valve, where the total quantity of a particular type and size of valve is more than 40.
1.12	Neoprene rubber unloading hoses with end connections (complete hose)	Ten (10) Nos.
	Steam Trap	2 numbers for each type and size
	Steam Control valves (complete assy)	one (1) no. complete for floor steam coil heaters one (1) no. complete for suction steam heaters
	Pressure reducing valve	One (1) no.
	Neoprene rubber unloading hoses (For HFO) with end connections complete hose)	Ten (10) Nos.
	Note : One (1) set means total numbers as required for one complete replacement for one equipment.	

~~17.00 ASH HANDLING SYSTEM~~

~~1. Bottom Ash Hopper:~~

- ~~a) Inspection window assembly : 3 Nos.~~
- ~~b) Flushing header nozzles : 10 nos~~
- ~~c) Gaskets for hydraulic operating cylinder : 4 sets~~

~~2. Clinker Grinder~~

- ~~a) Rolls with shaft (drive/driven) : 3 sets~~
- ~~b) Lantern rings for clinker grinder : 16 Nos.~~
- ~~c) Bearing for grinder motor clinker grinder gear box and clinker grinder : 2 Nos. each type~~
- ~~d) Fluid coupling assembly : 2 Nos.~~
- ~~e) Chain (complete length for clinker grinder : 4 Nos.~~
- ~~f) Sprocket (Drive/Driven) each set consist of 1 No. drive and 1 No. driven : 4 sets~~

SL. NO.	DESCRIPTION	TOTAL QUANTITY INCLUDED FOR THE PROJECT	REMARKS	UNITS RESPONSIBLE
21.01.02	Rigid joint	05 Nos. each type and rating	Price included in Cl. No. 21.01.00 above	EPD
21.01.03	Copper/Aluminum flexible for main run and tap offs busducts	1 Set of each type and rating per phase	Price included in Cl. No. 21.01.00 above	EPD
21.01.04	Seal of bushing for main run and tap offs busducts	1 Set of each type and rating per phase	Price included in Cl. No. 21.01.00 above	EPD
21.01.05	Jumpers, if any	2 Nos. of each type	Price included in Cl. No. 21.01.00 above	EPD
21.01.06	Rubber bellow for main run and tap offs busducts	1 Set of each type and rating per phase	Price included in Cl. No. 21.01.00 above	EPD
21.01.07	Silica gel breather	1 No.	Price included in Cl. No. 21.01.00 above	EPD
17.00.00	COMMUNICATION SYSTEM			TBG/PEM/EDN
	Spares of different types and ratings of equipment, accessories used including 1 set of electronic cards.		This is a repeat statement. Items pertaining to Communication System already been considered by BHEL at C & I. Accordingly this clause is NOT APPLICABLE .	TBG/PEM/EDN
18.00.00	POWER AND CONTROL CABLES		This is a repeat statement. Items pertaining to Power & Control Cables has already been considered by BHEL at Cl. No. 18.00.00 above. Accordingly this clause is NOT APPLICABLE .	TRY-FB/TBG/PEM/HWR
18.01.00	11 KV Grade power cables for each type and size.	10% of installed quantity	Refer comment above	TRY-FB/TBG/PEM/HWR
18.02.00	3.3 KV Grade power cables for each type and size.	10% of installed quantity	Refer comment above	TRY-FB/TBG/PEM/HWR
18.03.00	1.1 KV Grade power cables for each type and size.	10% of installed quantity	Refer comment above	TRY-FB/TBG/PEM/HWR
18.04.00	KV Grade control cables for each type and size.	10% of installed quantity	Refer comment above	TRY-FB/TBG/PEM/HWR
III.	CONTROL & INSTRUMENTATION (MANDATORY SPARES)			RU
1.00.01	Measuring & Field Instruments			RU
1.00.01.01	Indicators, Recorders, Electrical Metering and Skid Mounted Instruments		1. The applicable spares & quantity for package wise [(CWTP, DM Plant, PT Plant, ST Plant, ET Plant, Chlorination Plant) for C&I system Price is considered in the Prices of spares at I, Mech. System, Cl. No. 12.00], for CPU, price is considered at I, Mech. Cl. No. 6.00 (B), for FOHS, price is considered at I, Mech. Cl. No. 16.00. 2. However, Lot Price is considered here (except point no. 1 above) for applicable spares & quantity for this Cl. No. 1.00.01.01.	EDN/RPT/HWR/PEM
(i)	Indicators, recorders and meters offered from each model for the project. These instruments shall be supplied with three sets of blank scales.	10 % of Installed of each type/Model or a minimum of one number for each model and type, whichever is more	Refer comment above	EDN/RPT/PEM
(ii)	For skid mounted instruments	10% of total number of instruments for each Type and model or a minimum of one number for each model and type, whichever is more	Refer comment above	EDN/HWR/PEM
(iii)	Panel and Wall mounted Indicators	10% of total number of instruments or a minimum of one number for each type, model, range etc. whichever is	Refer comment above	EDN/PEM
1.00.01.02	Temperature Elements and Thermowells		1. The applicable spares & quantity (for Cl. No. 1.00.01.02 to 1.00.01.13) for package wise [(CWTP, DM Plant, ST Plant, PT Plant, ET Plant, Chlorination Plant, C&I Rotameter, C&I Ultrasonic flow meter) for C&I system Price is considered in the Prices of spares at I, Mech. System, Cl. No. 12.00], for CPU, price is considered at I, Mech. Cl. No. 6.00 (B), for FOHS, price is considered at I, Mech. Cl. No. 16.00. 2. However, Lot Price is considered here (except point no. 1 above) for applicable spares & quantity for this Cl. No. 1.00.01.02 to 1.00.01.13.	TRY-FB/EDN/RPT/HYD/PC/HWR/PEM

SL. NO.	DESCRIPTION	TOTAL QUANTITY INCLUDED FOR THE PROJECT	REMARKS	UNITS RESPONSIBLE
(i)	Thermocouple/RTD elements	15% of flue gas temp, coal air mixture temp, boiler/TG metal temp thermocouples and 5% for other applications of total duplex thermocouple element assemblies and duplex RTD assemblies (with head assembly, terminal block and nipple) of each type and length whichever is more. The element assembly shall be suitable for direct replacement in the corresponding thermowell.	Refer comment above	TRY-FB/EDN/RPT/HYD/PC/HWR/PEM
(ii)	Thermowells	10% for each type of temperature sensors or a minimum of one for each type & size, whichever is more	Refer comment above	TRY-FB/EDN/RPT/HYD/PC/PEM
1.00.01.03	Temperature Transmitters and Electronic Transmitters of all type, range and model no. (For Pressure, DP, Temp, Flow, Level), Process Transmitters, Radar type level transmitter, 3D type level Transmitter with local display, Magnetic/Electromagnetic flow meter with local display, mass flow meter with local display, Process meters, Junction Box, Position Transmitter, Transducer or any other instrument etc.	10% of total number of instruments/transducers offered for each model and type, rating or a minimum of one number for each model, rating and type, whichever is more.	1. 3D type level Transmitter with local display is not applicable for Coal Bunker Level Monitoring as per pr bid query reply. 2. Also refer comment at cl. No. 1.00.01.02 above	TRY-FB/EDN/HYD/HWR/PEM
1.00.01.04	Process actuated switch Devices- As applicable for each package as per following:	5% of total nos. or 1 no. of each make, model, range and type whichever is more	Refer comment above	TRY-FB/EDN/RPT/HYD/PC/HWR/PEM
	1. Temperature Switches		Refer comment above	TRY-FB/EDN/HYD/PC/HWR/PEM
	2. Differential pressure Switches		Refer comment above	TRY-FB/EDN/HYD/HWR/PEM
	3. Pressure switches		Refer comment above	TRY-FB/EDN/RPT/HYD/PC/HWR/PEM
	4. Flow switches		Refer comment above	TRY-FB/EDN/RPT/HYD/PC/HWR/PEM
	5. Level Switches		Refer comment above	TRY-FB/EDN/RPT/HYD/PC/HWR/PEM
	6. Safety Protection Switches		Refer comment above	TRY-FB/EDN/HYD/PC/HWR/PEM
1.00.01.05	Local Gauges like temperature gauges, pressure gauges, differential Pressure gauges, flow gauges, flow meters with local display etc.	10% of total number of instruments/transducers offered for each model and type, rating or a minimum of one number for each model, rating and type, whichever is more.	Refer comment above	TRY-FB/EDN/RPT/HYD/PC/HWR/PEM
1.00.01.06	All type of Rota meters & Sight Flow Indicator.	1 no. of each range and type	Refer comment above	TRY-FB/EDN/PC/HWR/PEM
1.00.01.07	PD Type flow transmitters with local display.	1 no. of each type and model	1. Coriolis Flow meter is considered. 2. Also refer comment at cl. No. 1.00.01.02 above	TRY-FB/EDN/PEM
1.00.01.08	Guided wave RADAR for Hot well application	1 no.	Refer comment above	EDN/PEM
1.00.01.09	Guided wave RADAR for LP heaters	1 no. for each of the LP heaters	Refer comment above	EDN/PEM
1.00.01.10	Impact head type flow element	20% or 2 nos. of each make and type, whichever is more	Refer comment above	PEM
1.00.01.11	Ultrasonic type flow measurement	20% or 2 nos. of each make and type, whichever is more	Refer comment above	PEM
1.00.01.12	Ultrasonic type level transmitter	50% of each type and length, including sensors	Refer comment above	EDN/PEM

SL. NO.	DESCRIPTION	TOTAL QUANTITY INCLUDED FOR THE PROJECT	REMARKS	UNITS RESPONSIBLE
1.00.01.13	Any other instruments not indicated in the tender P&ID but required for control, monitoring and operation of the equipment/plant/systems	10% or 2 nos. of each type whichever is more	Refer comment above	HWR/PEM
1.00.01.14	Level Gauges		1. The applicable spares & quantity (for Cl. No. 1.00.01.14 to 1.00.01.15) for package wise [(CWTP, ET Plant, ST Plant, Chlorination Plant) for C&I system Price is considered in the Prices of spares at I, Mech. System, Cl. No. 12.00]. 2. However, Lot Price is considered here (except point no. 1 above) for applicable spares & quantity for this Cl. No. 1.00.01.14 to 1.00.01.15.	EDN/PC/HWR/PEM
	a) 10% or 2 nos. whichever is more of each type of illuminators with holder and reflector		Refer comment above	EDN/HWR/PEM
	b) 20% or 5 nos. whichever is more of each type of bulb.		Refer comment above	EDN/HWR/PEM
	c) 10% or 2 nos. whichever is more of each type of bi-color rollers.		Refer comment above	EDN/HWR/PEM
	d) 10% or 2 nos. whichever is more of each type of glass along with pair of gaskets (cushion & wet gaskets)		Refer comment above	EDN/HWR/PEM
	e) 10% or 2 nos. whichever is more of each type of gaskets for gauge cocks/valve bonnet/ packing.		Refer comment above	EDN/HWR/PEM
	f) 10% or 2 nos. whichever is more of each type scale.		Refer comment above	EDN/PC/HWR/PEM
1.00.01.15	Complete Electronic card/PCB assembly and Power supply card assembly.	10% of Electronic card/PCB assembly for each type, model & rating or a minimum of one number for each model, rating and type, whichever is more for each type of Transmitter, switch & Flow Meters.	Refer comment above	EDN/HWR/PEM
1.00.02	DDCMIS, DCS, PLC system, Master slave clock system, Hart Management System, Vibration Monitoring system, CAAQMS, MIS, LAN, Simulator, WAN, Plant Intruder system, CCTV, Microprocessor based control system, and other Control System/Sub-systems/electronic system listed in NIT.		1. Lot Price is considered for applicable items related to this Cl. No. 1.00.02 here. 2. Lot Price for Applicable items related to Core TG C&I have been also included. 3. The detailed itemwise list meeting customer specification shall be furnished during detailed Engg. Stage.	EDN/HWR
	DDCMIS and PLC		Refer comment above	EDN/HWR
1.00.02.01	I/O cards		Refer comment above	EDN/HWR
a.	Analog Input module	20% of qty Installed of each category/type/model or at least 2 No. of each type/model (Whichever is more)	Refer comment above	EDN/HWR
b.	Analog output module	20% of qty Installed of each category/type/model or at least 2 No. of each type/model (Whichever is more)	Refer comment above	EDN/HWR
c.	RTD/TC cards/modules	20% of qty Installed of each category/type/model or at least 2 No. of each type/model (Whichever is more)	Refer comment above	EDN/HWR
d	Digital input module	20% of qty Installed of each category/type/model or at least 2 No. of each type/model (Whichever is more)	Refer comment above	EDN/HWR
e.	Digital output module	20% of qty Installed of each category/type/model or at least 2 No. of each type/model (Whichever is more)	Refer comment above	EDN/HWR

SL. NO.	DESCRIPTION	TOTAL QUANTITY INCLUDED FOR THE PROJECT	REMARKS	UNITS RESPONSIBLE
1.00.15	Control desk and Control Panels:-		1. The applicable spares & quantity for Control desk and Control Panels for Cranes & Hoists , Price is considered in the Prices of spares at I, Mechanical System, Cl. No. 18.00, EOT CRANES & Hoists. 2. Lot Price is considered here (except point no. 1 above) for applicable spares & quantity for this Cl. No. 1.00.15.	EDN/PEM
1.00.15.01	Devices mounted on Control desk	Ten (10) percent or 2 nos (whichever is more) of each type	Refer comment above	EDN/PEM
1.00.15.02	LEDs for indicating lights shall be furnished.	100.00%	Refer comment above	EDN/PEM
1.00.15.03	control circuit fuses	One hundred percent spare replacement of each current rating required	Refer comment above	EDN/PEM
1.00.15.04	MCB/MCCB	Ten percent spare replacement of each current rating required	Refer comment above	EDN/PEM
1.00.15.05	Blank Mosaic Grid Tiles.	Ten (10) percent or 20 nos (whichever is more)	Refer comment above	EDN/PEM
1.00.15.06	Push buttons, ILPBs.(complete with contact elements)	Ten (10) percent or 2 nos (whichever is more) of each type and color	Refer comment above	EDN/PEM
1.00.15.07	Cooling Fans	20% or 2 nos. (whichever is more) of each type, model and rating	Refer comment above	EDN/PEM
1.00.15.08	Electric meter.	Ten (10) percent or 2 nos (whichever is more) of each type	Refer comment above	EDN/PEM
1.00.15.09	Power supply modules.	Ten (10) percent or 2 nos (whichever is more) of each type	Refer comment above	EDN/PEM
1.00.16	Mandatory Spares for Control valves, Power Cylinder, Control Dampers, Actuators, Flow Elements and Accessories		1. Lot Price is considered here for Applicable items related to this Cl. No. 1.00.16 that are not specified elsewhere are only offered. 2. Spares of Special control valves that are covered elsewhere are not offered. [(As per Sl.No.44/STG-Mand. Spares of Technical clarifications & Deviations dtd 22.12.2015)]	TRY-FB/RPT/HYD/PC/HWR/PEM/TRY-V
(A)	Following spares shall be furnished for control valves, Power Cylinder, Control Dampers as applicable		Refer comment above	TRY-FB/HYD/PC/HWR/PEM
a)	One set of spare control valve stem packing for each control valve.		Refer comment above	TRY-FB/HYD/PC/HWR/PEM
b)	Two moulded rubber diaphragms for each control valve		Refer comment above	TRY-FB/HYD/PC/HWR/PEM
c)	100% of Diaphragms, O-rings and rubber gaskets, seals for each type, make etc. of control valve.		Refer comment above	TRY-FB/HYD/PC/HWR/PEM
d)	100 percent qty. of lubricants for gaskets for each control valve on one year consumption basis.		Refer comment above	TRY-FB/HYD/PC/HWR/PEM
e)	2 sets of limit switches and 1 set of valve positioner for each control valve.		Refer comment above	TRY-FB/HYD/PC/HWR/PEM
f)	20 percent of position transmitter (420mA) and its accessories for total qty. of control valve.		Refer comment above	TRY-FB/HYD/PC/HWR/PEM
g)	One (1) set of valve trims (such as plug, stem, seat ring / cage, guide bushing, stem lock pin, packing retaining ring, etc) for each type of control valve.		Refer comment above	TRY-FB/HYD/PC/HWR/PEM
h)	One complete Pneumatic and electro-hydraulic actuator assembly of each type or min 10% for each type, model, rating and size whichever is more.		Refer comment above	TRY-FB/HYD/PC/HWR/PEM/RPT
i)	20 percent of Solenoid valves or min 2 no. of each type for total qty. of control valves.		Refer comment above	TRY-FB/HYD/PC/HWR/PEM
j)	20% of I to P converters, Pressure regulators.		Refer comment above	TRY-FB/HYD/PC/HWR/PEM

SL. NO.	DESCRIPTION	TOTAL QUANTITY INCLUDED FOR THE PROJECT	REMARKS	UNITS RESPONSIBLE
k)	10% or 2 nos. of each type whichever is more air lock relays		Refer comment above	TRY-FB/HYD/PC/HWR/PEM
(B)	Mandatory spares for each type of critical applications special control valves.		Refer comment above	TRY-FB/HYD/HWR/PEM
a)	Soft Goods Kit Valve	1 Set	Refer comment above	TRY-FB/HYD/HWR/PEM
b)	Metal seat	1Set	Refer comment above	TRY-FB/HYD/HWR/PEM
c)	Seat Ring	1Set	Refer comment above	TRY-FB/HYD/HWR/PEM
d)	Spindle	1Set	Refer comment above	TRY-FB/HYD/HWR/PEM
e)	Actuator Soft Goods kit	1 Set	Refer comment above	TRY-FB/HYD/HWR/PEM
f)	Feed back transmitter unit	2 NOS.	Refer comment above	TRY-FB/HYD/HWR/PEM
g)	Electronic Position Transmitter	2 NOS.	Refer comment above	TRY-FB/HYD/HWR/PEM
h)	Solenoid valves	2 NOS.	Refer comment above	TRY-FB/HYD/HWR/PEM
i)	Air Filter Regulators	2 NOS.	Refer comment above	TRY-FB/HYD/HWR/PEM
j)	Air Lock Relay	2 NOS.	Refer comment above	TRY-FB/HYD/HWR/PEM
k)	Complete actuator for each type and model	1 Set	Refer comment above	TRY-FB/HYD/HWR/PEM
(C)	Following spares shall be supplied for each of the HP/LP By Pass & Spray control valves		Refer comment above	HWR/TRY-V
a.	Stem	1 NO.	Refer comment above	HWR/TRY-V
b.	Jet Cage	1 NO.	Refer comment above	HWR/TRY-V
c.	Nozzle Body	1 NO.	Refer comment above	HWR/TRY-V
d.	Seat	1 NO.	Refer comment above	HWR/TRY-V
e.	Guide bushing	1 NO	Refer comment above	HWR/TRY-V
f.	Valve Packing	1 Set	Refer comment above	HWR/TRY-V
g.	Valve Gaskets	1Set	Refer comment above	HWR/TRY-V
h.	Actuator seal set	1 Set	Refer comment above	HWR/TRY-V
(D)	Common spares for HP/LP By Pass & Spray control valves:		Refer comment above	HWR/PEM/TRY-V
i)	Feedback transmitter	2 NOS.	Refer comment above	HWR/TRY-V
ii)	Electronic positioner	2 NOS.	Refer comment above	HWR/TRY-V
iii)	Proportional Valve	2 NOS.	Refer comment above	HWR/TRY-V
iv)	Quick opening device	2 NOS.	Refer comment above	HWR/TRY-V
v)	Seal sets	4 Sets	Refer comment above	HWR/TRY-V
vi)	Solenoid Valves	2 NOS.	Refer comment above	HWR/TRY-V
vii)	Filters for Oil Units	1 set	Refer comment above	HWR/TRY-V
viii)	Supply manifold for oil units	1 No	Refer comment above	HWR/TRY-V
ix)	Hose for each service	1 each	Refer comment above	HWR/TRY-V
x)	Seal set for oil unit	1 Set	Refer comment above	HWR/TRY-V
xi)	Complete actuator for each type and model	1 set	Refer comment above	HWR/TRY-V
(E)	1 NO of Nozzle for each PRDS De Super heater & Spray water desuperheater and orifice plate for CEP flow		Refer comment above	HWR/PEM/TRY-V/PC
1.00.17	Mandatory Spares for Acoustic Steam leak Detection System		Lot Price	TRY-FB
1)	Processor and interface module	10% or 1 no. of each type and model, whichever is more.	Price included in cl. No. 1.00.17 above	TRY-FB
2)	sensor and Transceivers	10% or 1 no. of each type and model, whichever is more.	Price included in cl. No. 1.00.17 above	TRY-FB
3)	Consumables like batteries, fuses etc. for two years operation of Acoustic Steam leak detection system.		Price included in cl. No. 1.00.17 above	TRY-FB
1.00.18	Mandatory spares not covered above			TRY-FB

~~14.00.00 MOTORS (HV/LV/DC)~~

Sl. No.	Description	Quantity
14.01.00	11 KV & 3.3 KV Motor	
14.01.01	Termination kits (if elastimold type)	2 Nos. of each type
14.01.02	Termination kits (end connection)	20 Nos.
14.01.03	Temp. indicators	10 Nos.
14.01.04	Vibration indicators	10 Nos.
14.01.05	Terminal box Teflon glands	20 Nos.
14.01.06	Phase segregated terminal boxes	2 Nos.
14.01.07	Heaters	4 sets
14.01.08	Couplings	2 Nos. each
14.01.09	Bearings (DE and NDE) for each type and rating of motors	4 sets
14.01.10	Motor of each type and rating (Note : HT/LT 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
14.02.00	415V Motors	
14.02.01	Terminal plates	10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW
14.02.02	Heaters	2 sets
14.02.03	Greasing arrangements	4 sets each type of motor
14.02.04	Motor of each type and rating	10% of the installed quantity or minimum 1 number whichever be higher
14.02.05	Bearings (DE and NDE) for each type and rating of motor	4 sets
14.02.06	Stator winding coils for all type of LT motors	One (1) set
14.02.07	Dust seals and gaskets for each type of motors	Three (3) Sets
14.03.00	D C Motors	
14.03.01	Carbon brushes	10 sets each type
14.03.02	Brush assemblies	2 sets each type
14.03.03	Terminal blocks	2 sets each type
14.03.04	Heaters	2 sets each type
14.03.05	Pulleys	2 sets each type
14.03.06	Motor of each type and rating	10% of the installed quantity or minimum 1 number whichever be higher

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

1X660 MW UPRVUNL PANKI TPS, EXTENSION

TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & STORAGE SYSTEM

ANNEXURE - VI
(PAINTING SPECIFICATION)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

CHAPTER 7: PAINTING

1.0 SCOPE

This section covers the painting requirements for the power plant equipment, structures, piping etc. and any other surface required to be painted. The painting system should ensure optimal protection of the installation with minimum need for maintenance, environmental friendly & easy to apply.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS contract for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job:

IS: 5	:	Colours for ready mixed paints and enamels
IS: 101	:	All Parts and Sections for paint testing
IS: 1303	:	Glossary of terms relating to paints
IS: 2379	:	Colour code for identification of pipelines
IS: 1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS: 2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS: 6278	:	Code of practice for white washing and colour Washing
IS: 13183	:	Aluminium Paint, heat Resistant specification
IS: 158	:	Ready mixed paint, brushing, bituminous, black, Lead free, acid, alkali, water and heat resisting
IS: 2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS: 104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS: 2932	:	Enamel, synthetic, exterior (a) undercoating (b) finishing.
IS: 2629	:	Recommended Practice for Hot Dip Galvanising
BS EN ISO 14713	:	Code of practice for protection of iron & steel structure against corrosion
ISO 8501-1	:	Preparation of steel substrates before application of paint & related Products. Part-1: Rust grades & preparation grades of uncoated steel substrates & steel substrates after overall removal of previous coatings
ISO 8502-3	:	Assessment of dust on steel surface prepared for painting (Pressure sensitive tape method)
ISO 12944 (Part 1 to 7)	:	Corrosion protection of steel structures by Protective paint systems
SSPC	:	US Specifications of Steel Structures Painting Council, SSPC Volumes I and II
SSPC-SP-08	:	Surface preparation by Pickling
NORSOK M-501	:	Surface preparation & Protective coating
ISO 20340	:	Pre-Qualification test
ASTM	:	American Standard Test Method for paints and coatings
AWWA	:	American Water Works Association

In the event of conflict between the Codes and Standards referred to in the specification and the requirement of this specification, the latter shall govern. Statutory and Local regulations shall be strictly followed in selection and application of paint.

3.0 GENERAL

- 3.1 This specification covers the surface preparation, method of application and material to be used for all coating of equipment, steel structures and piping. Steel material subjected to surface preparation on shop/site shall have minimum requirements in accordance with Rust Grade B (SSPC/SSPM Volume-2).
- 3.2 Coating materials according to SSPC, EN ISO, ASTM, BIS or DIN standards, shall be used. The paint shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work. The materials shall be matched with each other so that they are compatible. Coatings deviating this specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.
- 3.3 The paint to be applied shall be approved by Customer / Engineer.
- 3.4 All paints & paint material used shall be procured from approved manufacturers. Paint shall be supplied in manufacturers original containers with the description of content, specification No., colour, ref no, date of manufacture, shelf life expiry date & pot life.
- 3.5 The paint manufacturers shall provide coating system data sheet for each coating system to be used containing the following information:
 - 1. Surface preparations
 - 2. Film thickness (min and max)
 - 3. Min and max recoating intervals at relevant temperatures
 - 4. Mixing ratio, thinner details and coating repair systems
- 3.6 The sample for testing the paint being used may be taken by the customer at any time.
- 3.7 In general Shop fabricated equipment will be delivered to the site coated with a shop applied system or the manufacturer's standard finish in accordance with the requirements of this specification.
- 3.8 For equipment that has received shop prime coat, touch-up prime coat and additional coats shall be applied in accordance with the coating schedule. It is responsibility of the vendor to ensure compatibility between shop and field applied paint systems.
- 3.9 Necessary precautions shall be provided to all equipment, structures to protect other surfaces from abrasive blasting, coating over spray and spatter. Damage to other surfaces or equipment shall be repaired by the vendor.
- 3.10 The Contractor shall submit the following for review and approval by the Customer:

1. Manufacturer's recommended paint scheme for the project
2. Latest published product & instructions for application data,
3. Procedures for surface preparation and application.
4. Pre qualification for equipments and blasting materials, product, procedure and personnel qualifications for the paint and painting systems.
5. Painting repair procedures

Painting records shall contain:

- Equipment/components/location painted
- Date of painting
- Paint details such as specification No, colour, date of manufacture, shelf life, expiry date
- Application equipments
- Ambient conditions at the time of painting
- Surface temperature
- Drying time between coating, DFT and number of coatings
- Appropriate work plan for painting.

- 3.11 The supply of all necessary equipments, weather protection, and scaffolding for painting to ensure work is carried out in accordance with the specification and agreed programme.
- 3.12 Maintenance of the paint work until completion of the contract, this shall include repair of any damaged areas caused by third party.
- 3.13 Disposal of painting waste resulting from painting, shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work and coating materials.
- 3.14 It is a mandatory requirement that all operatives working to this procedure take full cognizance and implement necessary safety precautions.

4.0 PREPARATION OF SURFACES

- 4.1 All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale, dust, rust, weld spatters, sharp edges and any other foreign matter. Removal of grease and oil contamination shall be in accordance with SSPC-SP1 prior to cleaning process described below.
- 4.2 Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out, hand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the Engineer.
- 4.3 The blast cleaned surface shall be checked for signs of salt contamination as per ISO 8502-6 & 9. The maximum allowable level of contamination shall be 20 mg/m². Surfaces that do not meet these criteria shall be reprocessed.

Mechanical Cleaning:

Manual/power tool cleaning shall be done as per grade St-2 or St-3, of ISO 8504-3. This method to be used for repair painting or on already painted

surface and in case of usage on new construction painting prior approval may be obtained from purchaser/engineer.

	Condition of surface	ISO 8504-3	SIS 055900	SSPC
Hand tool cleaning	Rusted	C St2	C St2	SP2
	Rusted and pitted	D St2	D St2	SP2
Power tool cleaning	Rusted	C St3	C St3	SP3
	Rusted and pitted	D St3	D St3	SP3

- i) Grade St-2: Thorough scraping and wire brushing, machine brushing, grinding etc. This grade of preparation shall remove loose mill scale, rust and foreign matter. Finally the surface is to be cleaned with a vacuum cleaner or with clean compressed air or with clean brush. After preparation, the surface should have a faint metallic sheen. The appearance shall correspond to the prints designated St-2.
- ii) Grade St-3: very thorough scraping and wire brushing, machine brushing, grinding etc. After preparing the surface, it should have a pronounced metallic sheen and correspond to the prints designated St-3.

Blast cleaning:

Compressors: Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air at 110deg C. The blasting activity shall be performed at ambient temperatures above 5°C and relative humidity less than 85%. Steel temperature shall be 3°C above dew point. Necessary safety precautions for equipment and operator shall be adhered to.

Abrasives: Abrasives used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives may be chilled iron grit or shot steel and malleable iron grit and shots non metallic abrasive (aluminium oxide, copper slag, garnet etc.).

Removal of mill scale and rust using abrasives such as grit or shot under high pressure. The grade of blasting performed in line with the approved painting scheme.

Surfaces to be coated shall be free of all grease, oil, loose rust, and loose mill scale. Rust, mill scale, weld spatter, flux, shall be removed by the methods indicated in the Coating Schedule. Oil and grease shall be removed by solvent cleaning method as outlined in SSPC - SP - 1 prior to blasting.

The quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the surface profile depth and cleanliness. Abrasives shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertaining to the work.

Profile measurements for abrasive blast cleaned surface shall be made with a Profile comparator and permanent record shall be maintained with Testex Press-O-Film.

Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and

commencement of painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

After blasting cleaning, depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 mm may be used.

The grades of surface finish:

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Paint Application

General:

Paints and other coating materials shall be applied in accordance with the paint manufacturer's instructions. The surface preparation and painting system shall be as described in ANNEXURE with the following exceptions:

- Nameplates, code stampings and push buttons
- Concrete brickwork, tile, and glass unless specified by the Purchaser / Engineer
- Non-ferrous materials
- Austenitic stainless steel
- Plastic and / or plastic coated materials
- Insulated surface of equipment and pipes except colour coating wherever required
- Any surface specified by the Purchaser / Engineer not to be painted.

Paint Application Requirements

The paint shall be applied in accordance with the paint manufacturer's product data sheet, which shall include the mix ratio, the method of application, and the use of thinners and over coating times.

Paint application shall be by brush, roller or spray gun. Local regulations regarding spray and roller coating shall be observed. A smooth uniform film shall be applied to the surfaces to be coated.

Painting shall be performed when the temperature of the surface is greater than 3°C above the dew point of the surrounding air and relative humidity of the air is less than 85% unless local conditions dictate otherwise and the Customer is in agreement. Guidance on the estimation of the probability of condensation can be found in ISO 8502-4. The measurement of these conditions is the responsibility of the Vendor.

In addition, paints shall not be applied under the following conditions:

- When the surface temperature is greater than 60 °C (unless a higher temperature is agreed by the paint manufacturer)
- When the air temperature is less than approximately 5°C, (depending on local conditions)

- When there is the likelihood of an unfavourable change in weather conditions within two hours after painting
- When there is a deposition of moisture in the form of rain, condensation, frost, etc., on the surface.
- When the available light is less than 500 lux.

Paints shall not be applied within 50 mm of edges which will later have to be welded. Such weld areas shall be taped/one coat of weldable primer for distance of 50 mm either side of the weld line.

When zinc rich primers are used, care shall be taken to mask to avoid any possibility of over spraying onto duplex, austenitic stainless steels; nickel alloys or 9% nickel steel components.

Two pack coatings like Air drying epoxy, Polyurethane coatings etc shall be mixed in the ratio recommended by manufacturer to ensure proper and complete curing of the coatings. The base and hardener are to be separately mixed first to obtain a homogenous mixture. The hardener is to be added to the base slowly, with continuous mixing / agitation and not the reverse. Power agitation is preferred over hand mixing.

Any addition of thinner to achieve the application viscosity should be made only after the components are thoroughly mixed. Excess thinner is not recommended, as increase in volume, leads to lower DFT, sagging, longer curing time, etc.

Coating containing heavy or metallic pigments that have a tendency to settle shall be kept in suspension by continuous use of a mechanical agitator whilst being applied, to ensure uniformity over the surface area (e.g., zinc MIO's pigmented materials).

Transport and erection of painted structures shall be carried out only after the drying time specified by the paint manufacturer has elapsed. Handling & packing of painted material shall be appropriate to avoid damage to painting, such as the use of non-metallic slings, etc for handling and by minimising handling after painting. All steel equipment shall be provided with priming or coating system to protect the steel surface during transport, storage, installation and construction.

Spray Application

Airless or pneumatic spray applications are preferred methods of application. Spraying shall be carried out keeping the spray gun at the minimum suitable distance from the work piece and consistently at 90° to the surface being painted.

Approval of Purchaser / Engineer shall be obtained during spray painting which may cause interference to other works. If spray painting is to be carried out, the following shall be taken into account:

The correct spray tips, air pressures, etc, as recommended by the equipment supplier, shall be used.

Conventional air spray equipment is used, the correct combination of air volume, air pressure and fluid flow to give good atomisation to be ensured to

get a defect free painted surface. The major disadvantage of conventional air spray is that high build coatings can generally not be applied by this method as most paints have to be thinned to a suitable viscosity for satisfactory atomisation, and so lose their high build properties. Vendor shall follow manufacture's instruction.

Air spray (pressure pot) is recommended in cases where large quantities of paint are to be applied as paint in the tank can be prevented from settling, reduces application time and also enables the gun to be turned to any angle to coat objects effectively without spilling paint.

Airless spray is recommended as high build coatings can be applied without thinning, very rapid application is possible, giving an economic advantage, compared to conventional spray, overspray and bounce-back are reduced, leading to reduced losses of material and less dust and fume hazards.

Each coat shall be applied uniformly and completely over the entire surface. All runs and sags shall be brushed out immediately or the paint shall be removed and the surface re-sprayed.

Very complex structures should be painted by brush instead of spray gun to avoid overspray, dry spray and unacceptable paint losses.

Brush application

Brush application may be used under the following circumstances:

- When areas cannot be properly coated by spraying for reasons such as material or environmental considerations
- For the initial coat of paint to corners, edges, crevices, holes, welds or irregular surface prior to spray application
- For "touch up" or repairs to localize damaged paint or areas of incorrectly applied paint
- Where the paint manufacturer considers the coating material suitable for brush application.

Brushes shall be of a style and quality that will permit the proper application of paint.

Brush applications should be done in two passes that are perpendicular to each other 'wet on wet' so that a smooth coat, as near uniform in thickness as possible, is obtained thereby avoiding running and droplets. There should be no deep or detrimental brush marks. Paint shall be worked into all crevices and corners. Runs and sags shall be brushed out.

During the application of each coat, all areas such as corners, edges, welds, small brackets, bolts, nuts and interstices shall receive additional paint to ensure that these areas have at least the minimum specified dry film thickness and to ensure continuity of coating.

Roller application

Roller application shall only be used on relatively large surface areas and only if spraying is not an option. Roller application shall only be used if the first or priming coat of paint has been applied by brush. Roller application shall be in accordance with the paint Manufacturer's instructions.

Coating materials

The selected coating materials shall be suitable for the intended use and shall be selected after an evaluation of all relevant aspects such as

- Corrosion protective properties
- Requirements to health, safety and environment
- Properties related to application conditions, equipment and personnel
- Experience with the coating materials and coating system.

All coating materials and solvents shall be protected from ignition sources and shall remain within storage temperatures and storage conditions recommended by the coating manufacturer. All coating materials and solvents shall be stored in the original container bearing the manufacturer's label and instructions. Performance standard as listed below shall be established by paint manufacturer the records shall be submitted for review.

- Adhesion test (pull off test)
- Flexibility test
- Salt spray test (min 1000 Hrs)
- Water absorption test
- UV resistance test (external coating)
- Cathodic disbonding test (internal coating)
- Abrasion test (internal coating)
- Impact resistance test
- Sea water immersion test (structures in tidal, splash zone and conveying sea water)

Each product shall have a batch number showing year and month of manufacture and giving full traceability of production. Shelf life shall be included in the technical data sheet. All coating materials and solvents shall be stored in the original container bearing the manufacturer's label and instructions.

The composition of the paint shall be at the discretion of the manufacturer, provided that the finished product meets the requirements of, State or Local regulatory bodies for the products. All vehicle components for use in the manufacture of paints and enamels shall meet the ASTM/ ISO Specification except as otherwise stated coating systems shall be selected as per corrosivity category listed in the table below. Coating systems are tabulated in ANNEXURE and shall be pre-qualified in accordance with specification. Coating systems/ alternative coating systems may be re-subjected to pre-qualification, at the discretion of OWNER/ ENGINEER. The specified coating systems, the number of coats and the coating film thicknesses given in Annexure are minimum requirements Top coat colors should be in accordance with Annexure.

Gratings and step threads

- i) Surface preparation

Gratings and step threads shall be cleaned by acid pickling as per SSPC-SP-08.

- ii) Hot dip galvanising

The hot dip galvanising shall be done as per IS 2629 .The average mass of coating shall be 610 gms/m².

iii) Post galvanising treatment

Immediately after galvanising, post treatment such as chromating shall be applied to retard white rust attack.

iv) Touch up mechanical damages

The repair of damages coatings shall be done as per the recommended practice ASTM A 780.

CORROSIVITY OF ENVIRONMENTS

Corrosivity category		Mass loss per unit surface (per year of exposure)	
		Mass loss g/mm ²	Thickness loss µm
C2	Low	>10 to 100	>1.30 to 25
C3	Medium	200-400 g/m ²	(25-50µm)
C4	High	400-650 g/m ²	(50-80µm)
C5	Very High Industrial & marine	650-1500g/m ²	(80-200µm)

Tests required for evaluation of acceptance of coating materials:

TABLE -1

PERFORMANCE TEST OF PAINT

SL. No.	Test	ASTM TEST METHOD
1.0	Abrasion Resistance: (topcoat only)	ASTM D4060
2.0	Adhesion:	ASTM D4541
3.0	Dry Heat Resistance:	ASTM D2485
4.0	Flexibility: (topcoat only)	ASTM D522, 180° bend
5.0	Pencil Hardness: (topcoat only)	ASTM D3363
6.0	Salt Fog Resistance:	ASTM B117, 1000 hours
7.0	Weather Resistance:	ASTMG23 Type D
8.0	Test	ASTM Test Method
9.0	Density	D 1475
10.0	Dipping properties	D 823
11.0	Drying time	D 1640
12.0	Flexibility	D 1737/D 522
13.0	Hardness	D 3363
14.0	Adhesion (pull off test)	D 4541
15.0	Abrasion resistance	D 968/D 4060
16.0	DFT/Coat	As per SSPC Guidelines
17.0	Storage Stability	D 1849
18.0	Resistance to	
	i) Humidity for 2000 hrs.	D 2247
	ii) Salt Spray for 2000 hrs.	B 117
	iii) Accelerated Weathering	D 822

INSPECTION:

Inspection will be performed by an inspector authorised by Purchaser / Engineer. Paint materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specification and shall be accompanied by manufacturer's test certificates.

The painting work shall be subjected to inspection by purchaser / engineer at all times. The vendor shall offer following stage of inspection:

- Surface preparation
- Primer application
- Subsequent coats
- Paint qualification test

Vendor shall provide the expert technical services of the paint manufactures as and when required by purchaser / engineer to ensure both the surface preparation and applications are carried out as per their recommendations. This service shall be provided without any obligation to purchaser.

The following coating inspection & test shall be carried out:

1. Ambient and steel temperature, relative humidity and dew point min twice in a shift.
2. Surface finish & profile check each component or once per 10 m2 after surface preparation.
3. Salt contamination test - Free from salt contamination.
4. Dry Film Thickness as per ISO 2808 No.6.
5. Holiday Test as per ASTM D 5162/ NACE RP 0188.
6. Adhesion Test as per ISO 2409 for cross-cut test, or a pull-off test as per ISO 4624/ ASTM D 4541.

6.0 SUGGESTED COLOUR CODES FOR PAINTING:

Sl. No.	Item/Service	Colour	IS-5	Colour (Band)	IS-5
1.0	Structures, platforms, ladders and handrails	Dark Admiralty Grey	632		
2.0	Boiler casing, ESP and ducting	Nut Brown	413		
3.0	Fans, pumps, motors,	Light Grey	631		
4.0	Tanks (without insulation and cladding)				
4.1	Outdoor	Aluminium			
4.2	Indoor	Light grey	631		
5.0	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631		
6.0	Switchgear	Light grey	631		
7.0	Control & relay panels	Light grey	631 78 of IS1650		
8.0	Turbine	Golden	356		

Sl. No.	Item/Service	Colour	IS-5	Colour (Band)	IS-5
		Yellow			
9.0	Generator & exciter	Light grey	631		
10.0	Transformers	Aluminium			
11.0	Machinery guards	Signal red	537		
12.0	Crane				
12.1	Crane structure	Golden Yellow	356		
12.2	Trolley and hook	Crimson	540		
13.0	Piping (without insulation and cladding)				
13.1	Water System				
13.1.1	Boiler feed	Sea green	217		
13.1.2	Condensate	Sea green	217	Light brown	410
13.1.3	Bearing cooling water	Sea green	217	French blue	166

Notes:

1. This colour code basically refers to IS: 2379 for piping with necessary modifications.
2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

PAINTING SCHEME FOR C2 AMD C3 ENVIRONMENT

S. No	Description	Surface Preparation	Primer			Intermediate paint			Finish coat			Total DFT
			Paint	No. of coats	DFT	Paint	No. of coats	DFT	Paint	No. of coats	DFT	
1.	Boiler structure, un-insulated ducts, suspensions, hangers temperature <120°C	Sa 2 ½	In organic Zn silicate	2	80 μ	HB MIO epoxy	1	120 μ	Poly urethane	2		260μ
2.	Indoor structure	Sa 2 ½	HB Zn Phosphate	2	80 μ	HB MIO epoxy	1	120 μ	--	--	--	260μ
3.	Insulated parts exposed to temp >120°C	Sa 2 ½	In organic Zn silicate	2	60 μ							60μ
4.	Work shop	Sa 2 ½	HB Zn Phosphate	2	80 μ	HB MIO epoxy	1	120 μ	--	--	--	260μ
5.	Water Treatment Plant (external)	Sa 2 ½	Zn rich epoxy	2	80 μ	HB MIO epoxy	2	200 μ	Aliphatic poly urethane	2	80 μ	360μ
6.	Coal Handling Plant	Sa 2 ½	In organic Zn silicate	2	80 μ	HB MIO epoxy	1	120 μ	poly urethane	2	60 μ	260μ
7.	Fuel pipings	Sa 2	Ethy Zn silicate	1	40 μ				HR aluminium paint	2	40 μ	80μ
8.	Un insulated silencer, steel stacks >120°C	Sa 2 ½	Ethy Zn Silicate	1	40 μ				HR silicone aluminium paint	2	40 μ	80μ
9.	Above ground piping	Sa 2 ½	In organic Zn silicate	2	80 μ	HB MIO epoxy	1	120 μ	Poly urethane	2	60 μ	260μ
10.	Burried piping (External)	Sa 2 ½	Coal tar primer, coal tar enamel, inner wrap of fibre glass, final outer wrap of enamel impregnated fibre									4.0m m
11.	Burried piping (Internal)	Sa 2 ½	Solid rigid poly urethane 500 μ									500μ
12.	Storage tanks (external)	Sa 2 ½	In organic Zn silicate	2	80 μ	HB MIO epoxy	1	120 μ	Poly urethane	2	60 μ	260μ
13.	Storage tanks (internal)	Sa 2 ½	3 coats of amine adducts									400μ

14.	DM water piping (internal)	Sa 2 ½	Hard rubber lining min 4 mm thickness									4. mm
15.	DM water tank (internal)	Sa 2 ½	In organic Zn silicate	2	80 μ	HB MIO epoxy	1	150 μ	HB coal tar epoxy	1	150 μ	380μ
16.	Fuel oil tanks (internal)	Sa 2 ½	In organic Zn silicate	2	80 μ	HB MIO epoxy	1	150 μ	HB coal tar epoxy	1	150 μ	380μ
17.	Insulated parts continuously exposed to condensing water	Sa 2 ½	In organic Zn silicate	2	75 μ							75μ
18.	For insulated piping <125°C	Sa 2 ½	Polyamide cured epoxy coating	2	250 μ							250μ
19.	Electrical parts, control panels, valves, pumps & motors (indoor)*	Sa 2 ½	Zn phosphate epoxy	2	80 μ				Chlorinated rubber	2	80 μ	160μ
20.	Electrical parts, control panels, valves, pumps & motors (outdoor)*	Sa 2 ½	Zn phosphate epoxy	2	80 μ				Chlorinated rubber	2	100 μ	180μ
21.	Switch yard, floor grills walk ways	Sa 2 ½	Hot dip galvanising 80μ									80μ

* Note: Manufacturer to specify details of painting system capable of withstanding environmental conditions for a period of 10 years before first maintenance

PAINTING SCHEME FOR C4 AMD C5 ENVIRONMENT

S. No	Description	Surface Preparation	Primer			Intermediate paint			Finish coat			Total DFT
			Paint	No. of coats	DFT	Paint	No. of coats	DFT	Paint	No. of coats	DFT	
1.	Boiler structure, un-insulated ducts, suspensions, hangers temperature <120°C	Sa 2 ½	HB Zn Phosphate	2	80 µ	HB MIO epoxy	2	200 µ	Epoxy PU HB	2	80 µ	360µ
2.	Indoor structure	Sa 2 ½	HB Zn Phosphate	2	80 µ	HB MIO epoxy	1	120 µ	Poly urethane	2	60 µ	260µ
3.	Insulated parts exposed to temp >120°C	Sa 2 ½	In organic Zn silicate	2	60 µ							60µ
4.	Work shop	Sa 2 ½	HB Zn Phosphate	2	80 µ	HB MIO epoxy	1	120 µ	Poly urethane	2	60 µ	260µ
5.	Water Treatment Plant (external)	Sa 2 ½	Zn rich epoxy	2	80 µ	HB MIO epoxy	2	200 µ	Epoxy PU HB	2	80 µ	360µ
6.	Coal Handling Plant	Sa 2 ½	HB Zn Phosphate	2	80 µ	HB MIO epoxy	2	200 µ	Poly urethane	2	60 µ	340µ
7.	Coal Fuel pipings	Sa 2	Ehthy Zn silicate	1	40 µ				HR aluminium paint	2	40 µ	80µ
8.	Un insulated silencer, steel stacks >120°C	Sa 2 ½	Ehthy Zn Silicate	1	40 µ				HR silicone aluminium paint	2	40 µ	80µ
9.	Above ground piping	Sa 2 ½	In organic Zn silicate	2	80 µ	HB MIO epoxy	1	120 µ	Poly urethane	2	60 µ	260µ
10.	Burried piping (external)	Sa 2 ½	Coal tar primer, coal tar enamel, inner wrap of fibre glass, final outer wrap of enamel									4.0 mm
11.	Burried piping (internal)	Sa 2 ½	Solid rigid poly urethane 500 µ									500µ
12.	Storage tanks (external)	Sa 2 ½	In organic Zn silicate	2	80 µ	HB MIO epoxy	2	200 µ	Poly urethane	2	60 µ	340µ
13.	Storage tanks (internal)	Sa 2 ½	3 coats of amine adducts									400µ
14.	DM water piping (internal)	Sa 2 ½	Hard rubber lining min 4 mm thickness									4.0

SECTION -IB

TECHNICAL SPECIFICATION

FOR

FUEL OIL HANDLING SYSTEM
(ELECTRICAL PORTION)

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for **FUEL OIL HANDLING 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, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “ both end equipment in vendor’s scope”shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

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

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder

furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

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

4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor
- b) Customer (M/s DCPL) specification for Motors
- c) Customer (M/s DCPL) cabling spec (to be referred by vendor for their scope of work (as per Electrical scope between BHEL & vendor)).
- d) Quality plan for motors
- e) Datasheet (Annexure- I)
- f) Datasheet-C
- g) Electrical Load data format (Annexure –II)
- h) BHEL cable listing format (Annexure –III)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling 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.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	a. In case, vendor's Fuel oil pump house building is located as combined with Heating & Pumping building (BHEL-TRICHY), cable tray/trench layout inside combined building shall be prepared by BHEL-PEM. Vendor to furnish drawing (both in print form as well as in AUTOCAD) of Fuel oil pump house layout clearly indicating all pumps, panels, JB's etc. which require cabling along with their terminal box/location/ Foundation etc. b. In case, vendor's Fuel oil pump house building is separate from Heating & Pumping building (BHEL-TRICHY), vendor shall prepare & submit cable tray/trench & equipment layout (both in print form as well as in AUTOCAD) of the complete Fuel oil pump house building indicating location and identification of all equipment requiring cabling for BHEL review & approval. Vendor to ensure the cable tray lay out shall confirm to NFPA (National fire prevention act)/TAC (Tariff advisory committee) applicable for hazardous area classification.

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

CHAPTER 17 : AC & DC MOTORS**1.00 MOTORS****1.1 SCOPE**

This specification is intended to cover design, manufacture, assembly and testing of AC Squirrel Cage Induction Motors for use in Thermal Power Plants and is supplement to the driven equipment specifications under which these motors are being procured for the project.

SITE CONDITIONS

Site conditions are covered in 'Project Data', contained in specification of the driven equipment.

1.2 Gases, Fumes & Dust Particles

1.2.01 General - Sulphur dioxide and/or trioxide fumes mildly present. Climate is tropical, conducive to fungus growth.

1.2.02 Dust Particles

1 Outdoor locations - Heavily dusty with abrasive dust and coal particles of size five (5) to hundred (100) microns present in atmosphere in large quantity.

2 Indoor Locations.

2.1 Coal conveyors - As for outdoor as per clause 1.02.02.1 above.

2.2 Other locations - Lightly dusty with abrasive dust and coal particles of size five (5) to twenty (20) microns present in atmosphere.

1.2.03 Special Fumes

1 Water treatment plant and acid cleaning room - Acid and alkali fumes present.

2 Fuel oil pumping areas & Hydrogen generation plant - Explosive fumes (flameproof motors required).

1.2.04 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

1.3 LOCATION OF MOTOR - As required

1.4 **SPECIFICATIONS & STANDARDS**.....Motors shall comply with the latest revisions of all relevant standards of BIS (IS-325, IS-900, IS-996, IS-1231, IS-1885, IS-2148, IS-2223, IS-2253, IS-2254, IS-2848, IS-3202, IS-4029, IS-4691, IS-4722, IS-4728, IS-4889, IS-6362, IS-7816, IS-8223, IS-8789, IS: 12615, IS:3177 and IEC : 60034 3Φ Induction motor) except as modified herein or in driven equipment specification.



Motors conforming to BS or IEC Publications, which ensure equivalent quality shall also be acceptable. In case of any difference between IS Specification/International Standards (IEC; NEMA etc.), this motor specification prevails.

1.5 TYPE**1.5.1 AC Motors:**

- a) Squirrel cage induction motor suitable for direct-on-line starting.
- b) Continuous duty LT motors upto 160 KW Output rating (at 50 deg. C ambient temperature), shall be **Efficiency class-IE2**, conforming to IS 12615, or IEC:60034-30.
- c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.

1.5.2 DC Motors Shunt wound.

1.6 VOLTAGE (NOMINAL)**1.6.1 LV Motors**

For motors upto and including 200 KW - Four hundred fifteen (415) V.

1.6.2 MV MOTORS

For motors above 200kW upto and including 1500kW, Three point three (3.3) kV.

For CHP conveyors motor above 160 kW, 3.3 kV, AC supply is to be used. However all the motors on stacker reclaimer shall be on 415 V AC only.

1.6.3 HV Motors

For motors above 1500kW - eleven(11) KV

1.6.4 All motors are to be designed for system grounding described in "System Particulars" under site information of the Driven Equipment Specification.

1.7 FREQUENCY (NOMINAL) - fifty (50) Hertz

1.8 NUMBER OF PHASES - Three (3)

1.9 SPEED - As required by the driven equipment

1.10 TYPE OF STARTING :

Direct on-line (VFD/Soft-starter/star/delta starting in special cases)

1.11 DUTY

1.11.1 Continuous motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment,



whichever is higher, considering highest system frequency and voltage variation. Crane motors shall be rated for S4 duty, 40% cyclic duration factor. If however, a higher margin is stipulated in the accompanying driven equipment specification, the higher stipulated margin shall prevail.

- 1.11.2 All HT motors shall have vibration pads for mounting vibration detectors.
- 1.11.3 All motors shall be designed to withstand hundred twenty (120) percent of rated speed without any mechanical damage for two (2) minutes.
- 1.11.4 Motors shall be designed to keep torsional and rotational natural frequencies of vibration of the motor and driven equipment atleast twenty five (25) percent above or below, preferably above the motor operating speed (to avoid resonance in vibration over the operating speed) range.
- 1.11.5 All LV motors rated 0.37kW and higher with S1 duty shall be compulsorily be of energy efficiency level IE 2 as per IS 12615:2011.
- Motors rated above 37kW shall have efficiency higher than 0.92 and high power factor of atleast 0.88.

1.12 **SUPPLY VARIATIONS**

Motors shall be capable of running continuously at full load under following variations in power supply:

- 1.12.1 All equipments shall be suitable for rated frequency of 50 Hz with a variation of (+) 3% and (-)5%, voltage variation of ($\pm$) 6% for 11 kV & 3.3 kV and ($\pm$)10% for 415V and 10% (absolute sum) combined variation of voltage and frequency unless specifically brought out in the specification.

