		QUALITY PLAN SHEET 9 OF 9			CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
					BIDDER/ VENDOR SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION VOLUME III			AGENCY REMARKS		
									P	W	V			
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 WITH THE CUSTOMERS, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.														
BHEL			PARTICULARS			BIDDER/VENDOR								
			NAME											
			SIGNATURE											
			DATE						BIDDER'S/VENDORS COMPANY SEAL					







TECHNICAL SPECIFICATION
2X500 MW NEW NEYVELI

SPECIFICATION No: PE-TS-400 & 402-554-A001


VOLUME II B

SECTION C4

REV. 00

DATE: AUGUST 2014

SECTION-C4
C&I SPECIFICATION


Varun Jain


S A Khan


Praveen Kishore

**C&I SPECIFICATIONS
FOR
VENTILATION SYSTEM
FOR
2X500MW NNTPP (TG & SG PACKAGE)**


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2X500 MW NNTPP- (TG & SG PACKAGE)

**SPECIFIC TECHNICAL REQUIREMENTS (C&I)
VENTILATION SYSTEM**

Specific Technical Requirements (C&I):

- 1.0 The control of Ventilation System shall be through PLC based control system having hot redundant Central Processing Unit. The PLC based control system shall be supplied under Air Conditioning Package. The operation and control philosophy of Air Conditioning System and Ventilation system has been elaborated in separate section in the specification. The PLC shall be common for both units, and shall be located in AC Plant Room. All the interface requirements of ventilation system which are to be hooked up with PLC in AC Plant Room shall be taken care by the bidder.
- 1.1 Bidder to keep the provision for accepting fire signals from Fire Alarm & Protection System and the closure of relevant fire dampers in Air Conditioning and Ventilation System.
- 1.2 The solenoid valves shall have limit switches for open/close feedback.
- 1.3 All electrical actuators shall be of non-integral starter type.
- 1.4 Interface of MCC, HT SWGR, field instruments, Actuators etc. with PLC based control system shall be as per Drive Control Philosophy attached in the specification.
- 1.5 All the instruments/drives shall be terminated on JBs/Panels in field. JBs/Panels shall be in Bidder's scope.
- 1.6 Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification.
- 1.7 The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.


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2X500 MW NNTPP- (TG & SG PACKAGE)

**SPECIFIC TECHNICAL REQUIREMENTS (C&I)
VENTILATION SYSTEM**

1.8 Following documents to be furnished by the bidder along with the bid:

- List of drives pertaining to Ventilation System
- I/O List for Ventilation System
- Duly stamped and signed copy of Quality Plan.

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

- Operation & Control Philosophy for Ventilation system
- Recommended logic diagram/ write up for Ventilation system
- Input/Output signal list.
- Cable schedule and cable interconnection drawing.
- Instrument schedule.
- Instrument Data sheets.
- Any other document decided during detailed engineering.


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Sl.No	Description	Unit	Qty.	Remarks
1.18.1	Complete set of control valve each size and type with actuator and its control	%	5	
1.18.2	<u>Control valves internals</u>			
1.18.2.1	Valve stem with plug & seat ring each size and type	Nos	2	
1.18.2.2	Gasket of each type and Size	Nos	5	
1.18.2.3	Body seal gaskets of each size and type	Nos	5	
1.18.2.4	Cage of each size and type	Nos	1	
1.18.2.5	Gland packing each size and type	Sets	5	
1.18.2.6	Valve Trim of each size and type	Nos.	1	
1.19	<u>Actuator internals</u>			
1.19.1	Complete set of control valve each size and type with actuator and its control	%	5	
1.19.2	Diaphragm of each type and size	%	5	
1.19.3	Seal box "O" ring of each type and size	%	5	
1.19.4	Color "O" ring of each type and size	%	5	
1.19.5	Limit switch (complete instrument) of each model and type	%	5	
1.19.6	Solenoid valve (complete instrument) of each model and type	%	5	
1.19.7	Valve positioned (complete instrument) of each model and type	%	5	
1.19.8	Position transmitters (complete instrument) of each model and type	%	5	
1.19.9	Air set / regulator with gauge	%	5	
1.19.10	Air lock relay	%	5	
1.19.11	Air booster / accumulator	%	5	
1.20	<u>HVAC system</u>			
1.20.1	Humidistat	no	2	
1.20.2	Pr. Gauge of each type and range	%	5	
1.20.3	Temperature gauge of each type and range	%	5	
1.20.4	Level switches of each type and range	Nos	2	
1.20.5	Solenoid valves of each type and range	Nos	2	
1.20.6	Flow meter of each type and range	Nos	2	
1.20.7	Flow Switch of each type	Nos	2	
1.20.8	Thermostat of each type	No	2	
1.20.9	PLC and its cards (if applicable)	%	10	