1.13 **ABNORMAL CONDITIONS CAPABILITY**

Motor shall have following capabilities as specified design ambient temperature:

- 1.13.1 The motors shall also be capable of running up again after voltage collapse to about 40% for approximate duration of 0.5 sec. Subsequent rise in voltage to 70% and further to 80% and 100%, the total duration not exceeding 20 sec.

1.13.2 Low Voltage Running :

Motor shall be capable of running satisfactorily at seventy five (75) percent nominal voltage for five (5) minutes.

1.13.3 Momentary Low Voltage Withstanding :

Motor, when running at full load, shall not stall when voltage drops down to seventy (70) percent nominal voltage for one (1) minute.

1.14 **STARTING CAPABILITY**

1.14.1 Low Voltage Starting :

Motor shall be capable of starting and accelerating to full speed at full load (including loaded equipment e.g. mills and conveyors etc) at eighty (80)

percent nominal voltage at motor terminals. Mill motors may be permitted to start with terminal voltage not below 90%.

1.14.2 Cold Motor Starting Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment eg mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.

1.14.3 Hot Motor Starting Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment e.g. mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.

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

1.14.5 Break-away Starting Current Breakaway starting current as percent of full load current for various motor ratings shall not exceed the values given below:

1.14.5.1 Motors above 1500 KW upto 4000kW 600% without any positive tolerance except for ID Fan Motor.

1.14.5.2 Motors above 4000 KW 450%. Not subject to any positive tolerance.

1.14.5.3 For D.C. Motors the starting current shall be limited to 2 times full load current.

1.14.5.3 **Starting voltage requirement**

a) All Motors (except Mill Motors)

- 80% of rated voltage for Motors upto 4000 kW
- 75% of rated voltage for Motors above 4000 kW

b) For Mill Motors:

- 85% of rated voltage for Motors above 1000 kW
- 90% of rated voltage for Motors below 1000 kW

Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.

1.14.5.4 **Starting Time**

1.14.5.4.1 For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.

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

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



1.14.5.5 Torque Requirements:-

- 1.14.5.5.1 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10%. Motor full load torque.
- 1.14.5.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty Motors.

1.15 SAFE STALL TIME

- 1.15.1 To avoid problem in selecting standard protective relays without using speed switches, safe stall time under hot conditions (corresponding to 110% nominal voltage at motor terminals) shall be more than the accelerating time (corresponding to 80% nominal voltage at motor terminals) by the following minimum values :
- 1.15.1.01 Two (2) seconds, where accelerating time (at 80% nominal voltage) does not exceed 20 seconds.
- 1.15.1.02 Three (3) seconds, where accelerating time (at 80% nominal voltage) exceeds 20 seconds.
- 1.15.1.03 At no stage, speed switch shall be provided to achieve the above requirements mentioned under Clause No. 1.14.5.4

1.16 CLASS OF INSULATION

- 1.16.1 LV Motors Class F.
- 1.16.2 MV & HV Motors Class F
- 1.16.03 However temperature rise shall be restricted to limits corresponding to Class 'B' insulation for both HT & LT motors. The temperature under abnormal running conditions shall be limited to 5°C above class 'B' limits.
- 1.16.04 The value of the polarization index for motors above 200kW should not be less than 2 when determined according to IS: 7816.
- 1.17 **TEMPERATURE RISE UNDER NORMAL CONDITIONS.....** Temperature rise over specified design ambient temperature when motor is running with full load at nominal supply voltage & frequency shall not exceed the values given below:

S.No.	Specified Design Ambient Temperature	Thermometer Method	Resistance Method
1.17.01	50°C	60°C	70°C
1.17.02	45°C	65°C	75°C
1.17.03	40°C	70°C	80°C

1.18 BUS TRANSFER WITHSTAND CAPABILITY

Motors will be connected to an automatic bus transfer system and hence may be subjected to one hundred and fifty (150) percent of the nominal voltage during changeover of buses due to the vector difference between the residual voltage and incoming supply voltage and the duration of this condition may be one second. Motors shall be capable of withstanding the voltage and torque stresses developed under such conditions without damage. The manufacturer/vendor shall indicate the special precautions taken to meet the above requirements and confirm.

- 1.18.01 That about 5000 bus transfers, in lifetime of motor, shall not puncture its insulation.
- 1.18.02 That motor shall be capable of withstanding heavy inrush transient current caused by such bus transfers without damage.
- 1.18.03 That the motor windings shall be adequately braced to satisfactorily withstand mechanical stresses under these conditions.
- 1.18.04 The motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torques under these conditions.

1.19 TYPE OF ENCLOSURE

- 1.19.01 Outdoor Motors IP 55 (Additional canopy to be provided by EPC contractor.
- 1.19.02 Indoor Motors IP 55
- 1.19.03 IP-55 degree of protection shall be achieved without application of any compound, putty etc.
- 1.19.04 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).

1.20 METHOD OF COOLING

- 1.20.1 Method of cooling shall be IC 411 (TEFC), IC 511 (TETV) or IC 611 (CACA). However, motors rated 3000kW or above can be closed air circuit water cooled (CACW).
- 1.20.2 Large capacity motors not available with above types of cooling may be accepted with IC 81 W for IC 91 W (CACW) cooling subject to the approval of the Owner.

1.21 TYPE OF MOUNTING As required for the driven equipment.**1.21 MAXIMUM MECHANICAL VIBRATIONS**

- 1.21.01 Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits



prescribed in IS: 12075 / IEC 60034-14. Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.

1.21.02 Noise level

The noise level of motors shall not exceed 85 db (A) at 1m from operating motor measured in accordance with IS: 10265.

1.21.03 Motor body shall have two earthing points on opposite sides.

1.21.04 11 KV motors shall be offered with Separate Insulated Connector (Elastimould or Equivalent make) as per IEEE 386. The offered Elastimould terminations shall be provided with protective cover and trifurcating sleeves. Elastimould termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.

1.21.05 3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.

1.21.06 The spacing between gland plate & centre of terminal stud shall be as per Table-I.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm
UP to 3 KW	As per manufacturer's practice.
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331

Above 125 KW-upto 200 KW 203

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

1.21.07 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

1.21.08 For motors rated 1500 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.

1.21.09 The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor.

(a)	Below 110KW	:	10.0
(b)	From 110 KW & upto 200 KW	:	9.0
(c)	Above 200 KW & upto 1000KW	:	10.0
(d)	From 1001KW & upto 4000KW	:	9.0
(e)	Above 4000KW	:	6 to 6.5

1.22 WINDING & INSULATION

- (a) Type : Non-hygroscopic, oil resistant, flame resistant
- (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature.
- (c) 11kV & 3.3 kV : Thermal class 155 (F) insulation.
AC motors
The winding insulation process shall be total Vacuum Pressure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15
- (d) 240VAC, 415V : Thermal Class(B) or better
AC & 220V
DC motors

1.23 DIRECTION OF ROTATION

1.23.1 As needed by driven equipment.

1.23.2 The 3 phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor.

1.23.3 If, in the case of HT motors, fan is suitable for only one direction of rotation, the fan shall be so designed that with the slight modification work, it can be made suitable for other direction of rotation also. No extra material shall be required for doing above modification work.

1.24 BEARINGS



- 1.24.1 General Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 20,000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing.
- Bearing shall be effectively sealed against dust ingress and shall be pressure grease gun lubricated.
- If the bearings are oil lubricated, a drain plug shall be provided for draining residual oil and oil level gauge shall be provided to show precisely oil level required under standstill and running conditions.
- Unless otherwise approved, bearing lubricating system shall be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.
- For MV & HV motors, the bearings shall be insulated wherever necessary to prevent damage to motor bearings from shaft current.
- When pressure oiling is required for horizontal motors, bearings shall be sleeve type arranged for pressure oiling supplied from lubrication system of driven machine, with ring oiling for starting and emergency duty. Ring oiling system shall be adequate for starting and continuous operation of motor for at least half an hour, without pressure oiling system in operation. Oil sight flow gauges shall be provided to indicate oil flow through each bearing.
- Lubricants shall be selected for prolonged storage and normal use of motors in tropical climate and shall contain corrosion and oxidation inhibitors. Greases shall have suitable bleeding characteristics to minimize setting. The selected lubricants shall be indigenously available.
- Sleeve bearings for use with motors having flexible coupling with limited end play, shall have adequate axial end play to prevent transmission of thrust from driven equipment to motor bearings.
- Bearings shall be of reputed make subject to the approval of the Owner/Consulting Engineer.
- 1.24.2 Large motors Large motors shall preferably have spherically seated babitted, ring forced, feed lubricated, water-cooled bearings. If anti-friction bearings are provided, these shall be roller bearings rated for a minimum standard life of 30000 hours taking all bearing and driven equipment loads into account.
- 1.25 **SHAFT EXTENSION** Key slotted bare shaft extension of required length with key on driving end.
- 1.26 **DRAIN HOLES** Two (2) drain holes with plugs, one (1) on either end of motor at the bottom most point.
- 1.27 **LIFTING DEVICES** Motors shall be provided with eyebolts, lugs or other means to facilitate safe lifting.
- 1.28 **DOWEL PINS**..... It shall be possible to drill holes vertically inclined through motor feet or mounting flange for installing dowel pins after assembling motor and driven equipment, before despatch (for completed driving + driven

equipment assembly) or at site after erection (for separate supplies of above equipment).

1.29 **CENTERING SPIGOT**..... Flange mounted motor shall have centering spigot to match driven equipment socket.

1.30 **EASE OF MAINTENANCE**..... Motor shall be so constructed that it can be de-assembled and reassembled with ease.

1.31 **NAMEPLATES**..... Motor shall have nameplate(s) showing diagram of connections, all particulars as per IS: 325 and following additional information:

In addition, an arrow block shall be screwed on to the body of motor on the non-driving end to indicate direction of rotation of motor.

1.31.1 Temperature rise under normal/abnormal conditions.

1.31.2 Type of bearing and recommended lubricants.

1.32 **FINISH**..... Motor shall have glossy, light grey finish No. 631 as per IS: 5 for withstanding site conditions as per Clause 1.00 above.

All sharp edges and scales shall be removed from the surface, which shall then be thoroughly degreased, de-rusted and given two (2) coats of primer and two (2) coats of finish paint. It is preferred that a phosphate coat is given to motor prior to application of primer coat. Motors for water treatment plant shall have Zinc Chromate base with acid resistant Epilex 4 paint.

1.33 **TERMINAL BOXES**

1.33.1 GeneralMotors shall be provided with separate terminal boxes for main, space heaters, embedded temperature detectors, bearing temperature indicators and moisture detectors terminals. When it is not possible to provide LT motors with separate terminal box for space heater terminals, space heater terminals shall be adequately segregated from the main terminals in the single box. Terminal boxes shall be weatherproof and water-tight confirming to minimum IP-55 degree of protection with removable front cover for making connections. IP-55 degree of protection shall be achieved without application of compound. Space between and around terminals shall be adequate for easily connecting aluminium conductor cables. Terminal box arrangement shall be to the approval of the Owner /Consulting Engineer. All terminal boxes shall be suitable for proper termination of the type and tentative size of cables specified in Clause 1.34 below, however, exact size of cables shall be furnished by Owner during engineering stage.

The terminal boxes shall be complete with cable glands and termination accessories as required. Suitable non-magnetic material construction shall be adopted for terminal boxes where single core cables are to be terminated. All HT motors shall be provided with phase segregated terminal box.

Terminal bushings and clamps shall be non-absorbent, non- inflammable, insulated material for connecting with cable.

1.33.2 **Main Terminal Box**



1.33.2.1 LV Motors Main terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.

1.33.2.2 MV & HV Motors Motor shall be provided with two (2) terminal boxes for stator terminals. One (1) terminal box shall be for phase terminals while other one for forming star connection. These should be interchangeable to facilitate cable routing.

Neutral terminal box for HT motors rated above 1500 KW shall be suitable for mounting of three (3) Nos. wound/bar primary/ring type cast resin insulated current transformers for differential protection. These transformers shall be supplied and mounted in the motor terminal box. In addition to above, 3 Nos. of identical current transformers shall be supplied loose for mounting in the switchgear. Stator phase terminal box may either be phase segregated or standard terminal box suitable for both top and bottom entry of cables (i.e. they should be capable of being turned through 180 Degrees). The terminal box shall be designed for termination of XLPE cables using heat shrinkable or push on type terminating Kit. Terminal leading shall be stud type or leading wire type.

1.33.2.3 Cable End Boxes.....Terminal Boxes shall be provided with cable end boxes having cable lugs and cable glands for cables of sizes as specified in Clause 1.34 below.

Cable box shall be suitable for glanding the cables; and shall have adequate space between cable glands terminating studs to allow suitable bends of cable inside the cable box for all 3 phases of relevant cable sizes specified.

1.33.2.4 The terminal boxes shall be capable of withstanding at the terminals the system fault level (as indicated below) without rupture for a duration of atleast 0.25 seconds.

Min. fault level for MV Motors - 40 KA

Min. fault level for LV & HV Motors - 50 KA

1.33.2.5 **PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:**

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

1.33.2.6 Terminal Accessories.....Each terminal end shall be furnished with bimetallic washers, spring washers, nuts and crimp type aluminium (preferably tinned) lugs suitable for cables of sizes as specified in Clause 1.34 below.

1.34 **TYPE AND SIZE OF CABLES**

1.34.1 **Space Heaters**



- 1.34.1.1 For LV Motors: Two point five (2.5) mm², two (2) core copper conductor PVC insulated, armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable to IS: 1554 (Part-I).
- 1.34.1.2 For MV & HV Motors: Six (6) mm² two core aluminium conductor PVC insulated armoured and FRLS PVC sheathed heavy duty 650/1100V grade cable to IS: 1554 (Part-I).
- 1.34.2 For Embedded Temperature Detectors two sets of six (6) Twisted triad 0.5 mm² ATC copper conductor armoured, shielded cable, 650/1100 V Grade IS: 1554 (Part-I). For bearing temperature, RTDS, two (2) sets of four (4) twisted triad 0.5 mm², ATC copper conductor armoured shielded 650/1100 V Grade, IS: 1554 (Part-I).
- 1.34.3 Bearing Temperature Indicators - For each indicator, 0.5 mm² six (6) tarnished triad ATC copper conductor, PVC insulated, shielded armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable as per IS: 1554 Part-I. Two (2) cables one (1) for each bearing temperature indicator.
- 1.34.4 For Moisture Detectors.....As for space heaters as per Clause 33.01.01 above.
- 1.34.5 **For Main Terminals**

LT Motors

1. Three (3) core cablesStranded aluminium conductor, XLPE insulated, colour coded, laid up, PVC sheathed, GI wire / strip armoured, FRLS PVC jacketed overall, 650 / 1100V grade, heavy-duty cables as per IS: 1554 (Part-I).
2. Single core cablesStranded aluminium conductor, XLPE insulated, hard drawn aluminium wire/ strip armoured FRLS PVC jacketed overall, 650 / 1100V grade, heavy duty cable as per IS: 1554 (Part-I).

HT Motors

1. Three (3) core cables stranded aluminium conductor, XLPE insulated, screened colour coded, laid up, PVC sheathed, GI wire/strip armoured FRLS PVC jacketed overall, 6.6 KV / 11 KV grade, heavy duty cables as per requirement for unearthed system as per IS: 7098 (Part-II).

The size and no. of cable to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box, cable gland and lugs suitable for the same.

Cable size may be increased in some cases because of large number of cables in under-ground ducts or because of voltage drop consideration. The supplier shall supply with terminal box and cable accessories suitable for higher size of cable at no extra cost.

1.35 **EARTHING**

- 1.35.01 General..... Two (2) grounding terminals one (1) on either side at the bottom suitable for connecting mild steel/GI flat/GI wire grounding conductor, size of grounding conductor shall be decided during detailed engineering.



- 1.35.02 LV Motors.....At each earthing point, two (2) drilled and tapped holes with hexagonal head bolts, plain washers, spring washers and tinned lugs (for motors upto 5.5 KW) for size of conductor specified shall be provided.
- 1.35.03 MV & HV Motors.....Non-corrodible metallic grounding pad shall be welded or brazed at each earthing point. The size of grounding pad shall be 75x65x25 mm. Grounding pad shall have 40 mm apart two (2) drilled and tapped holes with hexagonal head bolts, plain washers and spring washers for size of conductor specified. In addition, one suitable earthing terminal shall be provided inside the stator phase terminal box for earthing metallic shield of XLPE cables.
- 1.36 **EMBEDDED TEMPERATURE DETECTORS**.....HT motor shall be provided with six (6) Nos. duplex resistance temperature detectors (RTDs) embedded in stator winding at locations where high temperatures are expected. In addition one (1) duplex type RTD shall be provided in each bearing. The RTDs shall be 3 wire duplex platinum resistance type having a value of 100 ohms at 0 Deg.C
- 1.37 **BEARINGS TEMPERATURE INDICATORS**..... HT motors shall be provided with dial type two (2) bearing temperature indicators and will have two (2) sets of contacts, each set having 2 NO + 2 NC contacts rated for 5A at 240V AC and 0.5A at 220V DC. One set will be set to operate at lower value to give alarm and other set at a higher value to trip the motor.
- 1.38 **SPACE HEATERS**.....Valve / Damper actuator motors; and Motors above 30 KW shall be provided with one (1) or two (2) space heaters suitable for 240V, 50 Hertz single phase AC supply and of adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation or deterioration of insulation during shut down. Heaters shall be mounted inside the motor in accessible locations so that their removal and replacement is simple. Motors upto 30 kW shall have stator windings suitable for connections to 24V, 50 Hz AC supply for space heating.
- Motors upto 30 kW shall have stator windings suitable for connection to 24V, 50 Hz ac supply for space heating
- The terminals of space heaters shall be brought out to a separate totally enclosed dust proof and weatherproof terminal box.
- 1.39 **HOT AIR TEMPERATURE DETECTOR**
- If the motor is of CACA or CACW enclosure, a thermometer with alarm contracts in hot air circuit shall be provided.
- 1.40 **WATER FLOW INDICATOR**
- If the motor is of CACW enclosure a provision shall be made for visual indication of water flow and flow switch shall also be provided with alarm contacts. Thermometers shall be provided in water inlet and outlet circuits.
- 1.41 **MOISTURE DETECTORS**.....Motors with type of cooling 1C 81W or 1C 91 W shall be provided with moisture detectors for raising alarm in the event of water tube failure.

- 1.42 **BED PLATE**.....Whenever motor is supplied with driven equipment the Supplier shall ensure that bed plate suits both motor and driven equipment and is adequately braced to keep vibration and misalignment within allowable limits to the approval of driven equipment and motor manufacturers.
- 1.43 **OTHER ACCESSORIES**..... Motor shall be supplied with all accessories and parts other than those, specified above which are necessary and/or useful for efficient operation.
- 1.44 **TYPE TEST**
- 1.44.01 **HT MOTORS**
- a) The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract.
 - b) The type tests shall be carried out in presence of the Purchaser's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the Purchaser's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
 - c) In case the contractor has conducted such specified type test(s) within last five years as on the date of bid opening, he may submit during detailed engineering the type test reports to the Purchaser's for waiver of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Purchaser's reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.
 - d) Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Purchaser's either at third party lab or in presence of client representative and submit the reports for approval.
 - e) **LIST OF TYPE TESTS TO BE CONDUCTED**

The following type tests shall be conducted on each type and rating of HT motor

- i) No load saturation and loss curves upto approximately 115% of rated voltage
- ii) Measurement of noise at no load.
- iii) Momentary excess torque test (subject to test bed constraint).
- iv) Full load test(subject to test bed constraint)
- v) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

f) LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED

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

- i) Degree of protection test for the enclosure followed by IR, HV and no load run test.
- ii) Terminal box-fault level withstand test for each type of terminal box of HT motors only.
- iii) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15
- iv) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

1.44.02

LT Motors

- a) LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Purchaser's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
- b) However if the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Purchaser's shall conduct all such tests under this contract at no additional cost to the Purchaser either at third party lab or in presence of client representative and submit the reports for approval.

1.44.03

LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED

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The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only

- i) Measurement of resistance of windings of stator and wound rotor.
- ii) No load test at rated voltage to determine input current power and speed.
- iii) Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
- iv) Full load test to determine efficiency power factor and slip .
- v) Temperature rise test.
- vi) Momentary excess torque test.
- vii) High voltage test.
- viii) Test for vibration severity of motor.
- ix) Test for noise levels of motor(Shall be limited as per clause no 1.21.01 of this section)
- x) Test for degree of protection and
- xi) Over speed test.
- xii) Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

1.44.04 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

1.45 INFORMATION WITH PROPOSAL

1.45.1 AC Motor Data Sheet.

1.45.2 Dimension Drawing/Foundation load details of motor and driven equipment.
1.45.03 Manufacturer's catalogue showing constructional details.

1.46.00 **INFORMATION ON AWARD OF CONTRACT**.....Within six (6) weeks from the date of award of the Contract, following shall be furnished:

1.46.01 Motor Data Sheet.

1.46.02 Certified binding dimension drawing of motor complete with all accessories and fittings specifically showing terminal boxes, terminal spacing and sizes, earthing connections and sizes thereof, mounting details, lifting lugs, final foundation loads and dimensions with tolerances of centering spigot (where needed), shaft extension and key.

1.46.03 Following characteristics curves:

1.46.03.01 Torque-speed curves for motor at eighty (80), hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment.

1.46.03.02 Current-speed curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage

1.46.03.03 Current-time curves at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.

1.46.03.04 Thermal withstand curves for hot and cold at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.



- 1.46.03.05 Efficiency, power factor, current and speed versus power output curves.
- 1.46.03.06 Speed-time curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage.
- 1.46.03.07 Negative phase sequence current withstand characteristics.

1.47 COMMISSIONING CHECK LIST (HT MOTORS)

A PRELIMINARY CHECKS

Check the following:

1. Check the name plate details according to specification. Discrepancies, if any, to be satisfactorily resolved.
2. Check tightness of all bolts, clamps and connecting terminals.
3. Check body earthing
4. Check whether bearing lubrication is adequate
5. Check clearance inside terminal box
6. Checking stator (motor air gap) Check – Grease lubrication (for ball or roller bearing) is adequate if the motor was in storage for very long period replace the grease, by fresh grease after flushing the bearing clean. Excess grease in the bearing (housing ... is overheat of bearings) Check the free rotation of the rotor in decoupled condition. Check the air gap between stator and rotor at four positions 90o apart at driving and non-driving end. Compare the recorded values with factory results. For slip ring motors : with starting resistances.
 - a) Check the variation of resistance
 - b) Check brush lifting and slip ring short.

B COMMISSIONING CHECKS

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Measure resistance of motor winding (in case of large motors)
4. Control and interlocks should be checked
5. Motor protection relay to be calibrated
6. Phase sequence and direction of rotation
7. Other than DOL scheme to be checked example trafo starts
9. Measure starting current starting timer and no load current
10. On load operations starting and running currents (observed vibrations, temperatures of bearings and body)
11. On load operation, starting and running currents (observed vibrations, temperatures of bearings and body)
12. In case of forced water cooling of start or check winding temperatures as ready by built in RTDs.
13. Water level (start up cooling) low to be checked for limit switch operation.

1.48 COMMISSIONING CHECK LIST (LT MOTORS)**A PRELIMINARY CHECKS**

Check the following:

1. Check the name plate details according to specification. Discrepancies, if any, to be satisfactorily resolved.
2. Check tightness of all bolts, clamps and connecting terminals.
3. Check body earthing
4. Check whether bearing lubrication is adequate
5. Check clearance inside terminal box

B COMMISSIONING CHECKS

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Over load and short circuit relay tests and settings
4. Control and interlocks should be checked
5. Phase sequence and direction of rotation
6. Operation of timer in case of star delta starting
7. Measure starting current starting timer and no load current
8. On load operations starting and running currents

1.49 DC MOTOR SPECIFICATION

DC Motor will be of continuous duty type totally enclosed fan cooled (TEFC) having IP-54 degree of protection suitable for 220 V DC supply. DC motor will be shunt wound type having high torque characteristic suitable for Bi-directional rotation at rated speed and output. The general constructional features and details of DC motor will be in line with details/ particulars stipulated in the specification for AC squirrel cage induction motors.

Contractor will furnish the data in respect of DC motors.

DATASHEET

	Auxiliary power supply	
1.1	HV supply	
	11kV, 3Φ, 3W, 50 Hz non effectively earthed	Motors rated above 1500 kW
	Fault level	50 kA for 1 second
1.2	MV supply	
	3.3kV, 3Φ, 3W, 50 Hz non effectively earthed	Motors above 200kW upto and including 1500kW
	Fault level	40 kA for 1 second
1.3	LV supply	
	415V, 3Φ, 3W, 50 Hz effectively earthed	Motors below and including 200kW
	Fault level	50kA for 1 second
	110V, 1Φ, 2W, 50 Hz effectively earthed	Lighting, space heating, AC control and protective devices
1.4	DC supply	
	220V, 2W, unearthed	DC alarm, control and protective devices.
	Fault level	25 kA for 1 second
2	Range of variation	As indicated in the specification
2.1	AC supply	
	voltage	-----
	Frequency	-----
	Combined voltage & frequency	-----
2.2	DC supply	198 to 240 V
Note: During starting of largest motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.		

CHAPTER 26 : CABLING SYSTEM**1.00.00 SCOPE OF WORK**

The scope of work covers supply, erection, testing and commissioning of complete electrical system including cabling, fire stop mortar seal, fire retardant cable coating system etc. the scope shall broadly cover, but not be limited to:

- (a) Main power house building.
- (b) Boiler area, ESP.
- (c) Transformer yard.
- (d) All auxiliary buildings (including electrical rooms of respective buildings) and structures as per details in the General electrical specification/ plot plan/ & related drawings.
- (e) Coal handling plant.
- (f) Ash handling plant including ash dyke
- (g) Raw water system
- (h) Fuel oil unloading & transfer system.
- (i) Aux. power transformers
- (j) Pipe cum cable rack.
- (k) All electrical equipment as described in different sections.
- (l) As built drawing for all above systems on completion of project.

The scope of work shall also include all civil and structural works necessary for successful installation, commissioning & commercial operation of all electrical equipment to be erected under this specification.

2.00.00 SCOPE OF SUPPLY

2.01.00 The equipments and materials within the scope of supply shall include but not limited to :-

- i. Power & control cabling works (including that of special cables):
- ii. Galvanized steel pre-fabricated cable trays, coupler plates, nuts, bolts & washers, reducers, covers, wall brackets, hanger clamps, straight run, elbows, bends, cable trays supporting structures etc.
- iii. Supply and installation (including laying & termination) of control cables, special cables, instrumentation cables for all equipments and systems.

- iv. Supply and installation (including laying & termination) of all power cables (HV and LV) of all power cables (HV and LV) for all equipments and systems.
- v. Cable routing has to be planned such that it shall not cross the steam lines, oil lines.
- vi. Fire Sealing Arrangement: All cable entries into the panel (HV & MV & LV SWGR panels) should be provided with fire sealing arrangements.
- vii. Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be sealed by a fire proof sealing system (FPSS). The FPSS shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire.
- viii. 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.
- ix. All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.
- x. Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work involved 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.

3.00.00 CODES AND STANDARDS

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.

IS:513	Cold rolled low carbon steel sheets and strips.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubular and other wrought steel fittings
IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:9537	Conduits for electrical installation.
IS:9595	Metal – arc welding of carbon and carbon manganese steels - recommendations.
IS:13573	Joints and terminations for polymeric cables for working voltages from 3.3kv up to and including 33kv performance requirements and type tests.
IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.



IS:2309	Code of practice for the protection of building and allied structures against lightning.
IS:2629	Recommended practice for hot dip galvanising of iron & steel.
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:6745	Method for determination of mass of zinc-coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in-line connectors for aluminium conductors of insulated class.
IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.
BS:476	Fire tests on building materials and structures
DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors
VDE 0278	Tests on cable terminations and straight through joints
BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
	Indian Electricity Act.
	Indian Electricity Rules.

Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Contractor shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

4.00.00 DESIGN AND CONSTRUCTIONAL FEATURES

4.00.01 Inter Plant Cabling

4.01.00

Interplant cable routing will be on overhead cable trays on pipe cum cable trestle or only cable trestle except where approved by purchaser/consultant.

Major routes in boiler area to individual boiler drives, fly ash conveying compressor building, ESP building, CW pump house, Raw water pump house, DM plant, Filter water pump house, Clarified water pump house, Fly ash silo fluidizing blower house etc will be on overhead Cable trays either supported from available structures or on pipe cum cable trestle or on only cable trestle. Only in specific areas as will be approved by purchaser/consultant where number of cables are too small compared to the route length like Intake pump house & Ash dyke, cables may be directly buried underground with marker.

Overhead trestle will be provided to the extent possible. Cable route shall be provided in such a manner that movement of crane does not get restricted and also the cables are to be routed at a safe distance from hot pipes. Generally the bottom of steel supporting structure shall be at 6.5m above the grade level. Where rail/road crossing is involved the same shall be minimum at 8m above the grade level.

Individual shallow trench shall be routed from switchyard equipment to main switchyard trench which will be routed up to Switchyard control room. Interconnecting cables from Power House to Switchyard control room shall be routed through RCC trenches. From trenches to the switchyard equipments, all power and control cables shall be laid through PVC conduit.

Space for accommodating additional trays, which may come in future shall be provided in present cable route. Some trays may be required for use by the purchaser, which will be finalized during detail engineering stage. The successful bidder shall provide such trays without any extra cost to purchaser.

For Power supply to Raw Water Intake Pump house, Cable from powerhouse will run on overhead Cable trays up to Plant boundary. After that it will be buried cable that will follow the intake pipeline corridor.

For Power supply from Power House to Main CHP Substation Building and from Main CHP Substation Building to Crusher House & Pump House, Cable will run on overhead Cable trestles. Further, Cable shall be routed through the conveyor gallery / TPs / Crusher House by separate supporting structures and trench in the pump house.

4.02.00 Trenches

4.02.01 PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

4.02.02

4.02.03 All field switches for equipments corresponding to a stream located within a radius of 4-5 m shall be wired out to a field junction box and from field junction box to control panel/Input - Output cabinet by screened instrumentation cables.

4.02.04 For CHP following shall also be applicable:

- a) All cable routes shall be overhead along the route of the conveyor gallery by separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600 mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 6.5 M above the grade level except for rail/road crossings where it shall be at 8.0 M above grade level. However in bunker area the bottom of the cable trestle shall be 10 to 14 M depending on boiler/bunker layout.
- b) Cable trenches shall be provided only in Switchgear/MCC rooms.
- c) **Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches, receptacles etc.**
- d) Cables for Pull cord switches and belt sway switches shall be taken in cable trays. The trailing cables of the mobile machines shall also be laid in cable trays.

- e) Two separate cable routes one on each side shall be provided for each boiler unit. cables for one set of auxiliaries such as ID, FD & PA fans & half of the coal mills shall be routed in one route & for through other set of auxiliaries through other route.

Cable trays in Boiler & ESP area shall be supported from the Boiler & ESP structure. The same shall be co-ordinated with SG/ESP contractors

Cable trays in these areas shall be in vertical formation to avoid dust accumulation. No cable trenches shall be provided in Boiler/ESP area.

Contractor shall provide two independent routes for cables between ESP control room & ESP. Contractor shall provide the cable trays along with its supporting structure arrangement on the trestle.

f) **Turbine Hall Area:**

Two separate cable routes shall be provided for cable routing of working & standby drives or different sets/groups say 50% capacity) of auxiliaries.

g) **OffSite Area:**

In offsite area pumphouses, overhead cable tray arrangement shall be preferably followed.

h) **Cable Vault:**

Cable gallery (over ground) to be provided below each electrical control/switchgear room .

Cable vault of not less than 3 mts clear height from bottom of beam shall be provided.

Clear access passage of at least 750 mm wide & 2.0 Mts clear height shall be provided at entrances & along cable ways. Wherever the passage is through cable routes clear height shall not be less than 1.5 Mts.

Cable vaults shall be provided with adequate drainage facility for drainage of fire water.

Each cable vault should have two doors.

Exit signs shall be provided near doors for personnel escape in case of emergency.

5.00.00 EQUIPMENT DESCRIPTION

5.01.00 Cable trays, Fittings & Accessories

- 5.01.01 Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.), accessories (like side coupler plates, etc.) and hardware (like bolts, nuts,

washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.

5.01.02 These shall be either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron trays free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.

5.01.03 Cable trays shall have standard width of 600 mm, however trays with 450mm, 300mm and 150mm may be used in places considering the requirement and space constraint. and standard lengths of 2.5 metre. Minimum thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be minimum 3 mm.

5.01.04 Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of minimum thickness 2 mm and shall be hot dip galvanized as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.

5.01.05 Prefabricated hot dip galvanized sheet steel cable trays shall be used for maximum support span of maximum 1.25M for horizontally and 1.0M for vertically unless design is approved for larger span. Cable trays shall be suitable for a cable weight of 100 kg/meter running length of tray. Minimum thickness of sheet steel/galvanizing shall be 2mm/86 microns respectively. The amount of zinc deposit shall not be less than 610 gm per square meter.

In areas, where acid/alkalie ingration is likely to occur, glass reinforced plstic trays with fire retardant corrosion resistance properties shall be used.

5.01.06 Cable trays fabricated from standard rolled sections shall be 50x50x6/75x75x6 sections for runners for supporting spans limited to 2000 mm/more than 2000 mm respectively. Cross support shall be 32x6 mm / 50x6 flat for widths up to 500mm/more than 500mm respectively.

5.01.07 Separate coloured paint strips shall be applied for identification of different type of trays depending upon types of usage/applications/area as below:

High/ medium voltage cables: red strips, 2 inch width each, numbers
11kv/3.3kv equally spaced at 5 metres interval
1.1kv power cables : yellow strips ----- do -----
1.1kv control cables : blue strips ----- do -----
Instrumentation cables : green strips ----- do -----

5.02.00 Support System for Cable Trays

5.02.01 Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".

5.02.02 Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types: (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder:

a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor

plates, all hardware such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.

- b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardware's fittings and accessories shall be prefabricated factory galvanised.
- c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanized surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.
- d. All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation.
- e. The main support channel and cantilever arms shall be fabricated out of minimum 2.5 thick rolled steel sheets conforming to IS.
- f. Cantilever arms of 300 mm, 600 mm and 750 mm in length are required. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.
- g. Cable trays in areas subjected to excessive coal dust or mechanical damage shall have hot dip galvanized sheet steel metal trays cover installed on front tray in vertical run and inverted 'V' type on upper tray in horizontal run with consideration for ventilation.

5.02.03 The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above are indicative only. Nevertheless, the support system shall be designed by the contractor to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Contractor without any additional cost. The contractor shall submit the detailed drawings of the system offered by him along with the bid.

5.03.00 Pipes, Fittings & Accessories

5.03.01 Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

5.03.02 GI Pipes shall be of medium duty as per IS: 1239.

5.03.03 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.

5.03.04 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.

- 5.03.05 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.
- 5.03.06 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.
- 5.03.07 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.
- 5.03.08 Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

5.04.00 Junction Boxes

- 5.04.01 Junction Boxes shall comprise of a case with hinged door constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the boxes shall be arranged to slope towards rear of the box. Gland plate shall be 3 mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanised as per relevant IS, and suitable for mounting on wall, columns, structures etc. The boxes shall include brackets, bolts, nuts, screws M8 earthing stud etc. required for installation.

5.04.02 Glass Fibre Reinforced Junction Boxes (for outdoor use)

No. of Ways: 12/24/36/48 with 20% spares terminals.

- 5.04.03 Junction boxes shall be Glass Fibre Reinforced with saturated polyester conforming to standards like DIN 16911 type 803/16913 type 834, 5 self extinguishing in accordance with ASTM D635/UL 94 VO.

Junction boxes for use in outdoor or damp locations shall be sturdy construction. Temperature resistance shall be between – 10 to 100°C. Impact resistance shall be greater than 7 Nm, (EN 50014). Protective insulation shall be in line with VDE 0100, dielectric strength shall be greater than 10 KV/mm, halogen free toxicity, the enclosure and door cover shall be painted and electro statically power coated (preferably in RAL 7032). Earth connection (studs size shall be M 6) shall be provided on the cover as well as door.

- 5.04.04 Doors

With integrated viewing window of 3mm resistant plexi glass or equivalent. The doors shall be industrial heavy duty hinges. The doors shall be easily but firmly lockable with quick release fastener.

- 5.04.05 Protection Class

Protection Category shall be IP 66 to EN 60529. There shall be guaranteed perfect seal to meet Protection class IP 66 providing arrangement like highly elastic foamed in special type seal like polyurethane/chloroprene. The sealing

rubber shall not have aging effect and shall retain its sealing characteristics for more than 20 years. Contractor shall indicate this in data sheet. The rubber seal should be pasted at its place with pasting technology for like more than 20 years (double sealing arrangement is preferred).

5.04.06 **Mounting clamps and accessories**

Junction boxes shall be suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass. The accessories like mounting plates etc. of steel shall be powder coated. The support rails for terminal box shall be zinc coated.

5.04.07 General

- JBs shall have small canopy at the top.
- There shall be rainwater collection arrangement from top and side of the outer ages to ensure that any leakage into the junction box shall be avoided and it shall fall outside.
- Cable entry shall be from bottom side only.
- Ensure gland plate sealing perfect. It shall be of the same quality and arrangement as that of door to cover arrangement.

5.04.08 **Steel Junction Boxes (for indoor use)**

5.04.09 No. of Ways

12/24/36/48 with 20% spares terminals.

5.04.10 Junction boxes shall be designed in accordance with NEC, article 370, paragraph 18,19 & 20 or equivalent standards.

5.04.11 Enclosure

Junction boxes for use in outdoor or damp locations shall be sturdy steel construction. The enclosure and door cover shall be surface finished clean, degreased, phosphated, deep coated primed (preferably in RAL 7044) and electro-statically powder coated (preferably in RAL 7032). Earth connection (studs size shall be M6) shall be provided on the cover as well as door. The sheath steel thickness shall be more than 2 mm.

5.04.12 Doors

The doors shall be hinged and lockable. The doors shall have industrial heavy duty hinges. The doors shall be easily but firmly lockable with quick release fastener.

5.04.13 Protection Class

Protection Category shall be IP 66 to EN60529/1091 complies with NEMA 4. There shall be guaranteed perfect seal to meet Protection class IP 66 providing sealing arrangement like highly elastic foamed in special type seal like polyurethane. There shall be an arrangement like multifold protection channel for additional stability and prevention of ingress of dust and water when the enclosure is open.

The sealing rubber shall not have aging effect and shall retain its sealing characteristics for more than 20 years. Contractor shall indicate this in data

sheet. The rubber seal should be pasted at its place with pasting technology for like more than 20 years (double sealing arrangement is preferred).

5.04.14 Mounting clamps and accessories

The mounting clamps and accessories shall be suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass.

5.04.15 General

- JBs shall have small canopy at the top.
- There shall be rainwater collection arrangement from top and side of the outer ages to ensure that any leakage in to the junction box shall be avoided and it shall fall outside.
- Cable entry shall be from bottom side only.
- Ensure gland plate sealing perfect. It shall be of the same quality and arrangement as that of door to cover arrangement.

5.04.16 Junction boxes shall be provided with two nos. earthing terminals (externally available) suitable for connection of 8 SWG G.I. wire. Knockouts shall be provided at bottom and both sides. These shall be provided by fixing plates in order to make them detachable type with suitable neoprene gaskets. Bottom and side plates for cable/conduit connection shall be provided. All unused holes shall be sealed with suitable grommets.

5.04.17 Junction boxes shall be provided with external designation label. The label inscriptions shall be informed to the Contractor by the Owner. Junction boxes shall be provided with danger sign in case of 415V circuit.

5.04.18 Junction boxes shall be of two types, viz. One suitable for control cabling and the other suitable for power cabling.

Junction boxes for control cabling shall have 24 way/ 48 way terminal blocks suitable for up to 2.5 sq.mm. Cu. Cable. However, for instrumentation junction boxes there shall be 24/48 ways suitable for terminating cable of 0.5 sq.mm. Cu. Cable.

5.04.19 Junction boxes for power circuit cabling shall be suitable for 1 no. 3 core 16 sq.mm. Al. Incoming cable and 1 no. 3 core 2.5 sq.mm Cu. Outgoing cable.

5.05.00 Terminal blocks

Terminal blocks shall be 650 volts grade, rated for 10 Amps and in one piece, rigid, Bakelite moulded, with disconnecting /shorting link. It shall be complete with insulating barriers, Klip-on-type terminals and identification strips, terminal studs, washers, nuts, lock nuts, marking strips etc.

Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams. It shall be Elmex type CSLT-1 with insulating material of Melamine conforming to ESI Standard 12.1 or equivalent. Cage clamp type terminal block suitable for terminating 2 wires of 2.5 sq mm. on both sides arranged to facilitate easy termination shall be provided.

5.06.00 Terminations & Straight through Joints

5.06.01 Termination and jointing kits for 11/3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be pre-moulded type, taped type or heat shrinkable type. 11/3.3 kV grade joints and terminations shall be type tested as per IS: 13573. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the aluminium solder less crimping type cable lugs & ferrule as per DIN standard.

5.06.02 Straight through joint and termination shall be capable of withstanding the fault level for 11 kV and 3.3 kV systems.

5.06.03 1.1 KV grade straight through joints shall be of proven design.

5.07.00 Cable glands

5.07.01 Cable glands shall conform to BS: 6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene and of tested quality. Necessary cable dimensions shall be furnished to the successful contractor.

5.07.02 Cable glands shall be single compression for indoor use, double compression type for outdoor use. Glands for classified hazardous areas shall be double compression type flameproof and weather proof duly certified by CMRS and approved by CCE. Cable glands shall match with the sizes of different HT/LT/Control cables.

5.08.00 Cable lugs/ferrules

5.08.01 The cables lugs shall be conforming to IS: 8309.

5.08.02 Machine ferruling shall be adopted.

5.08.03 Cable lugs for power cables shall be Aluminium solder less crimping type suitable for aluminium compacted conductor cables.

5.08.04 The cable lugs for control/instrumentation/ telephone cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments.

Cable lugs shall be suitable for termination of different cross-sections of control/ instrumentation /telephone cables and shall be of following types.

- i) Copper tubular terminal end for solder less crimping to copper conductors.
- ii) Cable lugs for control cable termination shall be insulated type. These lugs shall be flat type/ring type/U type to suit the terminals provided in the panel.
- iii) Pin type lugs shall not be used.
- iv) Aluminium tubular terminal ends for solder less crimping of to Aluminium conductor.

Solder less 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.

5.09.00 Cable Clamps & Straps

5.09.01 The cable clamps required to clamp multicore cables on vertical run shall be made up of Aluminium strip of 25x3 mm size. For clamping the multicore cables, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment.

5.09.02 Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the system short circuit current of 105 KA peak.

5.10.00 Galvanizing

5.10.01 Galvanizing of steel components and accessories shall conform to IS: 2629 & IS: 2633. Additionally galvanizing shall be uniform, clean smooth, continuous and free from acid spots

5.10.02 The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS: 1367. The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified.

5.11.00 Welding

5.11.01 The welding shall be carried out in accordance with IS: 9595. All welding procedures and welders qualification shall also be followed strictly in line with IS: 9595.

6.00.00 CONSUMABLES AND HARDWARE

- i. The contractor shall furnish all erection materials, hardware and consumables required to complete the installation.
- ii. The materials shall include but not limited to the following:
- iii. Consumables: Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials etc.
- iv. Hardware: Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims etc.
- v. Supply of cement, sand, stone etc. required for the execution of the contract shall be the responsibility of the Contractor.

7.00.00 METHODS AND WORKMANSHIP

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



- ii. The erection work shall be supervised by competent supervisors holding relevant supervisory license from the government.
- iii. All details on installation shall be electrically and mechanically correct.
- iv. The installation shall be carried out in such a manner as to preserve access to other equipment installed.

8.00.00 INSTALLATION**8.00.01 Cable tray and Support System Installation**

- 08.01.01 Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures. All cable trays shall be in vertical configuration in boiler, CHP, AHP & ESP areas.
- 8.01.02 Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 1500 mm. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000 mm. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per relevant Standard. The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated in the relevant approved tray layout drawings.
- 8.01.03 All cable way sections shall have identification, designations as per approved cable way layout as and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/ stenciled with identification numbers at every floor.
- 8.01.04 In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. In such cases the Contractor shall fabricate at site suitable sections of trays, supports and accessories to make the installation complete for the specific purpose after obtaining owner's prior approval, which shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.

9.00.00 Conduits/Pipes/Ducts Installation

- 9.01.00 The Contractor shall be fully responsible for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.
- 9.02.00 GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.

- 9.03.00 Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material.
- 9.04.00 Cable routing between lined cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 150 to the trench wall. In case of larger dia cables i.e. 50mm and above, adequately sized pipe with larger bend radius shall be provided for ease of drawing of cable or for replacement. In places where it is not possible, a smaller trench may be provided if approved by Site Engineer.
- 9.05.00 Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit /pipe size (dia).	Spacing
Up to 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm	3.0 M

- 9.06.00 In areas like WTP, chemical handling, battery room etc. exterior surface of the conduits shall be further coated with chromate or polymer for better resistance to corrosion.
- 9.07.00 All G.I. pipes shall be laid as per approved layout drawings and site requirements. Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the contractor), all the burrs from the pipes shall be removed. The bends formed shall be smooth. GI Pipes with bends shall be buried in oil/concrete in such way that that the bends shall be totally concealed. For GI pipes shall be undertaken well before paving is completed and necessary co-ordination with paving agency shall be the responsibility of Electrical Contractor. The open ends of pipes shall be suitably plugged with G.I. plugs after they are laid in final position. G.I. plugs shall be supplied by the contractor at no extra cost.

10.00.00 Junction Boxes Installation

- 10.01.00 Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the approved drawings or as decided by Owner and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

11.00.00 Cable Laying and Installation

- 11.01.00 Cable network shall include power, control, lighting, communication and fire alarm system cables, which shall be laid in trenches, cables trays/conduits as detailed in the approved drawings and cable schedules. Erection of cable trays

and aligning and leveling as required shall be the responsibility of the contractor.

- 11.02.00 Cable installation shall be carried out as per IS: 1255 and other applicable standards. Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, 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 cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.
- 11.03.00a. In outdoor areas, buried cables, wherever called for, shall be laid and covered with sand/riddled earth and protected from damage by bricks at sides and precast slab at top.
- b. When buried cables cross road/railway track, additional protection shall be provided in the form of hume / galvanised iron pipes/RCC box culvert.
- 11.04.00 For coal handling plant the cables shall not be routed along conveyor galleries. The cables shall be routed on independent cable trestles.
- 11.05.00 All tray levels shall be checked after erection and marked in as built drawings. Cable routing given on the layout drawings shall be checked in the field to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc. and minor adjustments shall be done to suit the field conditions wherever deemed necessary. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings. The contractor shall have to secure rack/tray supports by welding to those inserts, suitable embedded steel inserts shall be provided. Outdoor trays shall be installed by welding on the steel/concrete structure with inserts by the contractor. 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.
- 11.06.00 While laying cable, ground rollers shall be used at every 2 metre interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables.
- 11.07.00 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all cables shall be tapped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted.

11.08.00 Cables installed above grade shall be run in trays, exposed on walls, ceilings or structures and shall be run parallel or at right angles to beams, walls columns. Cables shall be so routed that they will not be subjected to heat from adjacent hot piping or vessels.

12.00.00 Laying of cables in cable trays

12.01.00 Cables shall be laid on cable trays strictly in line with cable schedule furnished. Where specific cable layouts are not shown on approved drawings, contractor shall route these as directed by the Owner.

12.02.00 Power and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.V. cables shall be laid on topmost tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation. LT power cables above 95 sq.mm size shall be laid in single layer touching formation in trays while cables upto & including 95 sq.mm shall be laid in maximum of 2 layers. Control and Instrumentation cables can be laid upto a maximum of three layers in each tray.

12.02.00 All communication cables (telephone, P.A. System) RTD Cables shall run on instrument trays/ducts/trenches. Wherever these are not available, cables shall be taken in a separate trench/trays with a minimum clearance of 600mm away from electrical trench/trays as per the direction of Site Engineer and Communication cables shall cross power cables at right angles

12.03.00 Power and control cables shall be secured fixed to trays/support with self locking type nylon cable straps with de-interlocking facilities. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter by nylon cable strap. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by aluminium strips at every five meter interval and at every bend.

12.04.00 Bending radii for cables shall be as per manufacturer's recommendations and IS: 1255.

12.05.00 Individual cables or small groups which run along structures/walls etc will be clamped by means of 16 SWG GI saddles on 25x6mm saddle bars. The cost of saddle and saddle bars shall be deemed to have been included in the installation of cables. Alternatively small group of cables can be taken through 100mm slotted channel/ISMC 100. They shall be rightly supported on structural steel and masonry, individual or in groups as required, if drilling of steel must be drilled where the minimum weakening of the structure will result.

12.06.00 Cables shall be supported so as to prevent unsightly sagging. In general distance between supports shall be approximately 300mm for cables upto 25mm diameter and maximum 500mm for cables larger than 25mm dia and

- cables laid in vertical run of cable trays shall be clamped at an interval of 900mm.
- 12.07.00 Where cables cross roads/rail tracks, the cables shall be laid in Hume pipe/PVC pipe. At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends. the hume pipes shall be laid at a depth of minimum 1000mm such that cables are not damaged.
- 12.08.00 Power and Control Cables, as far as possible, shall be laid in complete, uncut lengths from one termination to the other. Straight through joints in power cable shall be allowed only in nearest of rare situation only after approval of owner.
- 12.09.00 Joints for less than 250 Meters run of cable shall not be permitted.
- 12.10.00 In each cable run some extra length shall be kept at suitable point to enable one LV/two HV straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.
- 12.11.00 Wherever few cables are branching out from main trunk route troughs shall be used.
- 12.12.00 Cables shall be neatly arranged in the trays in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trays shall be the responsibility of the contractor.
- 12.13.00 The contractor shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other works. Before the start of cable laying, cable drum schedule shall be prepared by electrical contractor and get that approved by site engineer to minimize/avoid straight through joints. The actual number of straight through joints required shall be worked out by the contractor. During the erection period the contractor shall furnish a monthly report on cable position in an approved proforma so as to keep the owner apprised of the position.
- 12.14.00 The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.
- 12.15.00 Electrical cable trays exposed to hazardous process fluid shall be covered with detachable G.I. covers. The covers shall be suitable to resist wind forces.
- For cables laid above ground in cable racks, asbestos sheeting of 3mm thickness shall be provided below the bottom cable tray to protect the cables from fire.
- 12.16.00 Supporting steel shall be painted before laying of cables. The painting shall be done with one coat of red lead paint and two coats of approved bituminous aluminium paint unless otherwise specified.

12.17.00 Separation

Sufficient spacing not less than 300mm shall be provided between different tiers of trays and maintained to permit adequate access for installation and maintenance of cables.

At least 300mm clearance shall be provided between :

- HV power & LV power cables,
- LV power & LV control/instrumentation cables,

12.19.00 Segregation

Segregation means physical isolation to prevent fire jumping.

Cables from two different services viz. supply from Station Board and Unit Board shall be segregated.

Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

For Coal Handling Plant all the cables of one stream shall be segregated from the cables of the other stream and shall run on either side of the trestle.

13.00.00 Cable fire sealing

13.01.00 Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be sealed by a fire proof sealing system (FPSS). The FPSS shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire.

13.02.00 Wherever the cables/cable trays pass through walls/floors, fire proof cable penetration seals rated for one-twenty (120) minutes shall be provided. This shall be by suitable block system using individual blocks with suitable framework or by silicon RTV foaming system. In case foaming system is offered, damming board, if used, shall not be considered for fire rating criteria. Any of the system offered shall be of proven type as per BS: 476 (Part-20) or equivalent standard.

13.03.00 In order to prevent fire propagation through cable penetrations, after laying, dressing & clamping of cables, all the openings shall be properly sealed by using Fire Stop Mortar Seal and Fire Retardant Cable coating compound. Also the cable runs both before and after the fire scale shall be suitably sprayed with anti-fire propagation liquid.

14.00.00 Cable laying in trenches

14.01.00 RCC cable trenches with removable covers will be provided by the contractor. Cables shall be laid in 3 or 4 tires in these trenches. Concrete cable trenches shall be filled with sand where specified to avoid accumulation of hazardous gases. RCC covers of trenches in process area shall be effectively sealed to avoid ingress of chemicals etc. Removal of concrete covers for purposes of

cable laying and reinstating them in their proper positions after the cables are laid shall be done by the contractor at no extra cost.

- 14.02.00 For cable trays are laid in trench in more than two tiers a space of minimum 600 mm shall be available for maintenance. In case two or more tiers of cable trays are running parallel along both sides of trench walls there shall be space of minimum 600 mm between them.
- 14.03.00 Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cable leaving trenches shall be coiled and provided with a protective pipe or cover till such times the final termination to the equipment is completed.
- 14.04.00 Prior to laying of cables inside both indoor and outdoor trenches, the contractor shall properly clean inside of those trenches.
- 14.05.00 When cables are laid in multiple tiers, spacing between individual tiers shall be as approved by Site Engineer. Space between individual tiers shall be filled and compacted with soil and sand.
- 14.06.00 As each row of cables is laid in place and before covering with sand every cable shall be given on insulation test in the presence of Site Engineer. Any cable, which proves defective, shall be replaced before the next groups of cables are laid.
- 14.07.00 All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/lined trench.
- 14.08.00 Where cables rise from trenches to motor, control station, lighting panels etc., they shall be taken in G.I. Pipes for mechanical protection up to a minimum of 150mm above grade.
- 14.09.00 Cable ends shall be carefully pulled through the conduit, to prevent damage to these cables. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer.