Any other equipment not specifically mentioned for Turbo generator area but necessary for operation of the plant shall be finalized at the end of detail engineering.

Document Number	Rev No.	Description	Page No.	Date of Issue
LII-GEOE11019-G-00155-002	02	NTA2, VOL.-VI, Spares	46	25-Jun-11

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:	
			VOLUME	
			SECTION	
			REV. NO.	DATE:
			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			
	OFFER REFERENCE			
	* TAG NO. SERVICE			
	* DUTY	<input type="checkbox"/> ON / OFF	<input type="checkbox"/> INCHING	
	* LINE SIZE (inlet/outlet): MATERIAL			
	* VALVE TYPE	<input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> 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, IP:67		
	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	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO	
	* ORIENTATION	<input type="checkbox"/> TOP MOUNTED	<input type="checkbox"/> 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	IE1 TYPE AS PER IS: 12615, SQUIRREL CAGE INDUCTION MOTOR SUITABLE FOR DOL STARTING.		
	ACTUATOR APPLICABLE WIRING DIAGRAM	<input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM) <input checked="" type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11		
	COLOUR SHADE	<input checked="" type="checkbox"/> BLUE (RAL 5012), To be decided during detail engg.		
	PAINT TYPE (## Refer Notes)	<input type="checkbox"/> ENAMEL	<input checked="" type="checkbox"/> EPOXY	<input type="checkbox"/>
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		
	@ STARTING / FULL LOAD CURRENT	600% OF FLC INCLUSIVE OF I.S. TOLERANCE		
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC	DOL STARTER	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 230 V <input type="checkbox"/> 110 V		
	@ ENCLOSURE CLASS OF MOTOR	<input checked="" type="checkbox"/> IP 67 <input type="checkbox"/> FLAME PROOF		
@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B			


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**SPECIFICATION
FOR
MOTORISED VALVE ACTUATOR**

SPECIFICATION NO.:	
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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)

	@ WINDING TEMP PROTECTION	<input checked="" type="checkbox"/> THERMOSTAT (3 Nos.,1 IN EACH PHASE) <input type="checkbox"/> -----		
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED		
INTEGRAL STARTER	INTEGRAL STARTER	<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED		
	TYPE OF SWITCHING DEVICE	<input type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS		
	TYPE	<input type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)		
	IF SMART			
	a) SERIAL LINK INTERFACE	<input type="checkbox"/> INTEGRAL <input type="checkbox"/> FIELD MOUNTED		
	b) SERIAL LINK PROTOCOL	<input type="checkbox"/> FOUNDATION FIELD-BUS <input type="checkbox"/> PROFI-BUS <input type="checkbox"/> DEVICE NET <input type="checkbox"/>		
	c) SERIAL LINK MEDIA	<input type="checkbox"/> TWISTED PAIR Cu-CBL <input type="checkbox"/> CO-AXIAL Cu-CBL <input type="checkbox"/> OFC		
	d) HAND HELD PROGRAMMER	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	e) TYPE OF HAND HELD PROGRAMMER	<input type="checkbox"/> BLUETOOTH <input type="checkbox"/> INFRARED <input type="checkbox"/>		
	f) MASTER STATION	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	g) MASTER STN INTRFACE WITH DCS	<input type="checkbox"/> MODBUS <input type="checkbox"/> TCP/IP		
	h) DETAILS OF SPECIAL CABLE	<input type="checkbox"/> ENCLOSED <input type="checkbox"/> NOT REQUIRED		
	STEP DOWN CONT. TRANSFORMER	<input type="checkbox"/> REQUIRED		
	OPEN / CLOSE PB	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	STOP PB	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
INDICATING LAMPS	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
LOCAL REMOTE S/S	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
STATUS CONTACTS FOR MONITORING	<input type="checkbox"/> REQUIRED <input type="checkbox"/> 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	<input type="checkbox"/> INTERPOSING RELAY <input type="checkbox"/> OPTO COUPLER <input type="checkbox"/> EITHER		
	QUANTITY	<input type="checkbox"/> 2 NOs. <input type="checkbox"/> 3 NOs.		
	DRIVING VOLTAGE	<input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC		
	DRIVING CURRENT	<input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX		
	LOAD RESISTANCE	<input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms		
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN / CLOSE	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 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	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2 Nos.	2 Nos. (ADJ.)	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos.
	CONTACT TYPE	2 NO + 2 NC		
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC		