Following guide of the pipe fill shall be used for sizing the pipe size:

- a) 1 cable in pipe - 53% full
- b) 2 cables in pipe - 51% full
- c) 3 or more cables - 43% full
- d) Multiple cables - 40% full

After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/'PUTTI' for sealing purpose. Alternatively G.I. Lids or PVC bushes shall be employed for sealing purposes. The cost for the same shall be deemed to have been included in the installation of G.I. pipe and no separate payment shall be allowed.

- 14.10.00 Where cables pass through foundation walls or other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or

structures, the electrical contractor shall determine their location and obtain approval of the Site Engineer before cutting is done.

15.00.00 CABLE IDENTIFICATION

15.01.00 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry & exit, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties of 'TY-CAB' or equivalent type with cable number heat stamped on the cable tags.

15.02.00 For laying of underground cable (applicable for Raw Water Intake Switchgear & Ash dyke) shall be provided with identity tags of Stain less steel securely fastened every 30 M of its underground length with at least one tag at each end before the cable enters the ground. In unpaved areas cable trenches shall be identified by means of markers. These posts shall be placed at location of changes in the direction of cables and at intervals of not more than 30 M for straight run and at cable joint locations with additional inscription 'Cable Joint'. For buried cables the marker shall project 150mm above ground.

15.03.00 Drum number of each cable from which it is taken shall be recorded against the cable number in the cable schedule.

16.00.00 CABLE TERMINATIONS & CONNECTIONS

16.01.00 The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer's instructions, drawings and/or as directed by Site Engineer. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.

16.02.00 Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Site Engineer.

16.03.00 Responsibility of proper termination shall lie on the contractor. Guarantee for termination shall also have to be given by the contractor.

16.04.00 The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.

- 16.05.00 Contractor shall drill holes for fixing glands wherever necessary at no extra cost. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables. If the cable end box or terminal chamber provided on the equipment is found unsuitable and requires major modifications the same shall be carried out by the contractor at the discretion of the Engineer- in-Charge.
- 16.06.00 Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.
- 16.07.00 The panels where a larger number of cables are to be terminated and cable identification may be difficult, each core ferrule shall include the complete cable number. The ferrules shall be indelible interlocking type and shall fit tightly on cores. Spare cores shall have similarly ferrules with a suffix letter 'S' alongwith cable numbers and coiled up after end sealing.
- 16.08.00 All cable terminations shall be appropriately tightened to ensure secure and reliable connections.
- 16.09.00 It is the responsibility of the Contractor to terminate the cables at motor terminals in correct phase sequence to ensure the proper direction of rotation.
- 16.10.00 All cables upto 1.1KV grade shall be terminated at the equipments by means of compression type cable glands. They shall have a screwed nipple with conduit electrical threads and check nut.
- 16.11.00 All cable entries shall be through bottom only and top entry terminations are made only after getting approval of Site Engineer.
- 16.12.00 Power cables, wherever colour coding is not available, shall be identified with red, yellow and blue PVC tapes. Where copper to aluminium connections is made, necessary bimetallic washers shall be used. For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.
- 16.13.00 In case of control cables all cores shall be identified at both ends by their terminal numbers by means of PVC ferrules. Wire numbers shall be as per schematic/ wiring/ inter-connection diagram. Contractors shall have the samples of PVC markers approved before starting the work. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends. Control cables shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.
- 16.14.00 Where threaded cable gland is screwed into threaded opening of different size, suitable brass threaded reducing bushing shall be used provided.
- 16.15.00 The cable shall be taken through glands inside the panels or any other electrical equipment such as motors. The individual cores shall then be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Only control cables of single strand and lighting cables may be directly terminated on to the terminals.

In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom, close fit hole should be drilled in the bottom plate for all the cables in one line, and then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables it should be sealed with cold setting compound. Cables shall be clamped over the open armouring to connect it to earth bus.

16.16.00 Cable leads shall be terminated at the equipment terminals by means of crimped type solder less connectors.

Crimping shall be done by hand crimping/hydraulically-operated tool and conducting jelly shall be applied on the conductor.

Insulation of the leads should be removed immediately before the crimping. Conductor surface shall be cleaned and shall not be left open.

16.17.00 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.

16.18.00 All cable entry points shall be properly sealed and made dust and vermin 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 one-twenty (120) minutes.

17.00.00 Cable accessories for H.V. Systems

17.01.00 The H.V. cables terminations/joints shall be done by skilled and experienced jointers duly approved by the Site Engineer.

17.02.00 The termination and straight through joint kits for use on high voltage system shall be suitable for the type of cables offered by the contractor or the type of cables issued by owner for installation. The materials required for termination and straight through joints shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction shall be included in each kit.

17.03.00 The termination kits shall be suitable for termination of the cables to an indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer/motor. The termination kits shall preferably be as of the following types.

- a. 'PUSH ON' type for LV cables.
- b. Heat-shrinkable sleeve type for LV & HV cables.

However, termination kits for HV cables shall be of Heat Shrinkable type of makes with specific approval of owner.

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

17.04.00 The straight through jointing kits shall be suitable for underground buried installation with uncontrolled backfill and possibility of flooding by water. The jointing kit shall be one of the following types.

- a. 'TAPEX' of M-seal make or equivalent for LV cables
- b. Heat-shrinkable sleeve type for LV & HV cables.

However, termination kits for HV cables shall be of Heat Shrinkable type of makes with specific approval of owner.

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

18.00.00 EXCAVATION AND BACK FILLING

18.01.00 The contractor shall perform all excavations and backfilling as required for buried cable and ground connections.

18.02.00 Excavation shall be performed up to the required depth. Such sheeting and shoring shall be done as may be necessary for protection of the work.

18.03.00 The contractor shall make use of his own arrangement for pumping out any water that may be accumulated in the excavation.

18.04.00 All excavation shall be backfilled to the original level with good consolidation.

19.00.00 CLEANING UP OF WORK SITE

19.01.00 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.

19.02.00 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.

20.00.00 QUALITY ASSURANCE PROGRAMME

20.01.00 Contractor shall furnish detailed Quality Assurance Programme and Quality Plans for all materials and accessories to be supplied and installed under the scope of the specification as per General Technical Conditions of technical specification. The Quality Plans shall include all tests/ checks as per relevant National/International Standards and the requirements of this specification including tests listed in this section.

21.00.00 TESTS

21.01.01 Type tests on Cable Trays support system

A) Test 1A:

On main support channel type-C2 for cantilever arms fixed on one side only. A 3.5 metre length of main support channel shall be fixed vertically at each end to a rigid structure as per appropriate fixing arrangement. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the following load intervals and other necessary points:

i) Working load

- ii) Working load + point load
- iii) Off load
- iv) Proof load + point load
- v) Off load

The deflection measured at working loads shall not exceed 16 mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.

B) Test 1B:

Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2

Test 2: On Main support channel type -C2 for cantilever arms fixed on both sides

a) Test 2A: A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per appropriate fixing arrangement. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall then be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at the following load intervals and other necessary points.

- i) Working load
- ii) Working load + Point load

iii) Off load

- iv) Proof load + Point load
- v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied

b) Test 2B: The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side.

Test 3:

A length of main support channel section shall be fixed to steel structure/floor and have loads applied as detailed below and other important points not mentioned herein.

a) Test 3A : A length of steel structure shall be rigidly supported. It should be fitted on a metre length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place.

- b) **Test 3B:** With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place.
- c) **Test 3C:** With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line.
The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded.

Test 4 Channel nut slip characteristics (what ever applicable)

Tests 4A1, 4A2, 4A3:

A length of channel C1 section 200 mm long shall have fitted bracket with the two bolts fixing.

With loads applied at the appropriate position nut slip shall be determined with bolt torque of 30 NM, 50 NM and 65 NM No fewer than three measurements shall be made or each torque setting.

A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM.

Tests 4B1, 4B2, 4B3:

The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing. With loads applied at the appropriate position, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting.

A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 65 NM

Test 5 Weld Integrity Test

After deflection test as per test 1A, 1B, 2, 3 & 4 weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any.

Cable termination kit and straight through joints should have been tested as per IS: 13573 for 3.3kV and 11kV class.

Fire proof Cable Penetration system should have been tested for the following tests:

- Accelerated Ageing test
- Water absorption test
- Fire rating test
- Hose Stream test
- Vibration test followed by fire rating test

21.02.00 Routine/ Acceptance Tests

Following routine/acceptance tests shall be carried out on all the equipments, devices & materials supplied:

22.00.00 Galvanizing Tests



The quality of galvanizing shall be inspected visually and shall be smooth, continuous, and free from flux stains.

- i) Uniformity of coating – The coating of any article shall withstand four 1 minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.
- ii) The quality of cadmium/zinc plating on items with screw threads shall be inspected visually and shall be free from visible defects such as unplanted areas, blisters and modules.
- iii) In addition, the plating thickness shall be determined microscopically/chemically or electronically.

23.00.00 Welding

The quality of welding shall be visually inspected, particular attention being paid to the following points.

- 1) The welded joints shall be continuous along its length on both sides and of uniform width and thickness. It should be free from blow holes.
- 2). The weld metal shall be properly fused with the parent metal without undercutting.
- 3) The outside surface of the weld shall be clean. All slag shall have been removed. All welding shall be regularly checked for cracking using magnetic particle inspection or their equivalent technique.
 - 1. Physical and dimensional checks for all items.
 - 2. All conduits/pipes, etc. shall be routine/acceptance tested as per relevant standards.
 - 3. All acceptance and routine tests on cable glands as for BS: 6121. Additionally Proof torque test shall be carried out as acceptance on each body group of cable glands.
 - 4. Deflection test cable trays.
 - 5. All acceptance and routine tests on Junction boxes.
 - 6. Following tests shall also be carried out on each type of equipments, devices and materials/items supplied:
 - i) Physical and Dimensional checks
 - ii) Check/measurement of thickness for Nickel chrome plating for cable glands and tinning for cable lugs.
 - iii) Check chemical composition of brass parts for cable glands.
 - iv) Hardness check on gaskets.
 - v) Test for uniformity of galvanization.

24.00.00 Cable trays / supports and accessories

- 1) Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories.
- 2) Check for continuity of cable trays over the entire route.
- 3) Check that all sharp corners, burrs, and waste materials have been removed from the trays supports.
- 4) Check for earth continuity and earth connection of cable trays.

QUALITY PLAN FOR MOTORS BELOW 55 KW (LV)

SL. NO.		COMPONENT/OPERATION		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :											
				SHEET 1 OF 2		BIDDER/ VENDOR		TITLE		NUMBER :											
				CHARACTERISTICS CHECK		SYSTEM		QUALITY PLAN		SPECIFICATION											
				CAT.		TYPE/ METHOD OF CHECK		ITEM AC ELEC.T. MOTORS BELOW 55KW (LV)		TITLE											
1		2		3		4		5		6		7		8		9		10		11	
1.0		ASSEMBLY		1.WORKMANSHIP 2.DIMENSIONS 3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE		MA		VISUAL		100%		MANUF'S SPEC		MANUF'S SPEC		-DO-		2		-	
2.0		PAINTING		1.SHADE		MA		VISUAL		SAMPLE		MANUF'S SPEC/BHEL SPEC./RELEVANT STANDARD		BHEL SPEC. SAME AS COL.7		LOG BOOK		2		-	
3.0		TESTS		1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC. 2.OVERALL DIMENSIONS & ORIENTATION		MA		-DO-		100%		IS-325/ BHEL SPEC./ DATA SHEET		SAME AS COL.7		TEST REPORT		2		1	
						MA		MEASUREMENT & VISUAL		100%		APPROVED DRG/DATA SHEET		APPROVED DRG/DATA SHEET & RELEVANT IS		INSPN. REPORT		2		1	
BHEL						PARTICULARS		BIDDER/VENDOR													
						NAME															
						SIGNATURE															

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :			
		SHEET 2 OF 2		BIDDER/ : VENDOR		QUALITY PLAN		SPECIFICATION : TITLE :			
		COMPONENT/OPERATION CHARACTERISTICS CHECK		SYSTEM CAT.		ITEM AC.ELECT. MOTORS BELOW 55KW (LV)		SECTION VOLUME III			
SL. NO.	2	3	4	5	6	7	8	9	AGENCY REMARKS		
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	P	W	V
		NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW . ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY									
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									
		BIDDER'S/VENDORS COMPANY SEAL									

QUALITY PLAN FOR MOTORS 55 KW & ABOVE

CUSTOMER :				PROJECT		SPECIFICATION :						
QUALITY PLAN				TITLE		NUMBER :						
SHEET 1 OF 9				BIDDER/ VENDOR		SPECIFICATION :						
COMPONENT/OPERATION		CHARACTERISTIC CHECK		SYSTEM		TITLE						
SL. NO.				CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION	VOLUME III	REMARKS
1	2	3	4	5	6	7	8	9	10	11		
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUF'R'S DRG.	MANUF'R'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL				PARTICULARS		BIDDER/VENDOR						
				NAME								
				SIGNATURE								
				DATE								
								BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN SHEET 2 OF 9		CUSTOMER :		PROJECT		SPECIFICATION :			
				BIDDER/ :		TITLE		NUMBER :			
				VENDOR		QUALITY PLAN		SPECIFICATION :			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS	
									P W V		
1	2	3	4	5	6	7	8	9	10	11	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND. 2. CHEM. & PHYSICAL PROPERTIES 3. DIMENSIONS 4. INTERNAL FLAWS	MA MA MA CR	VISUAL CHEM. & PHYSICAL TESTS MEASUREMENT UT	100% 1/HEAT NO. OR HEAT TREATMENT BATCH NO 100% -DO-	- MFG. DRG. SPEC. -DO- ASTM-A388	FREE FROM VISUAL DEFECTS RELEVANT IS MANUF'R'S DRG. MANUF'R'S SPEC. BHEL SPEC.	-DO- SUPPLIER'S TC LOG BOOK -DO-	3 3 3 3 3	- 2 2 2 1 2	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING 2. PHYSICAL COND. 3. DIMENSIONS (WHEREVER APPLICABLE) 4. PERFORMANCE/ CALIBRATION	MA MA MA	-DO- MEASUREMENT TEST	-DO- SAMPLE 100%	- MANUF'R'S DRG. / SPEC. -DO-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY MANUF'R'S DRG. / SPEC. -DO-	-DO- -DO- INSP. REPORT	3 3 3	- 2 2 2	
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE		BIDDER'S/VENDORS COMPANY SEAL							

		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :			
				BIDDER/ VENDOR :		TITLE		NUMBER :			
COMPONENT/OPERATION		CHARACTERISTIC CHECK		SYSTEM		QUALITY PLAN		SPECIFICATION :			
SHEET 4 OF 9						ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		TITLE			
SL. NO.				CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III REMARKS
										P W V	
1	2	3		4	5	6	7	8	9	10	11
		3.DIMENSIONS		MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3 -	2
1.10	BEARINGS	1.MAKE & TYPE		MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3 -	2
		2.DIMENSIONS		MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3 -	2
		3.SURFACE FINISH		MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3 -	2
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.		MA	VISUAL	100%	-	-DO-	-DO-	3 -	-
		2.DIMENSIONS		MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3 -	-
		3.TEMP.WITH-STAND CAPACITY		MA	ELECT.TEST	-DO-	MANUF'S SPEC./BHEL SPEC.	MANUF'S SPEC./BHEL SPEC.	-DO-	3 -	2
		4.HV/IR		MA	-DO-	100%	-DO-	-DO-	-DO-	3 -	2
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET		MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG/ SPECS.	-DO-	3 -	-
		2.SURFACE COND.		MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3 -	-
		3.DIMENSIONS		MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3 -	-
BHEL				PARTICULARS		BIDDER/VENDOR					
				NAME							
				SIGNATURE							
				DATE							

		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :				
				BIDDER/ : VENDOR		TITLE		NUMBER :				
						QUALITY PLAN						
		SHEET 5 OF 9				NUMBER PED-506-00-Q-007, REV-03						
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION			
									AGENCY	VOLUME III		
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ASTM-E165	MANUF'R'S SPEC./BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC./BHEL SPEC./RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
					BIDDER'S/VENDORS COMPANY SEAL							

भारतीय भेल		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :						
QUALITY PLAN		BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007. REV-03		SPECIFICATION : TITLE						
SHEET 6 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		VOLUME III						
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION			REMARKS
									AGENCY	P	W	
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUF'R'S SPEC.	MANUF'R'S SPEC.	Log Book	2	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUF'R'S SPEC./BHEL SPEC.	MANUF'R'S SPEC./BHEL SPEC.	Log Book	2	-	-	FOR MV MOTOR
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN.DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	THREE DIPS TO BE GIVEN
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
BHEL		PARTICULARS		BIDDER/VENDOR								
		NAME										
		SIGNATURE										
		DATE										
						BIDDER/ VENDORS COMPANY SEAL						

		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :											
						TITLE		NUMBER :											
SHEET 7 OF 9		BIDDER/ : VENDOR SYSTEM		TITLE		QUALITY PLAN		SPECIFICATION :											
COMPONENT/OPERATION		CAT.		TYPE/ METHOD OF CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III					
CHARACTERISTIC CHECK								ACCEPTANCE NORM		FORMAT OF RECORD		AGENCY		REMARKS					
SL. NO.		2		4		5		6		7		8		9		10		11	
1																			
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS 2.SOUNDNESS	CR	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			CR	MALLET TEST & UT															
2.9	COMPLETE ROTOR ASSEMBLY	3.HV 1.RESIDUAL UNBALANCE 2.SOUNDNESS OF DIE CASTING	MA	ELECT. TEST	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			CR	DYN. BALANCE	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
2.10	ASSEMBLY	1.ALIGNMENT 2.WORKMANSHIP 3.AXIAL PLAY 4.DIMENSIONS 5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE 6. RTD, BTD & SPACE HEATER MOUNTING.	CR	ELECT. (GROWLER TEST)	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	MEAS.	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	MEAS.	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-	-DO-
			MA	VISUAL	100%														
			MA	VISUAL	-DO-	-DO													

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :					
SHEET 8 OF 9		BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE		SECTION VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	SYSTEM	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
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1	2	3	4	5	6	7	8	9	10	11			
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1	
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2	
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1\$	1	\$ NOTE - 2	
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-		
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3	
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2	
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2	
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1\$	1	\$ NOTE - 2	
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3	
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1\$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2	
BHEL													
BIDDER/VENDOR													
PARTICULARS													
NAME													
SIGNATURE													
DATE													
BIDDER/SVENDORS COMPANY SEAL													

		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :		
				BIDDER/ :		TITLE		NUMBER :		
				VENDOR		QUALITY PLAN		SPECIFICATION :		
SHEET 9 OF 9		SYSTEM		NUMBER PED-506-00-Q-007, REV-03		TITLE		VOLUME III		
SL. NO.	(COMPONENT/OPERATION)	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION	REMARKS
									P	
1	2	3	4	5	6	7	8	9	10	11
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY										
BHEL		PARTICULARS		BIDDER/VENDOR						
		NAME								
		SIGNATURE								
		DATE								
BIDDER'S/VENDORS COMPANY SEAL										

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	≤200KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection (Indoor/Outdoor)	:	IP55
5.0	Type of Cooling	:	Refer clause 1.20 of Customer Motor Specification.
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –5%)
	c) Combined voltage & freq. variation	:	10%
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	○ 90kW & Above (Breaker controlled)	:	50 kA for 1 sec
	○ Below 90kW (MCCB Contactor controlled)	:	50 KA for 01 sec.
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Refer clause 1.16 of Customer Motor Specification
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	Refer clause 1.14.5.3 & 4 of Customer Motor Specification
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable upto 0.20 kW
13.0	Tests	:	Refer clause 1.44.02 of Customer Motor Specification
14.0	Energy efficient/ Flame proof motor	:	As per Customer spec. requirement

- **Also detail Customer spec. for Motors to be referred as enclosed with the specification.**

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		

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 $\geq 55\text{KW}$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	



Technical specification for
FUEL OIL HANDLING SYSTEM
1X660 MW TPS PANKI EXTN.

REV. NO. 00 DATE : 13.07.2018

C&I SPECIFICATION FOR FUEL OIL HANDLING SYSTEM



Technical specification for
FUEL OIL HANDLING SYSTEM
1X660 MW TPS PANKI EXTN.

REV. NO. 00 DATE : 13.07.2018

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Technical specification for
CONTROL & INSTRUMENTATION
1X660MW PANKI TPS EXTN.

SECTION D

REV. NO. 00

DATE : 13.07.2018

PART - C

SPECIFIC TECHNICAL REQUIREMENT

Specific Technical Requirements (C&I):

- 1.0 The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire Fuel Oil System. The requirements given are to be read in conjunction with detailed Technical 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 and time implication.
- 2.0 All KKS tag nos. shall have prefix 10.
- 3.0 The quantity of instruments for the system shall be as per tender P & ID wherever provided of 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 & items are required for safe & reliable operation of plant, bidder shall supply the same without any price implication. Instrument installation and required accessories shall be in bidder's scope.
- 4.0 **Redundancy of sensors shall be provided, irrespective of instrumentation shown in the PID, by bidder as per sheet attached in the specification. (ANNEXURE 1)**
- 5.0 Contractor's C&I representative shall be present at BHEL-PEM for 3 man-days, for preparation of Control scheme. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.
- 6.0 Contractor shall furnish Instrument Schedule, I/O list, Drive list, Cable Schedule, Cable interconnection (DCS end terminal details shall be provided to vendor during detail engineering to incorporate in cable interconnection), JB grouping, Annunciation list, SOE list, List of Instruments/devices for HART in BHEL approved format. Also reusable database format like MS Excel, MS Access etc. of these documents shall also be provided by Contractor in BHEL approved format. Soft copy of the formats shall be provided to the successful bidder.

- 7.0 For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.
- 8.0 Bidder shall provide Cable Schedule in BHEL excel format which shall be provided during detailed engineering. Also, Cable Interconnections for Complete System shall be in Bidders' scope. DCS side details for hardwired signals shall be furnished by BHEL during detailed engineering.
- 9.0 Interface of control panel, field instruments, actuators etc. with DCS based control system shall be as per Drive Control Philosophy enclosed in Section-D.
- 10.0 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.
- 11.0 MOVs (Motorized Valves) shall be integral type, if applicable.
- 12.0 Bidder to furnish electrical load/UPS load data during detailed engineering.
- 13.0 240 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 bidder at contract stage for all equipment supplied by the bidder as part of contract. Any other voltage level (AC/DC) required will be derived by the bidder. Bidder to include necessary power distribution board in his scope and all necessary hardware/software for the same shall be in bidder's scope.
- 14.0 Power supply derived for Transmitters, contact interrogation, interposing relay and solenoid shall generally be ungrounded 24V D.C only.
- 15.0 The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback. Solenoid Valve shall be rated for 24V DC only.
- 16.0 Bidder shall provide starter panel for local start/ stop monitoring of auxiliaries and equipment along with status indications and alarms as per requirement. The requirement shall be decided during detailed engineering.
- 17.0 Local push buttons in the field shall be in Vendor's scope.

- 18.0 Local control panel if any required for operation shall be in bidder scope.
- 19.0 Bidder to supply all the instruments (PT, LT, DPG, LG and DPS etc.) required for the package along with necessary fittings, accessories and valve manifold etc. All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments. Instrument Installation along with hardware shall be in bidder scope. Double root valves shall be provided where pressure is above 40 Kg/cm².
- 20.0 All transmitters shall be smart type and shall have 4-20mA DC signal with superimposed digital communication (HART). Each Temperature element shall be complemented with temperature transmitters, compensating cable, JB/rack & other erection hardware. All transmitters shall be fitted with a local analog/digital indicator displaying appropriate physical units which may be read clearly from an easily accessible position.
- 21.0 Use of process actuated switches shall be avoided unless Unavoidable.
- 22.0 All instruments and control elements shall be terminated on JB/LCP in field and both instrument and JB/LCP are in bidder scope. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable.
- 23.0 Instrument installation and accessories required for the same shall be in Bidder's scope and shall be submitted after award of contract. However, any instrument/ analyser installation not covered in the same shall be subject to customer and BHEL approval during detailed engineering.
- 24.0 DP instruments with minimum Capillary length of 15m is to be supplied.
- 25.0 All Temperature sensors shall be Duplex type and temperature transmitter shall be provided for all temperature measurement applications.
- 26.0 All field instruments enclosure shall be IP65 local panel/cabinet enclosure shall be IP 55, unless otherwise specified.

- 27.0 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.
- 28.0 The junction boxes/LIEs for termination of instruments are in bidder's scope.
- 29.0 The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial/ time implication in this regard shall be acceptable. In case of any conflict or repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- 30.0 The make of all the items shall be from approved sub-vendor list.
- 31.0 Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.
- 32.0 All Instruments must have separate tapping lines. Sharing of the same tapping pipe for redundant instruments or various different instruments is not acceptable.
- 33.0 As a general rule, measuring points and measuring equipment for critical protection shall be separate from and not combined with measuring equipment for the automatic control equipment.
- 34.0 Electronic instruments shall not be located close to hot lines, vessels or other hot equipment. Ambient temperatures exceeding 80 °C shall not result in calibration difficulties or rapid deterioration of electronic components.
- 35.0 All the instruments/equipment/electrical items shall be provided & designed with maximum star rating in line with energy conservation policies as per latest international standards at the time of supply.
- 36.0 Bidder to note that all the transmitters/instruments supplied by Bidder shall be rack mounted. The racks shall be preassembled and provided by Bidder. Also no Instruments/ analysers & JBs/Racks should be protruding on the walkway.
- 37.0 All field instruments shall be terminated on Junction box/Local control panel in field. All the instruments along with necessary fittings, accessories and valve manifold etc., erection hardware including

racks, junction boxes, canopies, structural steel, LIE, LIR, actuator limit switches etc.as required shall be in vendor's scope of supply.

- 38.0 Bidder to provide erection hardware including canopies, structural steel as required.
- 39.0 Bidder to perform tests of C&I items/instruments/systems as per quality plans/type test attached in the specification.
- 40.0 Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
- 41.0 Each valve/instrument shall be fitted with a stainless steel or aluminum nameplate indicating the valve/instrument service and reference number in accordance with the approved equipment coding system.
- 42.0 Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.
- 43.0 Mandatory spares have to be supplied by bidder as mentioned in the specification.
- 44.0 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.
- 45.0 The specifications for instruments mentioned in the specification are minimum requirements. Datasheets of instrument shall be subject to customer/owner approval.
- 46.0 All approval/Inspection are to be carried out by Owner or owner appointed agency only.
- 47.0 Drawings/Documents and data to be furnished after award of the contract shall be in line with MDL furnished elsewhere in the specification.
- 48.0 Mandatory spare list as per 'List of mandatory spares' attached elsewhere in the specification is in vendor's scope.

- 49.0 Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract:
- GA & wiring diagram of local panel.
 - Local control panel & instruments data sheet.
 - Any other document decided during detailed engineering.

Note: -

1. All equipment items shall be of latest design with proven on track record from reputed experienced manufacturers of specified type and range of equipment. The make/model of various instruments/items/systems and instrument sub-vendor shall be subject to approval of BHEL/Customer during detailed engineering stage.
2. 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.
3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.
4. Uniformity of make and type of instruments and control components shall be followed throughout for rationalization of spares' inventory, except for certain proprietary items where this requirement cannot be met.
5. In case of any discrepancy in Section-C and Section-D of the specification, Section-C shall prevail.

ANNEXURE - 1**(g) Redundancy requirements****i Triple Redundancy**

Triple Sensing device shall be provided for following applications:-

- a. **For** Binary and analog inputs required for protection of boiler, turbine and major auxiliaries of main plant whose non-availability may result in 50% loss of unit availability and loss of generation.
- b. 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 of main plant (fed by a supply feeder of ratings 3.3 kV onwards)/MDBP/TDBFP etc.,
- c. Separate triple sensors for Instruments required for auto starting of HT driven pumps or HT driven pump tripping due to very low level of water & discharge pressure very low.
- d. For binary and analog inputs which are also required for protection in addition to CLCS. The same shall include but not limited to the critical measurement used for following CLCS :-
Furnace draft, main steam and reheat steam temperatures, feed-water flow, throttle pressure, turbine first stage pressure, separator level, LPH and HPH level, deaerator level, hotwell level, CEP minimum recirculation, BFP minimum recirculation etc.
- e. For lube oil protection of all the HT drives, 2 out of 3 logics and necessary pressure transmitters for lube oil pressure shall be provided by bidder accordingly. However for bearing / winding temperature of HT motor, refer Electrical subsections, Vol. IV.
- f. Left and right side shall be treated as individual path / individual parameter, and each side/path shall have own triple redundancy accordingly.

ii Dual Redundancy

Dual Sensing device shall be provided for following applications:

- a. For binary and analog inputs required for all other closed loop control system (CLCS), protection and interlock conditions purpose of other equipments.
- b. For Instruments required for auto starting of LT driven pumps or LT driven pump tripping due to very low level of water/discharge pressure very low.
- c. Dual redundant position transmitters shall be provided for Steam Admission Valves i.e. (Emergency Stop & Control Valves, Reheat Stop Valves & Control valves), Extraction steam QCNRV, CRH NRV.
- d. For instruments required for Heat rate measurements & PADO calculations.

- iii. For binary and analog inputs used for alarm and monitoring only, single sensor criteria shall be applicable.



Technical specification for
CONTROL & INSTRUMENTATION

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SECTION D

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PART - D

DRIVE CONTROL PHILOSOPHY

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03	INDEX SHEET	X				
04	DDCMIS INTERFACE WITH HT SWGR (HT)	X				
05	DDCMIS INTERFACE WITH LT MCC (LT)	X				
06	DDCMIS INTERFACE WITH BID	X				
07	DDCMIS INTERFACE WITH BIDI	X				
08	DDCMIS INTERFACE WITH FIRE DAMPERS OF AC&VENT SYS (BID-FD)	X				
09	DDCMIS INTERFACE WITH MOTORISED OPERATED VALVE OF AC&VENT SYS (AC-MOV2)	X				
09A	DDCMIS INTERFACE FOR SCREW CHILLER AND ACCU OF AC&VENT SYS	X				
10	DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L)	X				
11	DDCMIS INTERFACE WITH SOV(WITHOUT FEEDBACKS)	X				
12	DDCMIS INTERFACE WITH SOV(WITH FEEDBACKS)	X				
13	DDCMIS INTERFACE WITH VFD OF AC SYSTEM(VFD-AC)	X				
14	DDCMIS INTERFACE WITH MODULATING DRIVES-CLCS	X				
15	DDCMIS INTERFACE WITH MODULATING DRIVES-CLCS-M	X				
16	DDCMIS INTERFACE WITH ERV CONTROL BOX	X				



UP RAJYA VIDYUT UTPADAN NIGAM LTD
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18	DDCMIS INTERFACE WITH FIELD BREAKER (FB)	X			
19	DDCMIS INTERFACE WITH ELECTRICAL BREAKER (EB-HT-SYNC)	X			
20	DDCMIS INTERFACE WITH ELECTRICAL BREAKER (EB-HT-NONSYNC)	X			
21	DDCMIS INTERFACE WITH ELECTRICAL BREAKER (EB-LT-SYNC)	X			
22	DDCMIS INTERFACE WITH ELECTRICAL BREAKER (EB-LT-NONSYNC)	X			
23	DDCMIS INTERFACE WITH DIGITAL INPUT SIGNAL	X			
24	DDCMIS INTERFACE WITH DIGITAL OUTPUT SIGNAL	X			
25	DDCMIS INTERFACE WITH ANALOG INPUT SIGNAL	X			
26	DDCMIS INTERFACE WITH ANALOG OUTPUT SIGNAL	X			
27	DDCMIS INTERFACE WITH LTCHP (DOL)	X			
28	DDCMIS INTERFACE WITH BELT WEIGHER (BW)	X			
29	DDCMIS INTERFACE WITH SUSPENDED MAGNET (SM)	X			
30	DDCMIS INTERFACE WITH METAL DETECTOR (MD)	X			
31	DDCMIS INTERFACE WITH INLINE MAGNETIC SEPARATOR (ILMS)	X			
32	DDCMIS INTERFACE WITH REV (DOL)	X			
33	DDCMIS INTERFACE WITH VVVF	X			
34	DDCMIS INTERFACE WITH HTCHP	X			
34a	FDR TYPE: SP FOR DC JOP, EOP & DC SOC MOTOR	X			
34b	DDCMIS INTERFACE WITH CEP VFD	X			

CABLE COLOR CODING PHILOSOPHY:

SL.NO	DCS END TB	CABLE COLOR
1	a	BLUE (BL)
2	b	RED (RD)
3	c	GREY (GE)
4	d	YELLOW (YE)
5	e	GREEN (GR)
6	f	BROWN (BN)
7	g	WHITE (WT)
8	h	BLACK (BK)



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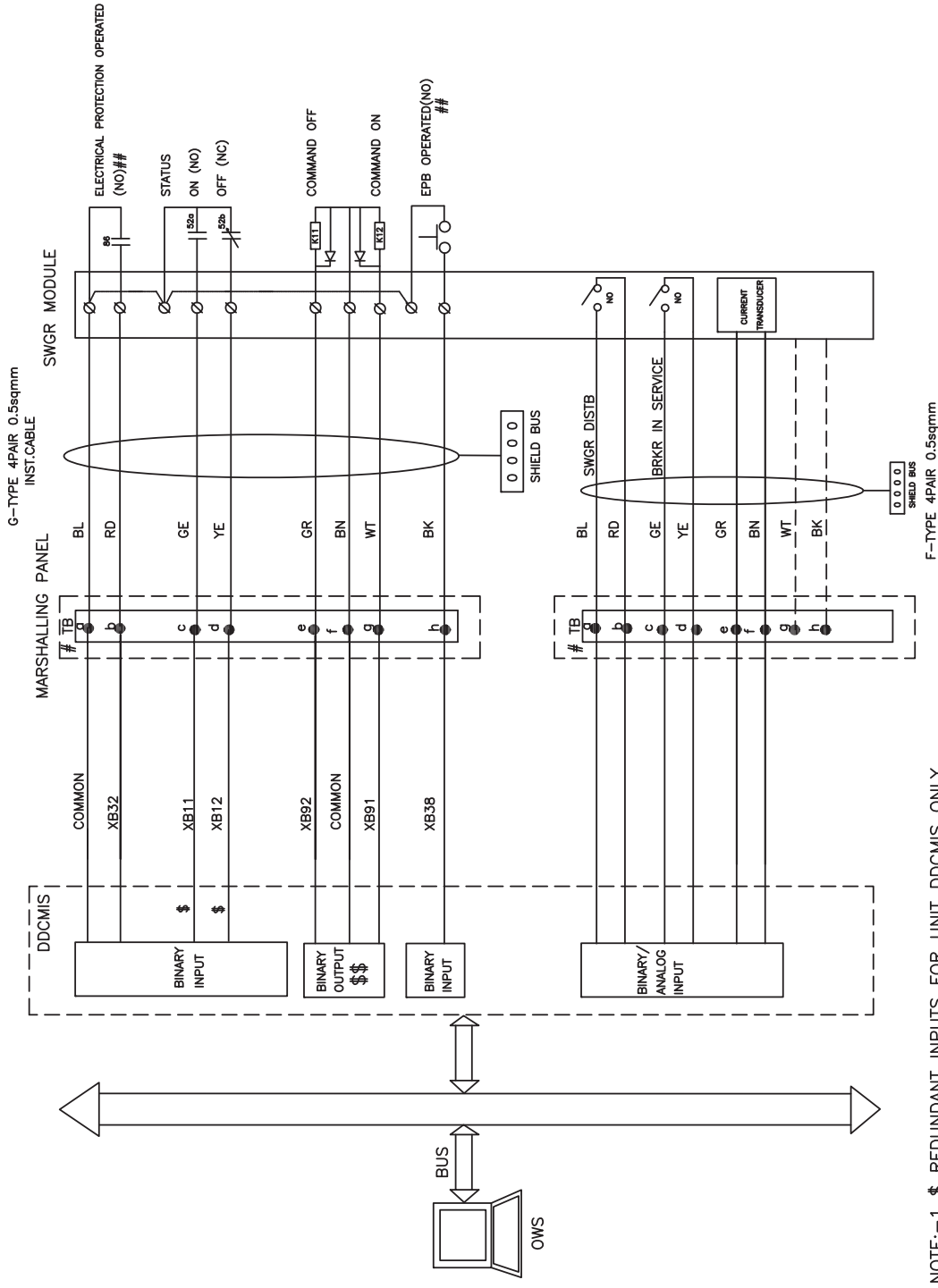
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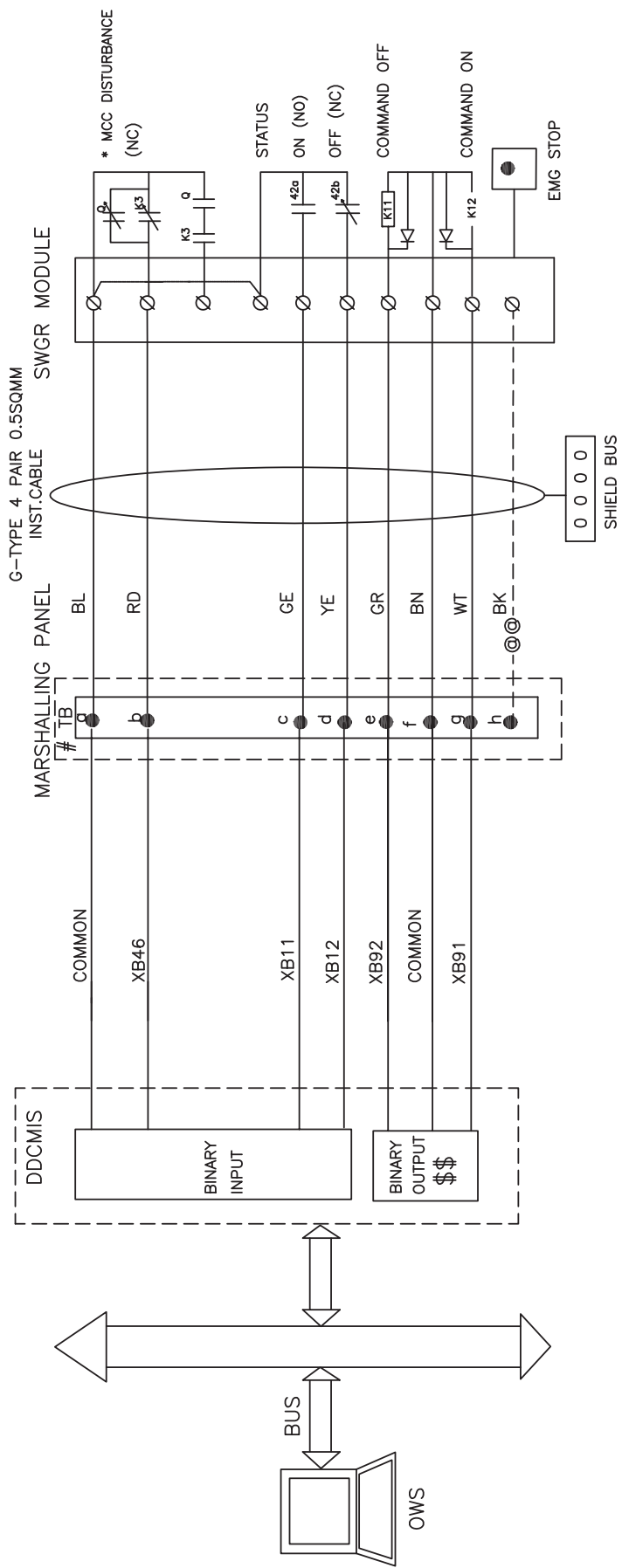
DDCMIS INTERFACE WITH HT SWITCH GEAR (HT)



NOTE:-1 \$ REDUNDANT INPUTS FOR UNIT DDCMIS ONLY
NOTE:-2 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-3 # 8 LEVEL TERMINAL BLOCK
NOTE:-4 ## DI-SOE SIGNALS FOR UNIT DDCMIS ONLY
NOTE:-5 CURRENT SIGNAL IS TO BE CONSIDERED IN DDCMIS FROM HT BREAKER FOR FD,ID,PA,MILL MOTORS, CHP HT CONVEYORS

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	DDCMS INTERFACE WITH HT SWITCH GEAR(HT)	SH	04 OF 34

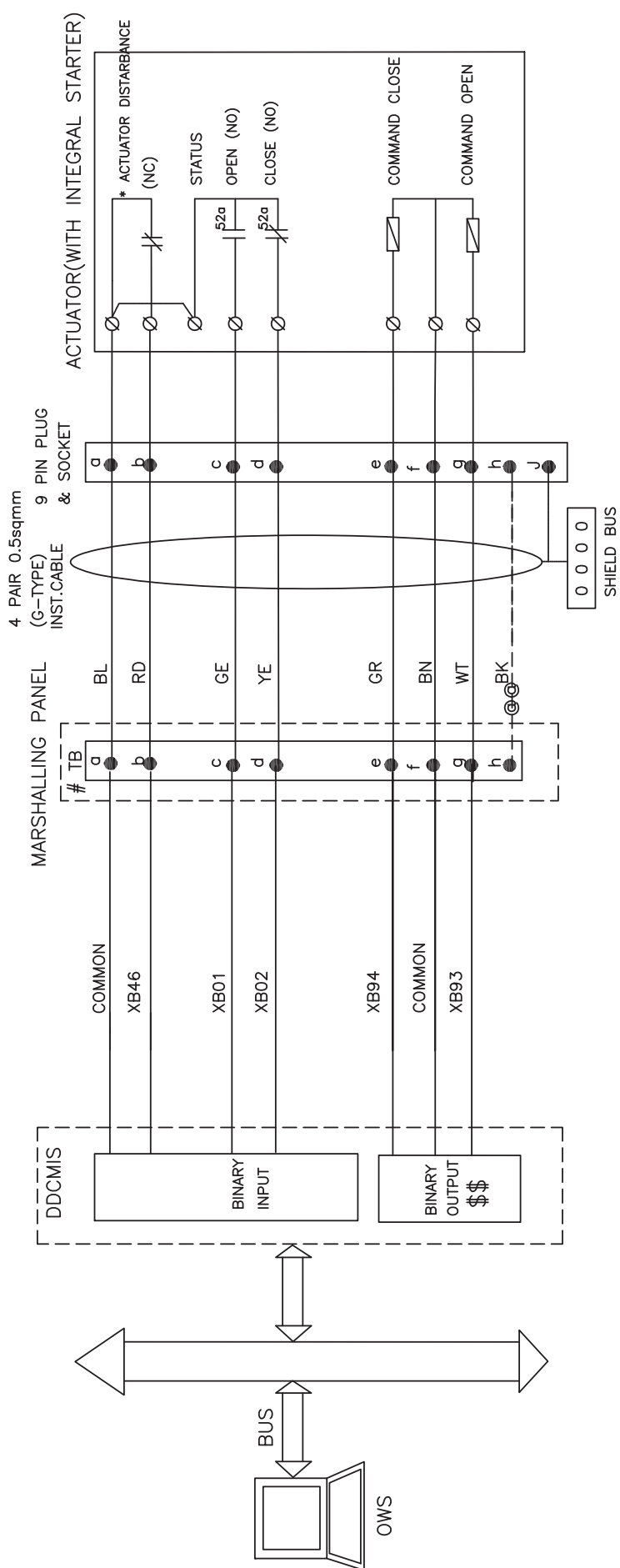
DDCMIS INTERFACE WITH LT MCC (LT)



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION SEQUENTIALLY.
NOTE:-4 * MCC DISTURBED= THERMAL O/L OPT/CONT SUPP FAIL/EPB OPTD /DRIVE POWER SUPPLY OFF

	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO.	9862-001-PE-405-PVL-B-152
	DDCMIS INTERFACE WITH LT MCC (LT)	SHT	05	OF 34

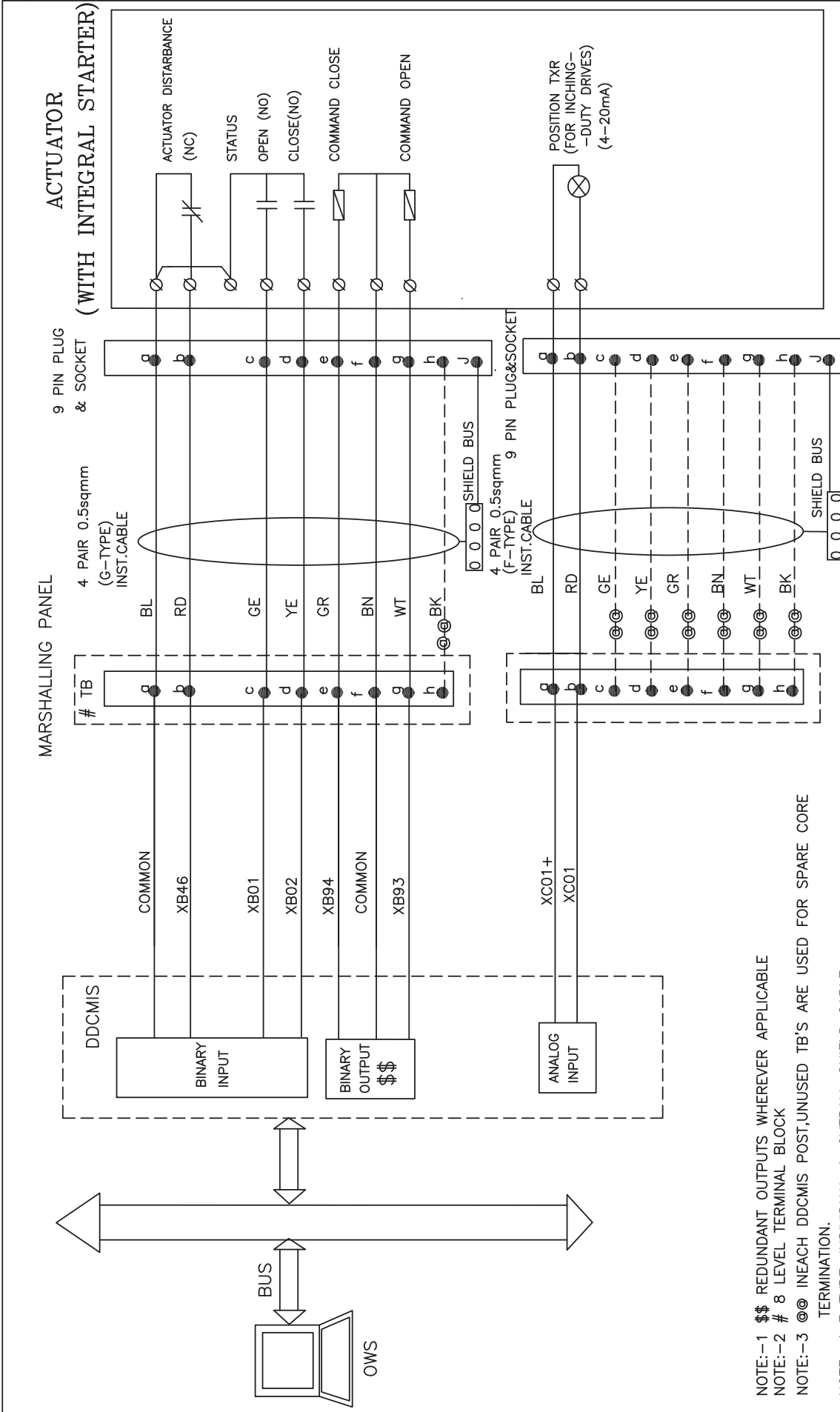
DDCMIS INTERFACE WITH BID/MOV/MOD



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * DISTURBANCE=LOSS OF POWER SUPPLY(1PHASE/3PHASE)/LOSS OF CONTROL SUPPLY/MOTOR THERMOSTAT TRIP/THERMAL OVER LOAD/
TORQUE SWITCH OPERATED, LOCAL/OFF/REMOTE SWITCH IN LOCAL/OFF POSITION

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	DDCMIS	INTERFACE WITH BID	SHT	06 OF 26

DDCMIS INTERFACE WITH BIDI/MODI/MOVI



NOTE:-1 \$\$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE

NOTE:-2 # 8 LEVEL TERMINAL BLOCK

NOTE:-3 @ @ @ IN EACH DDCMIS POST, UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

NOTE:-4 F-TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.

NOTE:-5 *DISTURBANCE=LOSS OF POWER SUPPLY/LOSS OF CONTROL SUPPLY/
MOTOR THERMOSTAT TRIP/THERMAL OVERLOAD/TORQUE SWITCH OPTD/
LOCAL/OFF/REMOTE SWITCH IN LOCAL/OFF POSITION

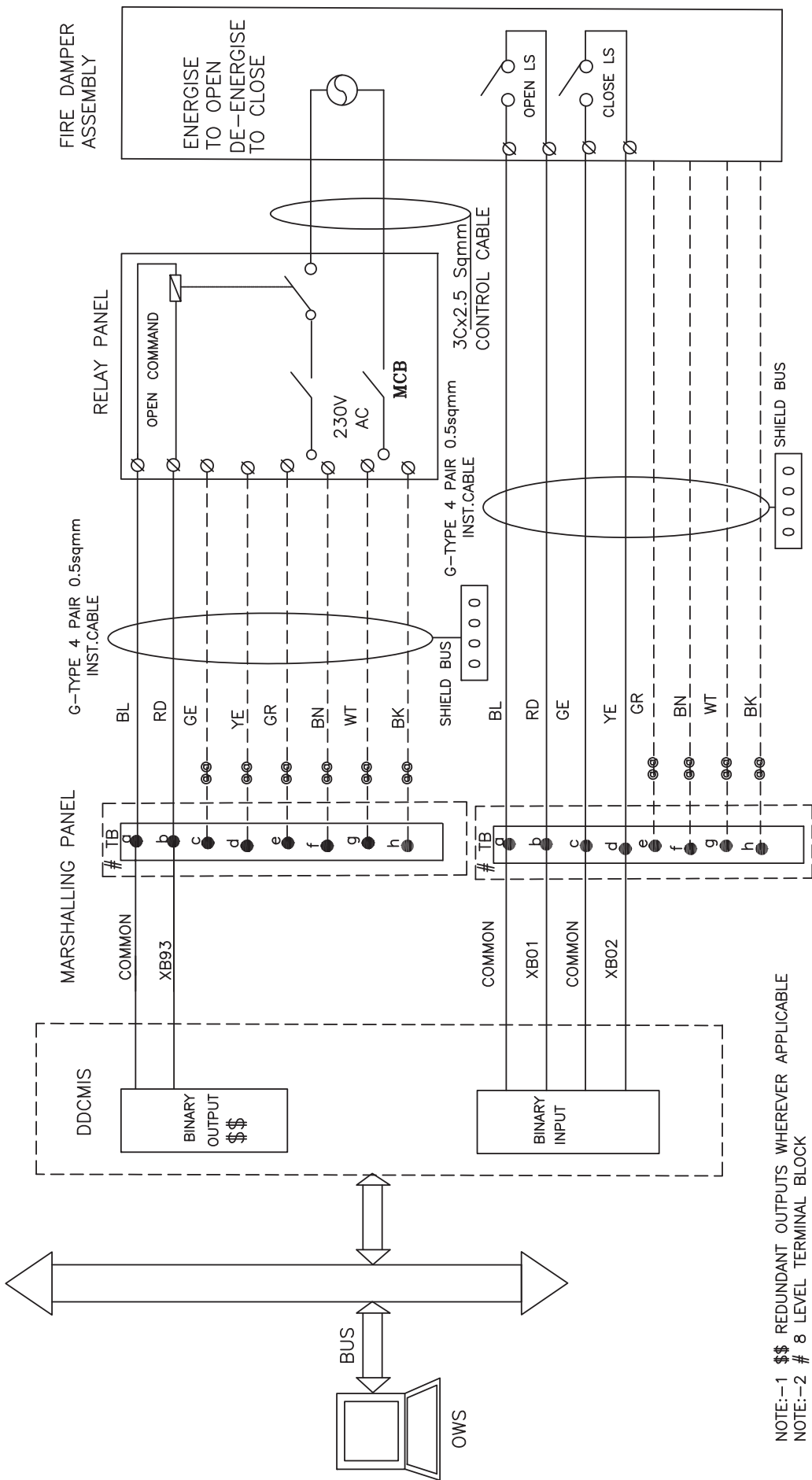


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DDCMIS INTERFACE WITH BIDI

DDCMIS INTERFACE WITH FIRE DAMPERS OF AC &VENT SYS(BID-FD)



NOTE:-1 \$\$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS	DDCMIS INTERFACE WITH FIRE DAMPER OF AC&VENT SYS(BID-FD)	DRG.NO. 9982-001-FE-405-PVI-B-152
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The diagram illustrates the DDCMIS (Digital Data Control and Monitoring Interface System) architecture. It shows the connection between the OWS (Operator Workstation), the DDCMIS unit, and the Relay Panel.

DDCMIS Unit:

- BINARY OUTPUT \$\$\$:** Connected to the MARSHALLING PANEL.
- BINARY INPUT:** Connected to the MARSHALLING PANEL.

MARSHALLING PANEL:

- COMMON:** Connected to the BINARY OUTPUT \$\$\$.
- XB93:** Connected to the BINARY INPUT.
- COMMON:** Connected to the BINARY INPUT.
- XB94:** Connected to the BINARY INPUT.

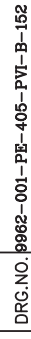
RELAY PANEL:

- 230V AC MCB:** Main circuit breaker.
- K-1, K-2:** Relays.
- 3C x 2.5 Sqmm CONTROL CABLE:** Connects the Relay Panel to the DDCMIS.
- OPEN COMMAND, COMMON, CLOSE COMMAND:** Control lines from the DDCMIS to the Relay Panel.