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**SPECIFICATION
FOR
MOTORISED VALVE ACTUATOR**

SPECIFICATION NO.:	
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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 (For inching duty & other specific applications)	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	<input type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	<input checked="" type="checkbox"/> 24V DC <input type="checkbox"/>	
	OUTPUT	<input checked="" type="checkbox"/> 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING	FOR MOTORS WITH RATING >30 KW	
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ <input type="checkbox"/> IP 68 @ <input type="checkbox"/>	
	@ EARTHING TERMINAL	8 SWG GI WIRE	
	PLUG & SOCKET(9 PIN) (FOR COMM, LS/TS FEED BACK, PoT)	<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED <input type="checkbox"/> 2 NOS. <input type="checkbox"/>	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:DDE	
	@ SPACE HEATER CABLE GLAND	SIZE:DDE	
	OTHER CONTROL CABLE GLANDS-1	<input type="checkbox"/> 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.

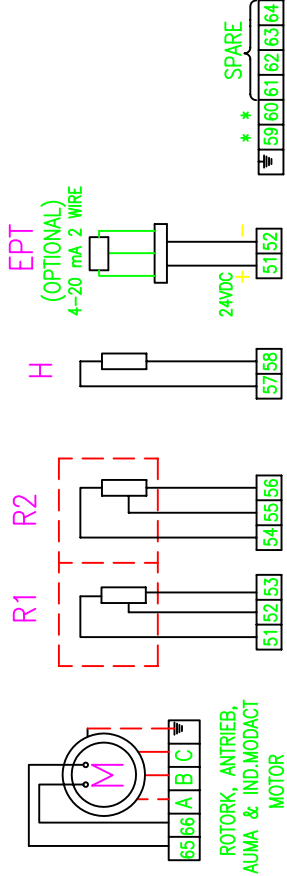
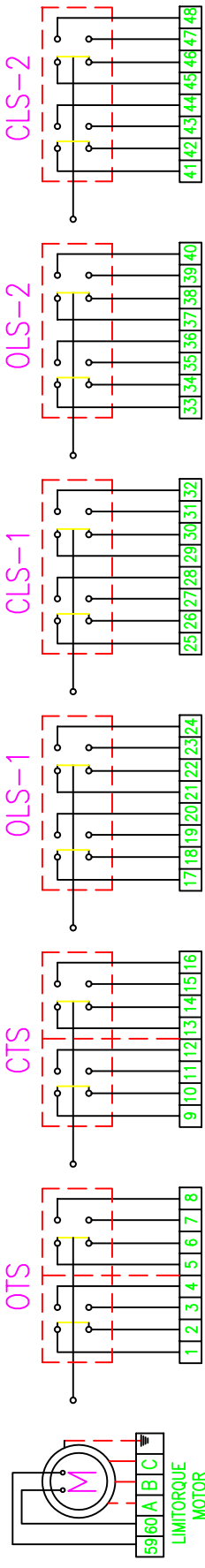
NOTES:

- SCOPE:** DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
 - CODES & STANDARDS:** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691, IS 12615 AND IS-4722
 - TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
 - CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL, WITH NICKEL COATING SHALL BE PROVIDED.
 - 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.
 - 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%.
 - 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.**

NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
				NAME
				SIGNATURE
				DATE

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @= TO BE FILLED BY ES

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CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OFF AT OVER TORQUE DURING OPENING TRAVEL
	5-6	ON AT OVER TORQUE DURING OPENING TRAVEL
	3-4	ON AT OVER TORQUE DURING OPENING TRAVEL
	7-8	ON AT OVER TORQUE DURING OPENING TRAVEL
CTS	9-10	OFF AT OVER TORQUE DURING CLOSING TRAVEL
	13-14	ON AT OVER TORQUE DURING CLOSING TRAVEL
	11-12	ON AT OVER TORQUE DURING CLOSING TRAVEL
	15-16	ON AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	17-18	
	21-22	
	19-20	
	23-24	
	25-26	
	29-30	
	27-28	
	31-32	
	33-34	
OLS-2	37-38	
	35-36	
	39-40	
	41-42	
	45-46	
	43-44	
	47-48	
SWITCH	TERMINAL NO.	VALVE POSITION
	a	INTERMEDIATE
	b	FULL CLOSE
		FULL OPEN

— INDICATES CONTACT CLOSED
 - - - INDICATES CONTACT OPEN

* - SPARE FOR ROTORK, AUMA, ANTRIEB & IND.MODACT SWITCHES - ALL ARE POTENTIAL FREE AND TWO PAIR OF CONTACTS CAN BE USED FOR DIFFERENT SUPPLY THERMOSTAT - 65-66 (ROTORK, AUMA, ANTRIEB & IND.MODACT), 59-60 (LIMITORQUE).
 EPT - ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
 THERMOSTAT TERMINALS - TERMINATED IN MOTOR TB IN ANTRIEB & IND.MODACT AND IN MAIN TB IN OTHER MAKES
 CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE) - 2 NO+2 NC
 OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN) - 2 NO+2 NC
 OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN - 2 NO+2 NC
 CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE - 2 NO+2 NC
 OTS, CTS - TWO INDEPENDENT SWITCHES IN ANTRIEB & LIMITORQUE
 OLS-2 & CLS-2 - CAM DISC IN ROTORK & ANTRIEB
 R1-R2- POTENTIOMETER 2 x 100 OHMS
 H - SPACE HEATER 1ø 240V AC SUPPLY
 M - MOTOR 3ø 415V 50 Hz AC SUPPLY

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS	CTS	⊕

⊕ - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT
 NOTE:
 1. BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)
 2. CONNECT THERMOSTAT WITHOUT FAIL IN THE STARTER CIRCUIT

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

BHARAT HEAVY ELECTRICALS LTD.
 UNIT: HIGH PRESSURE BOILER PLANT.
 TIRUCHIRAPPALLI 620014.

365-139

INTERNAL WIRING DIAGRAM
 FOR
 ELECTRICAL VALVE ACTUATORS (AC)
 (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

DRAWN	N.P.ESWAR	TITLE	INTERNAL WIRING DIAGRAM
CHECKED	KARUNACHALAM		
APPROVED	P.LOGANATHAN		
DATE	09.09.2000	CONTRACT DEV. FIG. ADDED.	
APPD		DESCRIPTION	
DRAWING No.	4-V-MISC-90271	REV	11

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9. FIELD INSTRUMENTS & FINAL CONTROL ELEMENTS

9.1 General Requirements

1. Measuring instruments/equipment and subsystems offered by the Contractor shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further, all instruments shall be of proven reliability, accuracy, repeatability requiring a minimum of maintenance. They shall comply with the acceptable international standards and shall be subject to owner's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, make/ numbers as approved by the owner during detailed engineering.
2. 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.
3. All local gauges as well as transmitters, sensors, and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment under the scope of specification shall be provided.
4. 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 tapings where the pressure exceeds 40 kg/sq cm.
5. For protection purposes, transmitters can be considered in place of switches.


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9.2 Pressure / Differential Pressure / Flow / Level Transmitter
Table 9.1
Specifications for Pressure / Differential Pressure / Flow / Level Transmitter