Connections:

- The BINARY OUTPUT \$\$\$ is connected to the COMMON terminal of the MARSHALLING PANEL.
- The BINARY INPUT is connected to the XB93, COMMON, and XB94 terminals of the MARSHALLING PANEL.
- The 3C x 2.5 Sqmm CONTROL CABLE connects the Relay Panel to the DDCMIS.
- The OPEN COMMAND, COMMON, and CLOSE COMMAND lines connect the DDCMIS to the Relay Panel.

NOTE:-3 @@@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.



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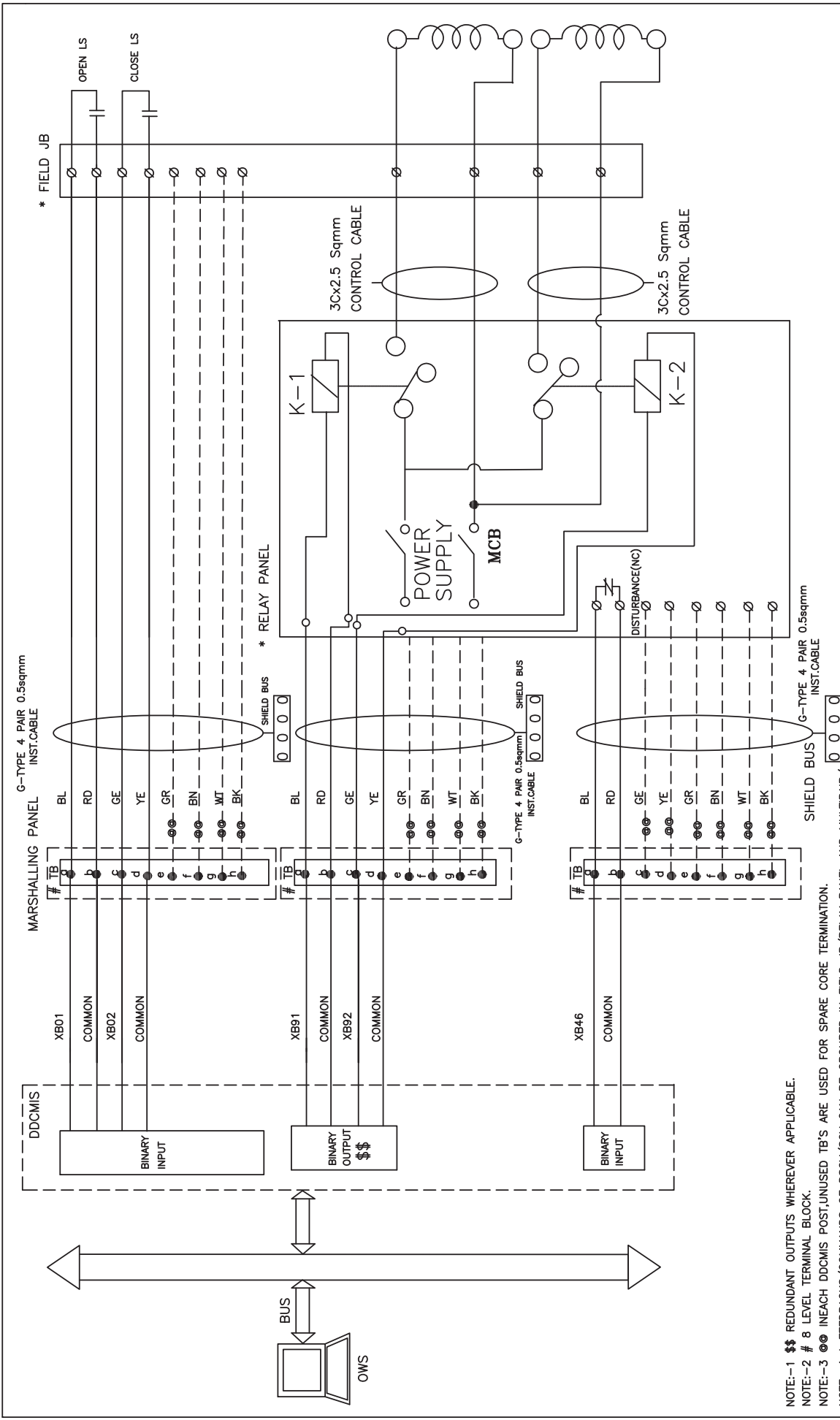
The diagram illustrates the DDCMIS (Digital Data Control and Monitoring Interface System) architecture. It shows the connection between the OWS (Operator Work Station) and the DDCMIS control panel. The OWS is connected to a BUS, which in turn connects to the DDCMIS panel. The DDCMIS panel includes a MARSHALLING PANEL, an INTERPOSING RELAY, and a SHIELD BUS. The MARSHALLING PANEL is connected to the INTERPOSING RELAY via a 5C x 2.5 Sqmm CONTROL CABLE. The INTERPOSING RELAY is connected to the SHIELD BUS via a G-TYPE 4 PAIR 0.5sqmm INST. CABLE. The SHIELD BUS is connected to the OWS via a SHIELD BUS connection. The diagram also shows the connection of various control cables (OPEN COMMAND, COMMON, CLOSE COMMAND) to the INTERPOSING RELAY and the SHIELD BUS.

UP RAJYA VIDYUT UTPADAN NIGAM LTD
1 X 660 MW PANKI TPS

DDCMIS INTERFACE OF SCREW CHILLER/ACCU FOR AC & VENT SYS

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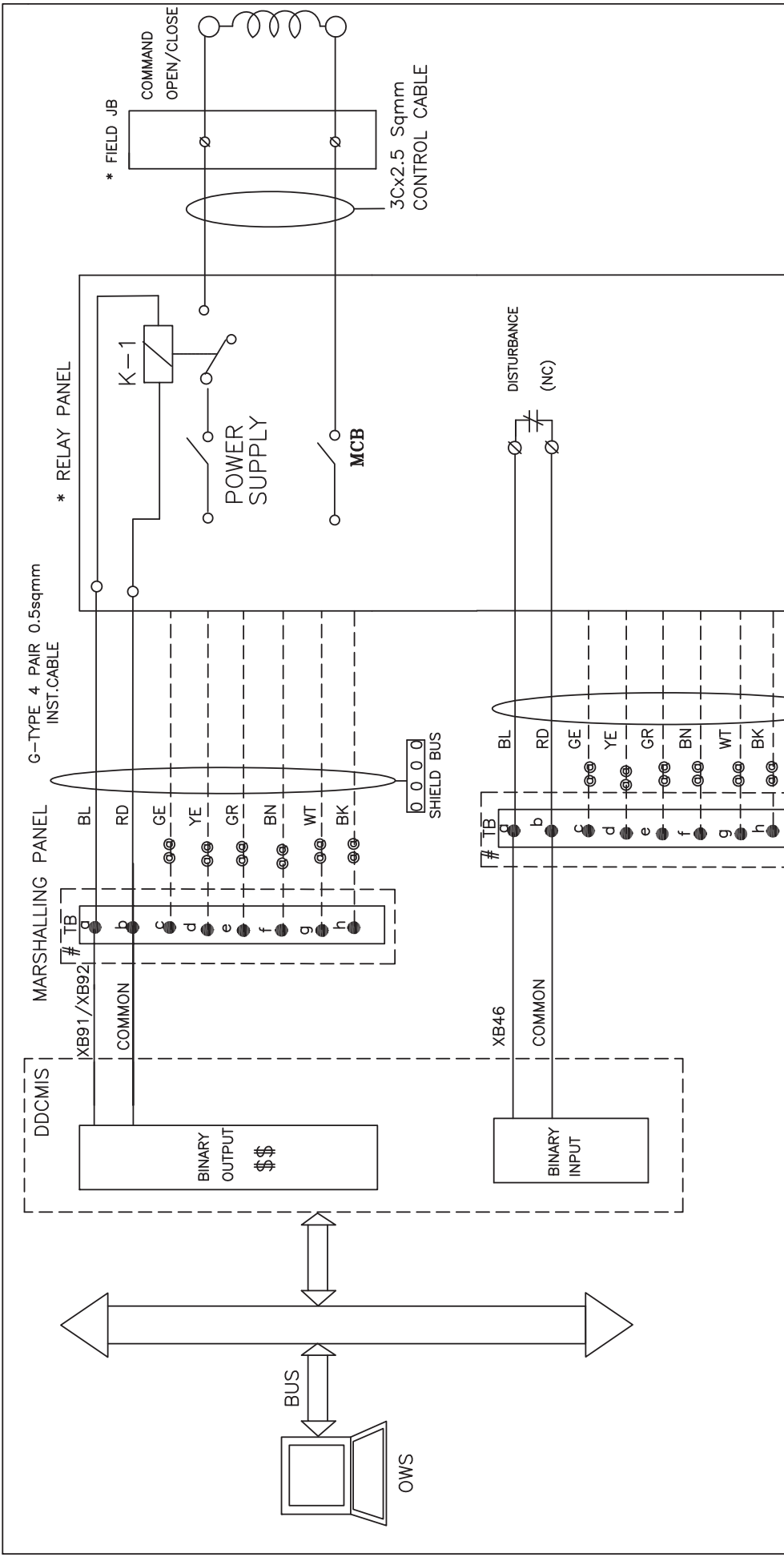
DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L)



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.
NOTE:-2 # 8 LEVEL TERMINAL BLOCK.
NOTE:-3 ## INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAYPANEL TO MARSHALING PANEL.
NOTE:-5 FOR ON/OFF TYPE,SOLENOID ACTUATED CONTROL VALVE.
NOTE:-6 TWO INDEPENDENT OUTPUT FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES,WITH DUAL COIL SOLENOIDS.

	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS	DRG.NO. 9982-001-PE-405-PVI-B-152
	DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L)	SHT 10 OF 34

DDCMIS INTERFACE WITH SOV/O/SOV/C(WITH OUT FEEDBACKS)



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.

NOTE:-2 # 8 LEVEL TERMINAL BLOCK.

NOTE:-3 @ @ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

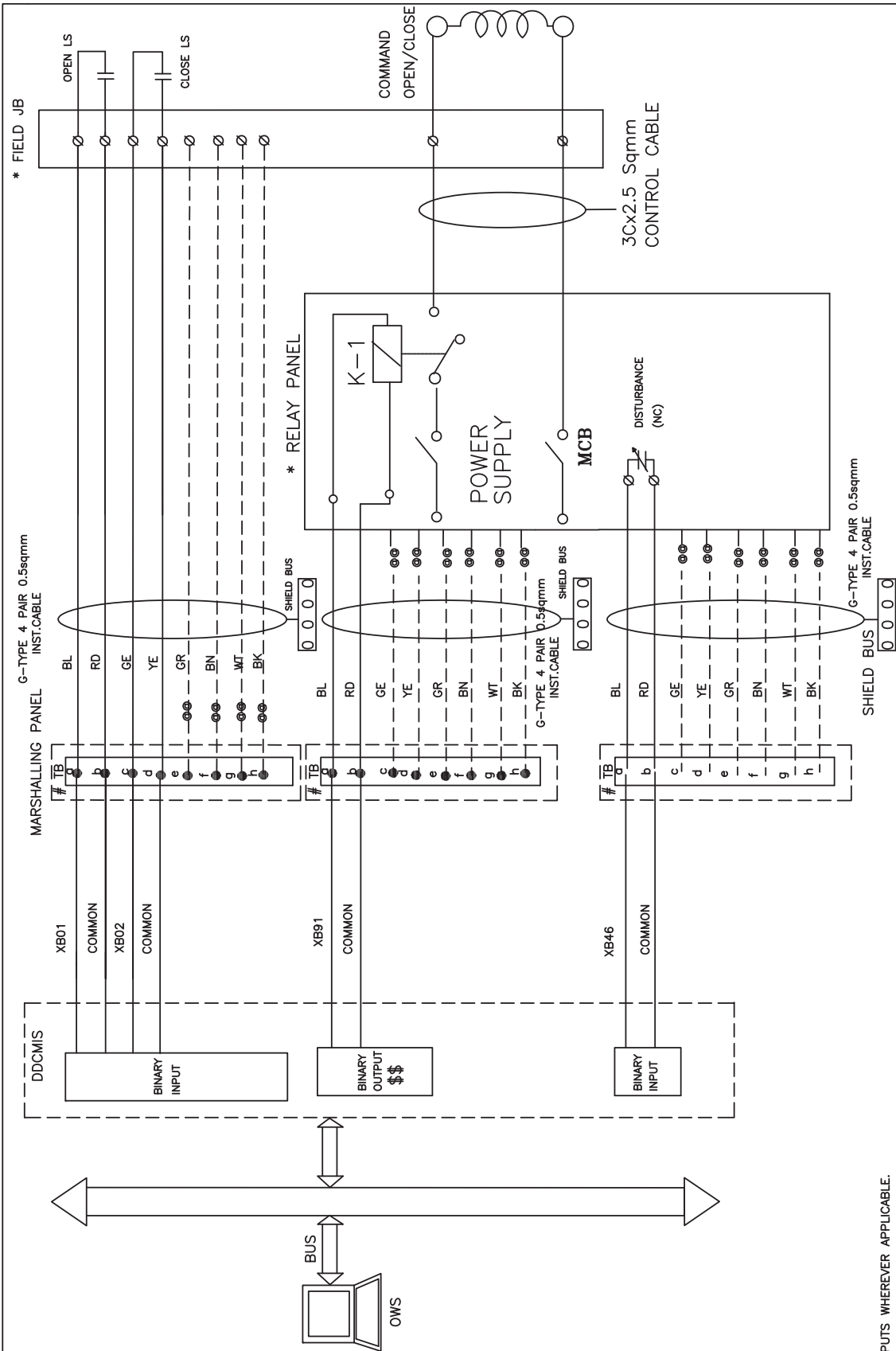
NOTE:-4 * FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAYPANEL TO MARSHELING PANEL.

NOTE:-5 FOR ON/OFF TYPE,SOLENOID ACTUATED CONTROL VALVE.

	DRG.NO.	9982-001-PE-405-PVI-B-152
	SHT	11 OF 34

UP RAJYA VIDYUT UTPADAN NIGAM LTD
1 X 660 MW PANKI TPS
DDCMIS INTERFACE WITH
SOV/O/SOV/C(WITHOUT FEEDBACKS)

DDCMIS INTERFACE WITH SOV/O/L(WITH FEED BACKS)

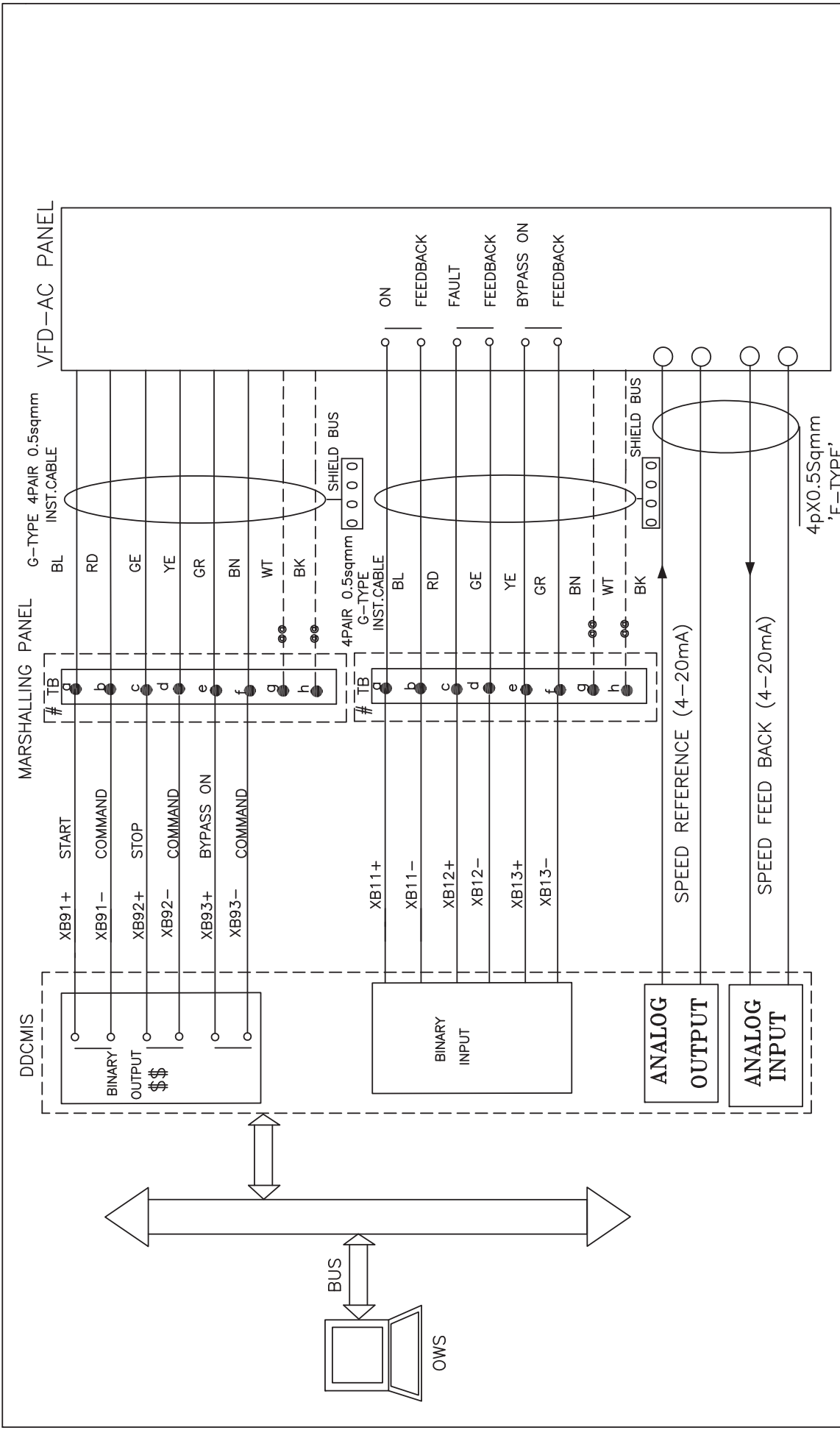


NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.
NOTE:-2 # 8 LEVEL TERMINAL BLOCK.
NOTE:-3 ●● INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/
MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS FROM FIELD JB/RELAYPANEL TO MARSHALING PANEL.
NOTE:-5 FOR ON/OFF TYPE,SOLENOID ACTUATED CONTROL VALVE.



UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS	DRG.NO.	9982-001-PE-405-PVI-B-152
DDCMIS INTERFACE WITH SOV/O/L(WITH FEEDBACKS)	SHT	12 OF 34

DDCMIS INTERFACE WITH VFD OF AC SYSTEM (VFD-AC)



NOTE:--1 \$\$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE

NOTE:--2 # 8 LEVEL TERMINAL BLOCK

NOTE:--3 @ @ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

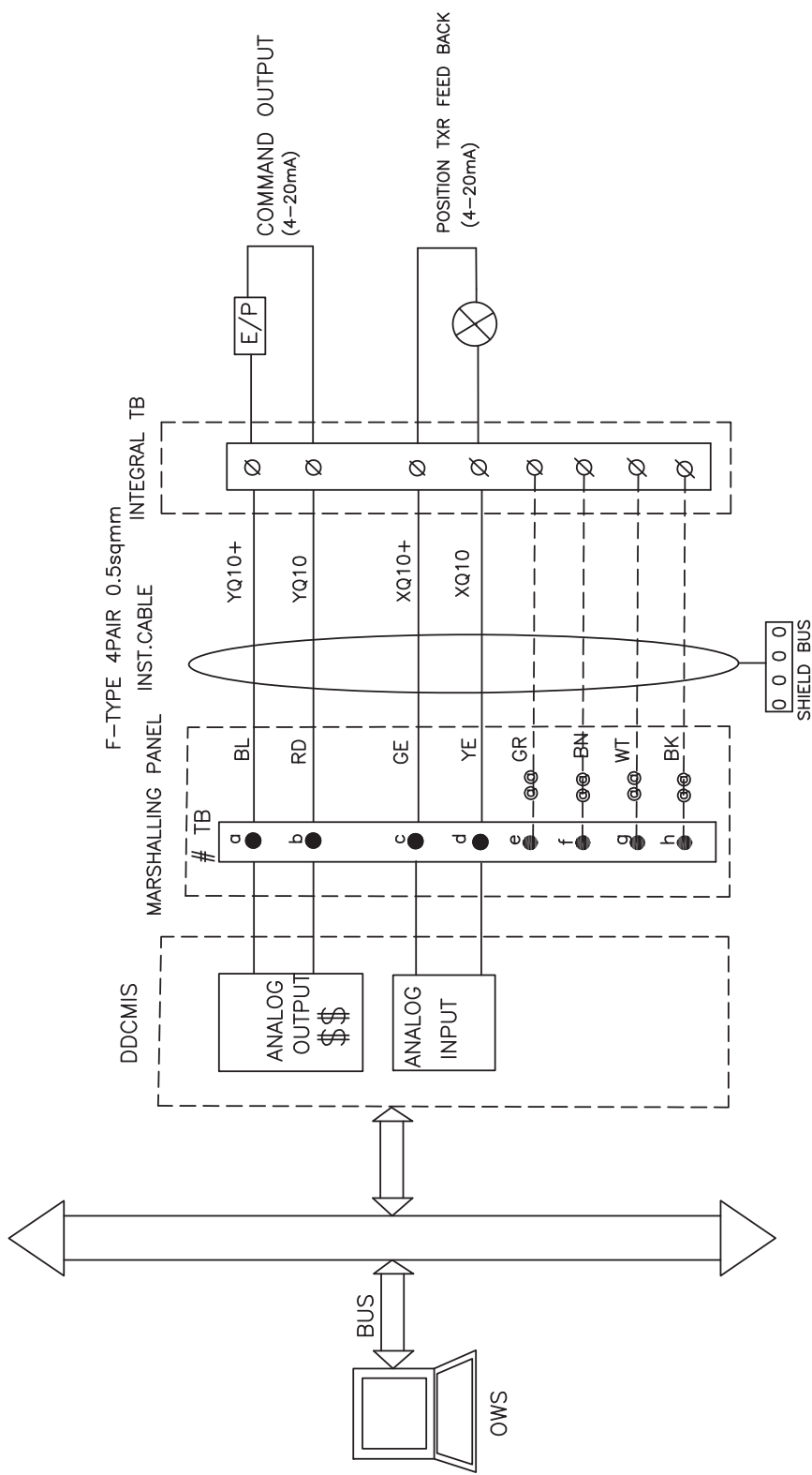
NOTE:--4 OTHER VFD SIGNALS WILL BE CONSIDERED AS PER IO LIST.



UP RAJYA VIDYUT UTPADAN NIGAM LTD
1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH VFD OF AC SYSTEM(VFD-AC)

INTERFACE FOR MODULATING DRIVES – CLCS



NOTE:--1 \$\$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:--2 # 8 LEVEL TERMINAL BLOCK
NOTE:--3 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.
NOTE:--4 F-TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.

	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO. 9982-001-PE-405-PVI-B-152
	INTERFACE FOR MODULATING DRIVES – CLCS		SHT 14 OF 34

Diagram illustrating the DDCMIS (Digital Data Control and Monitoring Interface System) architecture, showing connections between the DDCMIS unit, the Marshalling Panel, and the Integral TB (Terminal Block).

DDCMIS Unit:

- ANALOG OUTPUT (\$\$):** Connected to the Marshalling Panel terminal 'a'.
- ANALOG INPUT:** Connected to the Marshalling Panel terminal 'd'.
- BINARY INPUT:** Connected to the Marshalling Panel terminal 'p'.

Marshalling Panel:

- Terminals: a, b, c, d, e, f, g, h, p.
- Color-coded lines: BL, RD, GE, YE, GR, BN, WT, BK.
- Shield Bus: Connected to the Integral TB.

Integral TB (Terminal Block):

- Terminals: YQ10+, YQ10, XQ10+, XQ10, and various color-coded lines (BL, RD, GE, YE, GR, BN, WT, BK).
- Connections:
 - COMMAND OUTPUT (4-20mA) connected to YQ10+.
 - POSITION TXR FEED BACK (4-20mA) connected to XQ10+.
 - ACTUATOR DISTURBANCE (NC) connected to the BK line.

Other Components:

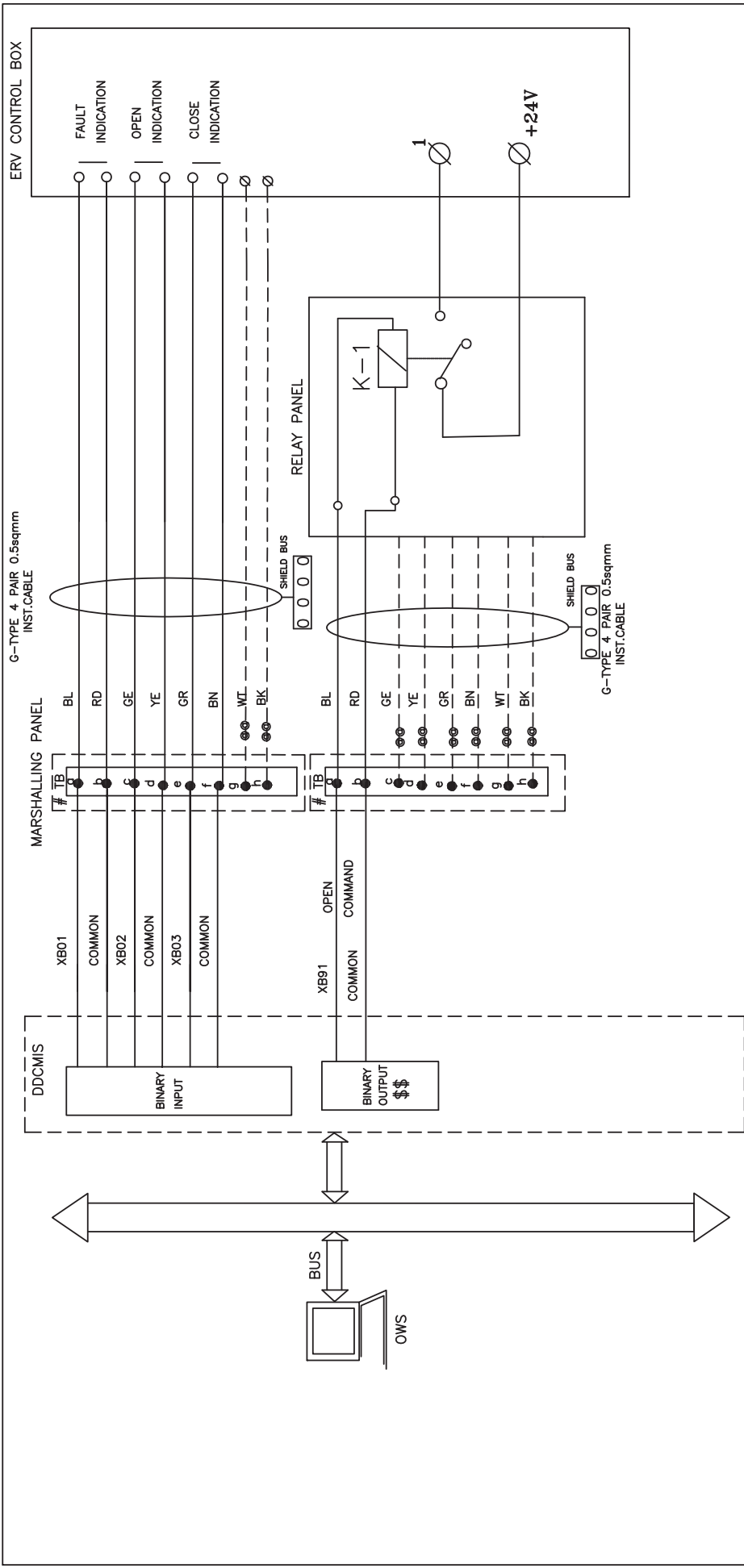
- BUS:** Connects the DDCMIS unit to the OWS (Operator Workstation).
- OWS (Operator Workstation):** Represented by a computer monitor icon.

Legend:

- NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
- NOTE:-2 # 8 LEVEL TERMINAL BLOCK
- NOTE:-3 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS	DRG.NO.	9962-001-PG-405-PVI-B-152
	INTERFACE FOR MODULATING DRIVES - CLCS-M	SHT	15 OF 34

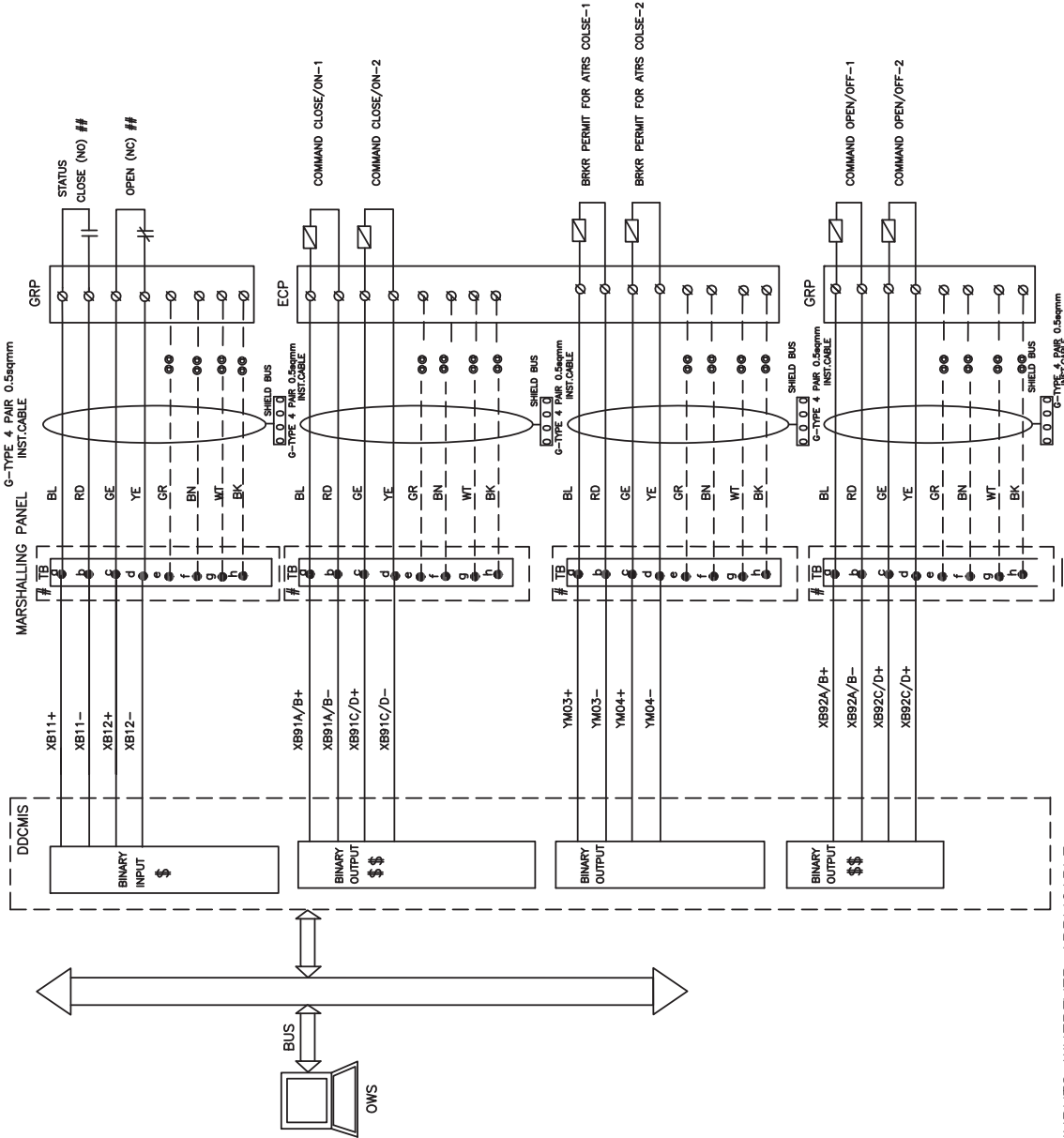
DDCMIS INTERFACE WITH ERV CONTROL BOX (ERV)



NOTE:-1 \$\$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.
 NOTE:-2 # 8 LEVEL TERMINAL BLOCK.
 NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS	DRG.NO. 99862-001-PE-405-PVI-B-152
DDCMIS INTERFACE WITH ERV CONTROL BOX	SHT	16 OF 34

DDCMIS INTERFACE WITH EHVCB

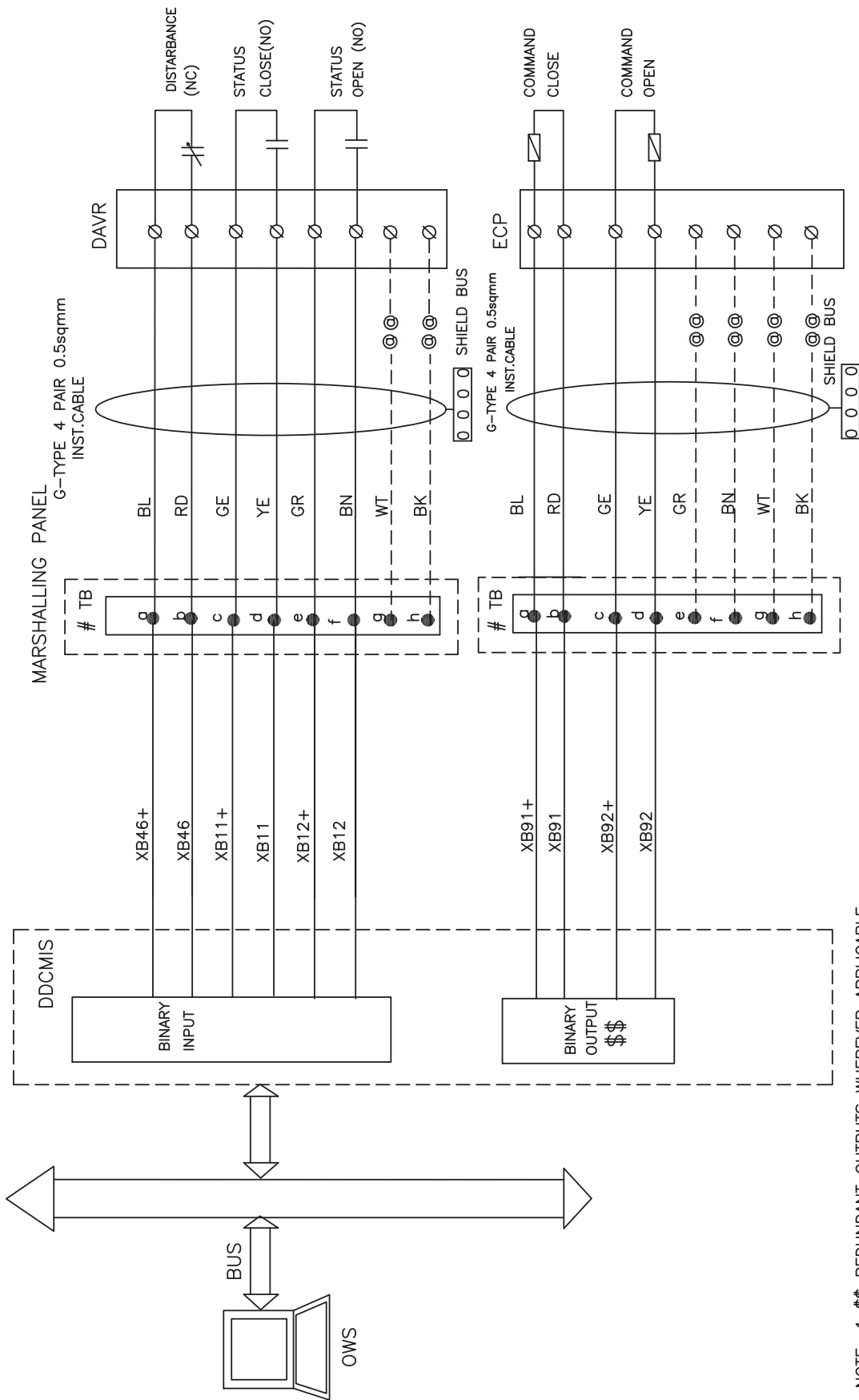


NOTE:-1 \$ REDUNDANT INPUTS WHEREVER APPLICABLE
NOTE:-2 \$\$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-3 # 8 LEVEL TERMINAL BLOCK
NOTE:-4 ## DI-SOE SIGNALS
NOTE:-5 @ @ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION



UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO. 9962-001-PE-405-PVI-B-152
		DATE 11.02.2019
DDCMIS INTERFACE WITH EHVCB		REV.NO. 01
		SHT 17 OF 34

DDCMIS INTERFACE WITH FIELD BREAKER (FB)

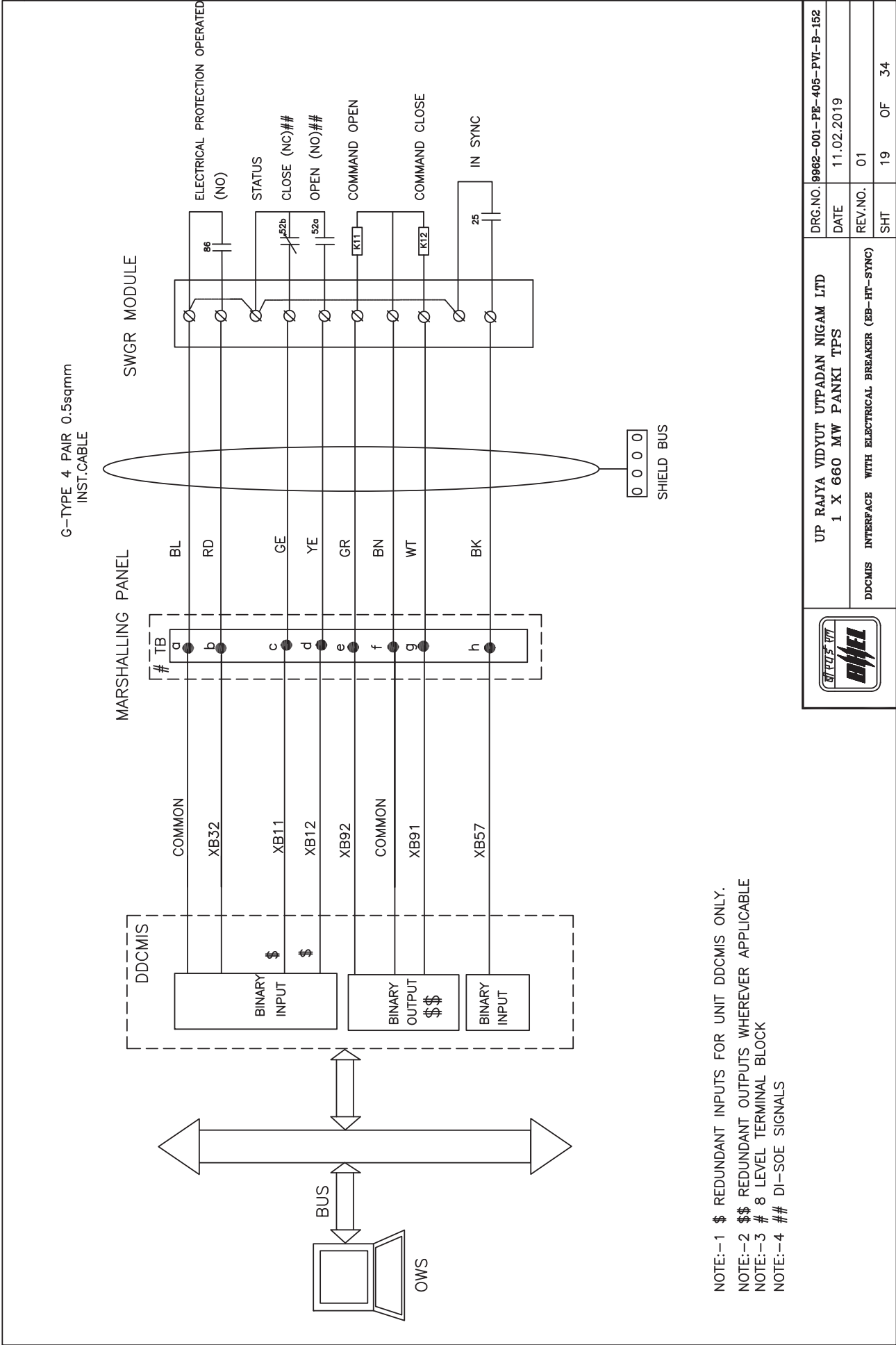


NOTE:-1 \$\$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @ @ IN EACH DDCMIS POST, UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.



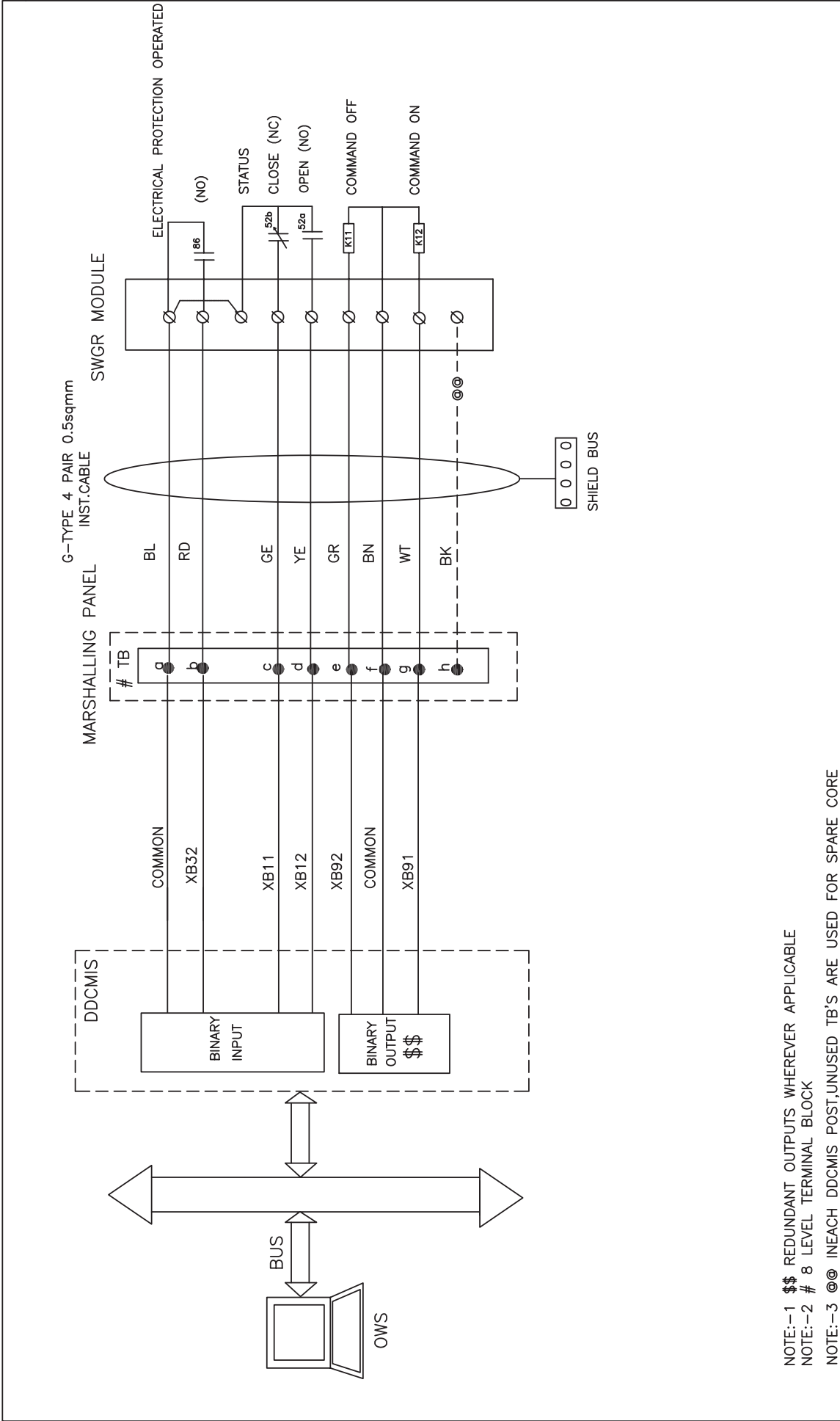
UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO. 9982-001-PE-405-PVI-B-152
DDCMIS INTERFACE WITH FIELD BREAKER (FB)		DATE 11.02.2019
		REV.NO. 01
		SHT 18 OF 34

DDCMIS INTERFACE WITH ELECTRICAL BREAKER (EB-HT-SYNC)



NOTE:-1 \$ REDUNDANT INPUTS FOR UNIT DDCMIS ONLY.
NOTE:-2 \$\$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-3 # 8 LEVEL TERMINAL BLOCK
NOTE:-4 ## DI-SOE SIGNALS

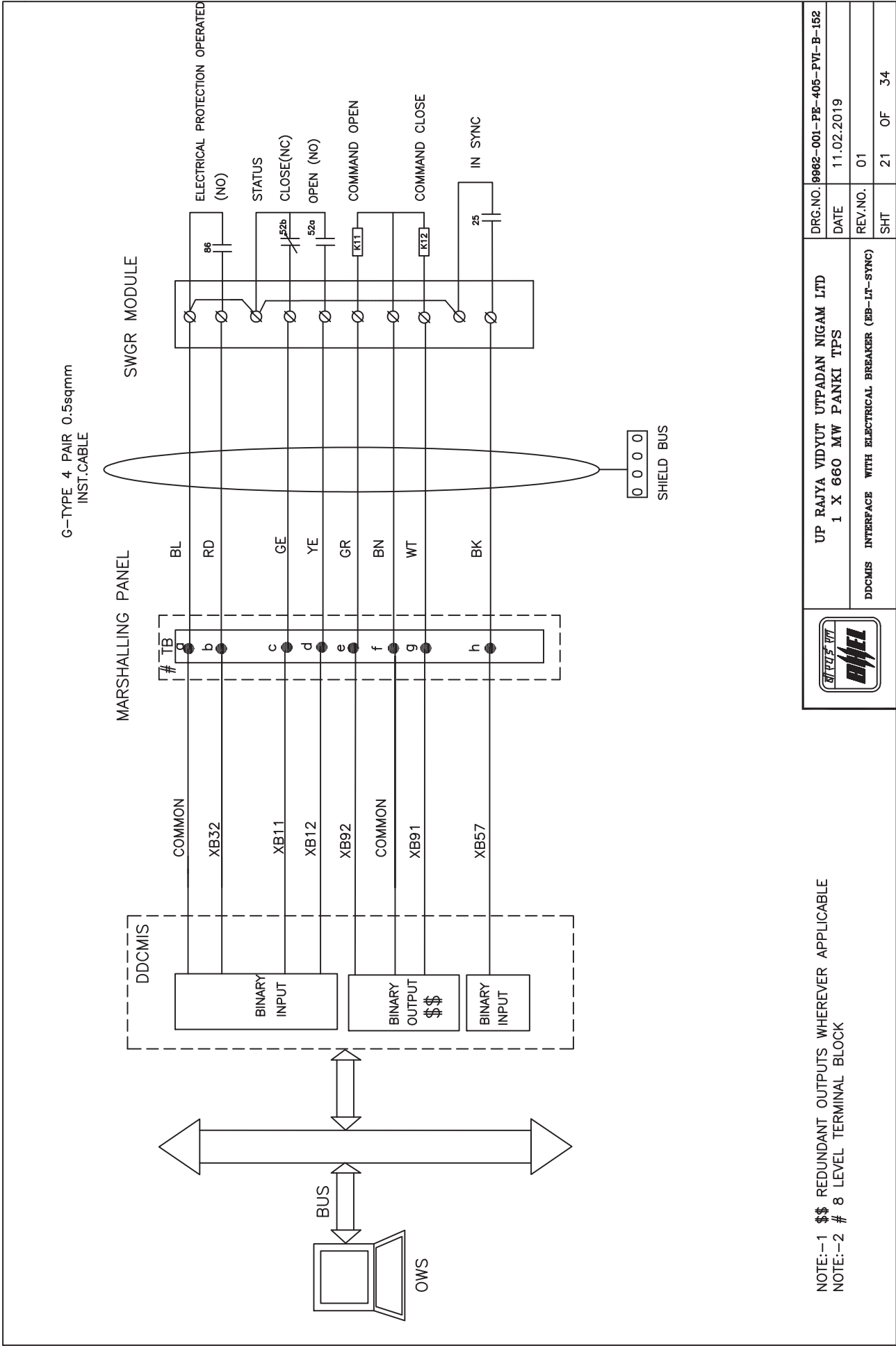
DDCMIS INTERFACE WITH ELECTRICAL BREAKER(EB-HT-NONSYNC)



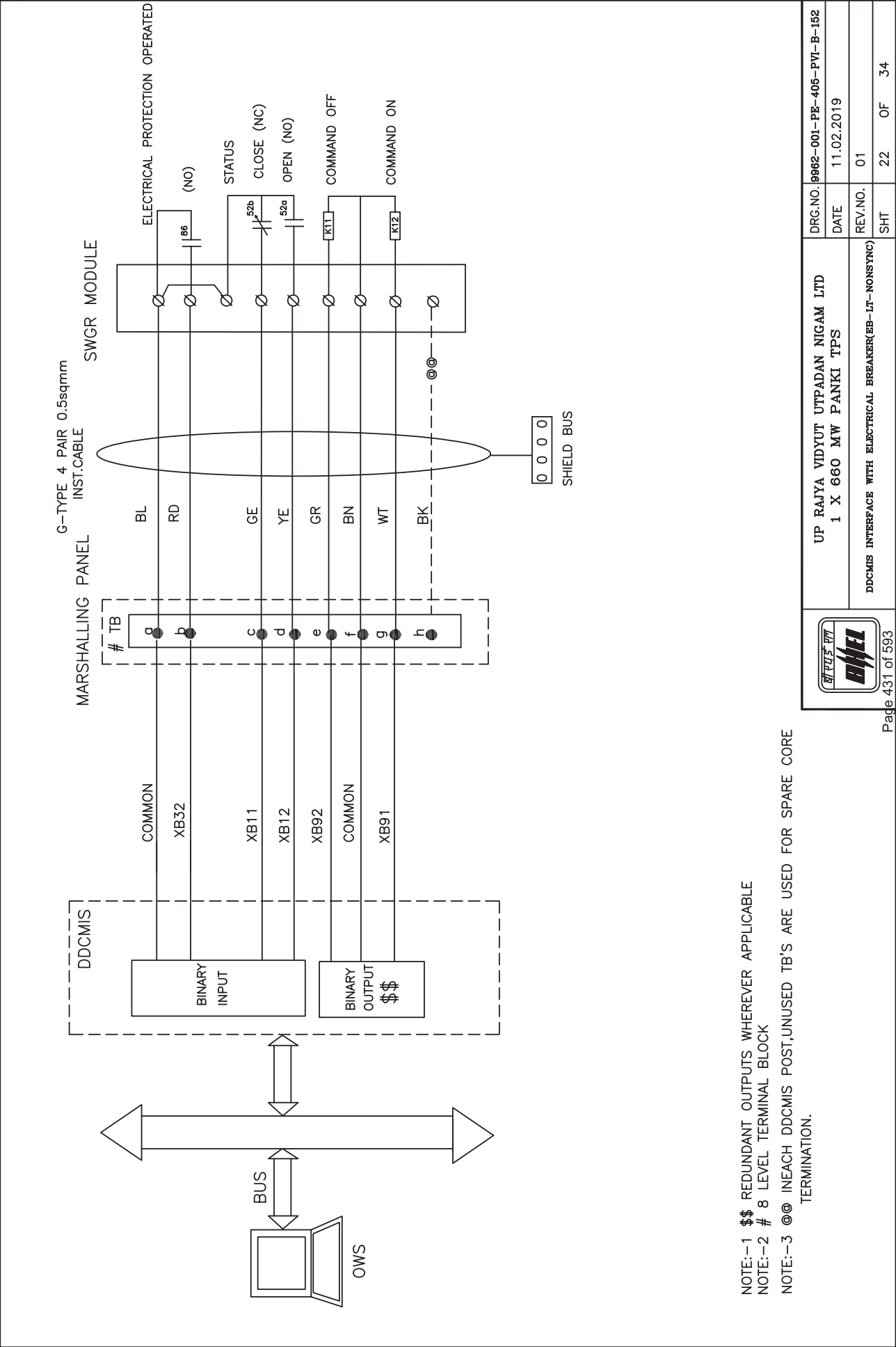
NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO.	9962-001-PE-405-PVI-B-152
	DDCMIS INTERFACE WITH ELECTRICAL BREAKER(EB-HT-NONSYNC)		DATE	11.02.2019
			REV.NO.	01
			SHT	20 OF 34

DDCMIS INTERFACE WITH ELECTRICAL BREAKER (EB-LT-SYNC)



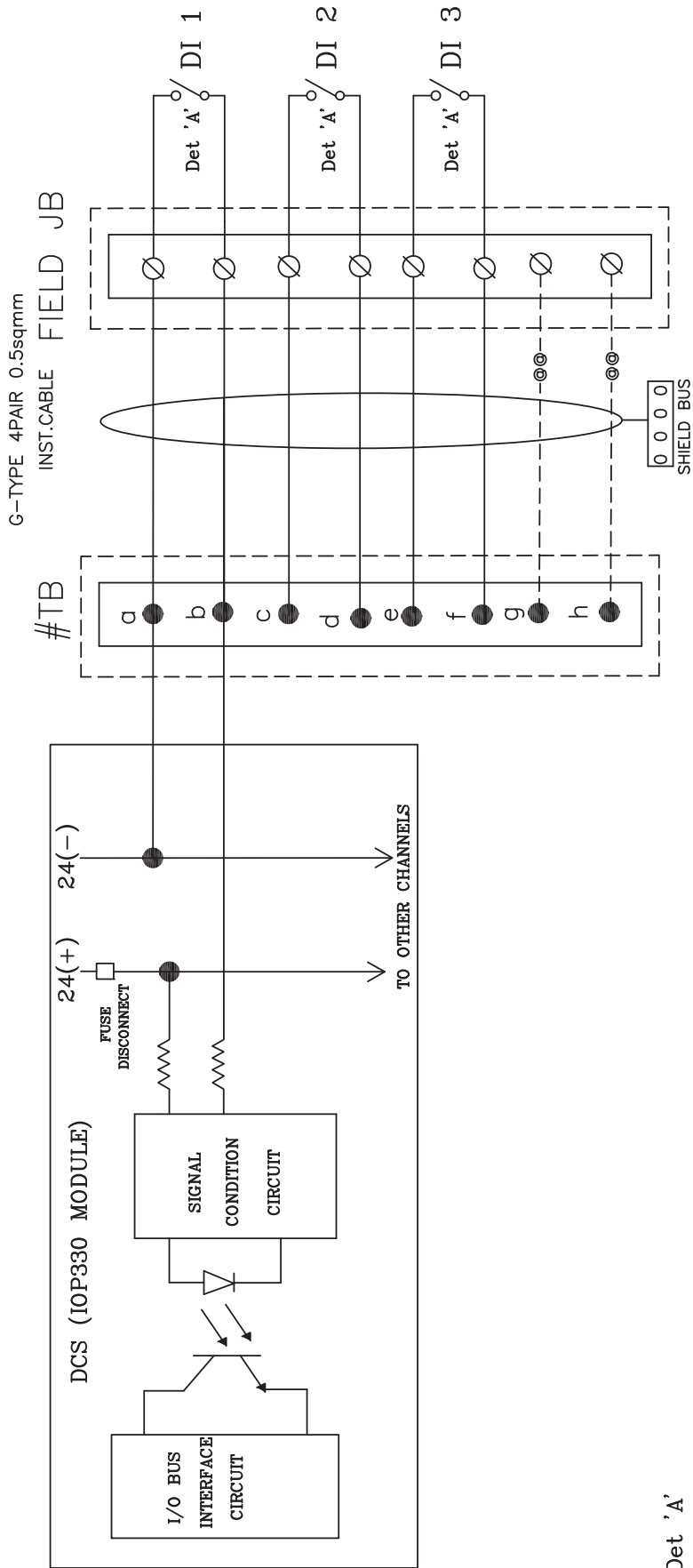
DDCMIS INTERFACE WITH ELECTRICAL BREAKER(EB-LT-NONSYNC)



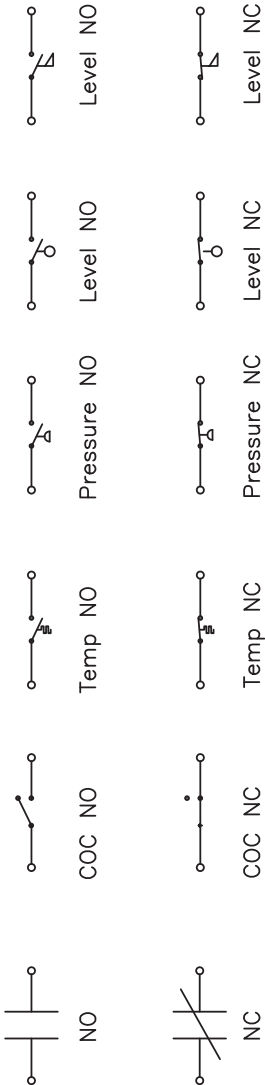
	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO.	9982-001-PE-405-PVI-B-152
	DDCMIS INTERFACE WITH ELECTRICAL BREAKER(EB-LT- NONSYNC)		DATE	11.02.2019
			REV.NO.	01
			SHT	22 OF 34

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DDCMIS INTERFACE WITH DIGITAL INPUT SIGNAL



Det 'A'



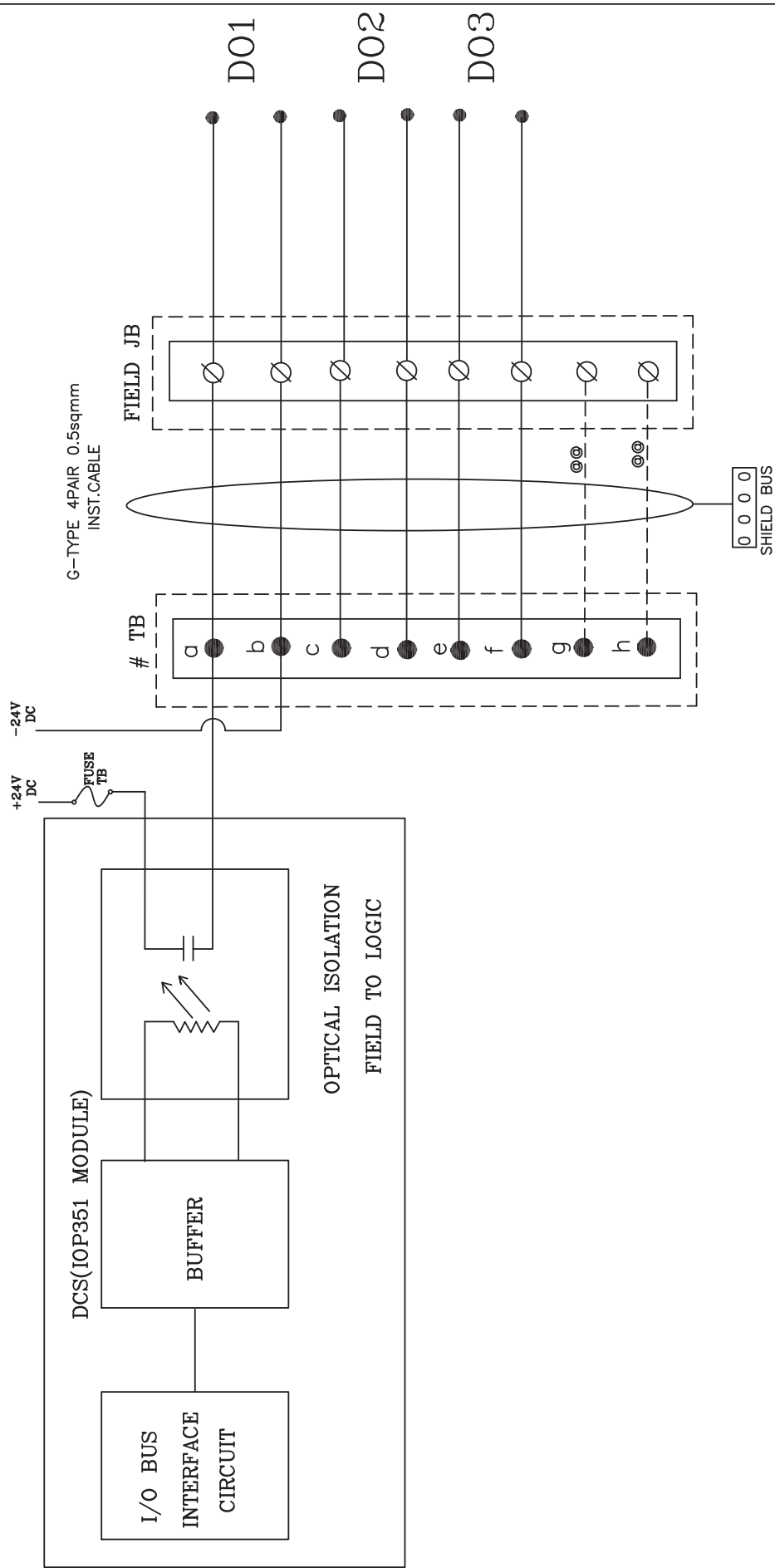
NOTE:-1 #8 LEVEL TERMINAL BLOCK.
NOTE:-2 @ @ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.



UP RAJYA VIDYUT UTPADAN NIGAM LTD
1 X 660 MW PANKI TPS
DDCMIS INTERFACE WITH DIGITAL INPUT SIGNAL

DRG.NO.	9862-001-PG-405-PVL-B-152
DATE	11.02.2019
REV.NO.	01
SHT	23 OF 34

DDCMIS INTERFACE WITH DIGITAL OUTPUT SIGNAL



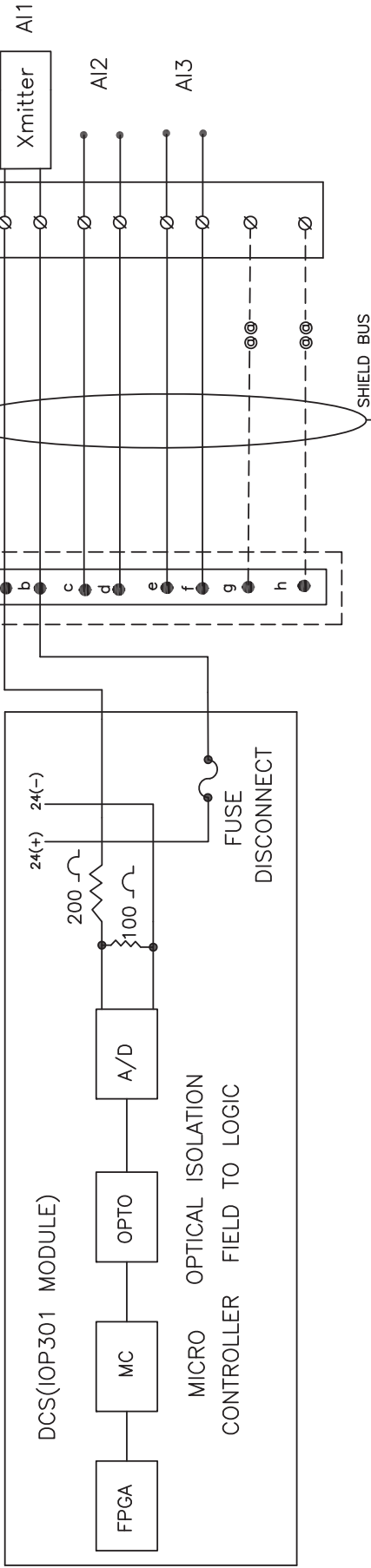
NOTE:-1 #8 LEVEL TERMINAL BLOCK.

NOTE:-2 @@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

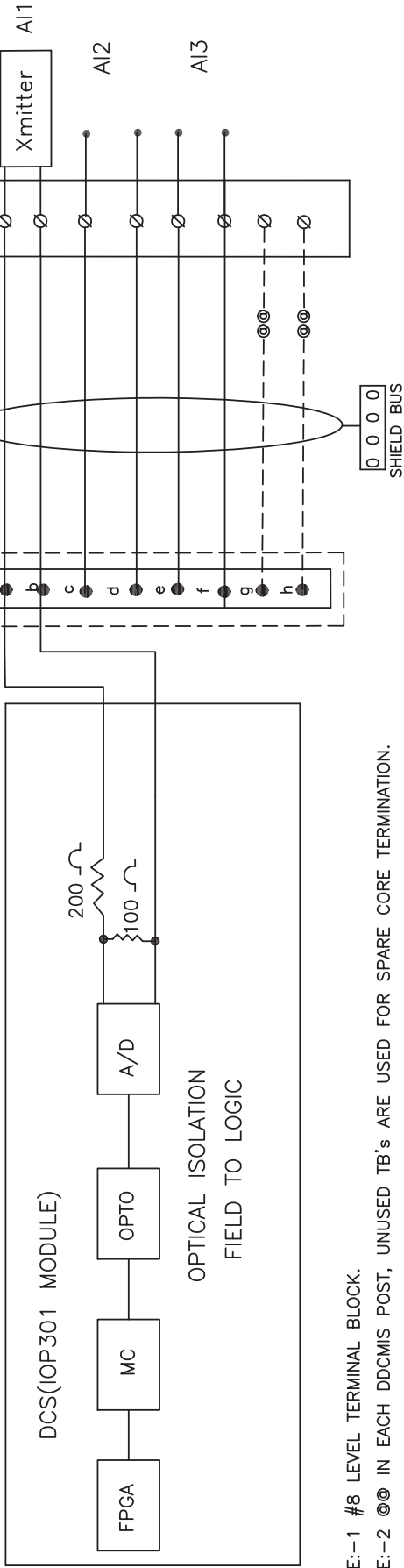
	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO.	9862-001-PE-405-PVL-B-152
	DDCMIS INTERFACE WITH DIGITAL OUTPUT SIGNAL		DATE	11.02.2019
			REV.NO.	01
		SHT	24 OF	34

DDCMIS INTERFACE WITH ANALOG INPUT SIGNAL

AI INTERFACE(4-20mA POWERED BY SYSTEM)



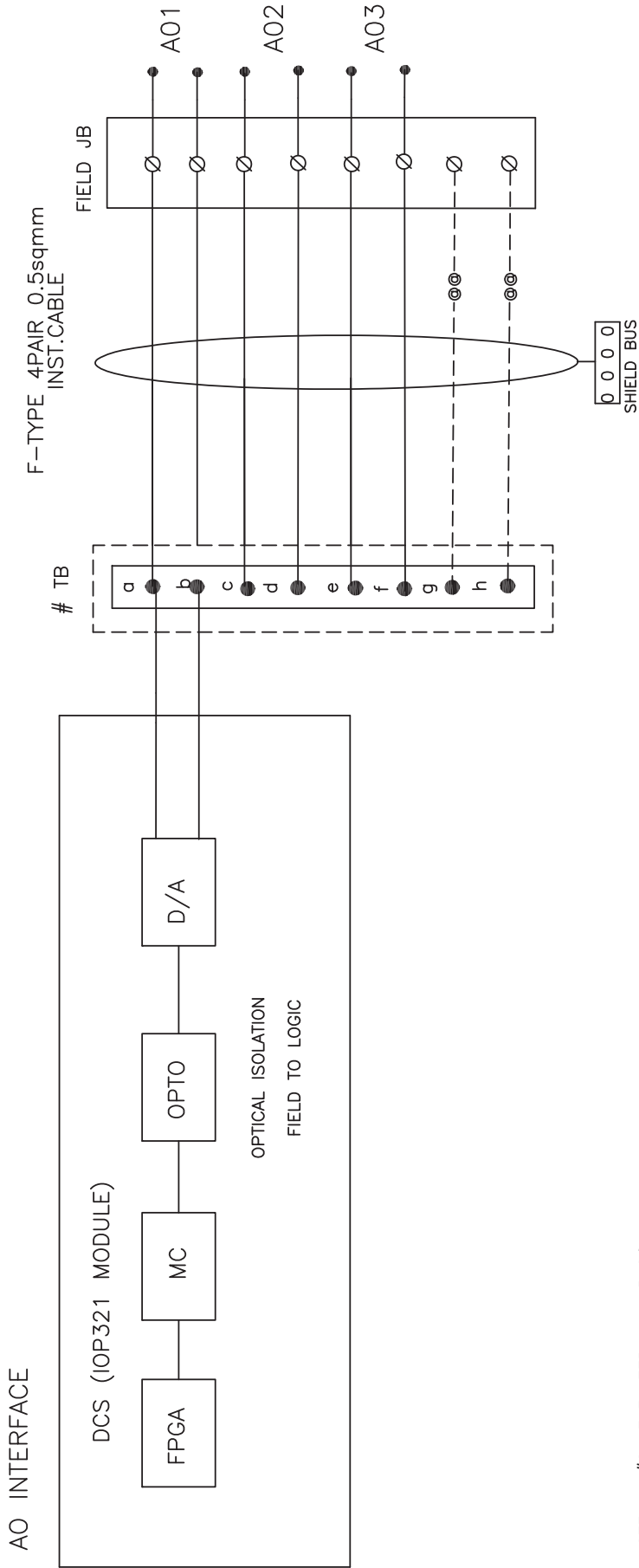
AI INTERFACE(4-20mA POWERED EXTERNALLY)



NOTE:-1 #8 LEVEL TERMINAL BLOCK.
NOTE:-2 @ in each DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.
NOTE:-3 F-TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.

		UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO. 9962-001-PE-405-PVI-B-152
DDCMIS INTERFACE WITH ANALOG INPUT SIGNAL		DATE 11.02.2019		REV.NO. 01
Page 434 of 593		SHT 25		OF 34

DDCMIS INTERFACE WITH ANALOG OUTPUT SIGNAL



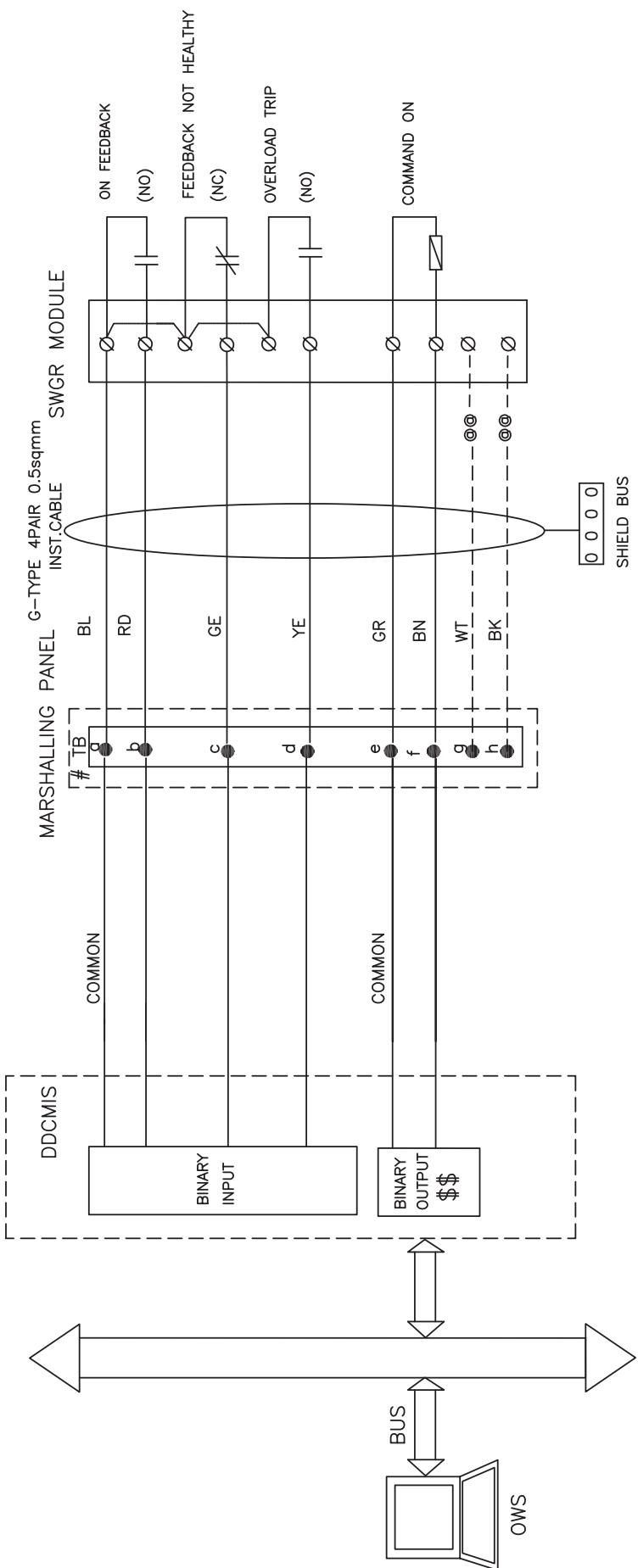
NOTE: -1 #8 LEVEL TERMINAL BLOCK.

NOTE:-2 @@@ IN EACH DDCMIS POST, UNUSED TB's ARE USED FOR SPARE CORE TERMINATION.

NOTE:--3 F-TYPE: INDIVIDUAL & OVERALL SHIELD CABLE.

	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS	DRG.NO.	9962-001-PE-405-PVI-B-152
		DATE	11.02.2019
		REV.NO.	01
DDCMS INTERFACE WITH ANALOG OUTPUT SIGNAL		SHT	26 OF 34

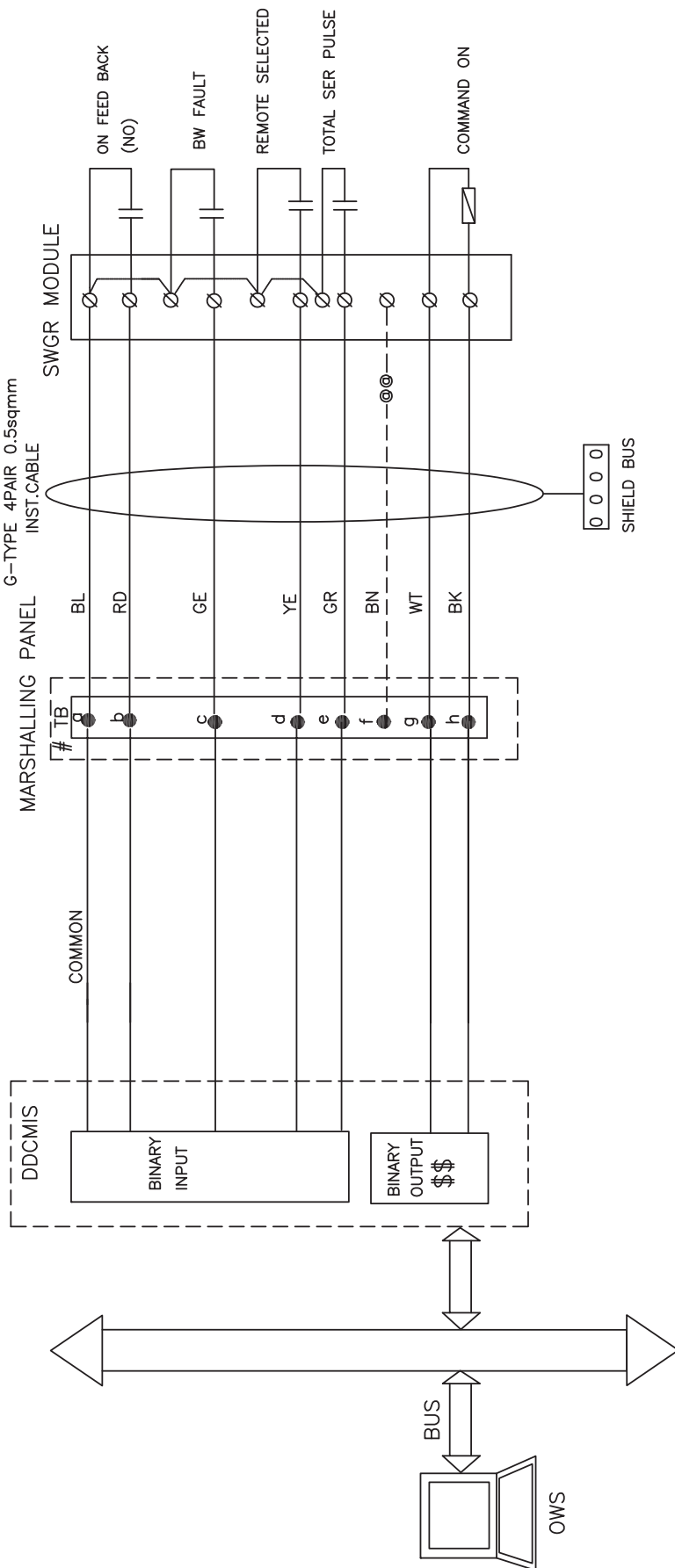
DDCMIS INTERFACE WITH LTCHP (DOL)



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO. 9962-001-PE-405-PVI-B-152
	DDCMIS INTERFACE WITH LTCHP (DOL)		DATE 11.02.2019
			REV.NO. 01
			SHT 27 OF 34

DDCMIS INTERFACE WITH BELT WEIGHER (BW)

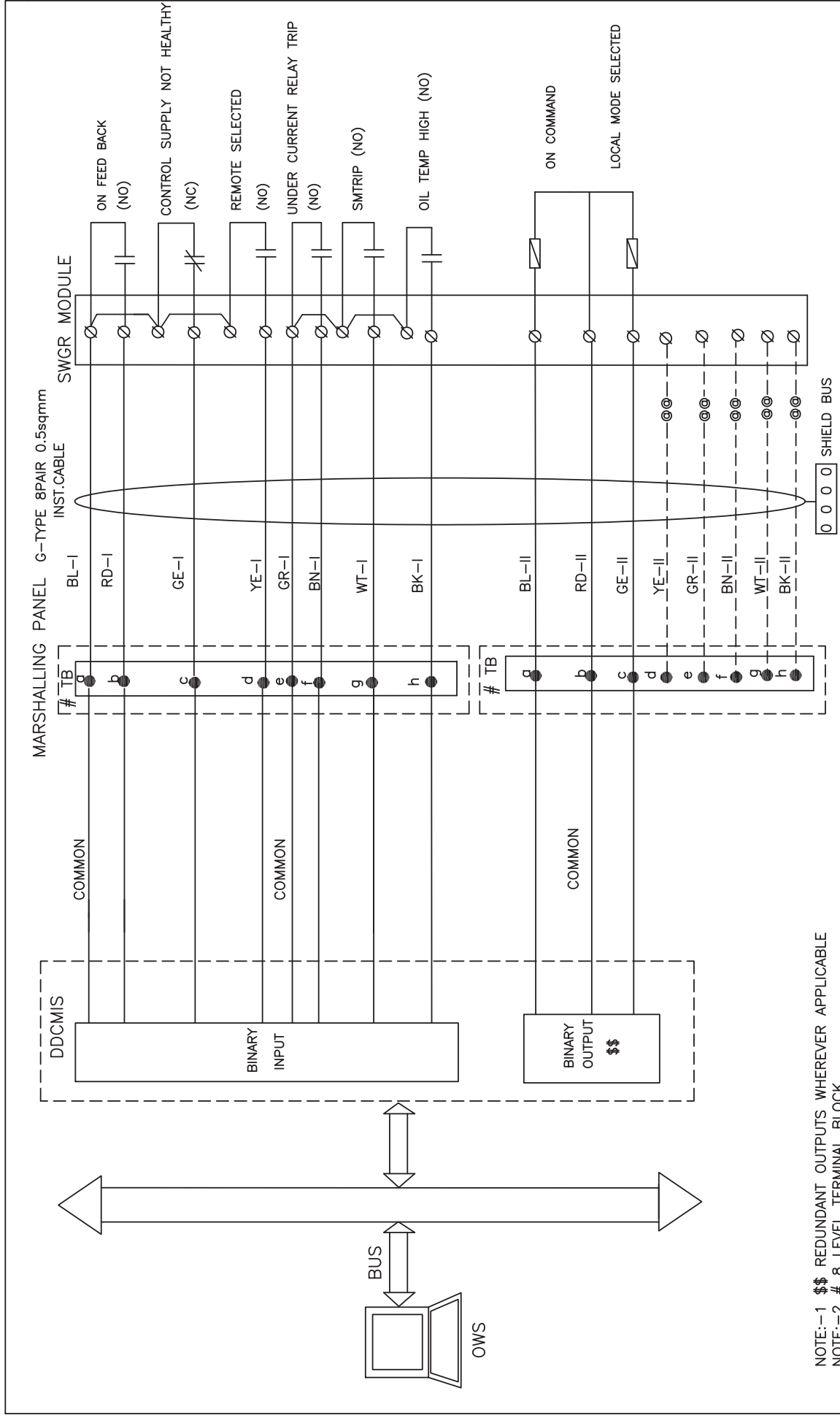


NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO. 9962-001-PE-405-PVI-B-152		
	DDCMIS INTERFACE WITH BELT WEIGHER (BW)		DATE 11.02.2019		
		REV.NO. 01			
		SHT 28 OF 34			

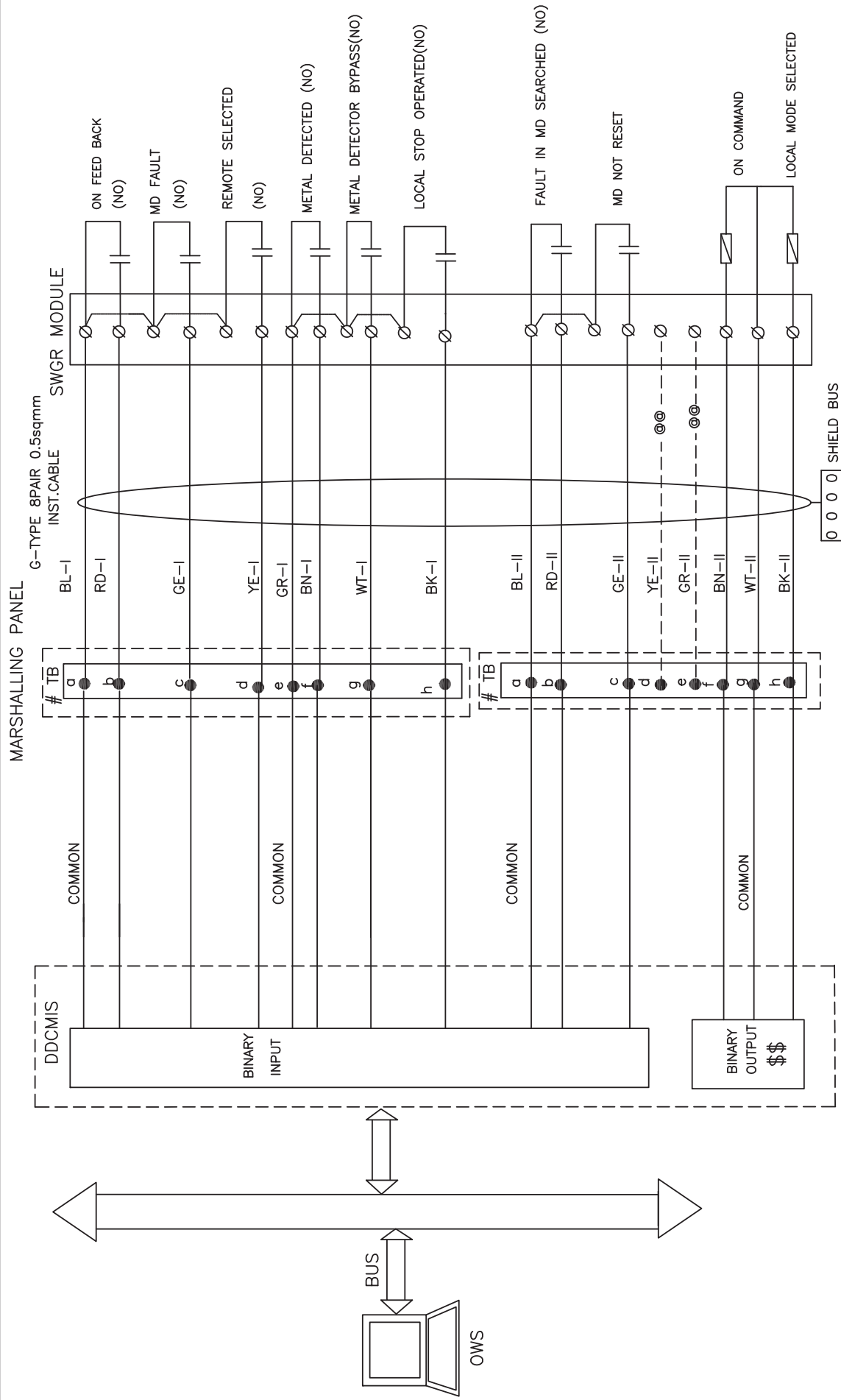
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DDCMIS INTERFACE WITH SUSPENDED MAGNET (SM)



	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO. 9962-001-PE-405-PVI-B-152
	DDCMIS INTERFACE WITH SUSPENDE MAGNET (SM)		DATE 11.02.2019 REV.NO. 01 SHT 29 OF 34

DDCMIS INTERFACE WITH METAL DETECTOR (MD)



NOTE:-1 \$\$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
 NOTE:-2 # 8 LEVEL TERMINAL BLOCK
 NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.



UP RAJYA VIDYUT UTPADAN NIGAM LTD
 1 X 660 MW PANKI TPS

DDCMIS INTERFACE WITH METAL DETECTOR (MD)	DRG.NO. 9962-001-PE-405-PVI-B-152
	DATE 11.02.2019
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MARSHALLING PANEL G-TYPE 8PAIR 0.5sqmm INST.CABLE

DDCMIS

BINARY INPUT

BINARY OUTPUT \$\$\$

COMMON

COMMON

COMMON

SWGR MODULE

BL-I

RD-I

GE-I

YE-I

GR-I

BN-I

WT-I

BK-I

BL-II

RD-II

GE-II

YE-II

GR-II

BN-II

WT-II

BK-II

ILMS ON FEED BACK (NO)

CONTROL SUPPLY NOT HEALTHY (NC)

ILMS FAULTY (NO)

REMOTE SETECTED(NO)

UNDER CURRENT RELAY TRIP(NO)

CLEARED BELT TRIP(NO)

OIL TEMP. HIGH(NO)

MAG. SEPERATOR DC SUPPLY ON(NO)

ON COMMAND

CONVEYOR SYSTEM TRIP

LOCAL MODE SELECTED

OWS

BUS

TB

TB

0 0 0 0 SHIELD BUS

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DDCMIS



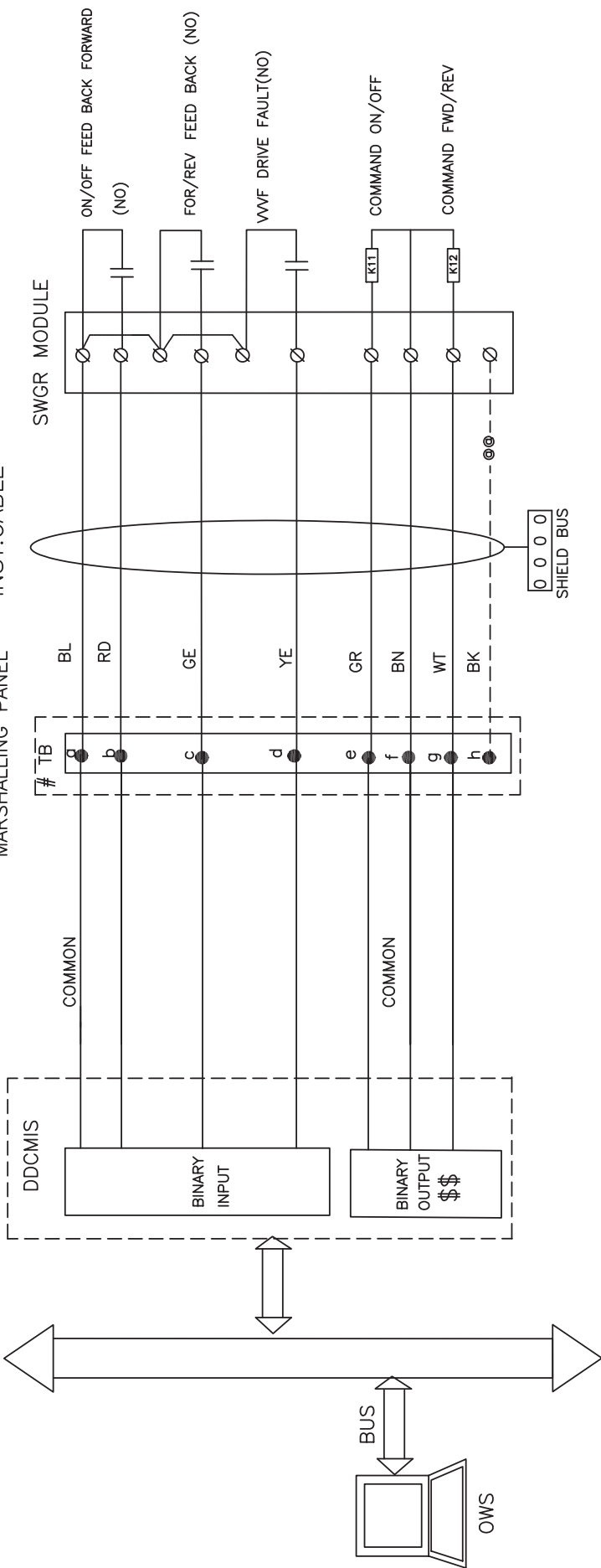
NOTE: -1 \$\$\$ REDUNDANT OUTPUTS WHEN
NOTE: -2 # 8 LEVEL TERMINAL BLOCK



DDCMIS INTERFACE WITH VVVF

G-TYPE 4 PAIR 0.5sqmm

MARSHALLING PANEL INST.CABLE



NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

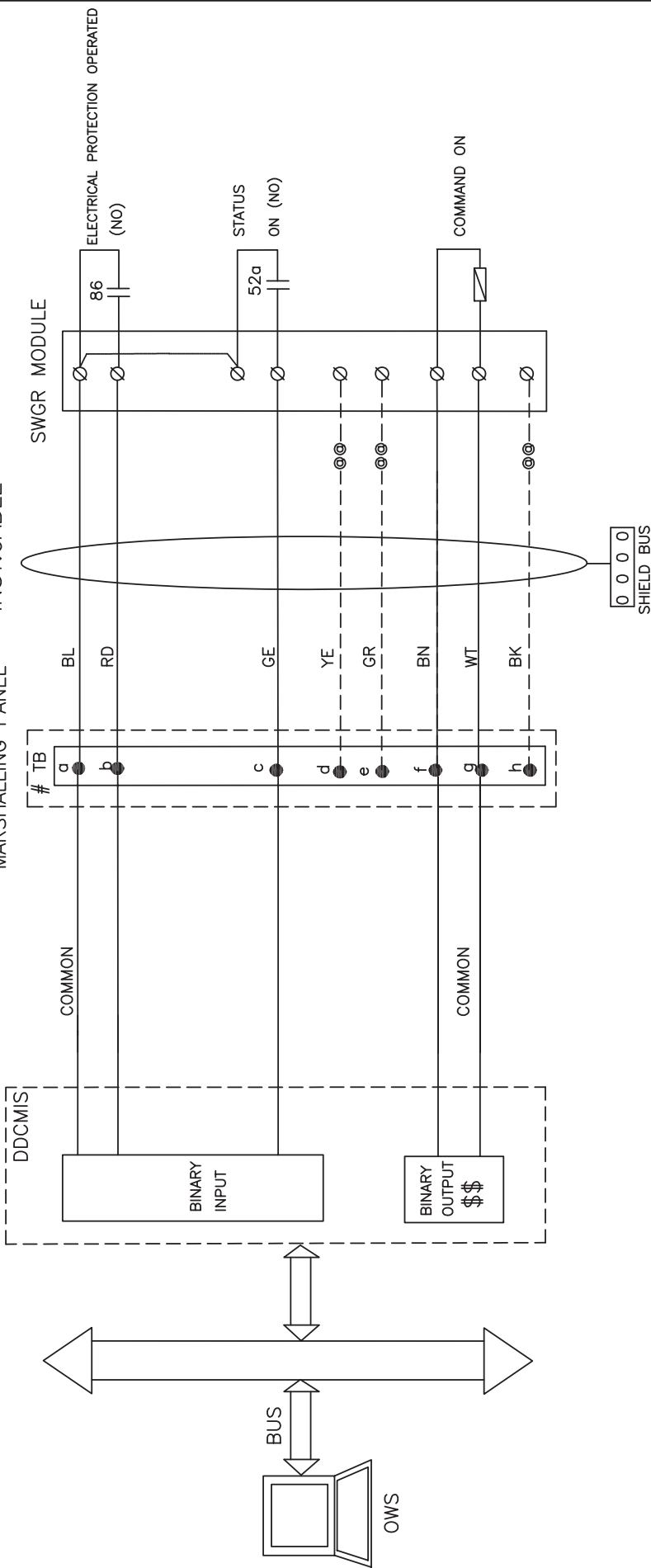


UP RAJYA VIDYUT UTPADAN NIGAM LTD	DRG.NO.	9962-001-PE-405-PVI-B-152
1 X 660 MW PANKI TPS	DATE	11.02.2019
DDCMIS INTERFACE WITH VVVF	REV.NO.	01
	SHT	33 OF 34

DDCMIS INTERFACE WITH HTCHP

G-TYPE 4PAIR 0.5sqmm

MARSHALLING PANEL INST.CABLE



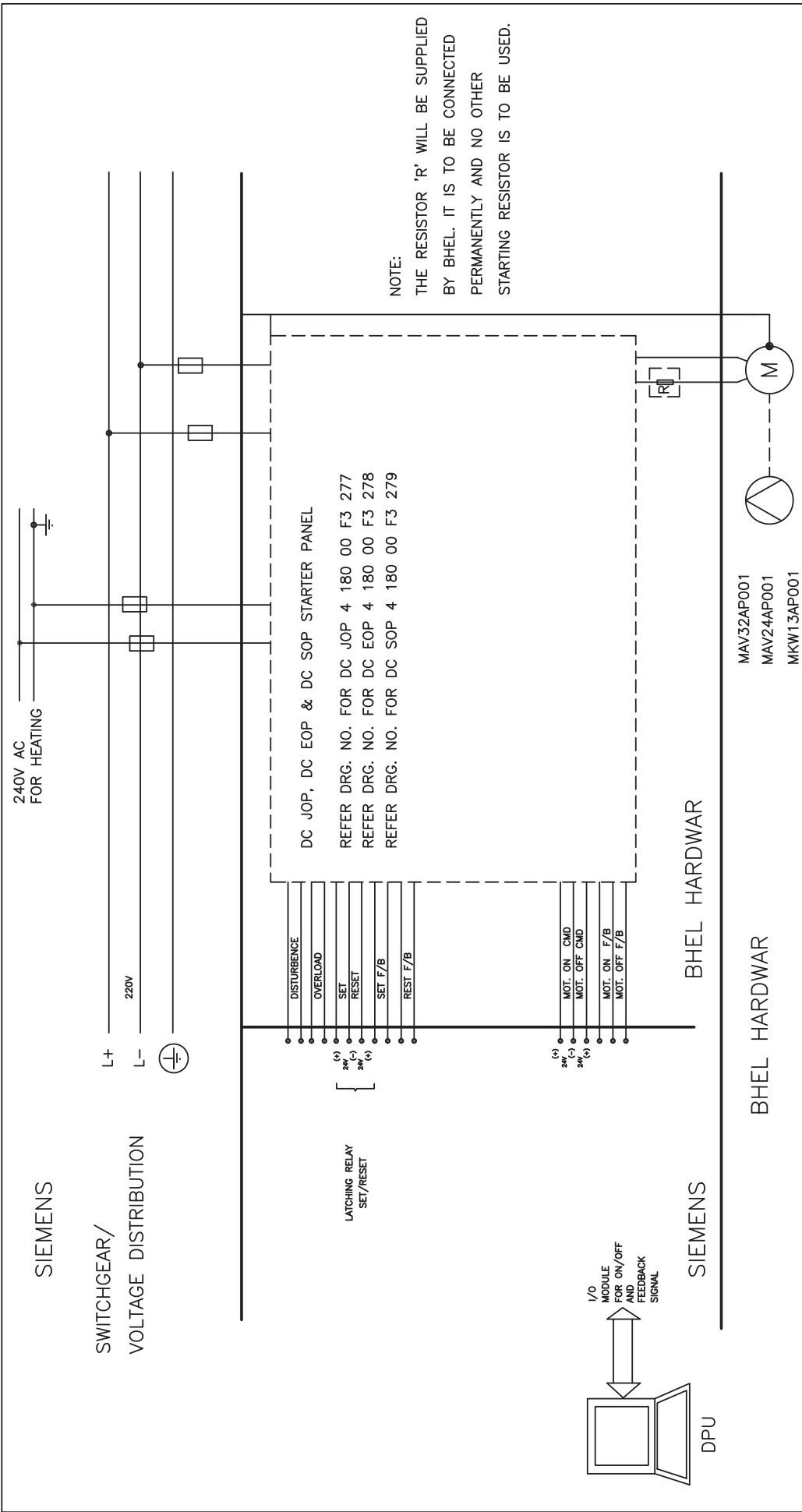
NOTE:-1 \$\$ REDUNDANT OUTPUTS WHEREVER APPLICABLE

NOTE:-2 # 8 LEVEL TERMINAL BLOCK

NOTE:-3 @ @ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

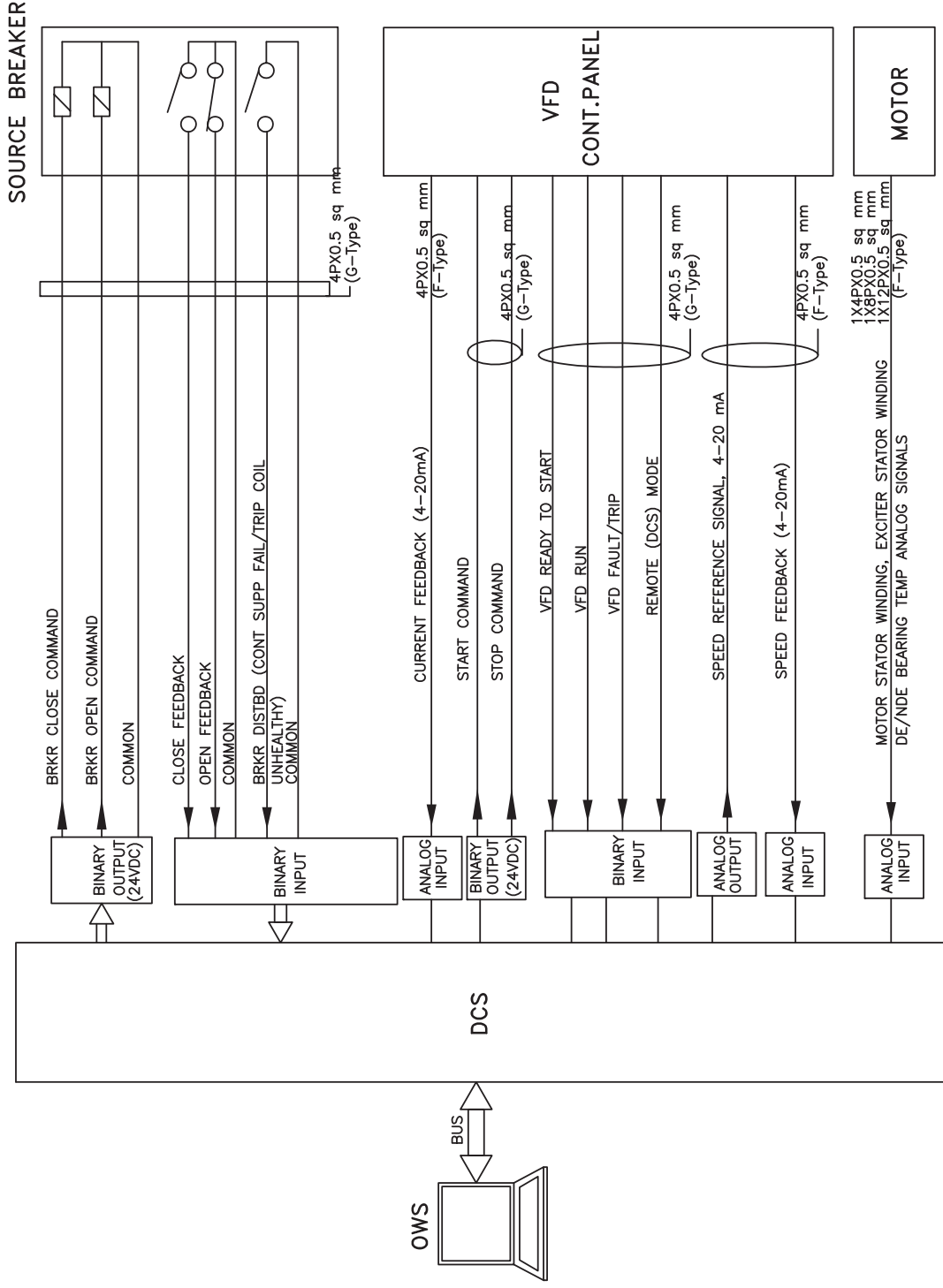
	UP RAJYA VIDYUT UTPADAN NIGAM LTD		DRG.NO. 9982-001-PE-405-PVI-B-152
	1 X 660 MW PANKI TPS		DATE 11.02.2019
	DDCMIS INTERFACE WITH HTCHP		REV.NO. 01
			SHT 34 OF 34

INTERFACE SP FOR DC JOP, EOP & DC SOP MOTOR



	UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO. 9962-001-PE-405-PVI-B-152
			DATE 11.02.2019
	FDR TYPE: SP FOR DC JOP, EOP & DC SOP MOTOR		REV.NO. 01
			SHT 34a OF 34

DCS INTERFACE FOR VFD CONTROL DRIVE



UP RAJYA VIDYUT UTPADAN NIGAM LTD 1 X 660 MW PANKI TPS		DRG.NO.	9962-001-PE-405-PV-B-152
		DATE	11.02.2019
DDCMIS INTERFACE FOR CEP VFD		REV.NO.	01
		SHT	34b

	ANNEXURE- WRITE UP FOR DRIVE CONTROL PHILOSOPHY (STATION C&I)	DOCUMENT NUMBER	PE-DM-426-145-I002		
		REVISION NUMBER	01	DATE	11.02.19
	PROJECT: 1 X 660 MW PANKI TPS				

A. DRIVE CONTROL PHILOSOPHY

The control philosophy for different type of Drives is detailed below:

1 Bi-directional drives with Integral Starter(Open/Close duty and inching/regulating duty)

- a) All bi-directional drives shall have integral starter. These drives shall be operable from Remote i.e. from Central Control Room (CCR).
- b) Remote manual operation of all drives shall be done from Operator Works Station (OWS).
- c) Remote control commands i.e. open/close generated from DCS shall be issued to Integral Starter through interposing relays, mounted in Integral Starter. For open/close duty bi-directional drives, DCS output command shall be latched in DCS, except for inching duty bi-directional drives where latching is not required.
- d) Necessary electrical protections shall be realized at Integral Starter, whereas process interlocks and protection shall be realized in DCS.
- e) Following signal exchange shall take place between Integral Starter & DCS.
 - open & close command
 - Integral Starter Disturbed (Loss of power supply/Loss of control supply/ Motor thermostat trip/ Thermal O/L / Torque open/close cut off/ Local/off/Remote S/S in Local or Off mode/Stop PB optd).
 - Valve status feedback by means of limit switches (open/close).
 - Valve position feedback (4-20mA) for inching duty drives.

2 Unidirectional LT Drives (Contactor Operated)

- a. Unidirectional LT drives shall be operable from Remote i.e. from Central Control Room (CCR). Drives shall be provided with Local Emergency Stop Push Button (**EPB**).
- b. Remote manual operation of all drives shall be done from OWS.
- c. Remote control commands i.e. start/stop, shall be generated from DCS and shall be issued to MCC through interposing relays located in respective MCC.DCS output command shall be latched in MCC. EPB (stay put type), in MCC supplier's scope, shall be wired directly to MCC. The EPB shall be provided with press to lock and turn to release type, keyless mechanism.

	ANNEXURE- WRITE UP FOR DRIVE CONTROL PHILOSOPHY (STATION C&I)	DOCUMENT NUMBER	PE-DM-426-145-I002		
		REVISION NUMBER	01	DATE	11.02.19
	PROJECT: 1 X 660 MW PANKI TPS				

- d. Necessary electrical protections for the drives shall be realised at MCC, whereas process interlocks and protections shall be realised in DCS.
- e. Following signal exchange shall take place between MCC & DCS
 - i. Drive Start & Stop commands.
 - ii. Drive ON & OFF feedback.
 - iii. MCC disturbed (Thermal O/L /Control supply fail/ EPB operated/ MCC switched off).
- f. Current transducers, 4-20mA types (in MCC suppliers scope), shall be mounted in the MCC for monitoring the current in DCS for all drives $\geq$ 30 KW and for important drives <30 KW. Auxiliary power supply to these transducers shall be provided from the control power supply of the respective MCC.

3 Solenoid Operated Drives

- a. Solenoid operated drives shall be operable from remote i.e. CCR only.
- b. Remote manual operation of all drives shall be done from OWS.
- c. Remote control commands i.e. open/close shall be generated from DCS and shall be issued to the respective solenoid through interposing relays located in Interposing Relay panels.
- d. Necessary process interlocks shall be realized in DCS.
- e. Following signal exchange shall take place between solenoid operated drive & DCS
 - i. Valve open & close command.
 - ii. Valve status feedback by means of limit switches (open/close), wherever available.

	ANNEXURE- WRITE UP FOR DRIVE CONTROL PHILOSOPHY (STATION C&I)	DOCUMENT NUMBER	PE-DM-426-145-I002		
		REVISION NUMBER	01	DATE	11.02.19
	PROJECT: 1 X 660 MW PANKI TPS				

4 **HT/LT Unidirectional Drives (Breaker operated).**

- a. Remote manual operation of Breaker operated drives shall be normally from remote i.e. Station DCS in main Control Room through OWS.
- b. Remote/Switchgear (SWGR) selection shall be realized from SWGR mounted R/S selector switch.
- c. Following are the operational combinations for breaker operated drives:

-SERVICE POSITION – Drive Operation (Start/Stop) shall be from CCR with R/S (Remote/SWGR) selector switch in Remote position.

-TEST POSITION – SWGR Testing (Start/Stop) from SWGR/CCR.

Switchgear mounted 'Trip/Neutral/Close' switch shall be provided for testing of switchgear when 'R/S' selector switch is selected as 'SWGR'.

- d. Remote control commands i.e. start/stop, pulse type, shall be generated from DCS and shall be issued to Switchgear through interposing relays located in respective Switchgear.
- e. The EPB shall be wired directly to switchgear. The EPB (stay put type), in SWGR supplier's scope, shall be provided with press to lock and turn to release type, keyless mechanism. Under its locked position, the drive operation shall be inhibited.
- f. Necessary electrical protections for the drive shall be realised at Switchgear, whereas process interlocks and protections are realised in DCS.
- g. Following signal exchange shall take place between SWGR and DCS:
 - i. Drive Start & Stop commands.
 - ii. Drive ON & OFF status feedback.
 - iii. Master Trip Relay (86 Relay) operated.
 - iv. Emergency Stop PB operated.
- h. Current transducers (for FD fan, PA fan, ID fan, Mill Motors, MDBFP, CEP & ECW pumps only), 4-20mA types (in SWGR suppliers scope), shall be mounted in the SWGR for monitoring the current in DCS. Auxiliary power supply to these transducers shall be provided from the control power supply of the respective switchgear.
- i. Multifunction relay shall be provided in SWGR which will be connected to DCS through serial link via Data concentrator for transmission of soft signals to DCS including over load alarm, relay fault, motor current, SWGR disturbed(control supply failed or trip coil unhealthy), SWGR available (Selector switch in remote, Breaker spring charged, SWGR is service position).