S.N	Features	Minimum Requirements
1	Type	Microprocessor based 2 wire type, HART protocol compatible
2	Sensor Type	Capacitive/ Piezo-electric
3	Output Signal	4-20 mA signals superimposed with HART signal.
4	Signal Processing Unit	Microprocessor based
5	Overpressure	150% of max. operating pressure. For vacuum service, the element shall have under – range protection to full vacuum
6	Turn-down Ratio	10:1 for vacuum / very low pressure applications. 100:1 for other applications.
7	Stability	± 0.1% of calibrated span for six months up to 70 Kg/cm ² and ± 0.25% for range more than 70 Kg/cm ² (g).
8	Span and Zero drift	± 0.015% per deg. C at max span & 0.11% per deg. C at min. span.
9	Enclosure Class	Weather proof as per IP 67 with corrosion resistance coating. For hazardous area explosion proof enclosure as described in NEC article 500
10	Zero & span adjustability	Continuous, tamper proof, remote as well as manual from instrument with zero suppression and elevation facility.
11	Local Indicator	To be provided
12	Display	Digital LCD Integral Display (minimum 5 digit) Engineering Unit
13	Process connection	½" NPT (F)
14	Electrical connection	½" NPT
15	MOC of Electrical Housing	Aluminum Alloy or better
16	Ambient Temperature	65 Deg. C
17	Operating Voltage	16 – 48 Volts DC
18	Load	600 Ohms (minimum) at 24 Volts DC
19	Accuracy	± 0.075% of span or better
20	Response Time	100 milli-second or better
21	Adjustment/ calibration/ maintenance	Centralised PC based system maintenance per clause.

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- All transmitters shall be equipped with all necessary accessories like valve manifolds, mounting bracket etc. Pulsation dampeners shall be used where the process media is unstable for measurement such as at the discharge of a pump. For absolute pressure transmitter, 2 valve manifold; for gauge / vacuum pressure transmitter, 3 valve manifold and



- for DP / level / flow transmitter, 5 valve manifold shall be provided. In case if it becomes necessary to use a DP transmitter for pressure measurement then a 3 valve manifold shall be used in place of 2 valve manifold.
2. Pressure transmitter shall have easily accessible span, zero and time constant adjustments. A range suppression / elevation device shall be provided wherever required.
 3. For pressure / differential pressure transmitter, proof pressure shall be 200% of maximum static process pressure.
 4. All transmitter cases shall be dust – tight and rugged. Weather – proof and explosion – proof cases shall be used in outdoor and hazardous areas respectively. Protection clause shall be of IP 67 or better.
 5. Transmitters for pressure / DP measurements of liquid and steam shall always be installed below the sampling point, preferably with the connection at the top.
 6. Transmitters for pressure / DP measurements for gases and air shall always be installed above the sampling point, preferably with the connection at the bottom.
 7. Transmitters with diaphragm seal system shall be considered when
 - The process temperature is outside of the normal operating ranges of the transmitter and cannot be brought into those limits with impulse piping or
 - The process is corrosive and would require frequent transmitter replacement or unusual materials of construction or
 - The process contains suspended solids or is viscous and may plug the impulse piping or
 - There is a need to make density or interface measurements or
 - The process medium may freeze or solidify in transmitter or impulse piping.
 8. Diaphragm seal shall be either capillary type or direct mounted type depending upon the application. 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.
 9. Differential pressure type level transmitters shall be used for range above 1219 mm, for services requiring purge or where liquid might boil in external portions.
 10. Differential pressure type level transmitters for use on corrosive service shall generally be diaphragm wafer with extended filled capillary type. Flush or extended diaphragm type DP transmitter shall be considered for special application. Diaphragm material shall normally be stainless steel or any other special alloy.


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11. Differential pressure type flow transmitters shall have in-built square-root extractors.

9.3 Temperature Transmitter

Table 9.2
Specifications for Temperature Transmitter

S.N	Features	Minimum Requirements
1	Type	2-Wire, Smart (HART)
2	Output Signal	4-20 mA signals superimposed with HART signal.
3	Signal Processing Unit	Microprocessor based
4	Accuracy	± 0.075 % of span or better
5	Local Indicator	To be provided
6	Display	Digital LCD Integral Display (minimum 5 digit) Engineering Unit
7	Input	Ohm input from Pt-100 RTD/ mV signal from thermocouples
8	Stability	± 0.1 % of reading or 0.1°C, whichever is greater, for 24 months for RTDs. ± 0.1 % of reading or 0.1 °C, whichever is greater, for 12 months for thermocouples
9	Output	4-20 mA DC, linear
10	Load	600 Ohms (minimum) at 24 Volts DC
11	Power Supply	24 VDC, 2- Wire Loop Power
12	MOC of Electrical Housing	Aluminum Alloy or better
13	Enclosure Class	Weather proof as per IP 67 with corrosion resistance coating. For hazardous area explosion proof enclosure as described in NEC article 500

1. The temperature transmitter of following types (2-wire Loop Powered temperature transmitter) compatible with thermocouples and RTDs shall be provided. Cold junction temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.

a. Single Input DIN-rail mounted Temperature Transmitter

These shall be suitable for mounting on DIN-rails in Panels/JBs in air conditioned room. 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.

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b. Dual-input Temperature Transmitter With Indicator

These shall be suitable for mounting on pipes/ supports. 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 changeover is to be alarmed. Protection class shall be IP67 minimum.

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

2. Transmitters shall be provided with following features:
 - Sensor drifts alarm for sensor failure prediction
 - Differential & average temperature measurement if required.
 - Automatic switch-over to back-up sensor on primary sensor failure.
 - Accepts any combination of two sensor types (RTDs, T/Cs, mV or ohms)
 - Ambient temperature compensation
 - Fault detection for electronics & sensors with fail-safe alarming.
 - Provision of built-in CJC
3. Transmitters to be used for RTD sensors shall be provided with RTD EMF correction features so that it shall detect and eliminate EMF errors which are the result of small voltage produced by RTD sensing elements.
4. The product and make shall be selected so that with one make of transmitter all applications with respect to measuring range, temperature sensor (resistance thermometer / thermocouple) and connection type (2/3/4) wire connection of resistance thermometers) shall be covered.
5. Transmitters shall be capable of communication with HART (Highway Addressable Remote Transducer) communicator. HART communicator shall be provided with transmitters for tuning / configuring / diagnosing / maintenance of the transmitters. It shall meet the intrinsic safety requirement if required depending upon the application.

All transmitters' cases shall be dust-tight and rugged. Weather-proof and explosion-proof cases shall be used in outer and hazardous areas respectively

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9.4 Thermocouple

Table 9.3

Specifications for Thermocouple

S.N	Features	Minimum Requirements
1	Wire Gauge	16 AWG (for K type



S.N	Features		Minimum Requirements
			24 AWG (for R type)
2	Protective tube		O.D. 8 mm Material SS 316 seamless Filling – Compacted Magnesium Oxide (Purity above 99.4)
3	Loading		Shall be spring loaded to ensure positive contact with the well. Prevention of rotation of the insert with respect to head and resultant twisting of leads shall be ensured.
4	Accuracy		As per ANSI MC 96.1 / IEC 751 / IS-2054 / 2055, 1974.
5	Characteristic		Linear with respect to temperature within +/- ½ per cent of top range value.
6	Reference		For temperature vs. mV characteristics, following IS shall be applicable : Type K IS – 2054, 1974 Type R IS - 2055, 1974
7	Head	Type	IP-65 universal screwed type (Explosion proof for NEC class-1, division-1 area)
		Material	Die-cast aluminium or better material painted with black enamel paint.
		Terminal Block	Brass screw type / silver plated on ceramic head.
		Cable Connection	½ " NPT gland & grommet
		Cover	Screwed cover with suitable gasket & SS Chain
8	Instrument connection to Well		½ " NPT
9	Accessories		a) Adjustable nipple-union-nipple {1/2" Sch. 80 X1/2" NPT (M)} with thermowell connection
			b) Compression fittings/union
			c) Flanges etc. (For flanged connection only)
			d) SS 316 forged/barstock thermowell as per ASME PTC code. Process connection M33X2 (M)in general or 1½" Flanged for Flue gas/ Furnace

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S.N	Features	Minimum Requirements
		air etc. application