B. SEQUENCE CONTROL PHILOSOPHY

	ANNEXURE- WRITE UP FOR DRIVE CONTROL PHILOSOPHY (STATION C&I)	DOCUMENT NUMBER	PE-DM-426-145-I002		
		REVISION NUMBER	01	DATE	11.02.19
	PROJECT: 1 X 660 MW PANKI TPS				

1.0 Sequence control is envisaged for startup and shutdown of main drives and their associated drives from OWS. The drives can be operated manually or automatically through group/sub-group control and through process interlocks.

1.1 Sequence Mode Operation

Sequence controls are organized hierarchically in accordance with the operation concept of the plant process. Accordingly following levels of sequence control exists.

- Functional group control
- Sub group control

Functional Group Control logic co-ordinates between functionally cascaded lower level sequence control logics. It performs following functions

- Mode of operation
- Sequential start/stop of sub group.

Sub Group Control performs sequence control strategies on main drive and related drives as required by the process and taking care of the healthiness of each drive e.g. BFP along with its recirculation valve, discharge valve and AOP in a sequence, will form sequence control logic for BFP.

1.2 Sequence Start Up Mode

- 1) **Automatic mode:** - In this mode of operation, once the sequence is initiated, it shall progress without involvement of the operator.
- 2) **Semi-automatic mode:** - In this mode of operation, once the sequence is initialized, the step progressing shall be displayed on the OWS. But the step execution command shall be interlocked and shall be sent by the operator via keyboard. It shall be possible to bypass and/or simulate one or more criteria to enable the program to proceed. This facility shall allow the program to be executed even if some criteria are not fulfilled. It shall be possible to put the system on the auto mode after operating it on semi-auto mode for some steps or vice-versa, without disturbance to the sequence operation.

	ANNEXURE- WRITE UP FOR DRIVE CONTROL PHILOSOPHY (STATION C&I)	DOCUMENT NUMBER	PE-DM-426-145-I002		
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- 3) **Operator test mode:** It shall be possible to use the sequential control in operator guide mode / test mode i.e. the complete system runs and receives input from the plant OWS but its command output is blocked. The whole program, in this case shall run in manual mode. This mode shall allow to practice manual operation using step and criteria indications. The actual protection shall remain valid during this mode of operation also.

C. ANALOG CONTROL & MEASUREMENT PHILOSOPHY

1) Analog Drives Control

- 1.1 A drive control function residing in controller is used to position the pneumatically/electrically operated control valves. Interlock and protection Open/Close Commands, originating from field or generated internally in Control Logics (ACS), are interfaced with the drive control function residing in controller.
- 1.2 Control Valve actuator design shall take care of fail safe condition i.e. bringing valve to full open/full close or stay put mode, on signal (pneumatic/electric) failure.
- 1.3 Auto/Manual operator control and display for various control loops shall be provided through OWS, using Analog Displays.
- 1.4 Analog Displays have following functionality:
 - Auto/Manual selection with control device “Raise/Lower Buttons”
 - Set point indication with “Raise/Lower Buttons”
 - Indication for deviation between set point and measured value
 - Measured value indication
 - Final control element portion indicators

INSTRUMENTS SPECIFICATION

CHAPTER-2: FIELD AND MEASURING INSTRUMENTS

2.00.00 MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

- 2.00.01 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. Refer Sub-section/chapter 1, Vol. V, Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Owner's approval.
- 2.00.02 Every panel-mounted instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
- 2.00.03 All transmitters, sensors, and switches, Gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price. The Bidder shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Owner during detailed engineering.
- 2.00.04 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. 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./sq.cm.
- 2.00.05 For corrosive applications, all instruments applications, they shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if proven ness experience of the proposed material for such applications is established by bidder).
- All instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.
- 2.00.06 All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC article 500, class 1/2, Division 1 area & Flame proof area) and an anti corrosive paint shall be applied to the field mounted enclosures / instruments.



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In general, double cable entry shall be provided, wherever available, unused cable entry shall be provided with blind metal plug. All the field instruments shall also be provided with SS tag nameplate. Counter and mating flange (SS316 material), fastener, gaskets, Nuts, bolts etc. shall also be included wherever required with the field instruments.

- 2.00.07 In general, front draw out type instruments with plug-in facility at the rear for connecting cables for power supply and signal shall be provided unless otherwise specified like for Explosion proof area, Flame proof area and high vibration prone area. Separate plugs & socket connection shall be provided for connecting power supply cables and signal cables.

The plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections.

Signal and Electrical connection shall be screwed connection with double compression type Nickel-plated brass/SS316 cable glands (Material as decided by owner) for Explosion proof area, Flame proof area and high vibration prone area.

- 2.00.08 The quantity of secondary instruments etc. to be provided by Bidder shall be adequate to meet the requirements of Technical Specifications. Any other additional quantity of secondary instruments envisaged by Bidder as per system and process requirements shall also be supplied without any cost implication.

2.01.00 SPECIFICATION FOR ELECTRONIC TRANSMITTERS

2.01.01 SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF. PRESSURE AND DP BASED FLOW, LEVEL MEASUREMENTS

Sl. No.	Features	Essential/Minimum Requirements
1	Type of Transmitter	Microprocessor based 2 wire type, Hart protocol compatible
2	Accuracy	± 0.1% of calibrated span (minimum) (upto turn down ratio of 10:1).
3	Output signal range	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)
4	Turn down ratio	10:1 for vacuum/very low pressure applications. 5:1 for very high pressure application. 30:1 for other applications.
5	Stability	± 0.1% of calibrated span for six months for Ranges up to and including 70Kg/cm ² . ± 0.25% of calibrated span for six months for Ranges more than 70Kg/cm ² .
6	Zero and span drift	+/- 0.015% per deg.C at max span.



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		+/- 0.011% per deg.C at min. span.
7	Load impedance	500 ohm (min.)
8	Housing	Weather proof as per IP-65 with durable corrosion resistant coating.
9	Over Pressure	150% of max. Operating pressure.
10	Connection (Electrical)	Plug and socket type
11	Process connection	1/2 inch NPT (F)
12	Span and Zero	Continuous, tamper proof, Remote as well as adjustability manual from instrument with zero suppression and elevation facility
13	Material	Die cast Aluminum with epoxy coating/SS316 for body. SS316 for Diaphragm.
14	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. - LCD/TFT digital integral Indicators with scale of Engg. Units. -2 valve SS316 manifold for absolute & Gauge pressure transmitters, 3-valve SS316 manifold for vacuum pressure transmitters & where DP transmitters are being used for pressure measurement and 5 valve SS316 manifold for DP/Level/Flow applicable. Transmitters should not be mounted directly on the manifold; Manifold shall be non integral type only. - Snubbers/Pulsation dampners shall be used where the process media is unstable for measurement such as the discharge of a pump. -For hazardous area, explosions proof enclosure as described in NEC article 500.
15	Diagnostics	Self Indicating feature
16	Power supply	24V DC $\pm$ 10%.
17	Adjustment/calibration From hand held calibrator/centralized OWS based system n/maintenance (as applicable).	From hand held calibrator/centralized OWS based system



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Notes

For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement.

LVDT type is not acceptable.

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.

2.02.00 Specification for Pressure Gauge, D.P Gauge, Temperature Gauge and Level Gauge

s. no.	Features	Essential minimum requirements		
		Pr. Gauge/DP Gauge/Draught gauges	Temperature gauge	Level Gauge
1	Sensing Element and Material	Bourdon for high pressure, Diaphragm/ Bellow for Low pr. Of SS 316	Mercury in Steel/Bimetallic type for below 450°C and inert gas actuated for above 450°C of SS bulb and capillary	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Body Material	Die Cast Aluminum with stoved enamel black finish /SS316	Die Cast Aluminum with stoved enamel black finish /SS316	Forged carbon steel/SS 304
3	Dial Size	150 mm with toughened shatter proof glass	150 mm with toughened shatter proof glass	Tubular covering entire range
4	End Connection	½ inch NPT (M)	¾" NPT (M)	Process connection as per ASME PTC and drain/vent 15 NB
5	Accuracy	+/- 1% span	+/- 1% span	+/- 2%
6	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
7	Range Selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale



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8	Over range test	Test pr. For the assembly shall be 1.5 to the max. Design pr. At 38°C		
9	Housing	Weather and dust proof as per IP-65	Weather and dust proof as per IP-65	CS/304 SS leak proof.
10	Zero/span Adjustment	Provided	Provided	-
11	Identification	Engraved with service legend or laminated phenolic name plate		
12	Accessories	Blow out Disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS316 Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of steel/SS as per CS/ alloy process requirement.
13	Material of Bourdon/ movement	SS 316	SS 316	

Notes – *Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.

Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.

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 inert liquid suitable for the application.

2.03.00 GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER

Guided wave radar type level transmitters shall be provided for level measurements of the vessel under vacuum or low pressure applications as specified in Part-A.	
Type	Guided wave Radar
Principle	TDR (Time domain reflectrometry)
Probe Type & Material	Coaxial, SS316/316L. If required, probe shall be suitable for overfill prevention.
Connection type and material	Flanged and SS316/316L.
Signal o/p	4-20mA with HART signal suitable for overfill prevention.
Display	Integral
Power supply	24 VDC



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Accuracy	5mm
Electromagnetic compatibility	Shall meet EN 61326-1 (1997) and AmdtA1, class A equipment/EN 50081-2 & EN 50082-2
Housing material	Die cast Aluminum/SS316.
Vent & Drain Plug material	SS 316
Local Display	LCD digital type, configured in engg. Units.
Accessories	Integral cable between sensor and transmitter unit with connectors on both side, gasket and cable gland, digital panel meter, name plate and metal tag. All material of accessories will be SS 316.
Mounting	External cage mounting
The transmitters shall be provided with IP-65 protection class with durable corrosion resistant coating. The transmitters shall be able to provide digital signals super imposed on 4-20 mA signal as per HART protocol.	

2.04.00 Ultrasonic Type level Transmitter

Sl.No.	Features	Essential/Minimum requirement
1.	Type of Transmitter	Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter. Also refer note-3.
2.	Output signal	4-20mA DC (Analog) along with superimposed digital signal (based on HART protocol)
3.	Sensor Accuracy	+/- 0.5% of calibrated span.
4.	Sensor Repeatability	3mm or better
5.	Power supply	24 V DC +/-10%
6.	Temperature compensation	To be provided within transducer
7.	Configuration	
8.	Housing	Weather proof as per IP-65 with durable corrosion resistant coating.
9.	Adjustment/Calibration/maintenance	From hand held calibrators/ centralized OWS HART based system (as applicable)
10.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It shall be possible to calibrate the instrument without any level in the tank/sump etc.



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11.	Sensor Material	Corrosion resistant material to suit individual application requirement.
12.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry
13.	Range	Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc.
14.	Display	LCD display with integral keypad to be provided.
15.	Diagnostics	Loss of echo alarm etc.
16.	Load Impedance	500 ohms minimum.
17.	Electrical Connection	Plug and socket.
18.	Accessories	- All weather canopy for protection from direct sunlight and direct rain. - All mounting hardware and accessories required for erection and commissioning mounting fittings materials shall be SS 316. For hazardous area, explosion proof enclosure as described in NEC article 500.
Note:- 1) Bidder can also provide Radar type transmitter in place of ultrasonic transmitters subject to approval by Owner during detailed Engineering. 2) The frequency used for Ultrasonic /sonic measurements shall be suitable for envisaged applications and this shall be supported by the standard product catalogue of the instrument manufacture. 3) Four wire type transmitters can also be provided subject to Owner's approval during detailed engineering stage. However, in such cases isolated 4-20mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 24V DC for main plant and CW system applications. Power supply can be 240V AC (UPS) / 24V DC for other application.		



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	4) Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided by owner during detailed engineering. Separate Sensor unit & electronics unit with LCD display to be provided for the applications, which will be decided during detailed engineering by owner.
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2.05.00**HART Hand Held calibrator**

Hand held calibrator shall be provided for adjustment/calibration/maintenance of the HART compatible transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided.

HART hand held calibrator shall be provided with following minimum accessories per set:-

- i. Soft carrying case with adjustable shoulder straps & lead compartments.
- ii. HART lead set.
- iii. Rechargeable batteries.
- iv. Battery charger.
- v. Power adaptor.
- vi. Universal plug kit for power adaptor.
- vii. Load resistor.
- viii. Interfacing cables of each type as per requirements.
- ix. Protective boot.
- x. Standard banana jack.
- xi. Operation manual & software CD.

The quantity of HART hand held calibrator to be provided by Bidder is listed in Appendix- I to Vol.V, Table IV, Part A of Technical Specifications.

2.06.00**Temperature Elements and accessories****2.06.01****Thermocouples**

S.No.	Features	Essential/Minimum Requirements
1.	Type of Thermocouple	16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type S/R) depending on operating temperature Range (ungrounded type).
2.	No. of element	Duplex
3.	Housing/Head	IP-65/Die cast Aluminum. Head of TE to be provided with sufficient space and arrangement to head



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		mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection.
4.	Sheathing of Thermocouple	Swaged type magnesium oxide insulation
5.	Calibration and accuracy	As per IEC-751/ANSI-C-96.1(special class) for T/C
6.	Characteristic	Linear with respect to temp, within $\pm 1/2$ percent of top range value
7.	Accessories	Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.
8.	Standard	ANSI C 96.1 for Thermocouple and ASME PTC-19.3 (latest edition) for Thermo-well.
9.	Sheath Material/ Insulation	316SS/Compacted Magnesium Oxide.
	Sheath O D	8 mm.
10.	Response Time	6-10 Sec bare & 30 Sec. With protective sheath/thermowell
11.	Instrument Connection	1/2 " NPT (F).
12.	Electrical connection	Gold plated Plug in type. Double entry, one unused entry with blind plug.
13.	Enclosure Class	IP-65 or better.
14.	Process Connection	i) M33 x 2 ii) Flanged for Air & Gas systems with mating flanges, fastner, gasket etc.
15.	Extension	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
16.	Extension neck length	Minimum 100 mm above Insulation of pipe and Minimum 160 mm when there is no insulation on pipe.

Notes

1. Extension cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of mill or due to coal burning. Hence The terminals of temperature sensors shall not be at the top of mills



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itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

2. Thermocouples provided for steam services like super heater / de super heater area, where the process pipe is inside the insulation of boiler penthouse, Thermowells are inaccessible and terminal head and connecting cable cannot withstand high temperature, for such services thermocouples shall be provided with flexible extension SS316 Sheath of 10-15 meters.
3. The specification for thermocouples of bearings metal and winding temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.

2.06.02 Resistance Temperature Detector (RTD)

S.No.	Features	Essential/Minimum Requirements
1.	Type of RTD	Four /Three wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
2.	No. of element	Duplex
3.	Housing/Head	IP-65/Diecast Aluminum. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection.
4.	Sheathing of RTD	Metal sheathed, ceramic packed
5.	Calibration and accuracy	As per DIN-43760/IEC 60751 Class-A for RTD
6.	Characteristic	Linear with respect to temp, within $\pm 1/2$ percent of top range value.
7.	Accessories	Thermo well (as specified below) and shall be spring loaded for positive contacts with the well
8.	Standard	DIN-43760/IEC 60751 for RTD and ASME PTC-19.3 (latest edition) for Thermo-well.
9.	Sheath Material/ Insulation	316SS/Compacted Magnesium Oxide.



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	Sheath O D	8 mm.
	Gauge	18 SWG
10.	Response Time	6-10 Sec bare & 30 Sec. With protective sheath/thermowell
11.	Instrument Connection	1/2 " NPT (F).
12.	Electrical connection	Gold plated Plug in type. Double entry, one unused entry with blind plug.
13.	Enclosure Class	IP-65 or better.
14.	Process Connection	i) M33 x 2 ii) Flanged for Air & Gas systems with mating flanges, fastner, gasket etc.
15.	Extension	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
16.	Extension neck length	Minimum 100 mm above Insulation of pipe and Minimum 160 mm when there is no insulation on pipe.

NOTES:

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

2.06.03 Metal Temperature Thermocouples

S.No.	Features	Essential/Minimum Requirements
1.	Measuring Medium	Metal Temperature
2.	Material of Thermocouple	Chromel Alumel Type K
3.	Type of Thermocouple	Duplex with separate hot junctions, ungrounded Insulation Mineral Insulation Magnesium Oxide.
4.	Thermocouple wire gauge	16 AWG
5.	Protective sheath	SS 321
6.	Protective sheath dia	8 mm O.D
7.	Characteristics of Thermocouple	Special limits of error as in ANSI thermocouple MC 96.01, 1975
8.	Mounting accessories	1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310



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		or as per OEM design
9.	Cold end sealing	SS pot weal with colour coded PTFE headed sleeve Insulated flexible tails. Sealing compound- Epoxy resin
10.	Minimum bending radius	30 mm
11.	Length of T/C	30 Mtr. (minimum)

Notes:

- 1) The specification for thermocouples of bearings metal and winding temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.
- 2) For boiler metal temperature applications considering the location of installation and response time, manufacturers standard and proven specification for metal temperature measurement can also be a accepted subject to OWNER approval. The manufactures shall submit adequate supporting documents for establishing their standard and proven practice.

2.06.04 Thermo well (for all process temp. elements) - (As per ASME PTC 19.3, latest edition)

- a. Shall be one piece solid bored type of 316 SS/F11/F22/F91 of step-less tapered design for water and steam Services depending upon process parameters.
- b. For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.
- c. For Air & Flue gas 316 SS protecting tube with welded cap. (However bidder shall provide better material for Flue gas service if required based on the specified boiler design parameters).
- d. For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.
- e. Bidder shall provide calculation for thermowell as per ASME – PTC-19.3 (latest edition).

"All Thermowells in high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safer size and design of Thermowells".

2.06.04 Void

2.06.05 TEST THERMOWELLS (TW)



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Applicable Standard	:	ASME PTC 19.3 TW - 2010
Type/Construction	:	Machined from Bar Stock
Material	:	316 SS/F11/F22/F91
Connection		
- Pipe	:	M33 x 2
- Test Instrument	:	To suit test instruments
Accessories	:	Plug with SS chain
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations Bidder shall provide calculation for thermowell as per ASME – PTC- 19.3 TW - 2010.

Test wells shall be provided on main steam, reheat steam, extraction steam, feed water, condensate, spray water lines and other piping as required to meet ASME test requirements.

2.07.00 TEMPERATURE TRANSMITTER

Following types of 2-wire temperature transmitter (directly powered from 4-20mA input cards of DDCMIS/PLC) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the bidder as well as Owner. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.

a. Single Input Head mounted Temperature Transmitter

These shall be suitable for mounting in the head of temperature element itself. The protection class of head of thermo well along with its plug-in connector shall be min. IP65.

b. Single Input DIN-rail mounted Temperature Transmitter

These shall be suitable for mounting on DIN-rails in JB's. The specifications of the JB's shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail.

Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.

c. Dual-input Temperature Transmitter with Indicator:



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These shall be suitable for mounting on pipes/ support. Indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails. This change-over is to be alarmed. Protection class shall be IP65 minimum.

The exact applications for which this type of transmitter is to be provided shall be finalized by owner during detailed engineering.

- d. Common requirements for each of the above type of temperature transmitters.
- | | | |
|-------------------------------|---|---|
| Output | : | 2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal. |
| Input | : | Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K&R types (input type to be selectable at site through HART terminal) |
| Isolation | : | Min. 500 V AC |
| EMC compatibility | : | as per EN 61326 |
| Operating ambient temperature | : | 0 to 85 deg C (without indicator)
0 to 70 deg C (with indicator) |
| Power supply | : | Compatible with input module of Control System |
| Accessories | : | Mounting arrangements including Clamps etc. |
| Composite Accuracy | : | (a) For head mounted and DIN-rail mounted type Refer note-2
RTD = <0.4% of 0-250 deg C span
T/C-K type = <0.4% of 0-600 deg C span
T/C-R type = <0.4% of 0-1000 deg C span

(b) For dual-input type:
RTD = <0.25% of 0-250 deg C span
T/C-K type = <0.2% of 0-600 deg C span |

- e. Field bus compatible temperature transmitters
- Temperature transmitters of this category shall be field mounting type & shall be capable of withstanding operating ambient temperature upto 85 deg C. These modules shall be connected to DDCMIS through field bus such as Profibus, Foundation Field bus etc directly from the transmitter. Maximum Number of inputs per such temperature transmitter shall be eight. These shall be mounted in cabinets in non-AC areas.



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As an alternate, these signals from temperature transmitters can be connected to DDCMIS through standard remote I/O modules of the DCS, in which case, the temperature transmitter signals will be acquired through 4-20mA input modules in the remote I/O cabinet for connecting to DDCMIS through remote I/O bus.

Notes (Common for a to e above):-

1. In case of failure (open or burn-out) of RTD/thermocouple, temp. Transmitter shall provide low temperature output.
2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures.

2.08.00 IMPACT HEAD TYPE FLOW ELEMENT

The impact head type element shall be tubular insert type with four impact ports facing upstream direction, located precisely for determination of average flow velocity and shall be of SS 316 L.

Accuracy shall be 1.0% of actual value or better. Repeatability shall be $\pm 0.1\%$ of actual value or better.

The elements shall be supplied complete with mounting hardware; end support plugs and SS316 valve manifold (1/2" NPT connection) for instrument connections. All pertinent data including Owner's instrument tag no. for the flow element shall be punched on a stainless steel plate and affixed to the element.

Flushing arrangement shall be provided.

Dual path transit time clamp-on Ultrasonic Flow meter may also be used for measurement of CW flow.



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2.11.00 Instrument Air System

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

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

On collection of water in the drains of instrument air lines, mechanical automatic drains and periodically solenoid operated drains (with electronic timer - 15m, 30m, 60m and 2 Hours & Timing adjustable) are to be provided.

For mechanical type & Electrical type, the locations to be provided in the instrument air lines of boiler area, Chimney area, turbine area etc., shall be decided during detailed Engineering.

2.11.01 Air Filter Regulator (AFR)

Constant bleed type AFR with an accuracy of ± 1.0 % inlet pressure range of 5-8 kg/ cm² and suitable spring ranges (AFR) for use with positioners in control valves, control damper, E/P convertors and shut off valves with phosphor bronze sintered filter element; Filtering particles above five microns. Weather and water proof enclosure. Built in blow down valve shall be provided. AFR shall have automatic drain feature. Material of accessories will be SS316. Body material of Air Filter regulator shall be Die Cast Aluminum or SS316. Degree of protection shall be IP 65.

Air filter regulators shall be provided in the :

- (a) Air supply line to valve positioners / power cylinders.
- (b) Air supply line to electric to pneumatic converters.



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- (c) Air supply line to pneumatic interlocked block valves.
- (d) For each instrument rack, field instruments enclosure for purging.

2.11.02 E-P CONVERTER

E-P converters and associated accessories shall be furnished in accordance with the specifications given below:

Air supply: 1.5 kg/cm sq., Input signal: 4-20mA dc (as required by the design of control system), Output signal: 0.2 to 1.0 kg/cm sq., Linearity: 0.5% of span or better, Hysteresis: 0.5% of span or better, Ambient Temperature Effect: less than 0.02% of span per deg C between -20 to +60 deg C. Mounting: Close to actuator (but not on the actuator), output capacity-to suit the actuator, protection class IP 65. On loss of control signal, the last set point pressure shall be maintained so that the associated control valve remains in stay put condition without any additional solenoid valve. The allowable drift rate will be +2% of set point/ hour maximum. Material of accessories will be SS. E/P converters shall have fail freeze (stay put) feature also. Zero/span adjustment facility shall be provided.

2.12.00 SPECIFICATION FOR FLOW ELEMENTS & FLOW METERS

2.12.01 Orifice Plate

Sr No.	Features	Essential/Minimum Requirements
1	Features	Essential/Minimum Requirements
2	Type	Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042, ISO 5167
3	Material	316 SS
4	Thickness	3 mm for main pipe diameter up to 300 mm and 6 mm for main pipe dia above 300 mm.
5	Material of branch pipe	Same as main pipe
6	Root valve type	Globe
7	Root valve material	316 SS
8	Root valve size	1 / 2 inch or 1 inch (as applicable)
9	Impulse pipe of same material up to root valve	Required
10	Tapping	Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable). Root valves to be provided in all the tappings.
11	Beta Ratio	0.34 to 0.7
12	Beta Ratio	Yes



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	calculation to be submitted	
13	Assembly drg. and flow Vs DP Curves	Yes
14	Accessories	Root valves, flanges, Vent/drain hole (As required)
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. One Flow element of each type shall be calibrated in the test laboratory for validation of commutated flow calculations		

2.12.02 Flow Nozzle

Sr No.	Features	Essential/Minimum Requirements
1.	Type	Long radius, welded type as per ASME PTC- 19.5 (Part-III) or BS-1042
2	Material	316 SS
3	Thickness	Suitable for intended application.
4	Material of branch pipe	Same as main pipe
5	Root valve type	Globe
6	Root valve material	316 SS
7	Root valve size	1 inch
8	Impulse pipe of same material up to root valve	Required
9	Tappings	Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable).
10	Beta Ratio	Around 0.7
11	Beta Ratio calculation to be submitted	Yes
12	Assembly drg. and flow Vs DP Curves	Yes
13	Accessories	Root valves, vent and drain hole.
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. One Flow element of each type shall be calibrated in the test laboratory for validation of commutated flow calculations		

2.12.03 ROTAMETERS

Sr No.	Features	Essential/Minimum Requirements
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1	Type	Variable Area Metal Tube
2	Fluid media	Water/oil
3	Tube body	SS316
4	Material of float	316 SS
5	Indicator	Linear scale
6	Accessories	Flange, orifice in case of bypass Rota meter (for line size above 100 mm)
7	Housing protection class	IP-65
8	Accuracy	$\pm 2\%$ of measured value

2.12.04 POSITIVE DISPLACEMENT TYPE FLOW TRANSMITTERS

The meter shall be a volumetric meter type consisting of two meshing oval wheels driven by the fluid. Each revolution of the oval wheels shall displace a precisely known volume of the fluid from inlet to outlet. The housing/measuring chamber and oval wheels shall be of 316 SS. Air eliminators shall also be provided to ensure maximum accuracy.

The measurement accuracy of the transmitter shall be better than $\pm 0.2\%$.

The transmitter shall provide suitable 4-20mA dc output signal for control and indication/recording. Converters if necessary shall be provided to generate the 4-20mA signal.

A local indicator of fuel oil flow shall also be provided. The instrument shall be calibrated in Tons/hr.

Suitable strainer shall be provided before the transmitter for the protection of oval wheel meters against foreign matter contained in the fuel oil.

The exact model no. and type of material being used, etc., shall be subject to Owner's approval during detailed engineering without any price repercussion to Owner.



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2.12.06 Mass Flow meter**Sensor**

Measuring Principle	:	Coriolis Mass flow.
Primary Element	:	Flow Tube of 316SS or better
Heating Arrangement	:	Integral with Flow Meter.
Temperature Control	:	To be provided
For Heating		
Process Connection	:	ANSI RF Flanged and rating as per process requirement.
Drain	:	Self-draining facility
Accessories	:	Counter flanges, Mounting nuts, bolts, gaskets, liners etc.
Transmitter		
Measured quantities	:	Mass Flow rate, Total Mass Flow, Density, Temperature as minimum.
Input Signal Processing	:	Digital Processing.
Display	:	Digital Display (LCD).
Output	:	2 Nos. isolated output of 4-20mA DC HART selectable from four measured quantities.
Load	:	< 750 ohms.
Power supply	:	230V AC, 50 Hz. From UPS
Accuracy	:	0.15% of measured value for Liquid 0.5% of measured value for Gas
Repeatability	:	0.05%
Housing	:	IP 65/ (Explosion proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable).
Hazardous duty Version	:	FM Standards.
Nameplate	:	Tag number, service engraved in stainless steel tag plate



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Accessories	:	a)	As required for field mounting, Handheld configurator & complete Software, External zero adjustment facility
		b)	Mounting U-bolts, nuts, bolts, prefab cable etc.
Application	:		Fuel oil unloading & handling area, HFO main line, LDO main lines, HFO recirculation lines etc. after Day Oil Tanks in boiler area.

2.13.00 PROCESS ACTUATED SWITCHES

Sr No.	Features	Essential/Minimum Requirements		
		Pressure/Draft Switches/DP Switches	Temperature switches	Level switches
1	Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (10 m minimum)	Capacitance types for oil and dirty medium, water, condensate application. Float type for applications as



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				decided by owner during detailed engineering. Capacitance/Conductivity/Ultrasonic type for acid and alkali application. RF/ Ultrasonic type for ash hopper, ash slurry application. Detailed spec are also included below.
2	Material of sensing element & movement.	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS
3	End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard
4	Over range proof pressure	150% of max. design pr	-	150% of max. design pressure
5	Repeatability	± 0.5% of full range		
6	No. of contacts	2 Nos. +2NC. SPDT snap action dry contact. Auto reset with internal Adjustable snap action micro switch.		
7	Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS/PLC)		
8	Elect. Connection	Plug in socket		
9	Set point	Provided over full range. Differential shall be adjustable.		
10	Dead band adjustment	Adjustment upto 10% at set points.		
11	Enclosure	Die cast Aluminum with stoved enamel black finish/SS316, Weather and dust proof as per IP-65. Epoxy painting shall be provided for corrosive atmosphere.		
12	Accessories	Siphon, snubber, chemical, pulsation dampers as required by process.	Thermo well of 316 SS and packing glands	All mounting accessories
13	Mounting	Suitable for enclosure/rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-
14	Power Supply (wherever	24 V DC, to be arranged by Bidder except for Ash Level Switches, where the same shall be as per Bidder's Standard practice.		



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	Required)	
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Notes:-

- 1) 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.
- 2) Pressure / Diff Pressure switches for very low pressure / DP measurements can have sensor material other than SS316 e.g. silicon etc., if the offered material is suitable for that application and the offered product is standard product of the manufacturer for very low pressure applications.
- 3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.

2.13.01 Conductivity Type Level Switch

Type	:	Conductivity discrimination.
Mounting	:	Flanged – on standpipe.
Probe MOC	:	Stainless steel with high purity ceramic.
Probe rating	:	> Maximum design pressure of vessel.
Input	:	Four independent channel with selectable switching threshold for water conductivity.
Relay Output	:	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
Contact type & rating	:	2SPDT or 1 DPDT @ 5A 30V DC.
Faults Detection	:	Power Fail/Electrode Connection Open circuit/short circuit to ground, Ground failure. In built Fail Safe Logic.
Indicator	:	One Red LED for steam/ one Green LED for water/ Two no. LED one each for Process & system fault.
Power supply	:	Dual 230V AC, 50 Hz, 1Ph from UPS.



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Enclosure	:	Corrosion resistant & wall mounting type. IP-65 or better (Explosion proof For NEC Class-1/2, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable).
Accessories	:	i. PTFE cable from probe to electronics unit. Electronic unit shall be separate. Head mounted electronic unit is not preferred. ii. Mounting accessories iii. standpipe iv. Washer & gasket
Test pressure	:	Two times rated pressure

2.13.02 Capacitance Type Level Switch

Type	:	Capacitance type
Probe	:	a) Rod or suspended electrode b) Rope type probes may be used only where required probe length is greater than 3 meters.
Probe Mounting	:	Stainless steel 1-1/2 ANSI RF Flange / 3/4"
Material of construction	:	NPT (M) 316 SS
Insulation	:	PTFE Part/Full as per service.
Enclosure	:	Powder/Epoxy coated Die cast Aluminum. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1/2, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable).
Ambient temperature	:	0-60 °C.
Mounting	:	On Top
Supply voltage	:	230V AC, 50Hz from UPS / 24V DC
Relay output	:	2SPDT
Contact rating	:	5A min. at 240V AC on resistive load
Response time	:	100 m sec or better
Cable connection	:	Plug in type



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Accessories : Counter flange, Cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.

2.13.03 RF TYPE LEVEL SWITCH

A. Electronic Controller

- | | | | |
|----|---------------------|---|--|
| 1. | Input Supply | : | 230 V AC from UPS |
| 2. | Construction | : | Cast Aluminum Housing |
| 3. | Relay Output | : | 2 Nos. Relay Changeover Potential Free Contacts (2 SPDT) |
| 4. | Contact Rating | : | 5A at 240 V AC & 0.25 at 220 V DC |
| 5. | Class of Protection | : | IP-66 |
| 6. | Ambient Temperature | : | 55 Deg. C (Max) |
| 7. | Local Indication | : | Local LED Indications |
| | Green | : | Normal Level |
| | Red | : | Alarm Level |
| | Yellow | : | Probe Healthy |
| 8. | Cable Connection | : | 3/4" ET (2 Nos.) for Supply and Output
5/8" ET (1 No.) for Probe Connection |
| 9. | Repeatability | : | 100% |

B. Sensing Probe

- | | | | |
|----|--|---|---|
| 1. | Type of Probe | : | Rigid |
| 2. | Material | : | Stainless steel SS 316 |
| 3. | Probe Head Housing | : | Cast Aluminum |
| 4. | Insulation (B/W Active & Shield And Shield & Ground) | : | PTFE |
| 5. | Probe Head Protection | : | IP-66 |
| 6. | Mounting | : | Side Mounted |
| 7. | Cable Connection | : | 5/8" ET (1No.) |
| 8. | Process Connection | : | 40 NB BSP THREADED |
| C. | Signal Cable | : | Coaxial cable for Connection Between Sensing probe and electronic Controller (@ 10 Mtrs. Per Level Probe) |

D. Application : Silos

2.14.00 SOLENOID VALVES

Solenoid valves shall fulfill the following requirements:



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- a. Type 2/3/4 way with body material of SS 316/Forged Brass and epoxy painting (depending on the application subject to Owner's approval during detailed Engg.). Material of Wetted parts shall be SS316.
- b. Power supply 24 V DC + 10%.
- c. Plug and socket electrical connection.
- d. Insulation: Class 'H'.
- e. All solenoid shall be with, LED indication, surge suppression diode circuits.

2.15.00 Power Cylinders (Pneumatic)

Mounting Type	:	a) Fixed position mounting (End mounting).
	:	b) Trunnion mounting
Control Signal	:	0.2 to 1 Kg/Sq. cm. from I/P converter for modulating purposes. 24V/48VDC operated solenoid valve operating on pneumatic line. The Pilot solenoid will have separate coils for open closing purpose.
Supply Air	:	0-7 Kg / Cm ² .
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.
Casing	:	IP-65.
Accessories (as required)	:	a) Air lock relay b) Hand wheel. c) Air filter regulator with gauge. d) Volume Booster. e) Limit Switches. f) Positioner with Input, Output and supply pressure gauges. g) Pilot Solenoid Valve (Double Coil type) h) Position Transmitter (4-20 mA DC linear output, LVDT or non contact type).
Fail-safe operation	:	Stay put, open or close position on pneumatic / electrical power supply failure as per process safety criteria.
Repeatability	:	Better than 0.5% of full travel.



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UPS

2.16.08 FLOAT & BOARD TYPE LEVEL GAUGE

Type of Instrument	:	Mechanical Type (Float Operated)
Service/ Application	:	As per service requirement
Measuring Range	:	As per requirement
Material Specification		
a) Float Material	:	SS316 having 2 nos. Guide wires
b) Float Wire Pulley	:	Shall comprise of 2 nos. Cast Aluminum Pulley housing Assembly with SS 304 pulley and pulley shaft. Steel ball bearings shall be provided in pulley housing for easier float movement. Float wire material shall be SS316L. Between 2 pulleys, 1" NB G.I. short pipe.
c) Guide wire Assembly	:	CS chamber with spring and adjuster having 1" Class 150 ANSI RF MS flange. Guide wire rope shall be SS316L.
d) Counter Weight	:	MS counter – weight with Aluminum Pointer and Brass assembly Pull Chain.
e) Scale details	:	Aluminum/SS316 scale Graduated in mm with 1% accuracy of full scale range with arrow.
Nozzle Details	:	For float wire pulley assembly, one tapping and for guide wire assembly two tapping at the top of the tank; Size 1" NB (Top Mounting Type).
Process Connection	:	Flanged as per ANSI B 16.5 to suit 1" NB nozzle
		(Nozzle length - 150 mm for float wire, 100 mm for guide wire)
Accessories (to be supplied with the instrument)		
a) Counter flange	:	All mating Flanges, Nozzle
b) Mounting Accessories	:	All mounting accessories
c) Tag Plate	:	To be provided (material SS316)



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2.18.00 Limit switches

For offsite plant application Limit switches shall be gold plated with high conductivity and non corrosive type. Contact rating shall be sufficient to meet the requirement of DDCMIS subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP 65. Contact shall be either 1 no, DPDT or 2 nos. SPDT minimum.

For main plant application, limit switches are to be provided as per bidder standard and proven practice.

All limit switch shall be conform to IEC-60947-5-1.



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Applicable Standard	:	ASME PTC 19.3 TW - 2010
Type/Construction	:	Machined from Bar Stock
Material	:	316 SS/F11/F22/F91
Connection		
- Pipe	:	M33 x 2
- Test Instrument	:	To suit test instruments
Accessories	:	Plug with SS chain
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations Bidder shall provide calculation for thermowell as per ASME – PTC- 19.3 TW - 2010.

Test wells shall be provided on main steam, reheat steam, extraction steam, feed water, condensate, spray water lines and other piping as required to meet ASME test requirements.

2.07.00 TEMPERATURE TRANSMITTER

Following types of 2-wire temperature transmitter (directly powered from 4-20mA input cards of DDCMIS/PLC) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the bidder as well as Owner. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.

a. Single Input Head mounted Temperature Transmitter

These shall be suitable for mounting in the head of temperature element itself. The protection class of head of thermo well along with its plug-in connector shall be min. IP65.

b. Single Input DIN-rail mounted Temperature Transmitter

These shall be suitable for mounting on DIN-rails in JB's. The specifications of the JB's shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail.

Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.

c. Dual-input Temperature Transmitter with Indicator:



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These shall be suitable for mounting on pipes/ support. Indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails. This change-over is to be alarmed. Protection class shall be IP65 minimum.

The exact applications for which this type of transmitter is to be provided shall be finalized by owner during detailed engineering.

- d. Common requirements for each of the above type of temperature transmitters.
- | | | |
|-------------------------------|---|---|
| Output | : | 2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal. |
| Input | : | Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K&R types (input type to be selectable at site through HART terminal) |
| Isolation | : | Min. 500 V AC |
| EMC compatibility | : | as per EN 61326 |
| Operating ambient temperature | : | 0 to 85 deg C (without indicator)
0 to 70 deg C (with indicator) |
| Power supply | : | Compatible with input module of Control System |
| Accessories | : | Mounting arrangements including Clamps etc. |
| Composite Accuracy | : | (a) For head mounted and DIN-rail mounted type Refer note-2
RTD = <0.4% of 0-250 deg C span
T/C-K type = <0.4% of 0-600 deg C span
T/C-R type = <0.4% of 0-1000 deg C span

(b) For dual-input type:
RTD = <0.25% of 0-250 deg C span
T/C-K type = <0.2% of 0-600 deg C span |

- e. Field bus compatible temperature transmitters
Temperature transmitters of this category shall be field mounting type & shall be capable of withstanding operating ambient temperature upto 85 deg C. These modules shall be connected to DDCMIS through field bus such as Profibus, Foundation Field bus etc directly from the transmitter. **Maximum Number of inputs per such temperature transmitter shall be eight.** These shall be mounted in cabinets in non-AC areas.



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As an alternate, these signals from temperature transmitters can be connected to DDCMIS through standard remote I/O modules of the DCS, in which case, the temperature transmitter signals will be acquired through 4-20mA input modules in the remote I/O cabinet for connecting to DDCMIS through remote I/O bus.

Notes (Common for a to e above):-

1. In case of failure (open or burn-out) of RTD/thermocouple, temp. Transmitter shall provide low temperature output.
2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures.

2.08.00 IMPACT HEAD TYPE FLOW ELEMENT

The impact head type element shall be tubular insert type with four impact ports facing upstream direction, located precisely for determination of average flow velocity and shall be of SS 316 L.

Accuracy shall be 1.0% of actual value or better. Repeatability shall be $\pm 0.1\%$ of actual value or better.

The elements shall be supplied complete with mounting hardware; end support plugs and SS316 valve manifold (1/2" NPT connection) for instrument connections. All pertinent data including Owner's instrument tag no. for the flow element shall be punched on a stainless steel plate and affixed to the element.

Flushing arrangement shall be provided.

Dual path transit time clamp-on Ultrasonic Flow meter may also be used for measurement of CW flow.

2.09.00 FLUE GAS ANALYSER

The following flue Gas analyzers are envisaged:-

- i) Flue Gas analyzers for control and monitoring – quantities as indicated in Vol. V, Appendix I, Sr. no. G1, Part A.
- ii) Flue Gas Dust Emission analyzer for each ESP (at each Path) – quantities as indicated in Vol. V, Appendix I, Sr. no. G1, Part A.



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001





Technical specification for
CONTROL & INSTRUMENTATION
1X660MW PANKI TPS EXTN.

SECTION D

REV. NO. 00

DATE : 13.07.2018

CONTROL VALVE SPECIFICATION

CHAPTER –11: CONTROL VALVES WITH ACTUATORS**11.01.00 CONTROL VALVES, ACTUATORS & ACCESSORIES****11.01.00 General Requirements**

- 11.01.01 The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA" or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification.
- 11.01.02 All the control valves and accessories offered by the Bidder shall be from reputed, experienced manufacturers of specified type and range of valves.
- 11.01.03 For special type of control valves such as combined pressure and temperature control valves for Aux PRDS application, separator drain control valves, also refer to the corresponding mechanical sections.

Control valve station shall be provided at the interconnection line between service air header and instrument air header before air dryer unit. When instrument air header pressure falls below set value, the control valve will start opening and maintain the instrument header pressure at specified level in line with plant requirement. Again when instrument air header pressure goes above specified level in line with plant requirement the control valve will fully close automatically. Complete system shall be in bidder scope.

11.02.00 CONTROL VALVE SIZING & CONSTRUCTION

- 11.02.01 The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.
- 11.02.02 The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves trim exit outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Owner's approval during detailed engineering.
- 11.02.03 Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and downstream piping. Thus for cavitation/flashing service, only valve with anti cavitations trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished.



- 11.02.04 Control valves for application such as Feed water control valve, HP & LP by pass spray control valves, APRDS control valves, Soot blower control valve, separator drain control valve, SH Spray Control, RH spray Control, Heavy Oil Heating, pressurizing and Control system, HP/LP heater Emergency level control, Emergency Make-up to condenser hotwell, GSC minimum flow, Deaerator Drain to Condenser Hotwell, Condensate spill to condensate reserve tank, condenser normal make- up and valve gland sealing supplying pressure control, CEPs minimum flow control, BFP minimum circulation control valve shall have permissible leakage rate as per leakage Class V. All other control valves shall have leakage rate as per leakage Class-IV.
- 11.02.05 The control valve induced noise shall be limited to 85 dba at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.
- 11.02.06 The Liquid pressure recovery factor (FL) shall be 0.995 or better for severe flashing/cavitation services.
- 11.02.07 The Liquid pressure recovery factor (FL) shall be 0.985 or better for low flashing/cavitation services.
- 11.02.08 The valve travel time shall be less than 10 second for non critical services valves.
- 11.02.09 Rangeability should be 50 to 1 (min.) for non critical services valves.
- 11.02.10 Modulating Type Control Valve's Linearity, Hysteresis, Accuracy shall be < +1% and Sensitivity shall be < + 0.5%.
- 11.03.00 VALVE CONSTRUCTION**
- 11.03.01 All valves shall be of globe body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit.
- 11.03.02 Valves with high lift cage guided plugs & quick-change trims shall be supplied.
- 11.03.03 Cast Iron valves are not acceptable.
- 11.03.04 Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Owner. Bonnet joints of the internal threaded or union type will not be acceptable.
- 11.03.05 Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.
- 11.03.06 All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing)
- 11.03.07 Valve characteristic shall match with the process characteristics.
- 11.03.08 Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C.
- 11.03.09 Flanged valves shall be rated at no less than ANSI press class of 300 lbs.

11.04.00 VALVE MATERIALS

Sr.No.	Service	Body material	Trim Material
1	Non-corrosive, non-flashing, and non-cavitation service except DM water	Carbon steel ASTM-A216 Gr WCB for fluid temperature below 275 Deg. C Alloy steel ASTM-A217Gr. WC9 for fluid temperature above 275 Deg. C	316SS stellited with faced guide posts and bushings.
2	Severe flashing/cavitation services	Alloy steel ASTM-A217 Gr. WC9	440 C
3	Low flashing/cavitation services	Alloy steel ASTM-A217 Gr. WC6	17-4 PH SS
4	DM water services	SS 316	316 SS

NOTE Valve body rating shall meet the process pressure and temperature requirement as per ANSI B16.34.

However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Owner's consideration and approval.

11.05.00 END PREPARATION

Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalized during detailed engineering and as per Owner's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.

11.06.00 VALVE ACTUATORS

All control valves shall be furnished with pneumatic actuators except for pressure and temperature control valve for auxiliary PRDS application (Electro-hydraulic / pneumatically operated) and HP & LP bypass valves, separator drain control valve (Electro-hydraulic type). The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously.

Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the

selection of the actuator to ensure tight seating unless otherwise specified.

The travel time of the pneumatic actuators shall not exceed 10 seconds.

11.07.00 CONTROL VALVE ACCESSORY DEVICES

11.07.01 All pneumatic actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, microprocessor based electronic Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.

11.08.00 SPECIFICATIONS FOR MICROPROCESSOR BASED ELECTRONIC POSITIONER

1	Electrical	a) Input Demand Signal	4-20 mA
		b) Power Supply	Loop Powered from the output card of Control System.
		c) HART Protocol	Compatibility for Remote Calibration & Diagnostics (Super-imposed HART signal on input Signal (4-20 mA)
		d. Valve position sensing	Position sensing, 4-20 mA output signal to be provided for control system.
2	Environment	a) Operating temp.	(-)30 To 80 Deg. C
		b) Humidity	0-95 %
		c) Protection class	IP-65 Minimum with Die cast Aluminum/SS316 enclosure.
3	Software for Configuration and Diagnostics	Software	Windows based software. Software shall meet the requirements for Configuration, Diagnostics, Calibration and Testing of the actuator.
		Diagnostic/Test features	Advanced diagnostic features like Stroke counter or Travel counter, Leakage in actuators, Valve Signature analysis, Step Response test, Valve friction /Jamming detection etc. to be provided.

4	Test reports/ Certificates	Factory Valve Signature Tests Reports (Pressure versus Valve travel and Travel versus I/P signal) are to be provided.	
		Test certificates as per Manufacture Standard/Relevant Standard are to be submitted.	
5	Configurat ion/ Calibration	Remote & Local Calibration, Auto & Manual Calibration shall be possible.	
6	Operating Range	Full range/ Split range.	
7	Modes	Valve Action	Direct / Reverse Valve Action
		Flow Characterization	Possible to fit Valve Characteristic Curves- Linear , Equal percentage etc.
8	Fail Safe/Fail Freeze	Fail Safe/Fail Freeze feature is to be provided. (In case the fail freeze feature is not intrinsic to the positioner, Bidder shall achieve the same externally through solenoid valve connected in the pneumatic circuit).	
9	Pneumatic	Air capacity	Sufficient to handle the valves & actuators selected/ Boosters to be supplied, if required.
		Air pressure	To suit the air supply pressure/quality available.
		Process connection	1/4" NPT
10	Performance	Characteristic deviation	≤ 0.5 % of span.
		Ambient temp effect	≤ 0.01 %/ deg C or better.
11	EMC & CE compliance	Required to International Standard like EN/IEC.	EN50081-2 & EN 50082 or equivalent.

12	Accessories	In-built Operator Panel	Display with push buttons for configuration and display on the positioner itself (Password protected/Hardware lock).
		Hand Held Hart Calibrator	Universal Hart Calibrator to be provided (for quantity, refer Part-A Vol-V C&I :).
		Pressure Gauge Block & Position Indicators.	For supply & output pressures, Air Filter Regulator, integral type position transmitter, in built mechanical position indicator and other accessories shall be provided on as required basis for making system complete.
		Electrical Cable Entry	1/2" NPT, side or bottom entry to avoid water ingress.
		Valves Mounting Assembly	For Sliding Stem/Rotary/Single acting/Double acting actuators on as required basis.

*** Note:**

The HART signals shall be picked up from marshalling terminals of DDCMIS (SG/TG DDCMIS as well as BOP DDCMIS), as applicable. The details of the above mentioned HART management system specification are mentioned in HART system Vol-V, Part B, Chapter 3, DDCMIS, cl. no. 3.45.00

The positioners shall be monitored from this HART management system .To achieve this, Bidder shall provide the necessary software to achieve the functionalities described above under "Remote Configuration and Diagnostics", and this software shall be loaded in the HART management system.

11.09.00 FOR FOLLOWING CRITICAL APPLICATION SPECIAL CONTROL VALVES ARE REQUIRED:

1. HP & LP Bypass Valves and Control System
2. BFP – Minimum Re-circulation Valve
3. Feed Water Control Valve
4. SH & RH spray Control Valves
5. APRDS System
6. Soot Blower control valve
7. Separator Drain Control Valve.
8. Fuel oil heating and pressurizing
9. Minimum economizer flow control
10. DM make up (emergency / normal)

11. Control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control.
12. CEP minimum flow control

11.09.01 General Requirements for Critical Application Control Valves -

- i) The valve accessories shall include hand wheels, limit switches, smart valve positioner (4-20mA DC type), electro pneumatic converter, Air lock relay, Solenoid valve and all other items required for the completeness and the accessories shall be explosion proof type as per hazardous area classification wherever applicable.
- ii) Control valves shall be furnished with IBR certification wherever required.

1. **Noise:** The maximum allowable noise level shall be 85 dba or less at 1 m. distance from the downstream bare pipe surface. The specified noise level shall be attained without the use of orifices, mufflers, diffusers. No credit for thermal or acoustical insulations shall be taken.

2. **Valve Trim:** Valve shall have quick change type trim utilizing top entry. No components shall be screwed or welded into the body. The valve shall have equal pressure distribution around the plug to avoid chattering / vibration.

Trim of severe/critical service valve shall be of multi stage & multi path design with sufficient no. of discrete pressure drop stage to eliminate the chance of erosion, cavitations, noise, vibration through out the control range of valve.

3. **Leakage Class:** The valve shall have minimum class-V leakage for all steam applications including RH/SH, APRDS, Soot Blower control valve, HP/LP Bypass spray control valves, BFP minimum recirculation valve & Low Load feed water control valve.

In case of HP/LP Bypass control valve application, the leakage class should be MSS-SP 61 (block valve leakage).

4. **Actuator:** Actuator type should be pneumatic double acting piston/electro-Hydraulic.

11.10.00 TEST AND EXAMINATION

All valves shall be tested in accordance with the quality assurance program agreed between the Owner and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following:

- 11.10.01 Non Destructive Test as per ANSI B-16.34.
- 11.10.02 Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test.
- 11.10.03 Valve closure test and seat leakage test in accordance with ANSI-B 16.34 and as per the leakage class indicated above.
- 11.10.04 Functional Test: The fully assembled valves including actuators control devices



and accessories shall be functionally tested to demonstrate times from open to close position.

11.10.05 CV Test: Please refer CI No. 13.00.00, Vol. V Part-B, Chapter : 13 (Type test requirements), Control Valves.

Bidder shall furnish all the control valves under this main plant package as finalized during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this chapter has to be read in conjunction with other relevant chapter of this specification.

INSTRUMENT CHECK LISTS



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

CHECK LIST FOR PRESSURE SWITCH

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	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST			P	V	V	
4	ELECT. INSULATION/HV TEST	ONE	P	V	V		
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT	V	V	V		
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST	V	V	V		
7	REVIEW OF TC OF MICROSWITCH	FOR LOT	V	V	V		

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

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and 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 :

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



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

CHECK LIST FOR PRESSURE & DP GAUGE

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

Legend :

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

Note :

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



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	ONE / LOT		P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR			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 :

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



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

CHECK LIST FOR 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 :

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



Technical specification for
CONTROL & INSTRUMENTATION
1X660MW PANKI TPS EXTN.

SECTION D

REV. NO. 00

DATE : 13.07.2018

CONTROL VALVE QUALITY PLAN

 PEM :: C&I		STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-999-145-I 006 VOLUME IIB SECTION D REV. NO. 06 DATE: 05.09.2013 SHEET 1 OF 7				
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
1.0	MATERIAL											
1.1	Body & Bonnet casting / forgings, plug, valve stem, seat ring/cage.	1. Physical, Chemical properties	MA	Physical, Chemical tests	One/ Heat(HT Batch)	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Test Certificate	3	---	2,1	
		2. Heat Treatment	MA	Review of H. T. Chart	Each H. T.	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Test Certificate	3/2	2	1	IBR Certification (if applicable) to be verified by BHEL
		3. Internal quality of castings	MA	RT for Body & UT for Bonnet(NDT)	100%	ASME B 16.34	ASME B 16.34	Test Report / FILM	3/2	2	1	Only for rating ANSI 900 and above. Applicable for Body and Bonnet only. For Lower rating only if called for in specification.
		4. Surface Quality	MA	1. Visual 2. MT/PT	100% 100%	MSS-SP-55 ASME B 16.34	MSS-SP-55 ASME B 16.34	Test Certificate Test Certificate	3/2	---	2,1	
								Test Certificate	3	2	1	After Machining on machined surface only

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

\$ P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

PEM :: C&I STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)		QUALITY PLAN NO.: PE-QP-999-145-I 006											
		VOLUME IIB											
		SECTION D											
		REV. NO. 06 DATE: 05.09.2013											
		SHEET 2 OF 7											
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks	
									P	W	V		
		5. Pressure test for shell	MA	Hyd. Test	100%	ISA-S-75.19/ ASME B 16.34	ISA-S-75.19/ ASME B 16.34	Test Certificate	2	2	1	For Body & Bonnet after machining	
1.2	Diaphragm	1. Surface Quality	MA	Visual	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2,1		
		2. Hardness	MA	Measurement	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2,1		
		3. Endurance / Life cycle	MA	Cyclic test 10,000 cycles	One / Type	10,000 cycles/ Mfr. standard.	No damage	Test Certificate	3/2		2,1		
1.3	Spring	1. Composition	MA	Chemical- Analysis	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1		
		2. Mech. Properties	MA	Mech. Test	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1		
		3. Performance	MA	1. Stiffness ratio	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1		
				2. Scrapping	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1		
				3. Cyclic test (Endurance)	One / type	10,000 cycles	Material spec. / Mfr. standard	Test Certificate	3	---	2,1		
				4. Dimension (Measurement)	One sample/ Lot	Mfr. standard	Appd Drg	Record	3	---	2,1		

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics		RT- Radiographic Test UT - Ultrasonic Test	PT - Dye penetrant Test MT- Magnetic Test	\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
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 PEM :: C&I		STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)										QUALITY PLAN NO.: PE-QP-999-145-I 006			
												VOLUME		IIB	
												SECTION		D	
												REV. NO.		06	
												DATE:		05.09.2013	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks			
									P	W	V				
1.4	Electrical items [Limit switches, Solenoids, Position Transmitter(if provided externally)]	1. Routine Test	MA	HV, IR, Continuity function	100%	Rele. Standards	Rele. Standards	Test Certificate	3	---	2,1	In case TC is not available, Actual test shall be conducted			
		2. Degree of protection	MA	IP/NEMA Tests	One sample / type	Approved Data sheet	Approved Data sheet	Test Certificate	3	---	2,1				
1.5	Pressure Gauges	1. Performance	MA	Review of calibration certificates	100%	Mfr. Standard	Mfr. Standard	Test Certificate	3	---	2,1				
		2. Marking	MA	Visual	100%	Mfr. standard	Mfr. standard	Records	3	---	2,1				
2.0 IN PROCESS INSPECTION															
2.1	After machining, i, Body ii Bonnet iii Plug iv Valve Stem v seat ring/cage	1. Surface flaws	MA	Visual & MT/PT	100% (on accessible surfaces)	ASME B 16.34	ASME B 16.34	Test Records	2	---	1	Butt weld ends shall be included.			
		2. Dimensional checks	MA	Measurement	100%	Mfr. Standard	Mfr. Standard	Records	2	---	1				
		3. Hard facing (wherever applicable)	MA	Hardness Measurement	One sample/Lot	Mfr. Standard	Mfr. Standard	Records	2	---	1				
2.2	Lapping	Machining surface contact	MA	Blue Matching	One sample/lot	-----	Proper Physical Contact	---	2	---	---				
3.0 TESTS ON COMPLETED VALVE															
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics															
\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.															
1 - BHEL 2 - Vendor 3 - Sub-vendor															

PEM :: C&I 		STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)										QUALITY PLAN NO.: PE-QP-999-145-I 006				
												IIB				
												D				
												DATE: 05.09.2013				
												06				
												4 OF 7				
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks				
									P	W	V					
3.1	Actuator Chamber	Leakage & Strength	MA	Pneumatic test	100%	Mfr. Standard	No Leakage	Test Certificate	2	1	1	Refer Note-4				
3.2	Body	Leakage and Pressure test (Body Mount Leakage)	MA	Hydro test	100%	ISA - S-75.19	No Leakage	Test Certificate	2	1	1	Refer Note-4				
3.3	Seat leakage test for completed valve	Seat Leakage	MA	Pneumatic Test	100%	FCI-70.2	FCI-70.2	Test Certificate	2	1	1	Refer Note-4				
4.0	OPERATION TEST ON COMPLETED VALVE (Final inspection)	1. Valve Travel	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4				
		2. Opening/Closing time	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4				
		3. Linearity/cam characteristic	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4				
		4. Repeatability	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4				
		5. Hysteresis	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4				
		6. Sensitivity	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4				
		7. Accuracy (Overall)	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4				
		8. Control Valve characteristics / CV Test	MA	♦ Measurement (Press. vs. discharge and discharge vs. opening 0-100% in steps of 10%)	One per type	As per specs/ Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Certificate	2	--	1	♦ Size = Body & port size Or Body size & CV for non std port. Refer Note 1.				

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics				RT- Radiographic Test UT – Ultrasonic Test	PT – Dye penetrant Test MT- Magnetic Test	\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
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 PEM :: C&I		STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)										QUALITY PLAN NO.: PE-QP-999-145-I 006			
												VOLUME IIB			
												SECTION D			
												REV. NO. 06 DATE: 05.09.2013			
												SHEET 5 OF 7			
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks			
									P	W	V				
		9. Operation of limit switch & solenoids and other accessories	MA	Function	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Report	2	1	1	On assembled valve Refer Note-4			
		10. Overall dimensions	MI	Visual and dimensional	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Records	2	1	1	Refer Note-4			
		11. Pre defined valve position in case of air failure	MA	Visual	100%	As per spec & Appd drg	As per spec & Appd drg	Test Certificate	2	1	1				
		12. Cleanliness, painting, stamping (for direction of flow), Tag No.	MA	Visual and dimensional	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Certificate	2	1	1				
5.0 AUXILIARY ITEMS (Performance test of auxiliary items shall be performed on the completely assembled valve)															
5.1	Positioner	Overall leakage after assembly including Nozzles leakage	MA	Leak Test (in the steady state input signal)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	Overall leakage including tubing			
5.2	Air filter regulator	1. Normal air consumption	MA	Measurement	Each type	Mfr. Standard	No leakage	Test Certificate	3/2	---	1				
		2. Overall leakage	MA	Visual (soap solution)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	1				
5.3	Air lock relay	Performance Test	MA	Leakage test	100%	Mfr. Standard	No leakage	Test Certificate	3/2	---	1				
5.4	Electronic position transmitter(not applicable if provided integral to smart positioner)	1. Accuracy	MA	Operation	100%	Approved data sheet /	Approved data sheet /	Test Certificate	2	1	1				

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics	RT- Radiographic Test UT – Ultrasonic Test	PT – Dye penetrant Test MT- Magnetic Test	\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
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 PEM :: C&I		STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)										QUALITY PLAN NO.: PE-QP-999-145-I 006 VOLUME IIB SECTION D REV. NO. 06 SHEET 6 OF 7 DATE: 05.09.2013				
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks				
									P	W	V					
5.5	Current to Pneumatic converter(not applicable for smart positioner)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	2,1					
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	2,1					
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1					
		4. Hysteresis	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1					
5.6	Smart Positioner (As Applicable)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	2,1					
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	2,1					
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1					
		4. Hysteresis	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1					
		5. Calibration with Hand Held Communicator	MA	Measurement	Each type	Approved data sheet / Mfr. Standard	Approved data sheet / Mfr. Standard	Test Certificate	2	1	1					
6.0	PAINTING	Soundness of Painting	MA	Visual and Measurement	100%	BHEL specn. / Mfr. Standard	BHEL specn. / Mfr. Standard	Inspection Report	2	---	---	Refer Note-2				
7.0	PACKING	Soundness of Packing against transit damage	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-3				
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics \$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor																

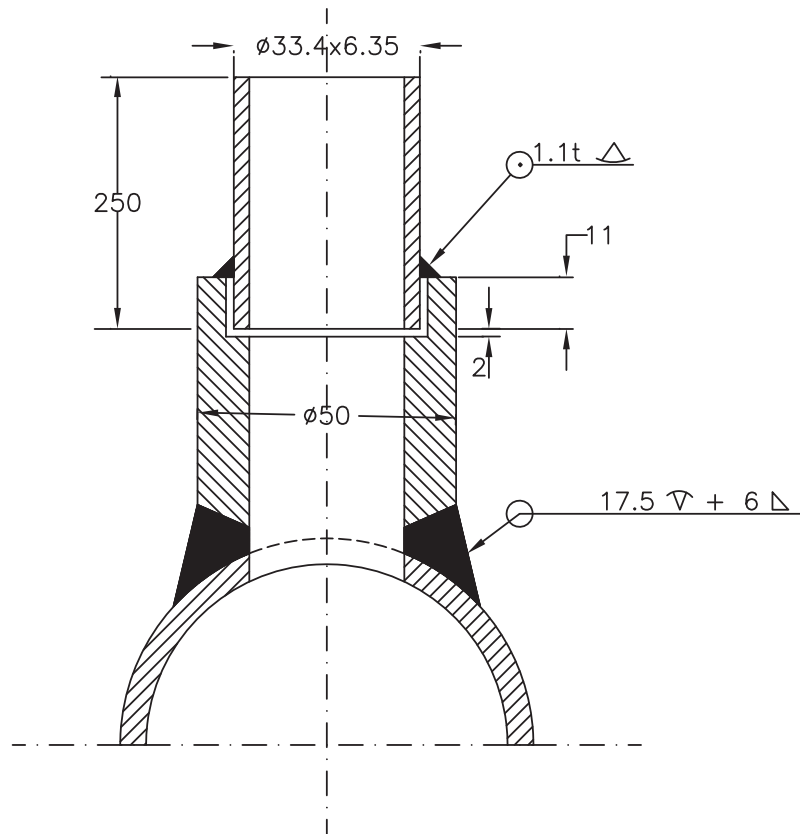
 PEM :: C&I		STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)										QUALITY PLAN NO.: PE-QP-999-145-I 006									
												VOLUME		IIB							
												SECTION		D							
												REV. NO.		06							
												DATE:		05.09.2013							
Sl. No.		Component / operation		Characteristics Checked		* Category		Type/Method of Check		Extent of Check		Reference documents		Acceptance Norms		Format of Records		Agency \$		Remarks	
																7		OF		7	
																		P		W	
																		V			

NOTES:

1. In case valid CV test certificate for a similar control valve(Same type, Same size, Same CV) is not submitted to BHEL by the vendor, CV test shall be conducted at FCRI/Any govt. approved laboratory/ BHEL approved Laboratory.
2. In the absence of BHEL spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
3. Sea worthy packing shall be provided, if applicable.
4. The quantum of check shall be 100% for manufacturer and 10% for BHEL/BHEL nominated inspection agency.
5. IBR certificates in Form III-C shall be submitted if called for in the specification/datasheet.
6. Copies of all TC's(Test Certificates) for materials duly correlated with Heat Nos., TC's for electrical items and mechanical tests(Leak/Operation) shall be submitted to BHEL for verification and acceptance.

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics		RT- Radiographic Test UT – Ultrasonic Test	PT – Dye penetrant Test MT- Magnetic Test	\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor
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INSTRUMENT STUB DETAILS



NOTE :

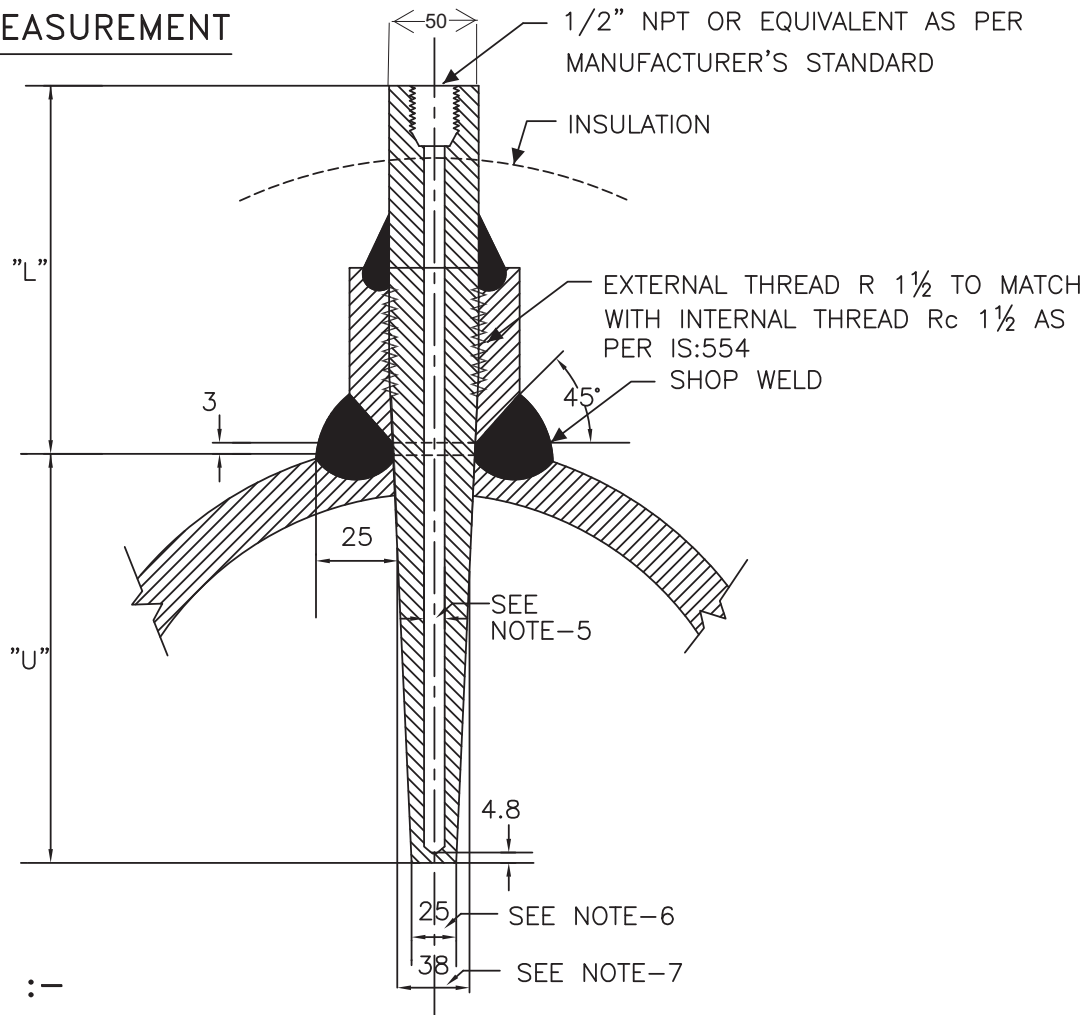
1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY ($1/64''$ RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES



TITLE :
**INSTRUMENT STUB DETAILS
 FOR PRESSURE MEASUREMENT**
 (SYSTEM PRESS > 40Kg/Cm2, CLASS 6000#)

DRG. NO.
PE-SS-999-145-I101A
 REV. 00
 SH. 03 OF 10 SHS.

TEMP. MEASUREMENT



NOTES :-

1. THIS TYPE OF TEMPERATURE BOSS SHALL BE USED FOR THE PROCESS PRESS EQUAL/ ABOVE 40 KG/CM2(g).
2. THE MATERIAL OF THE BOSS SHALL BE SIMILAR TO PIPING MATERIAL.
3. MATERIAL OF THE THERMOWELL SHALL BE OF 316SS.
4. THERMOWELL SHALL BE DRILLED BAR STOCK TYPE.
5. INTERNAL BORE OF THE THERMOWELL SHOULD BE SELECTED BASED ON THE NORMAL SIZE OF THE SENSING ELEMENT AS PER ASME PTC-19.3.
6. THE BOTTOM DIAMETER OF THE THERMOWELL TYPICALLY SHOWN HERE SHALL BE SUBJECT TO VARIATION BASED ON THE INTERNAL BORE OF THERMOWELL AND THICKNESS OF THERMOWELL MATERIAL TO WITHSTAND THE PROCESS PRESS AND TEMP AS PER ASME PTC-19.3.
7. THERMOWELL SHALL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER Rc 1 1/2.
8. THE 'U' & 'L' DIMENSIONS SHALL BE SELECTED BASED ON PARTICULAR APPLICATION.
9. ORIENTATION OF STUB ON VERTICAL/ HORIZONTAL PIPES SHALL BE 90° TO THE CENTRE LINE OF THE PIPES, FOR PIPE SIZE LARGER THAN 4". HEIGHT OF STUB SHALL BE 64mm FOR PIPE OD < 200Nb AND 45mm FOR PIPE OD ≥ 200Nb.
10. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED



TITLE :

INSTRUMENT STUB DETAILS (TEMP)

(APPLICABLE FOR PIPE SIZE ABOVE 4")

[PROCESS PRESS EQUAL/> 40 Kg/Cm2 (g)]

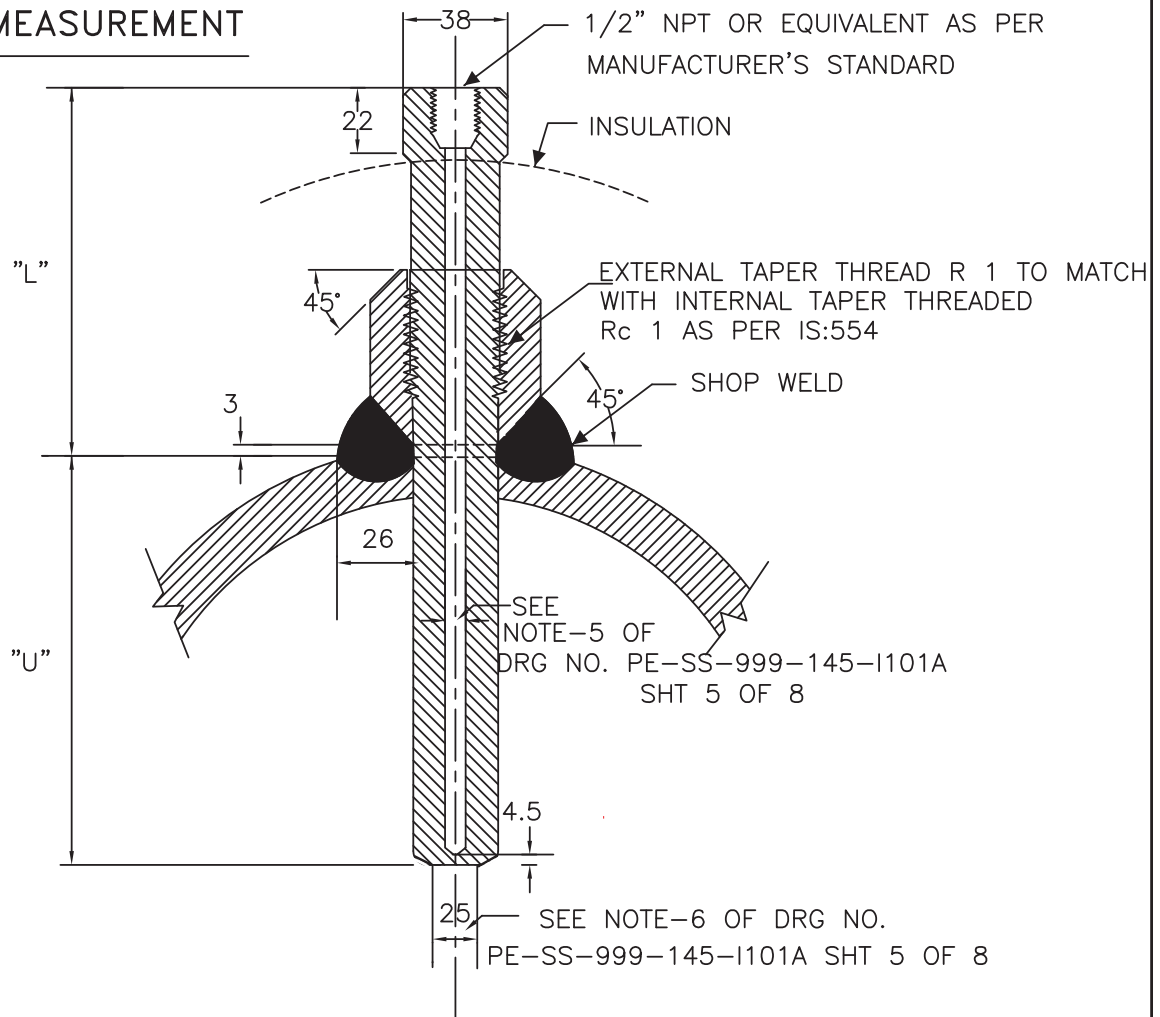
DRG. NO.

PE-SS-999-145-I101A

REV. 00

SH. 05 OF 10 SHS.

TEMP. MEASUREMENT



NOTES :-

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESS/ TEMP. BELOW 40 KG/CM²(g)/400°C.
2. FOR PRESS. TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. SEE NOTES-2 TO 9 IN SHT. 5 OF 8 OF THIS DRG.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. FOR PU COATED PIPING REFER SHEET NO-10 FOR TEMP STUB DETAILS.

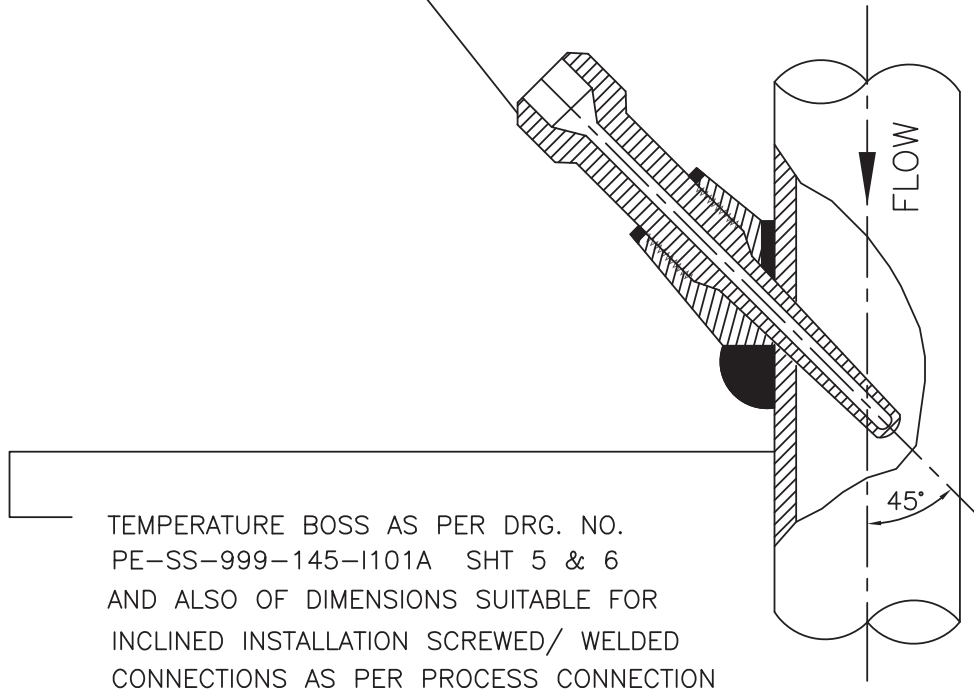


TITLE :
INST. STUB DETAILS (TEMP)
 (APPLICABLE FOR PIPE SIZE ABOVE 4")

DRG. NO.
PE-SS-999-145-I101A
 REV. 00

[PROCESS PRESS < 40 Kg/Cm² (g), TEMP < 400 °C] SH. 06 OF 10 SHS.

THERMOWELL SUITABLE FOR THE BOSS
AS PER DRG. NO.
PE-SS-999-145-I101A SHT 5 & 6



TEMPERATURE BOSS AS PER DRG. NO.
PE-SS-999-145-I101A SHT 5 & 6
AND ALSO OF DIMENSIONS SUITABLE FOR
INCLINED INSTALLATION SCREWED/ WELDED
CONNECTIONS AS PER PROCESS CONNECTION

NOTES :-

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION TO BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (AT LEAST 3-4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDES OF THE INSTALLED THERMOWELL).



TITLE :

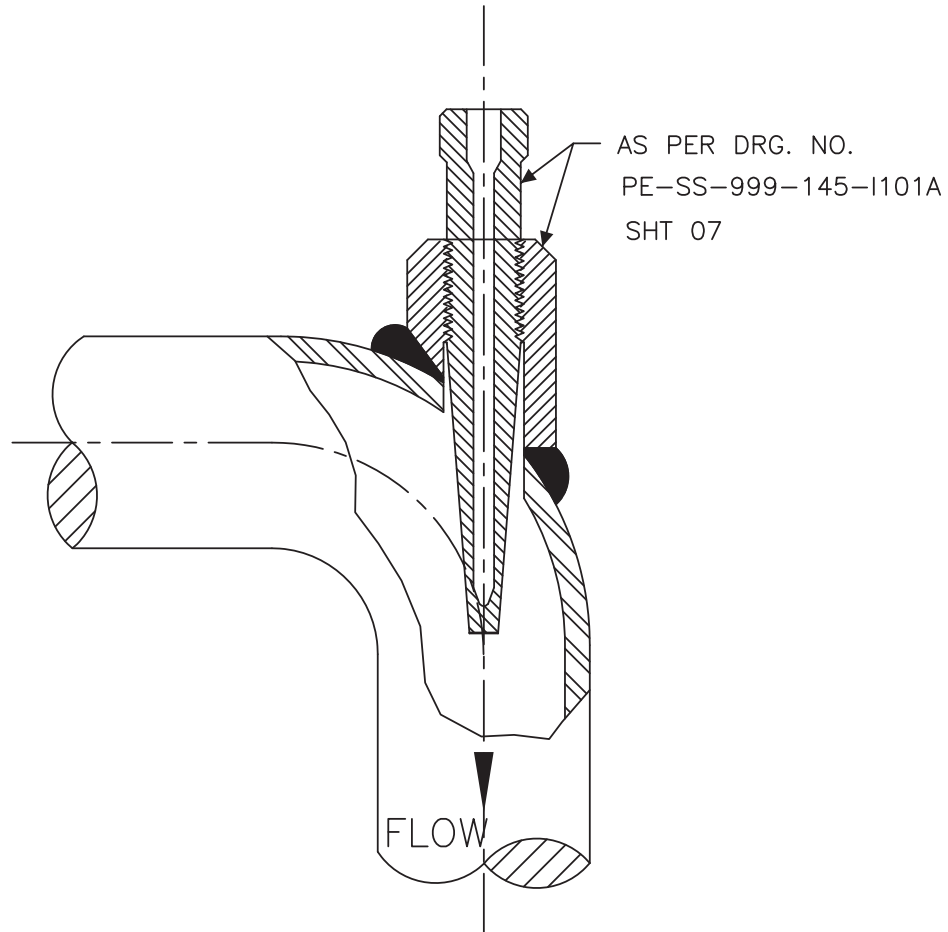
THERMOWELL INSTALLATION

DRG. NO.

PE-SS-999-145-I101A

REV. 00

SH. 07 OF 10 SHS.



NOTES :-

1. FLOW INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF MINIMUM 3" SIZE SHALL BE USED.
3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE TO BE USED FOR LIQUID SERVICE. FOR STEAM SERVICES EXPANDER SECTION TO BE USED IN VERTICAL PLANE.



TITLE :

THERMOWELL INSTALLATION

DRG. NO.

PE-SS-999-145-I101A

REV. 00

SH. 08 OF 10 SHS.

LOCAL CONTROL PANEL SPECIFICATION & QUALITY PLAN

6.10.00 CONSTRUCTIONAL FEATURES OF LOCAL CONTROL PANELS, CONSOLES, CONTROL Desk, CUBICLES & ENCLOSURES

- i. All control panels, cubicles, consoles, SOV panels and enclosures provided anywhere for subject plant per this specification shall be of free standing type and shall be constructed of specified gauge of steel plates (CRCA). The minimum sheet thickness of panels shall be as follows unless otherwise specified herein.

Side and top – not less than 1.6 mm

Door – not less than 2.0 mm

Mounting plate – 2.5 mm

Base metal plate - 2.5 mm

Gland plate – 3 mm

- ii. The panels, consoles/desks shall be reinforced as required to ensure true surfaces and adequate support for instruments mounted thereon. All instrument cutouts, mounting studs, and support brackets shall be accurately located. All welds on the exposed panel surfaces shall be ground smooth. Finished panel surfaces shall be free from waves, bellies, or other imperfections. Unless specified, otherwise, panel doors shall be 4 points hinged and shall have turned back edges and additional bracing where required to ensure rigidity. Door hinges shall be of the concealed type. Door latches shall be of the three/four -point type to ensure tight closing. Door locks shall be furnished which will allow actuation of all locks by a single master key. All panels shall have removable lifting eyebolts for safe lifting from top during storage and installation handling.

Cabinet doors shall be hinged and shall have turned back edges and additional bracing where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three/four -point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is equal or more than 800 mm, double doors shall be provided.



- iii. All panels shall be mounted on vibration dampers, which are secured to C-channels mounted on the floor. The channels shall be field welded to steel plates set into the concrete flooring. The steel plates shall be located such as to approximate the outline of panel bases. The exact mounting details shall be as approved by the owner during detailed engineering stage. All panels shall be provided with adequate ventilation and packaging density of components shall be restricted so as to limit the temperature rise above ambient to 10°C under the worst conditions. All panels shall have auto on/off switch for internal lighting. All the power supply circuit for control panels shall be provided with auto changeover circuitry.
- iv. In each panel /cabinet, a 24 VDC Voltmeter digital type shall be provided to check the Field Interrogation voltage.
- v. Exhaust Fans with louvers & filters shall be provided on upper side to remove hot air in all consoles and panels.
- vi. Fire & Smoke detectors shall be provided inside the Control room mounted system/control cabinets.
- vii. Feeder failure/ healthy indication shall be provided in each cabinet & remote indication shall be hooked up to DDCMIS/ PLC/annunciation & suitably grouped.
- viii. All the panels shall be equipped with Anti vibration pad of min. 15 mm size thickness. Cable gland plate thickness shall be 3 mm. C Channel height shall be min. 100 mm.
- ix. Doors shall be provided with neoprene/polyurethane gasket only. The front and rear doors shall be of full height .
- x. Protection class shall be as specified at Vol. V, Part B, chapter 1.
- xi. All the cable entries shall be at the bottom of electronic cubicles/control panels.
- xii. Control panels shall be provided with proper arrangement and hardware to terminate the inert gas required for fire protection.
- xiii. 25x6 mm copper ground bus to be provided for each panel/control desk.
- xiv. Terminal blocks shall be Rail mounted 650 V AC grade Terminal blocks (Screw less cage clamp type) with markers and 20% spare wired terminals of each type.
- xv. For Panels/cubicles internal wiring details, Bidder to refer Vol. V, Part B, Chapter 9.

6.11.00 TERMINATION/Marshalling CABINETS & Interposing Relay Panel

Marshalling/Termination cabinets for the control system shall be supplied for terminating all cables originating from the field, MCC/SWGR or any other source

of signal and for distributing the signals to different functional panels, MCC/SWGR and control cubicles.

Incoming cables from the field, MCC/SWGR or any other source of signal shall be terminated in suitable terminal blocks in logical sequence.

Prefabricated cables with plug in connectors at both ends shall be used for extending the signals to the functional panels. Matching plug sockets shall be provided in the termination cabinets for terminating the plugs.

Interposing relay panels for the system shall be supplied for mounting interposing relays & terminating all cables originating from the DO cards in case of solenoid valves, HW Annunciation windows and other required services etc. IPR panels shall be placed in CER and LCR.

Interposing relay shall be mounted in respective SWGR/MCC/integral starter required for commands signals of HT/LT unidirectional drives and bidirectional drives, breakers, isolators, bus couplers etc from DDCMIS/DCS/PLC or any control system.

Terminal blocks shall be located inside the cabinets on support wings fabricated of metal plates.

The plug socket shall be mounted on hinged plates to provide an access to the rear pins of the plugs.

General features of termination cabinets and accessories shall conform to the general design and construction specification of panels. Terminal blocks shall be Rail mounted 650 V AC grade Terminal blocks (Screw less cage clamp type) with markers and 20% spare wired terminals.

Wiring shall be 650V grade. PVC insulated FRLS stranded copper wire.

6.12.00 SURFACE PREPARATION AND PAINTING

All panel exterior steel surfaces shall be ground smooth, and painted as specified below:

Suitable filler shall be applied to all pits, blemishes and voids in the surfaces. The filler shall be sand blasted so that surfaces are level and flat, corners are smooth and even. Exposed raw metal edges shall be ground burr free. The entire panel surface shall be sand blasted to remove rust and scale and all other residue due to the fabrication operation. Oil grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods. Alternatively 7 tank process shall be followed.

Two spray coats of inhibitive epoxy primer – surface shall be applied to all exterior and interior surfaces, each coat of primer surface shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish colour (Catalysed epoxy finish) shall be applied to all surfaces of dry film thickness 2.0 mil. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6



mm. As an alternative, single coat of anodic dip coat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.

The Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory applied painted surface of each item of equipment.

The finish colours for exterior and interior surfaces shall conform to the following shades:

a) Exterior - RAL 7032/RAL 7035.

b) Interior - Glossy white two coats/RAL 7035 with fire resistant paint

One uniform colour shade as finalized by owner during detailed engineering shall be applicable for complete plant.

Paint films, which show sags, checks, blisters teardrops, fat edges or other painting imperfections, shall not be acceptable and if any such defects appear, they shall be repaired by and at the expenses of the Bidder.

6.13.00 PANEL ILLUMINATION

Panels shall be provided with LED based illuminating lamps with door switch and six (6) point 5/15A, 240V AC universal type power sockets with switch for maintenance purposes. These switches shall be with quick make and break mechanism. 100 % spare LED lamps shall be provided with each panel, these are in additional to mandatory spares.

6.14.00 Panel Cooling Fans (for ventilation of the DDCMIS/ PLC / DCS & other cabinets)

Filter Fan for electrical cabinets and enclosures to be used with 120 V or 230 V AC versions having very low acoustic noise and lower power consumption. The fans must have UL approval and should have air flow volume as per the cabinet requirement. Wherever required, the EMC filter fans may be used. Fans should have a life of 50,000 Hours at 40 Deg C. Fan Housing, cover should be of V0 material as per UL94. Filter mat should be compliant to EU3 according to DIN 24185 standard and have a filtering degree of 80 to 90 %. The Ambient temperature range °C should be -10 to +70 Deg C and Protection class should be IP 54. Filter Material shall be Synthetic fibre with progressive construction, temperature resistant to +100°C, self extinguishing, Class F1 as per DIN 53438 standard.

6.15.00 Panel Thermostat (for temperature control of the DDCMIS/PLC/DCS panel – to be connected to switch On/Off Fan/Heater)

The panel thermostat shall be DIN Rail Mounted with an inbuilt snap action thermostatic bimetal sensor and shall be connected in series with the load without any additional supply voltage. The panel thermostat shall be available in setting temperature range of -20 deg C to 40 deg C or 0 to 60 deg C with separate modules for NO or NC contact. The electrical life at rated load AC1 shall be 1 Lakh switching cycles and shall work at an ambient temperature of -45 to +80 deg C. With AgNi contact material for switching, the contact current carrying

capacity shall be 10 Amp at a rated voltage of 250 V AC with a dielectric strength between open contacts of 500 V AC and shall have UL approval.

6.16.00 FUSES & MCB

All fuses shall be fast acting semiconductor types for AC supply and compatible to the UPS fuses. For all DC Powered devices, similarly the fuses shall be fast acting compatible to DCDB fuse provisions. All the AC power supplies shall be provided with the protection of Fast acting semi conductor fuses & 2 P thermo magnetic type MCB. For all the DC power supply circuits, electronic type DC MCB shall be used only. Make of DC MCB shall be Siemens, Phoenix contacts, Murr, Weidmuller, or Lutze.

50 % spare fuses shall be provided with each panel, these are in additional to mandatory spares.

6.17.00 NAME PLATES AND LABELS

Name plates of adequate size shall be provided for each panel on front and rear of the panel. Instruments/other accessories mounted inside the panels shall have identification marking clearly visible from inside.

Devices to be mounted on the panels shall also be labeled on the panels shall also be labeled on the outside of the panel. Name plates shall be of polyamide sheets with black letters on white background. Name plates shall be attached to the boards by means of stainless steel panhead screws. Fuses provided for protection of various boxes shall be accessible for replacement. Fuse boxes shall be provided with circuit label and fuse rated current and voltage.

Markings/Labels

All markers/labels shall be made of halogen & silicon free polyamide material with inflammability class V2 as per UL 94, ensuring scratch proof printing with the use of environment friendly solvent free ink & latest BLUEMARK UV technology so as to comply the WIPE RESISTANCE according to DIN EN 61010-1/VDE 0411-1.

6.18.00 QUANTITIES

Refer Appendix-I to Part-A, Vol.-V of Technical Specifications. Quantities indicated are the minimum requirements, however each & every item shall be provided as per system requirements.

6.19.00 Design Criteria for Control Rooms:

The interiors of the each control Room shall be aesthetically designed with modern designs and technologies. The bidder shall have 2-D and 3-D software for designing the control room layouts. The bidder shall have thorough knowledge on Indian power plant control room requirements. Control rooms shall also be designed as per standard "ISO 11064 (1-7) - Ergonomic design of control centres".



- 6.19.01 The TG building operating floor area and other elevations shall be partitioned to different rooms suitably by bidder with approval from owner to house the following equipment/panels/cabinets:
- (a) Unit Control Desk (UCD), Printers, Electrical Control Panel (ECP), LVS, Fire Alarm Panel, Plant CCTV monitoring System, etc. in the main central control room.
 - (b) The system cabinets, marshalling cabinets and electrical auxiliary cabinets, TSI & VMS panels, Electrical panels, DAVR panels, GCP, DDCMIS/DCS Network panels, & other aux. system cabinets etc. in the electronic cubicle room.
 - (c) Maintenance Engineer & Shift Incharge's OPERATING STATIONS with keyboards, printers and other peripherals in Maintenance Engineer room (Computer Room) and Shift Incharge's Room respectively. A separate air conditioned room shall also be provided for PADO.
 - (d) Uninterrupted Power Supply (i.e., inverters and distribution boards) (UPS) in UPS room and 24 V DC charger with DCDB in 24 V DC charger room. A separate room shall also be provided for Batteries.
 - (e) Similarly OPC servers, MIS server & station LAN Network panel shall be located in separate Air conditioned room.
 - (f) SWAS Room.
- 6.19.02 Every control room layout shall be designed in line with guidelines given below.
- (a) Lighting shall be designed for maximum comfort and minimisation of OPERATING STATION/LVS glare and shall be adjustable.
 - (b) Co-ordinated colours and material for floors, walls and ceiling shall be provided.
 - (c) Room designs shall absorb noise in the control room and engineers/shift supervisor room.
 - (d) Positively pressurised and filtered air conditioning shall be provided for all control rooms.
 - (e) Designs and material will be in accordance with NFPA Fire protection for Power/Electric Generating plant.
 - (f) All control Rooms shall be designed to minimise dust ingress. Air locks shall be provided at main entry.
 - (g) Double Doors and the corridors shall be of sufficient size and layout to allow access of 2750 mm height for equipment.
 - (h) Fire and Smoke detection equipment shall be located in all ceilings.
 - (i) Temp. & humidity monitoring system in each control room, cubicle room, meeting room, training room, & conference room etc.



(j) Air Curtains at each entrance to Main Control room & BOP control room.

6.19.03 Item (a) to (e) referred above at cl. No. 6.19.01 shall be mounted in an air-conditioned control room having false roof and false flooring. In addition SWAS dry room shall also be air conditioned only. The control room will be partitioned with toughened glass/insulated glass between the following rooms:

(a) Main Control Room and Maintenance Engineer's Room/Computer Room.

(b) Maintenance Engineer/Computer's Room and Electronic Cubicle Room

(c) Main control room and Shift Incharge room.

(d) Main control room and Electronic cubicle room.

(e) Main control room and Operating Floor.

6.19.04 In additions to above following rooms shall be provided at operating floor-

1) C&I Staff air-conditioned room.

2) Shift Supervisor air-conditioned room.

3) Documentation air-conditioned Centre for storage for all Plant O & M manuals, control system software backup, & all others operating / maintenance files, logs, records etc.

4) Conference air-conditioned sound proof Room.

5) Pantry room.

6) Toilets/refreshing room.

6.19.05 Following C&I rooms shall be provided in service building -

1) Meeting Room/ Conference air-conditioned sound proof Room.

2) DMS air-conditioned Room.

3) C & I Maintenance/laboratory air-conditioned Room.

4) DDCMIS/DCS Simulator air-conditioned sound proof room.

5) CAAQMS air – conditioned room.

6) Training air-conditioned sound proof Room.

6.19.06 Following rooms shall be provided at Local control room building for respective BOP/offsite packages-

1) Control room and Electronic cubicle room (air-conditioned).

2) UPS room (air-conditioned).

3) UPS Battery room.



- 4) Toilets/refreshing room.
- 5) Locker & staff air-conditioned room.
- 6) Pantry Room.
- 7) Office Rooms.

6.19.07 Quantities of above mentioned rooms are minimum to be met by bidder, however actual quantities & size of rooms shall be finalised by owner during detailed engineering.

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 PEM :: C&I														VOLUME		IIB			
														SECTION		D			
														REV. NO.		01		DATE: 22-02-2008	
														SHEET		1		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks							
									P	W	V								
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Relevant standard	Relevant standard	Test Certificate	3	---	2								
		2. Bend Test	CR	Mech. test	Sample	Relevant standard	Relevant standard	Log Book	2	---	---								
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---								
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---								
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---								
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	1							
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Relevant standard	Relevant standard	Log Book	2	---	---								
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---								
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---								
		4. Mill marking	MA	Visual	100%	Relevant standard	Relevant standard	Log Book	2	---	---	1							
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---								
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---								
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics														\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.					
														1 - BHEL 2 - Vendor 3 - Sub-vendor					

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056							
										VOLUME IIB		SECTION D		REV. NO. 01		DATE: 22-02-2008	
										SHEET 2		OF 7					
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	P	W	V	Remarks					
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---						
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	3	---	2						
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	--- --- --- --- --- 1 ---	+ for relay & contactors only @ for all components except relays & contactors.					
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics													1 - BHEL 2 - Vendor 3 - Sub-vendor				

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL													STD QUALITY PLAN NO.: PE-QP-999-145-1056								
PEM :: C&I													VOLUME			IIB					
													SECTION			D					
													REV. NO.			01			DATE: 22-02-2008		
													SHEET			3			OF 7		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks									
									P	W	V										
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make 2. Surface defects 3. IR / HV on Terminal Blocks	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	--	--	--									
			MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	--	--	--									
			MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	--	--	--									
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions 2. Surface defects after bending	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	--	--	--									
			MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	--	--	--									
7.0	Nibbling / Punching	1. Cutout Sizes 2. Deburring	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	--	--	--									
			MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	--	--	--									
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions 2. Alignment 3. Welding Quality 4. Surface defects	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	--	2										
			MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	--	2										
			MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	--	2										
			MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	--	2										

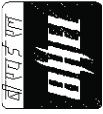
LEGEND:	* CR	- Critical characteristics	\$	P	- Agency Performing the Test.	1	- BHEL
	MA	- Major characteristics	W	W	- Agency Witnessing the Test.	2	- Vendor
	MI	- Minor characteristics	V	V	- Agency Verifying the Test.	3	- Sub-vendor

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056					
										VOLUME		IIB			
										SECTION		D			
										REV. NO.		01		DATE: 22-02-2008	
										SHEET		4		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks			
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1				
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1				
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1				
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1				
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1				
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1				
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1				
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1				
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1				
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		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056			
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												DATE: 22-02-2008			
												SHEET 5 OF 7			
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks			
									P	W	V				
10.	Panel Wiring	1. Wiring Layout 2. Wiring Termination (Crimped Lugs) 3. Ferrule numbers 4. Colour of wiring 5. Size of Conductor	MA MA MA MA MA	Visual Visual Visual Visual Measurement	100% 100% 100% 100% 100%	Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs.	Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs.	Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2	-- -- -- -- --	-- -- -- 1 1				
11.	Component Mounting	1. Correct components 2. Fixing	MA MA	Visual Visual	100% 100%	Approved drgs., Specs. & BOM Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM Approved drgs., Specs. & BOM	Log Book Log Book	2 2	-- --	-- --				
12.	FINAL Final Inspection	1. Workmanship 2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components 3. Components identification Marking / Name plates	MA MA MA	Visual Visual Visual	100% 100% 100%	Factory Standard BHEL approved drg. / Spec. BHEL approved drg. / Spec.	Factory Standard BHEL approved drg. / Spec. BHEL approved drg. / Spec.	Inspection Report Inspection Report Inspection Report	2 2 2	1 1 1	1 1 1	At Random by BHEL, based on 100 % internal test reports by Mfr.			

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 STD QUALITY PLAN NO.: PE-QP-999-145-1056		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										
		VOLUME IIB		SECTION D		REV. NO. 01		DATE: 22-02-2008		SHEET 6 OF 7		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1	
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1	
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1	

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 V - Agency Verifying the Test.

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 2 - Vendor
 3 - Sub-vendor

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056			
												VOLUME IIB			
												SECTION D			
												REV. NO. 01			
												DATE: 22-02-2008			
												SHEET 7 OF 7			
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks			
									P	W	V				
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IEC-60947, IEC-60079	BHEL approved spec., drg relevant IEC-60947, IEC-60079	Type Test Certificate	3	---	1				
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant standard	BHEL approved spec., drg., BOM & relevant standard	Test Report	2	1	1				
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1				
		2. Instrument Calibration	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1				
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec./drg. & relevant standard	BHEL approved spec./drg & relevant standard	Inspection Report	2	1	1				

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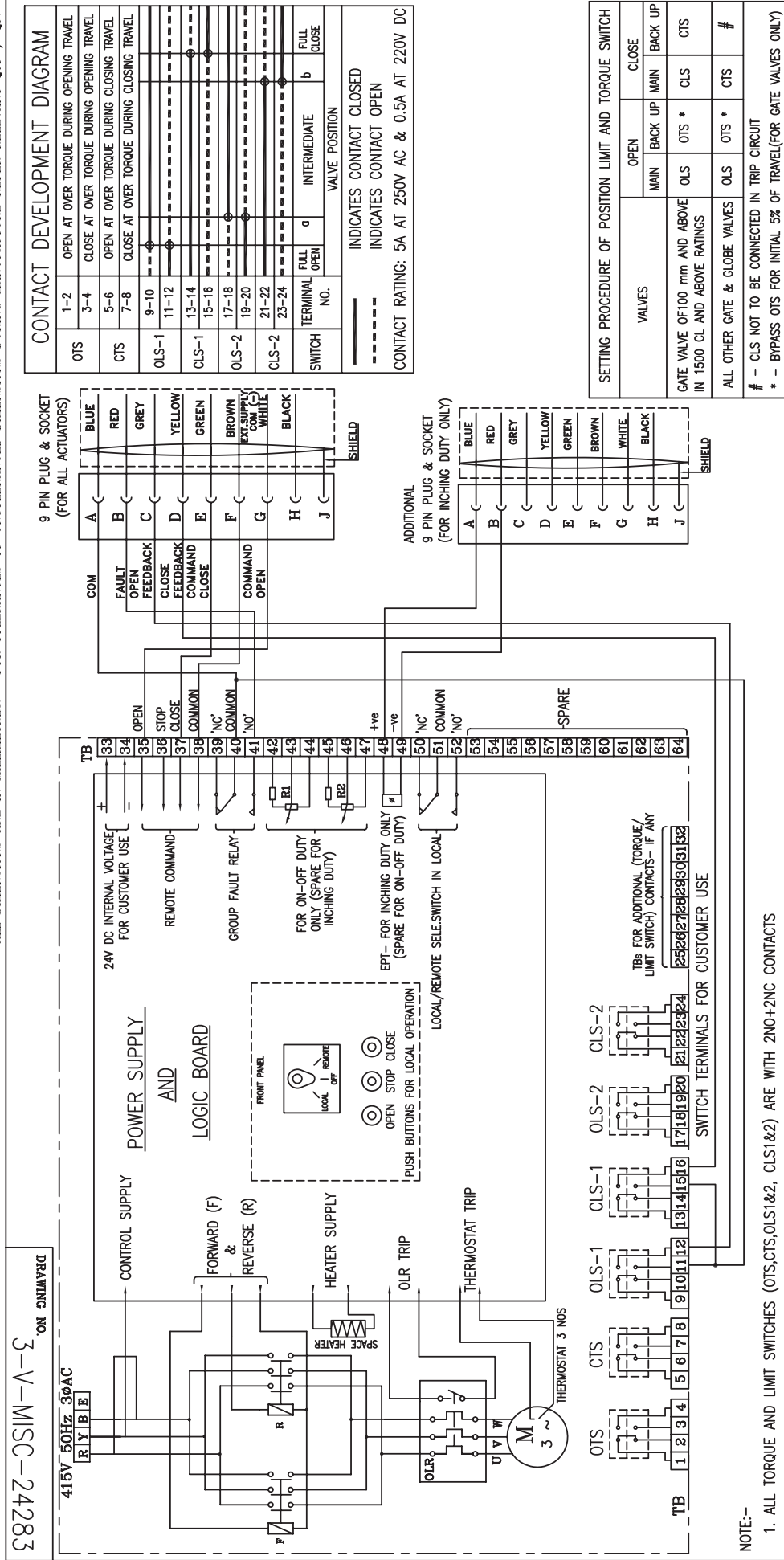
1 - BHEL
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ACTUATOR SPECIFICATION & DATASHEET

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:			
			VOLUME			
			SECTION			
			REV. NO.	00	DATE:	27.02.18
			SHEET	1	OF	3
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 PANKI TPS				
	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 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%				
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY				
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY				
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY				
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, DUST TIGHT, WEATHER PROOF, SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, IP:65				
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL				
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED 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 90% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR REGULATING SERVICE - 150 STARTS/HR MINIMUM				
HANDWHEEL	* REQUIRED	☒ YES ☐ NO				
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED				
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.					
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY				
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY				
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF I.S. TOLERANCE				
	ACTUATOR APPLICABLE WIRING DIAGRAM	☒ ENCLOSED ☒ DRG. NO. 3-V-MISC-24227 R00 (INDICATIVE)				
	COLOUR SHADE	☒ BLUE (RAL 5012), To be decided during detail engg.				
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☒ EPOXY ☐				
	SHAFT RPM	BIDDER TO SPECIFY				
	OLR SET VALUE	BIDDER TO SPECIFY				
	@ 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 65 ☐ FLAME PROOF				

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:		
			VOLUME		
			SECTION		
			REV. NO.	00	DATE: 06.01.2015
			SHEET	2	OF 3
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	@ 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			
INTEGRAL STARTER	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED			
	TYPE OF SWITCHING DEVICE	☒ CONTACTORS ☐ THYRISTORS			
	TYPE	☒ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)			
	IF SMART	NOT APPLICABLE			
	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			
	INDICATING LAMPS	☒ REQUIRED ☐ NOT REQUIRED			
	LOCAL REMOTE S/S	☒ REQUIRED ☐ NOT REQUIRED			
	STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED			
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT. /POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)			
	INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☒ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER		
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			
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ 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) (\$\$ 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			

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:		
			VOLUME		
			SECTION		
			REV. NO.	00	DATE: 06.01.2015
			SHEET	3	OF 3
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
POSITION TRANSMITTER	POSITION TRANSMITTER	☒ REQUIRED ☐ NOT REQUIRED			
	MFR & MODEL NO.	BIDDER TO SPECIFY			
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☒ ELECTRONIC (2 WIRE) CONTACTLESS			
	SUPPLY	☒ 24V DC ☐			
	OUTPUT	☒ 4-20mA			
	ACCURACY	$\pm 1\%$ FS			
SPACE HEATER	@SPACE HEATER	REQUIRED			
	@ POWER SUPPLY (NON INTEGRAL)	240V 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 (9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ☒ NOT REQUIRED ☐ 2 NOS. ☐			
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:-----			
	@ SPACE HEATER CABLE GLAND	SIZE:-----			
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP (Cable size 2Px1.5mm2)			
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE: 1no., 2.5 sq. mm			
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY		_____ Kg.	
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 INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722 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, WITH NICKEL COATING 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 OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. 7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING. \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE. ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.					
			VENDOR COMPANY SEAL NAME SIGNATURE DATE		
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ES					



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 TRANSMITTER
(CONTACTLESS TYPE, FOR INCHING DUTY)
7. RT-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
10. TORQUE SWITCH BYPASS WITH LIMITSWITCH BOTH ON OPEN & CLOSE DIRECTION TO BE DONE INTERNALLY.

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.																	
TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT																	
ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS FOR NIPC PROJECTS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)																	
 365-121				BHARAT HEAVY ELECTRICALS LTD., UNIT: HIGH PRESSURE BOILER PLANT. TRUCHIRAPALLI-680014.				DRN CHD		NAME N.P.ESWAR		SIGN N.P.		DATE 17.03.05		NO OF VAR.	
DEPT		VL		SCALE		WEIGHT (KG)		REFERENCE INFORMATIONS									
CODE		-				NTS		-									
TITLE				WIRING DIAGRAM (TERMINAL PLAN)				CARD CODE				DRAWING NO.				REV	
FOR ACTUATOR WITH INTEGRAL STARTER WITH PLUG & SOCKET								U 01				3-V-MISC-24283				0	
FOR NIPC PROJECTS																	
Page 535 of 508																	

APPLICABLE CABLE TYPES

Cable Sizes for 1X660MW TPS PANKI EXTN.	
Sl no.	Cable Type
G-TYPE	
1	2P X 0.5 sqmm
2	4P X 0.5 sq mm
3	8P X 0.5 sqmm
4	12P X 0.5 sqmm
F-TYPE	
1	4P X 0.5 sqmm
2	8P X 0.5 sqmm
3	12P X 0.5 sqmm
4	20P X 0.5 sqmm
CONTROL CABLE	
1	3C X 2.5 sqmm

KKS PHILOSOPHY

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	A	A	Y	Y	B	B	B
---	---	---	---	---	---	---	---	---	---

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-1**.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

**ANNEXURE-1****List of System / Sub-System Codes used in Power Plant:**

- 1) Compressed air system : QEA, QEC
- 2) Ventilation System : SAA TO SAZ
- 3) Fire Detection & Protection System + Fire Water pumps : SGM, SGN, SGO, SGP
- 4) Sewage Treatment : SJA TO SJZ
- 5) Pre-treatment Plant : GBI, GBM, GBV
- 6) RO DM Plant : GCI, GCM, GBV

ANNEXURE-2**Standard Equipment Codes:**

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holdings, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings



Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level
CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level

- i) Use 10, 20, 30, To distinguish between main systems having same Alpha Codes. Examples:
 - a) Main Steam (Left) and Main Steam (Right)
 - b) BFP – A/B/C
 - c) ID Fan – A/B, FD Fan A/B, AH – A/B
- ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.
- iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

- i) Valves and Dampers --- *Equipment Code – AA*

N1

N2 N3



DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

Motorised (<i>on/off duty</i>)	-	0	01 to 50
Motorised (<i>inching duty</i>)	-	0	51 to 99
Pneumatic (Control)	-	1	01 to 50
Motorised (<i>thyrestor Control</i>)	-	1	51 to 99
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99
NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99
Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99

ii) Field Instruments

Field Transmitters & Analog Signals	-	0	01 to 99
Field Switches & Binary Signals	-	1	00 to 99
PG Test Point	-	4	00 to 99
Gauges	-	5	00 to 99
Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99

(Reserved for protection Signals used by Hardwar)

Example of Numerical Key Usage:

In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, Where system code is same.

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

1X660 MW UPRVUNL PANKI TPS, EXTENSION

TECHNICAL SPECIFICATION

FOR

FUEL OIL UNLOADING & STORAGE SYSTEM

SECTION - II

STANDARD TECHNICAL SPECIFICATIONS



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT PPEI,
NOIDA-INDIA

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

1X660 MW UPRVUNL PANKI TPS, EXTENSION

TECHNICAL SPECIFICATION

FOR

FUEL OIL UNLOADING & STORAGE SYSTEM

SECTION IIA

(STANDARD TECHNICAL SPECIFICATION-MECHANICAL)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA



TITLE

STANDARD TECHNICAL SPECIFICATION FOR
MISC TANKS

SPECIFICATION NO. PE-TS-STD-167-A001

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1.0 SCOPE

The specification is intended to cover design, engineering, manufacture, inspection and testing at vendor's/ sub-vendor's works, proper packing, delivery at site including freight, unloading, storage & handling at site, erection & commissioning, hydro test at site, painting, handing over, tools & tackles, commissioning spares etc. for Misc. Tanks- site fabricated as mentioned in different sections of this specification

2.0 CODES & STANDARDS

The design, fabrication & assembly, erection & performance of steel tanks shall comply with all latest statutory regulations and safety codes applicable in the locality where the tanks are to be installed. Tanks shall conform to the latest applicable Indian/British/ USA standards. The vendor shall not be construed to be relieved of his responsibility by virtue of this specification. The tank in general shall conform to the latest editions, as is applicable, out of the following standards.

- 1 IS-800 Code of practice for use of steel in general building construction
- 2 IS-803 Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tank.
- 3 IS-804 Specification for rectangular pressed steel tanks
- 4 IS-805 Code of practice for use of steel in gravity water tank.
- 5 IS-816 Code of practice for metal arc welding for general construction in MS .
- 6 IS-817 Code of practice for training and testing for metal arc welder
- 7 IS-2825 Code of practice for unfired pressure vessel
- 8 BS-2594 Specification for carbon steel welded horizontal cylindrical storage tank
- 9 BS-2654 Specification for vertical steel welded storage tanks with butt welded shells for the petroleum industry
- 10 Indian explosive act and statutory requirements of chief controller of explosives, Nagger. (For oil storage tanks.)
- 11 Indian Boiler Regulations
- 12 Indian Factories Act
- 13 American code for oil tanks API 650

3.0 DESIGN REQUIREMENT

3.1 General Requirement



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STANDARD TECHNICAL SPECIFICATION FOR MISC TANKS

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- 3.1.1 All tanks will be mild steel tanks. The tanks will be of welded construction and will be designed to withstand satisfactorily the internal forces due to the liquid these tanks have to hold as specified and external forces due to wind and seismic forces without deformation or undue strain. The plates will be cold rolled through plate bending machines by several no. of passes to the curvature.
- 3.1.2 All tanks will be designed for the capacities, dimensions and working conditions as specified in **TANKS DATA SHEET** given under section-C. These tanks will be provided with all necessary connections as specified. The design of tanks will be such as to allow easy inspection, cleaning and repair. Due consideration will be given to wind loading and adequate stiffening will be provided to prevent failure of tank due to buckling when it is empty. A 2.0 mm corrosion allowance until unless specified in **DATASHEET-TANKS** for shells, bottom and roof and beyond the required thickness shall be provided.
- 3.1.3 Vessel seams shall be so positioned that they do not pass through vessel connections.
- 3.1.4 The inside seam should be ground smooth, suitable for application of corrosion resistant primer. Except where otherwise indicated in the specification, if the stiffening of shell and/ or roof is necessary, tanks will be stiffened from outside.
- 3.1.5 Flange faces of all nozzles shall be machined and squared with the vessel center line.
- 3.1.6 All roofs and supporting structures shall be designed to support dead load plus a uniform live load of not less than 150 kg/m² of projected area.
- 3.1.7 The tanks shall be designed to have all courses truly vertical. Adequate distance between vertical joints in adjacent courses shall be taken so that the distortion is reduced to minimum.
- 3.1.8 When removing temporary attachments from shell plates, care should be taken that parent plate is not damaged. Holes in plate work to assist in fabrication / erection should be avoided as far as possible. The location of holes and method of filling shall be indicated in the fabrication drawing. Any projection of metal shall be chipped and ground flush with the plate surface. The plate shall not be gouged or torn in process of removing lugs.
- 3.1.9 In the construction of shell, very care shall be taken to minimize distortion or lack of circularity due to welding or for any other reason.
- 3.1.10 The successful bidder shall furnish design calculations to BHEL during detailed engineering stage for approval along with the Xerox copies of relevant pages of authentic supporting literature e.g. Code, Hand book, National / international Standards etc. Calculation shall be necessarily done in SI UNITS for the followings: -
- The tanks shall be designed as per good engineering practice as applicable and referred code shall be of latest edition.
 - Plate thickness calculation (different courses of shell plate, bottom plate and roof plate thickness), roof curb angle, top wind girder, intermediate wind girder, tank internal pressure vis –a-vis. allowable value.
 - Design of roof and roof structures for vertical storage tanks shall be designed based on guidelines given in the book titled “Process equipment design” by Brownell and Young.



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- d) Tank stability calculation (wind load / seismic / overturning stability) shall be done as per good engineering practice as applicable and referred code shall be of latest edition. However, factors / coefficients as required for the design of tank shall be obtained from BHEL by the bidder after placement of order.
- e) Vent sizing calculation shall be done as per good engineering practice as applicable and referred code shall be of latest edition.
- f) Sizing calculation for vent, NaOH / KOH breather, seal pot and breather valve.
- g) Weight calculation of plates, appurtenances & structures separately shall be included in the design calculation/GA.
- h) Staircase / access ladder and hand railing shall be provided as per the relevant codes and standards.

3.1.11 **Alignment**

- 3.1.11.1 Plates to be joined by butt welding shall be matched accurately. Misalignment in completed vertical joints shall not exceed 10% of the plate thickness or 1.5 mm for plates of 20 mm thick and under, whichever is larger.
- 3.1.11.2 In completed horizontal butt joints, the upper plate shall not project beyond the face of the lower plate at any point by more than 20% of the upper plate thickness with a maximum of 3 mm for plate thickness exceeding 8 mm except that for plate thickness 8 mm and under, the maximum shall be 1.5 mm.
- 3.1.11.3 Each tank shall be properly constructed ensuring perfect vertical alignment within 5 mm and tank circularity within 5 mm on diameter. Local bulging and / or depressions at any location of tank particularly shell shall not be permitted.

3.1.12 **WELDING**

- 3.1.12.1 Tanks and other attachments shall be welded as per AWS and the qualification of welder should be as specified in ASME.
- 3.1.12.2 Welding sequence shall be so adopted that distortion due to welding shrinkage shall be minimum. Welding procedure specification shall be submitted for approval of BHEL giving details of material, welding position, sequence, type of electrode used, pre-heat & post weld requirement etc as per the code of construction. Brand name of electrodes to be used with proper classification (e.g. E 6013) shall be as per BHEL's approval.
- 3.1.12.3 Welding shall not be carried out when the surface is wet and during periods of rain and high winds unless the welder and the work are properly shielded which should meet the approval of the purchaser.
- 3.1.12.4 Inspection of all welds shall be carried out in accordance with the governing code of construction. All material used by the purchaser such as electrodes, gaskets, bolts, nuts etc shall be conforming to relevant standards of repute and approved by the purchaser prior to use.
- 3.1.13 Each tank shall be complete with access staircase and fittings like drain connection, overflow connection, tank inlet and outlet covers, level gauge glass, fittings with isolation cocks and



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protection covers , tank vent connection etc all complete with needed accessories for the completeness of the tanks and as specified in data sheet -A .

3.1.14 All openings in tank plate shall be well reinforced in approved manner by adding pad plates of adequate size and / or structural sections.

3.1.15 **STAIRCASE / ACCESS LADDER AND HAND RAILING**

3.1.15.1 All cylindrical vertical tanks shall be provided with spiral staircase and shall conform to the requirements specified in API 650 unless specified otherwise. All stair treads shall be 32 mm steel fabricated gratings. Each tread, if needed, shall be housed in individual steel fabricated frame which shall be adequately supported from the tank outer periphery. The staircase shall have minimum 750 mm clear width.

3.1.15.2 Access ladder, one (1) for each horizontal cylindrical / rectangular tank shall be provided for access to the tank roof. It shall be steel fabricated having minimum 450 mm width. Ladder stringers shall be heavy steel flats or angle section. All rungs shall be minimum 20 mm Dia rods spaced at not more than 30 cm center to center. All ladders shall have steel fabricated safety cage to the approved construction. Safety cage shall be provided about 2.5 m clear height of the ladder. Access ladder's stringers shall be widely spaced at top for free access to the tank roof.

3.1.15.3 All staircase and roofs of vertical cylindrical tanks shall be provided with pipe hand railings of 1070 mm effective height throughout. Handrails shall be constructed out of 32 NB medium class galvanized steel pipe conforming to ASTM A 53 Gr.B. Handrail posts shall be arranged at spacing not greater than 1850 mm. Two (2) sets of pipes horizontal runners all along the length shall be provided. All welds joints in the handrails shall be ground flush to protect any person getting injured. Steel toe plates of 100 mm flats shall be used. Hand railing shall be fabricated installed in an approved manner as directed by purchaser in accordance with approved drawings.

3.1.16 Unless otherwise specified, for all flanged connections vendor shall furnish suitable counter flanges and necessary nuts, bolts and gaskets materials.

3.1.17 Unless otherwise specified bolts and nuts shall be hexagonal head conforming to ISO -898-1:1999.

3.1.18 Gaskets shall be 3 mm thick full face rubber or CAF. On completion of hydraulic test / water fill test, contractor shall replace the gaskets used during testing at his own cost.

3.1.19 Float level indicators of approved make, as specified in data sheet-A shall be provided.

3.1.20 During erection of tank, shell plates shall be suitably supported both for outside and inside to avoid buckling / collapsing of tank due to high speed wind , gust or severe storm ,if any, occurring during erection.

3.1.21 The contractor shall furnish two (2) grounding pads for each vertical tank. Each pad shall be stainless steel plate 100 mm x 100 mm x 6 mm thick, with two 15 mm holes on 45 mm centers. Pads shall be edge welded to tank shell within 450 mm from the tank base. Two grounding lugs shall be provided for each horizontal tank.



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3.2 VERTICAL CYLINDRICAL STORAGE TANKS

- 3.2.1 The vertical cylindrical storage (non- pressure) tanks shall be of mild steel welded construction and shall be designed in accordance with API-650 / AWWA D - 100. The vertical cylindrical storage tanks shall have slightly sloping bottom towards an adequately sized sump inside the tank to enable complete draining of the tank. The tank shall be designed for a wind pressure and seismic coefficient as specified. While worst of these two shall be increased as per API.
- 3.2.2 Conical roof shall be self-supported over the tank periphery. The roof shall have a slope of not less than 1 in 16 to ensure drainage of rainwater. Needed roof rafters and purlins adequately designed shall be provided.
- 3.2.3 All plates to be used for fabrication of tank shall be checked and all sides trimmed to make them square.
- 3.2.4 All bottom plates shall have lap weld joints on all sides with overlap not less than five times the plate thickness.
- 3.2.5 All shell course plates shall be taken during bending to prevent plate skewing. For butt weld joints, edges shall be prepared which shall be uniform and smooth throughout. To maintain needed root penetration gap at any butt weld joint, sufficient numbers of erection cleats shall be provided on all sides of outer periphery of each shell plate. Plates for tanks shall be straightened by pressing or by other non-injurious methods.
- 3.2.6 Each shell course shall be of uniform width throughout longitudinal weld in plates. Make up for the course width shall not be permitted. Shell plates in each course width shall be so arranged that all vertical joints are staggered having a minimum of 600 mm stagger. Shell thickness could be reduced in upper courses depending on design requirements but in no case the plate thickness shall be less than 6 mm.
- 3.2.7 The tank height shall be completed by the provision of top curb/ angle which shall be butt welded to the adjacent tank plate courses. The outstanding leg of the curb angle shall be kept outside the tank periphery. All butt weld joints shall be full strength welds but for design of shell plate thickness adequate weld efficiency as recommended by applicable code(s) shall be used.
- 3.2.8 Tank roof shall be supported over steel fabricated central column(s). Adequately sized and spaced rafters and purlins shall be provided. All rafters shall have sliding bolted connections at one end and preferably on the tank periphery side. The roof supporting frame shall have needed tie rods or bracing sets.
- 3.2.9 Roof plates shall have lap joints with lap not less than 25 mm and lap weld over the top surface only. Roof plates shall have continuous fillet welds around the tank curb angle. No joint of roof plate over the supporting frame shall be made.
- 3.2.10 Needed openings for mounting various specified accessories shall be well reinforced in accordance with application codes and as approved. Manhole shall be bolted and shall have hinged covers unless otherwise specified.
- 3.2.11 All inlet pipe nozzles located at the top of tanks shall be provided with internal piping up to 500 mm high above the tank's bottom inside with suitable weir plate at bottom. The inside piping shall be adequately supported and shall be provided with adequately sized vent connection at pipe top.



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- 3.2.12 The manhole shall be of hinged & bolted type with nuts, bolts and gaskets with minimum size of 600 mm.
- 3.2.13 NaOH / KOH breather and seal pot shall be located in the bottom / ground level and necessary connection from tank vent to NaOH / KOH breather shall be provided through 200 NB SS pipe. The sizing of NaOH breather and Seal pot shall be decided based on emptying and filling rate of tanks. A tentative rate of 5 cum/hr may be considered for both emptying and filling of tank. However, the complete information shall be provided to vendor during detail engineering.
- 3.2.14 Material of construction of all pipes, fittings, valves, nozzles, flanges and counter flanges shall be as per datasheets given at the end of this section.
- 3.2.15 Material of construction for standpipe (if applicable) shall be stainless steel (SS) and size shall not be less than NB 100 unless otherwise specified in Datasheet-A for tanks given at the end of section.
- 3.2.16 Two (2) nos NaOH / KOH breather shall be provided by the bidder for each tank, out of which one shall be used for in-breathing purpose and the other shall be used for out-breathing purpose.
- 3.2.17 The size of the drain and vent valve of standpipes shall be 25 NB and size of the isolating valves (2 nos) for standpipe shall be 50 NB unless otherwise specified in the specification.
- 3.2.18 The overflow pipe from overflow nozzle shall be connected to seal pot.
- 3.2.19 All stair treads and platforms shall be made from gratings
- 3.3.0 RECTANGULAR TANKS**
- 3.3.1 Rectangular tanks shall be fabricated from steel material and shall be designed to withstand internal hydrostatic pressure. In addition these shall be checked for a wind pressure and seismic coefficient as specified wherever applicable. While worst of these two shall be considered, the permissible stress shall be increased as per IS when their effect considered with tank load.
- 3.3.2 Tank bottom and / or side plates shall be of minimum 6 mm thick plate. Corrosion margin of at least 2 mm shall be provided over the design thickness of bottom and / or side plates.
- 3.3.3 To support tank plates and to maintain required unsupported plate length, adequately sized and spaced steel structural closed frame shall be provided inside the tank. Longitudinal and / or vertical structural members to connect and adequately support these frames shall be provided at corners. Horizontal diagonal members / sway bracings at corner shall also be provided.
- 3.3.4 Tank plates cut to size shall be welded on these frames. Plate butt weld joints at other locations shall be eliminated to avoid warping of the plates at free joints. Adequate openings in the structural frames, particularly at the bottom shall be provided to ensure complete unrestricted drainage of tank at one point.
- 3.3.5 Complete assembled tank shall have at its bottom longitudinal steel fabricated bearer beams welded to it. The tank with bearer will rest over number of concrete blocks to be provided by purchaser. The tank shall be adequately bolted / welded to the concrete blocks. Needed inserts / anchor bolts shall be furnished by the bidders. Grouting of tank over concrete blocks in approved manner shall be included in bidder's scope of work, if erection is also awarded to the bidder.



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3.3.6 Where rectangular tanks are flushed in dual compartments the inside partition plate shall be well reinforced to withstand hydrostatic test pressure completely on one side throughout the full height.

3.4 HORIZONTAL CYLINDRICAL TANK

3.4.1 The horizontal cylindrical tank with dished ends shall be of mild steel welded construction and shall be designed in accordance with BS- 2594. The tank shall be designed for a wind pressure and seismic coefficient as specified. While worst of these two shall be considered, the permissible stress shall be increased as per IS.

3.4.2 The shell and dished end plate thickness shall be chosen as per design requirement but in no case the dished end and shell plate thickness shall be less than 8 mm.

3.4.3 All seams, longitudinal as well as circumferential, shall be butt welded. Longitudinal seams should not be situated in the lower third of a tank or on the top centre line.

3.4.4 All tank shall be supplied with integral saddle support and shall be designed in accordance with BS-2594.

4.0 TESTING AND INSPECTION AT MANUFACTURER'S WORKS

4.1 General

4.1.1 The supplier shall provide inspection to establish and maintain quality of workmanship in his works and that of his subcontractors to ensure the mechanical accuracy of components, compliance with drawings identity and acceptability of all materials, parts and equipment. He shall conduct all tests required to ensure that the equipment and material furnished shall conform to requirements of the acceptable codes. All tests and test procedure proposed by manufacturer shall be submitted to the purchaser for their prior approval.

4.1.2 All materials used for manufacture of the equipment under this specification shall be of tested quality. Relevant test certificates shall be made available to the purchaser before the final shop inspection. In case the relevant correlating test certificates are not available, the supplier shall arrange to carry out the necessary tests required by codes at his own cost.

4.1.3 Alloy cast iron and cast steel components shall be tested for both physical and chemical properties in absence of purchaser's representatives. Test bears shall be either integral or taken from the same ladle of material as the casting they represent.

4.2 TESTING AND INSPECTION FOR TANKS

4.2.1 The scope of testing and inspection for pressure vessel / tanks covered in this specification shall generally comprise of the following:

i) Examination and approval of fabrication drawings to ensure that design, materials and fabrication details meet requirement of code and specifications. Purchaser will review these drawings for interface problems and conformity with the general arrangement drawings and accord their approval.

ii) Examination of materials of construction and identification with material test certificates.



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iii) All the plates of thickness 50 mm or more shall be ultrasonically tested to ensure freedom from laminations.

iv) Ensuring the relevant weld procedure and welder qualification tests are in accordance with stipulated code requirements.

v) Inspection of dished end flanges and alloy steel bolting where required.

vi) Inspection during fabrication at appropriate stages including fit ups.

vii) For all butt welds, the root run and final run shall be subjected to dye penetrant or magnetic particle inspection. For all fillet welds the final run shall be subjected to dye penetrant / magnetic particle examination.

viii) Examination of radiographs including radiographic techniques, supervision of other non - destructive tests and heat treatment procedure as required by codes and specifications.

ix) Examination of internal cleanliness before final closure.

x) Dimensional examination of completed vessel including axis marking, proof marking, match marking etc.

xi) Witnessing of hydrostatic, pneumatic or vacuum tests or special tests as required by the code and specification. In case of hydrostatic tests, the test pressure must be kept for a minimum of two hours.

xii) Witnessing cleanliness, preservation, packing and marking.

xiii) Stamping of vessel and issue of certificates.

4.2.2 NON - PRESSURE TANKS

FIELD TESTING

Scope of testing and inspection for non-pressure tanks covered in this specification will comprise of the following:

4.2.2.1 Identification of materials to manufacturer's test certificates.

4.2.2.2 Inspection of plates, edges after edge preparation and checking curvature against template if shell plates sent after rolling.

4.2.2.3 Checking of dimension and match marking.

4.2.2.4 DPT / MPI on all welds (100%).

4.2.2.5 All cross / Tee joints and butt welds to be 10% Radio graphed.

4.2.2.6 For the offered tanks, fill test shall be carried out for at least 24 hours. Atmospheric storage tanks on inside surface shall be leak tested before painting.



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4.2.2.7 All quality plans / checklists for various items shall be furnished during detail engineering stage for BHEL / customer's approval and any changes required by BHEL / customer shall be incorporated in the documents and adhered without any price implication. However, minimum requirement of MQP as indicated in the technical specification shall be followed. All necessary items as required for inspection and testing of the tank including instruments shall be arranged by the bidder

4.2.3 REPAIR OF LEAKS

4.2.3.1 All leaks detected during testing shall be repaired to the satisfaction of the purchaser and on completion retested for leakages as per approved procedure.

4.2.3.2 In the joints between roof plates only, pin hole leaks may be repaired by mechanical method. However, where there is any indication of considerable porosity, the leaks shall be sealed by laying down an additional layer of weld over the porous sections.

4.2.3.3 In the other joints, whether between shell plates or bottom plates or both, leak shall be repaired by only welding and if necessary, after first cutting out the defective part.

5.0 PAINTING REQUIREMENT

Surface preparation, being a pre-requisite for any paint application, shall be such as to clean the surface thoroughly of any materials which will be conducive to premature failure of the paint substrata. Blast clean type (Grit blasting by copper/ MS/other) shall be decided during detailed engineering for which no commercial implication shall be entertained by BHEL.

All surfaces shall be cleaned of loose substances and foreign materials, such as dirt, rust, scale, oil, grease, welding flux etc. in order that the prime coat is rigidly anchored to virgin metal surface.

Paint shall be applied in accordance with paint manufacturer's recommendation and shall meet the requirement of the exposure condition and specific system of painting thereof.

The above is the minimum requirement to be followed by the successful bidder. Any additional requirement to ensure prevention of atmospheric corrosion shall be provided by the successful bidder without any commercial implication.

6.0 OTHER TECHNICAL REQUIREMENTS

1. All drawings shall be prepared as per BHEL's title block and bear BHEL's drawing No. and customer / consultant's drawing no; which will be forwarded to the successful bidder during detail engineering stage.
2. All the drawings which are required to be furnished to BHEL during detailed engineering stage shall include technical parameters, details of paints, BOQ / BOM etc in tabular form indicating all components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
3. All testing of tanks shall be done in line with testing requirement of this specification and as finalized during detailed engineering and customer approvals.

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

1X660 MW UPRVUNL PANKI TPS, EXTENSION

**TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & STORAGE SYSTEM**

**SECTION-IIB
(FORMAT FOR O& M MANUAL)**



**BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA**

Check List for Operation & Maintenance Manual

Project name:

Project number:

Package Name:

Sl.no. & Sections	Description	Yes	No	Not Applicable	Remarks
1.	Cover page				
1.1	Project Name				
1.2	Customer Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX email address				
1.5	Name and sign of prepared by , checked by & approved by				
2.0	Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	Description of Plant				
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				
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	Transportation and handling 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 and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipments.				
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.				
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.				

Dealing Engineer

Key Resource Person

Section Head

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

1X660 MW UPRVUNL PANKI TPS, EXTENSION

**TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & STORAGE SYSTEM**

**SECTION - IIC
(SITE STORAGE AND PRESERVATION MANUAL)**



**BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA**

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



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

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self- life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self- life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

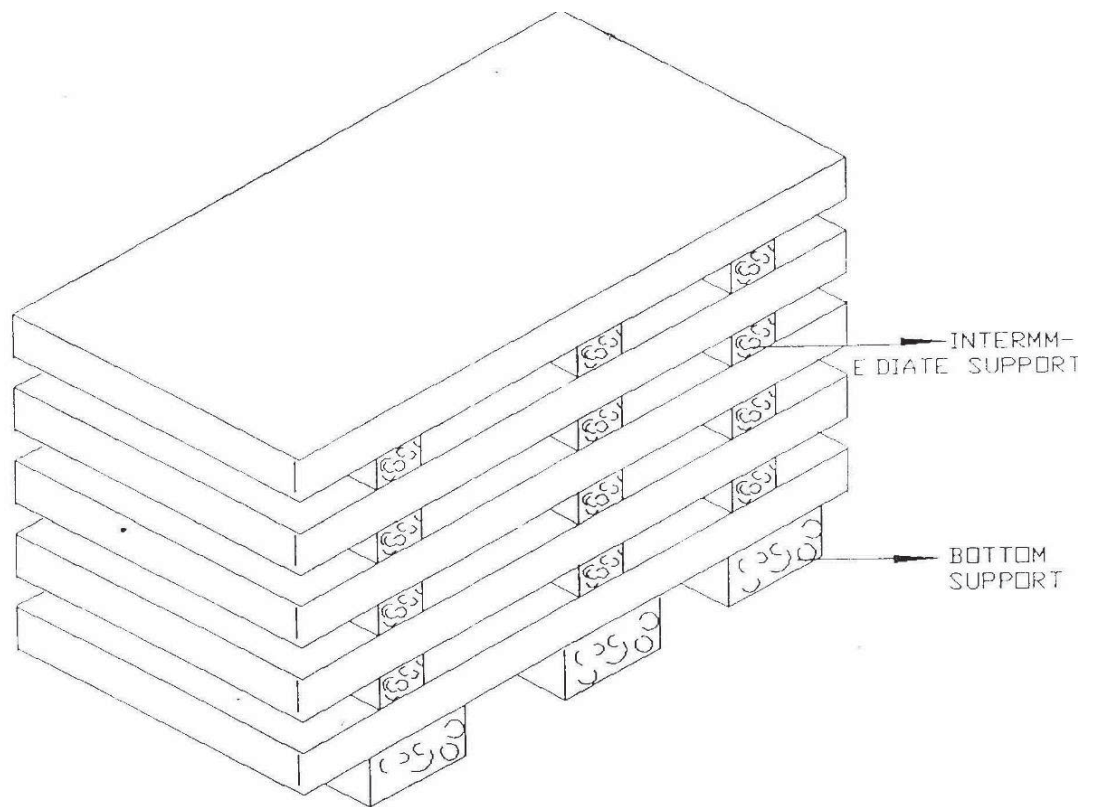


Figure – 1 – PLATE STACKING ARRANGEMENT

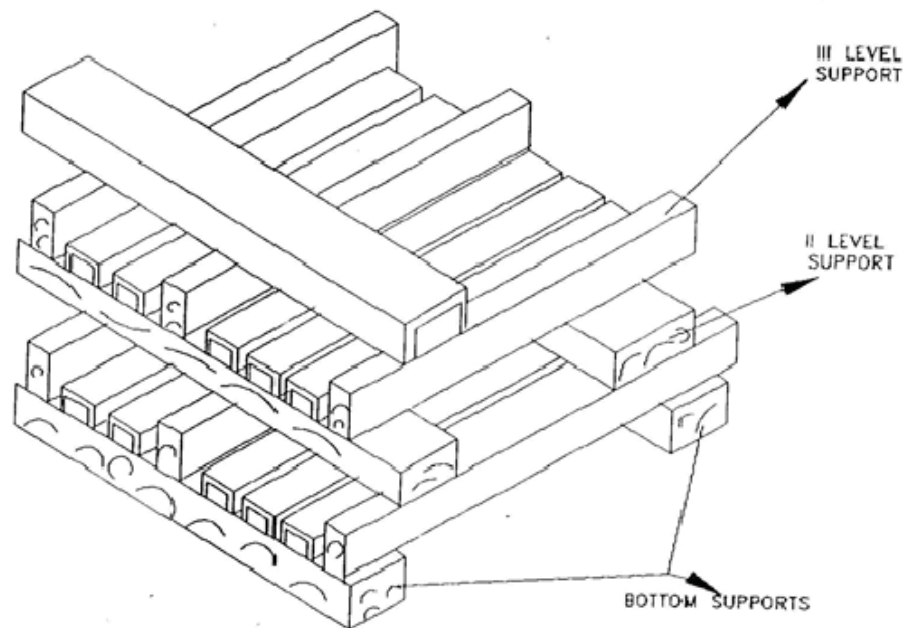


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

CHAPTER 10 : STORAGE OF EQUIPMENT / GOODS AT SITE

1.0 SCOPE

- 1.1 This specification details the general guidelines for storage of mechanical and electrical equipment at site from the date equipment are taken over by the CONTRACTOR until the same are erected and handed over to the OWNER.
- 1.2 The equipment covered under this specification shall be stored in the type of storage as recommended by the MANUFACTURER/OWNER/CONSULTANT.

2.0 CONSTRUCTION OF STORES

- 2.1 Normally, the OWNER makes available the space for the CONTRACTOR to construct the necessary stores as specified.
- 2.2 To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise wasteful handling during retrieval of items required for erection.
- 2.3 The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. The CONTRACTOR shall check the satisfactoriness of these facilities prior to monsoon.
- 2.4 The stores sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
- 2.5 In case of storage of certain equipment / materials, it may be necessary to maintain specified temperature ranges. In such cases, it is the responsibility of the CONTRACTOR to provide adequate heating / air conditioning facilities on round the clock basis. The CONTRACTOR shall check that space heaters, heating bulbs and air conditioners are kept energised continuously as applicable. In the event there is a prolonged failure of electric power, rendering such air-conditioners/space heaters inoperative, the CONTRACTOR shall make alternative arrangements to ensure that items under storage do not suffer any damage / deterioration on this account.
- 2.6 Adequate lighting facility shall be provided by the CONTRACTOR in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials entrusted to him by the OWNER. The CONTRACTOR shall carry out regular inventory of materials received, issued and erected and notify the OWNER of any loss when noticed.
- 2.7 The CONTRACTOR shall provide adequate number of competent stores personnel including store-keepers, clerical staff, inspection engineers, watchmen and security staff to efficiently store and maintain the equipment / material entrusted to him.
- 2.8 Where necessary, the CONTRACTOR shall provide necessary space heating and other protective care to equipment in case it will take a long time to haul them

to the stores. Any equipment left in the open under such conditions shall be, if required, covered with tarpaulin.

3.0 MAINTENANCE DURING STORAGE

- 3.1 Where unloading from the carriers and transport to warehouses is excluded from the CONTRACTOR'S scope .The CONTRACTOR shall take over the materials from the OWNER'S storage area / sheds.
- 3.2 Where materials is unloaded by the OWNER before the CONTRACTOR arrives at site or even when the CONTRACTOR is already at site, the OWNER can hand over the material to the CONTRACTOR and thereupon it will be the responsibility of the CONTRACTOR to store and maintain these material in a proper and approved manner.
- 3.3 While taking over the materials, the CONTRACTOR shall carry out inventory and inspection of the same and submit a report of his observations to the OWNER. After taking over of the equipment / materials, the CONTRACTOR is solely responsible for the same until handing over to the OWNER the erected plant and surplus materials, if any. The CONTRACTOR is responsible for maintenance of the equipment / materials in storage, during erection and until commissioning including protection of the same against theft, elements of nature and corrosion damages. In case commissioning of the equipment is delayed, the CONTRACTOR shall be responsible for maintenance of the erected plant and equipment as directed by OWNER / CONSULTANT.
- 3.4 The CONTRACTOR shall repack the equipment after inspection and store the same in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks, preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks.
- 3.5 The CONTRACTOR shall carry out frequent inspection of materials stored and also extend necessary facilities to the OWNER / CONSULTANT to carry out such inspection, when considered necessary. The CONTRACTOR shall implement the suggestions of the OWNER/CONSULTANT in this connection.
- 3.6 At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground by providing good wooden sleepers.
- 3.7 Welded and cast units shall be stored in such manner that there is no danger of distortion.
- 3.8 All special measures to prevent corrosion shall be taken by the CONTRACTOR.
- 3.8.1 Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The CONTRACTOR shall inspect the materials and in case of signs of wear or damages to protective coating, that portion shall be cleaned with carbon tetra chloride or any other approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
- 3.9 While handling the equipment, no dragging on the ground is permitted. The CONTRACTOR shall submit his scheme for handling major pieces of equipment

for approval by the OWNER / CONSULTANT prior to actual handling of the same. In cases where a scheme is recommended by the OWNER / MANUFACTURER, it shall be strictly adhered to.

- 3.10 The CONTRACTOR shall periodically inspect materials with specific reference to
 - 3.10.1 Ingress of moisture and corrosion damages.
 - 3.10.2 Damage to protective coating.
 - 3.10.3 Open ends in pipes, vessels and equipment. In case any open ends are noticed, the CONTRACTOR shall get them capped.
 - 3.10.4 Insulation of electrical equipment. Regular insulation checks are essential and these values shall be properly logged.
 - 3.10.5 Any damages to equipment / materials.
 - a) In case of any damages, these shall be promptly notified to the OWNER. In all cases, the repairs / rectification shall be carried out strictly as directed by the OWNER / CONSULTANT.
 - b) If such repairs / rectification is necessitated due to causes attributable to the CONTRACTOR, such repairs / rectification shall be carried out at no extra cost to the OWNER. In other cases, compensation for such repair / rectification works will be as mutually agreed to.
 - c) In case such damages are attributable to the CONTRACTOR and if, in the opinion of the OWNER/ CONSULTANT, the CONTRACTOR is not competent to carry out necessary repairs / rectification, the OWNER shall get this done by any other agency and recover the expenditure incurred by him from the CONTRACTOR.

4.0 MODES OF STORAGE

Given below are the general guidelines for storage of various equipments under the broad storage classifications. Wherever the specific recommendations of the MANUFACTURER/OWNER/CONSULTANT are at variance with what is indicated below, the former shall prevail.

4.1 Special Storage – Air Conditioned

The following materials are normally stored in air conditioned storage.

4.1.1 Welding Electrodes

These deteriorate under adverse conditions of storage and are preferably stored in air conditioned storage. As an alternative, if approved, these can also be stored in hot boxes / ovens.

It is essential to regularly inspect the conditions of electrodes and ensure that temperature is maintained within specified range at all times.

4.1.2 Ball, needle and roller bearings: These shall be stored in their original packing.

4.1.3 Photographic materials and films: These shall be stored in their original moisture vapor proof packages.

4.1.4 Rubber Goods: These shall be protected against sunlight and artificial light as well as high humidity conditions.

4.1.5 Hydraulic / Electronic equipment / instruments and components - These shall be stored in sealed packages.

4.2 Closed storage

The following materials are normally stored in closed storage.

4.2.1 Cement bags.

4.2.2 All small parts / components liable to be misplaced / lost. These shall include the following:

- a) Small structural cleats, bolts, nuts, washers, etc. High tensile bolts and nuts shall be stored in separate sealed boxes with proper identification to avoid mix up with other items
- b) Pipe hangers, spring hangers, etc. The identification numbers on spring hangers shall be carefully preserved during storage
- c) Stainless steel and copper tubes, pipe fittings, etc.
- d) Electrical clamps, cable boxes, cable glands, ferrules, fuses, control cables, copper cables and grounding strips, push button switches, etc.
- e) Pilot valves, pull rods, keys, control valves. These shall be greased, wrapped in paraffin paper and stored in packing boxes
- f) Turbine governing system components

4.2.3 All loose turbo generator parts, turbine sole plates and packing plates, bolts and studs.

4.2.4 Generator and turbine rotors, stators, bearings, liners, control gears, etc.

4.2.5 Boiler fine fittings, soot blowers, mill and fan bearings, hangers and couplings.

4.2.6 Electrostatic precipitator electrodes, connecting links, etc.

4.2.7 Drive units of regenerative air heaters, fans, mills, etc., motors, pumps, blowers, ejectors and compressors, including those supplied disassembled.

4.2.8 Oil and hydrogen coolers.

4.2.9 Seal oil and gas control system equipment.

4.2.10 All indoor switch gear equipments.

4.2.11 Bus ducts, exciters, excitation system equipment, voltage regulators, circuit breakers, potential and current transformers, lightning arrestors, bushings, storage batteries and cells.

- 4.2.12 All instrument parts such as measuring instruments, controllers and regulators, interlock system, control drive units, gauges, instrument valves, thermocouples and leads.
- 4.2.13 Thermal and insulation materials. Mineral wool, glass wool, castable refractories, fire bricks, asbestos, etc.
- 4.2.14 DM plant chemicals and resins.
- 4.2.15 Synthetic paints. Normally in separate stores.

4.3 Semi-Closed Storage

The following materials are normally stored in semi-closed storage.

- 4.3.1 Condenser tubes stored in boxes.
- 4.3.2 Dust collector elements in boxes.
- 4.3.3 Coal mill liners, shell, coal feeders and gates, separator assembly.
- 4.3.4 Boiler dampers, manhole doors, mountings, casing frames, buck stays, Air pre-heater frames tubes, baskets. Burner panels and burners, Electrostatic precipitator shell, discharge and collecting plates.
- 4.3.5 Fan impellers, large assembled pumps, compressors, crushers, pulleys and idlers, wagon tippler drive assemblies and bearings, outdoor motors, etc..
- 4.3.6 Large C. I. Valves, butterfly valves, stop and control valves, expansion joints.
- 4.3.7 Outdoor switch gears and panels, small transformers, cable tray parts, etc.
- 4.3.8 Crane rope drums, hoists, trolleys. Wire ropes in drums covered with tarpaulin.
- 4.3.9 Bearing stands
- 4.3.10 Conveyor belts

4.4 Open Storage

The following materials are normally stored in open storage.

- 4.4.1 Fabricated and un-fabricated structural steel members, Chimney steel, stairways and hand rails. Gallery steel Crane bridges and steel members, Reinforcement steel.
- 4.4.2 Coarse aggregates and sand.
- 4.4.3 Un-fabricated pipes and fabricated pipe assemblies, Concrete and hume pipes. Large diameter conduits / pipes in boxes, Ash disposal pipes.
- 4.4.4 Boiler, drum, tubes, tube panels and headers.
- 4.4.5 Mill drums, bunker plates, etc.
- 4.4.6 Condenser shell parts, water boxes, etc.

- 4.4.7 Air pre-heater tube plates.
- 4.4.8 De-aerators, feed water heaters, etc.
- 4.4.9 Conveyor steel, and wagon tippler parts except drive units
- 4.4.10 Pressure vessels, reaction towers and columns, Fabricated vessels and tanks shall have their openings firmly blanked.
- 4.4.11 Flocculator Bridge, D.M. plant filters, vessels, etc.
- 4.4.12 Cable drums
- 4.4.13 Large power transformers

5.0 SPECIFIC GUIDELINES FOR STORAGE

Given below are the guidelines for certain other major equipment / materials. These are broad guidelines only and storage shall be strictly as directed by the Manufacturer / OWNER / CONSULTANT.

5.1 Condenser

Condenser shells shall be stored on sleepers in open storage. The materials shall be kept resting in such a manner that there is no distortion to the assemblies. The bracings provided at the factory shall not be disturbed. Handling shall be strictly as per the recommendations of the Manufacturer. The tube sheets shall be protected against corrosion and tube holes against scratches. The condenser tubes shall be inspected on receipt and stored in boxes in which they are reviewed.

5.2 Deaerator

The deaerator shall be drained of water and stored dry. The nozzles shall be sealed / capped. If trays are delivered separately, these shall be stored on racks in closed storage.

5.3 Feed Water Heaters, Heat Exchangers, Vessels and Bearings

- 5.3.1 These equipment shall be drained of water and stored dry, with openings and flanges sealed / capped.
- 5.3.2 The hooks, eye bolts, etc., provided shall be used for handling these equipment.
- 5.3.3 All machined surfaces shall be coated with approved protective coating at regular intervals.
- 5.3.4 Heat exchangers shall be stored in horizontal position.

5.4 Rotating Equipment such as Pumps and Compressors

- 5.4.1 These are normally stored in assembled condition in closed / semi-closed storage. When stored in semi-closed storage, they shall be covered with tarpaulin and bed plates shall rest fully on sleepers.

- 5.4.2 The CONTRACTOR is responsible for proper lubrication of these equipment as directed.
- 5.4.3 The gear boxes and oil sumps shall be kept filled with recommended lubricating gear oil. The couplings and bearings shall be covered with approved grease and nozzle flanges screwed with caps or suitably plugged.
- 5.4.4 Pumps, if delivered in dis-assembled condition, shall be stored with the parts properly greased and wrapped in paraffin paper. Smaller parts are to be stored on racks whereas larger parts on sleepers in closed storage. Occasional flushing with hot lubricating oil may have to be carried out, if so directed; in the cases of equipment such as boiler feed pump.
- 5.4.5 The shafts of rotating equipment shall be turned by 90° every week to avoid rotor journals from rusting and to ensure that shaft is free to rotate.
- 5.4.6 The CONTRACTOR shall maintain record of lubrication with details of lubricants used as well as protective measures carried out.

5.5 Piping and Valves

- 5.5.1 All pipes shall be stored on sleeper beds with open ends securely capped. The beveled ends shall be protected with a coating of approved grease. If so directed, inside surfaces of piping shall be coated with approved protective solution.
- 5.5.2 Pipes shall be neatly arranged and stacked for easy identification and retrieval.
- 5.5.3 Pipes shall be blown with air prior to installation and it shall be ensured that there is no obstruction.
- 5.5.4 Valves shall be stored with the discs screwed down on the seat so that packing surfaces are not exposed to dust. All machined surfaces shall be covered with grease. Preservation of identification tags is essential to avoid installation in a wrong service.

5.6 Switch gear & Control Panels

- 5.6.1 Depending on whether these are of indoor or outdoor design, these shall be stored in closed / semi-closed storage.
- 5.6.2 The spaced heaters, where provided, shall be kept connected with power supply irrespective of mode of storage where space heaters are not provided, use of adequate number of heating bulbs is recommended.
- 5.6.3 Insulation resistance shall be measured at regular intervals and megger values properly logged.

5.7 Transformers

- 5.7.1 It is advisable to assemble and set the transformer filled with oil in its permanent location soon after receipt even if it is not likely to be put in service for a while. In case of gas filled transformers, a positive pressure should be maintained during storage as recommended by the Manufacturer. If transformer is to be stored partially or fully dis-assembled, it shall be protected against moisture ingress / absorption by keeping them immersed in

transformer oil or as recommended by the MANUFACTURE / OWNER / CONSULTANT.

- 5.7.2 Prior to charging any transformer, it is essential to check the satisfactoriness of insulation values and di-electric strength of oil.

5.8 Cells, Accumulators, Batteries

These shall be stored in a dry and well ventilated place and protected from extreme cold. Internal parts of large cells are loose and the cells should be handled with care to avoid displacement of internals. Saw dust shall never be used for packing batteries as it is hygroscopic.

5.9 Cables

Cable drums if stored indoors shall be in dry, ventilated stores. Cables are normally supplied with ends sealed. When a length is cut, the end should be resealed. The drums shall be stored with adequate spacing between them for better air circulation.

5.10 Motors

Besides general procedures such as regular inspection and recording of insulation resistances, in the case of LT motors, if so recommended, low voltage current flow through the windings may be maintained during storage.

5.11 Instruments

- 5.11.1 These are stored on racks in closed storage and in air conditioned storage if so recommended. These shall be stored in their packages in dry condition and shall be handled with extreme care.
- 5.11.2 Instrument flanges and nozzles, if directed, shall be coated with technical Vaseline.
- 5.11.3 In the case of fragile instruments, the storage shall be in a separate zone away from where heavy materials are stored to minimise danger of damage.

5.12 STEEL

5.12.1 Reinforcement steel:

Reinforcement steel shall not be kept in direct contact with the ground but stacked on top of an arrangement of timber sleepers or the like. If stored for long periods, these may be coated with cement wash before stacking to prevent loose scales and rust. Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion and deterioration.

5.12.2 Structural steel:

Structural steel could safely be stored in open storage but with sufficient space in between for handling and crane movement. All steel shall be stored 200 mm above ground on suitable packing to avoid damage. It should be stored according to sizes and sections preferably in the order required for erection. The area for open storage should be properly graded to avoid water logging in the storage area. Steel shall not be stored in the vicinity of areas where excavation or grading will be done. Scratched or abraded steel shall be given a

coat of primer for protection after unloading and handling prior to erection. All milled and machined surfaces shall be properly protected from rust / corrosion by suitable coating.

5.13 Cement

- 5.13.1 Cement shall be stored in bags in a separate shed away from where mechanical and electrical equipment are stored to minimise the possibility of cement dust settling on the equipment.
- 5.13.2 The storage shed where cement is stored shall be absolutely water tight. The flooring shall be a 15 mm thick concrete slab laid on a dry course soling or as recommended. The ground shall be drained away from the shed to prevent accumulation of water in its vicinity.
- 5.13.3 The bags shall be neatly stacked with adequate passage in between for easy retrieval. The cement shall be issued on 'First-In-First-Out' basis.
- 5.13.4 In case different grades of cement are stored in the same shed, each grade shall be stacked separately to avoid mix up and clear indication boards shall be provided to identify different grades.

5.14 Synthetic Paints

These have limited life and as a safeguard against possible deterioration, the drums shall be inverted at regular intervals as specified to minimise risk of hard settling of pigments.

5.15 Slings & Wire Ropes

All slings and wire ropes shall be coated with approved grease and hung from racks in rolled condition.

6.0 DOCUMENTATION

The CONTRACTOR'S store-keeping function will include maintaining various records as required by the OWNER / CONSULTANT. These records shall include but not be limited to:

- 6.1 Supplier wise record of equipment / material received stored and issued for erection as well as stock position.
- 6.2 Record of inspection and repairs carried out, protective measures and lubrication of equipment in storage as well as erected until the same are taken over by the OWNER.



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
1X660 MW UPRVUNL PANKI TPS, EXTENSION**

SPECIFICATION NO. PE-TS-426-166-A001

SECTION IIIA

REV – 00

DATE - 03.07.18

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

1X660 MW UPRVUNL PANKI TPS, EXTENSION

TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & STORAGE SYSTEM

SECTION-IIIA



**BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT PPEI,
NOIDA-INDIA**



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
1X660 MW UPRVUNL PANKI TPS, EXTENSION**

SPECIFICATION NO. PE-TS-426-166-A001

SECTION IIIA

REV – 00

DATE - 03.07.18

LIST OF DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder shall submit following drawings / documents along with their bid:

- a. Copy of electrical scope between BHEL & vendor duly signed and stamped.
- b. Electrical equipment specification for Fuel oil system duly signed and stamped.
- c. Electrical load list
- d. Deviation schedule with reference to specific clauses of the specification along with reason for such deviation.
- e. Copy of unpriced price bid indicating “QUOTED / NOT QUOTED” / “NOT APPLICABLE” as the case may be.
- f. Copy of drwg/doc schedule duly signed and stamped.
- g. Compliance cum confirmation certificate

NOTES:

OFFER WILL BE CONSIDERED AS INCOMPLETE IN ABSENCE OF ANY OF THE ABOVE DOCUMENTS.

DOCUMENTS OTHER THAN ABOVE, IF ANY, SUBMITTED WITH THE OFFER WILL NOT FORM PART OF CONTRACT AND ACCORDINGLY WILL NOT BE CONSIDERED FOR BID EVALUATION.

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

1X660 MW UPRVUNL PANKI TPS, EXTENSION

TECHNICAL SPECIFICATION

FOR

FUEL OIL UNLOADING & STORAGE SYSTEM

SECTION - IIIB

COMPLIANCE CUM CONFIRMATION CERTIFICATE



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT PPEI,
NOIDA-INDIA

	TITLE:	SPEC. NO.: PE-TS-426-166-A001
	1X660 MW UPRVUNL PANKI TPS, EXTENSION	SECTION: IIIB
	COMPLIANCE CUM CONFIRMATION CERTIFICATE	REV. NO. 0 DATE
		SHEET 1 OF 2

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate (every sheet) and furnish 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 other than those mentioned under "exclusion" and those resolved as per 'Schedule of Deviations', if applicable, with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & 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. This shall be within the contracted price with no extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified/ intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre - bid discussions, otherwise BHEL/ Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.
- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment as applicable, shall be as per relevant clause of GCC /SCC /Other Commercial Terms & Conditions.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities. This clause will apply in case during site commissioning additional requirements emerges due to customer and/ or consultant's comments. No extra claims shall be put on this account.
- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.



TITLE:

1X660 MW UPRVUNL PANKI TPS, EXTENSION

COMPLIANCE CUM CONFIRMATION CERTIFICATE

SPEC. NO.: PE-TS-426-166-A001

SECTION: IIIB

REV. NO. 0	DATE
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SHEET 2 OF 2

- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

1X660 MW UPRVUNL PANKI TPS, EXTENSION

TECHNICAL SPECIFICATION

FOR

FUEL OIL UNLOADING & STORAGE SYSTEM

SECTION - IIIC

PRE BID CLARIFICATION SCHEDULE



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT PPEI,
NOIDA-INDIA



TITLE

TECHNICAL SPECIFICATION FOR FOUS**1X660 MW UPRVUNL PANKI TPS, EXTENSION**

SPECIFICATION NO. PE-TS-426 -166-A001

SECTION IIIC

REV 00

PRE-BID CLARIFICATION SCHEDULE

S.No.	Section/Clause/ Page No.	Statement of the referred clause	Clarification required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

1X660 MW UPRVUNL PANKI TPS, EXTENSION

TECHNICAL SPECIFICATION

FOR

FUEL OIL UNLOADING & STORAGE SYSTEM

SECTION - IIID

SCHEDULE OF TECHNICAL DEVIATION



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT PPEI,
NOIDA-INDIA

DEVIATION SHEET (COST OF WITHDRAWAL)**PROJECT:- 1X660 MW UPRVUNL PANKI TPS, EXTENSION****PACKAGE:- FUEL OIL UNLOADING AND STORAGE SYSTEM****TENDER ENQUIRY REFERENCE:-****NAME OF VENDOR:-**

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

COMMERCIAL DEVIATIONS

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATIONS	SIGN & DATE	
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NOTES:

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

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

1X660 MW UPRVUNL PANKI TPS, EXTENSION

TECHNICAL SPECIFICATION

FOR

FUEL OIL UNLOADING & STORAGE SYSTEM

SECTION - IIIIE

ELECTRICAL LOAD DATA



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT PPEI,
NOIDA-INDIA

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.	CONT ROL CODE	REMA RKS	LOAD No.	VERIFICATI ON FROM MOTOR DATASHEE T (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)	4	5	RUNNING		7	8	9	10	11	12	13	14	SIZE CODE Nos		17	18	19	20	21
					6	STANDBY															
1	2	3																			
LDO U/L PUMP MOTORS		90	S	4	1	D	U		I			FO P/H									
DRAIN OIL PUMP MOTORS		11	S	1	1	D	U		I			FO P/H									
SUMP PUMP MOTORS IN WATER PIT OF OIL WATER SEPARATOR		7.5	S	1	1	D	U		I			NEAR FO TANK FARM AREA									
RECOVERY OIL PUMPS IN OIL PIT OF OIL WATER SEPARAOTR		4	S	1	1	D	U		I			NEAR FO TANK FARM AREA									
SUMP PUMPS IN LDO P/H		7.5	S	1	1	D	U		I			FO P/H									
SUMP PUMPS IN LDO U/L TRENCH		7.5	S	1	1	D	U		I			LDO U/L TRENCH									
SUMP PUMPS IN LDOU/L DRAIN TRENCH		7.5	S	1	1	D	U		I			LDO U/L TRENCH									
MOTORISES VALVES		2.2	S	1	3	D	B		I			INLET & OUTLET VALVES OF LDO TANKS									
MOTORIZED VALVES		1.5	S	4	1	D	B		I			AT DISCH. OF LDO U/L PUMP									
Note: Bidder to note that these are the maximum loads that will be feeded by BHEL MCC. Any changes if required in the above loads shall be informed by bidder in the prebid stage itself. Later on, if bidder asks any change in loads, the cost of modification in BHEL MCC for accommodating the change in loads shall be borne by bidder.																					
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 (CONTACTACTER CONTROLLED)																					
LOAD DATA (ELECTRICAL)	JOB NO.		PROJECT TITLE		SYSTEM		DEPTT. / SECTION		FUEL OIL SYSTEM		MAX		SHEET 1 OF 1		REV. 00		DE'S SIGN. & DATE		PEM (ELECTRICAL)		
	426		1X660 MW UPRV/JNL PANKI TPS. EXTENSION										NAME		DATA FILLED UP ON						
													SIGN.		DATA ENTERED ON						