1. The following types of sensors shall be used for the different temperature ranges:
 - For measurement of temperatures of up to max. 1100 °C, rapid-responded sheathed thermocouples with insulated tip, 16 AWG wire, as Chromel-Alumel (NiCr-NiAl, ISA type K) measuring element, with admissible deviation of thermo voltage of half the values stated in IS-2054, 1974 or DIN 43710.
 - For measurement of temperature between 1100°C and 1300°C, 24 AWG, Platinum Rhodium (13%) – Platinum (ISA type R) measuring elements, with admissible deviation of thermo voltage of half the values stated in IS-2055, 1974 or DIN-43710.
2. All thermocouples shall be duplex type with tip grounded. Thermoelectric properties and accuracy shall be as per ANSI MC 96.1 / IS-2054 / 2055: 1974.
3. The design of thermocouple assemblies shall be such that replacement on line is possible.
4. Gas-tight ceramic sheaths partially reinforced with stainless steel sheath shall be used as protective tube for Pt Rh – Pt thermocouples. For other type of thermocouple stainless steel tubes shall be used as protective sheaths. For measuring temperature of high pressure process fluid, tapered protection sheath made from solid bar stock shall be used.
5. The time-constant of thermocouples shall suit the process requirement and shall be subject to approval of Owner / Consultant.
6. The thermocouples shall be supplied with factory tested and calibrated assemblies. The assemblies shall be complete with thermo well, sensing element, connection lead, duplex terminal block, extension nipple, compression fittings / unions /flanges etc. to meet all functional requirements as per Owner's / Consultant's approved drawings. The thermocouples equipped with thermo well shall be spring loaded for positive contact with the well.
7. The duplex terminal block shall be constructed with high temperature ceramic base with brass screw type terminals.
8. Thermocouple shall be suitable for steam, water or any other liquid application.
9. All thermocouples shall be terminated to the nearest junction boxes. The cold junction compensation shall be implemented within the measuring module level, no local/ field cold junction compensation box is allowed.


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9.5 Resistance Temperature Detector (RTD)

**Table 9.4
Specifications for RTD**

S.N	Features	Minimum Requirements
1	Type	3 / 4 wire , Pt-100 (100 ohm at 0 deg C) (as per DIN 43760)
2	No. of Element	Duplex
3	Housing/Head	IP-65/Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection
4	Sheathing of RTD	Metal sheathed , mineral insulated, ceramic packed
5	Calibration and accuracy	As per DIN-43670 Class-A for RTD
6	Stability	Zero & span drift within 0.1% of span for a 6 month period.
7	Characteristic	Linear with respect to temp, within $\pm 1/2$ percent of top range value
8	Standard	As per DIN-43670 for RTD & ASME PTC-19.3 for Thermowell
9	Accessories	a) Adjustable Nipple-Union-Nipple with thermo well connection / plug in connectors
		b) Compression fittings / unions
		c) Flanges etc.
		d) Thermowell as per requirement

- RTDs shall be of duplex, platinum three / four wire type with a nominal resistance of 100 ohms at 0°C and conform to DIN 43760 / BS 1904.
Stability of RTD over full range shall be better than 0.05 ohms and the repeatability figure shall be better than 0.02 ohms. Accuracy shall be of the order of 0.15% or better and response time shall be less than 20 seconds with thermo well.
- The protective-sheath material shall be SS 316, seamless tubes using compacted magnesium oxide packing for insulation. The insulation resistance at 540°C shall not be less than 5 mega-ohms.
- The time constant of the RTD shall suit the process requirements and shall be subject to approval of Owner / Consultant.

9.6 Thermowell for Temperature Elements

- The design of the thermo well shall take into consideration the temperature, pressure, medium and fluid velocity specified in the process in accordance with ASME Standard PTC 19.3, 1974.



2. Thermo wells shall, in general, be of SS 316 and shall be drilled from bar stock except for air and flue gas services. However, selection of thermo well material shall be as per following guideline.
3. Welded type thermo wells with 38 mm O.D. for welding & ½" NPT internal threads shall be used for pressure above 100 kg / sq cm or temperature above 400 deg C. Socket weld type thermo well with 34 mm O.D. for welding & ½" NPT internal thread, shall be used for pressure between 40-100 kg/cm² and temperature up to 400°C. Screwed type thermo wells with ½" NPT internal threads & M33X2 (M) outer threads shall be used for pressure below 40 kg/cm² and temperature below 400°C. For pipes having probability of prolonged vibration, seal welding may be done all around after tightening the thermo well within the base.
4. Thermo well manufacturing drawing covering material specification, dimensional details, details of special treatment, finish etc. as well as test procedure shall be subject to Owner's / Consultant's approval. Material certificate shall have to be furnished for each thermo well.
5. Wherever any approval is necessary from any recognized body / authority during manufacturing of high pressure wells, the same shall have to be arranged by the Contractor.
6. The thermo well immersion depth (U) shall be sufficient to eliminate conduction error. A general rule which may be followed is to use an immersion length equalling a minimum of 10 times the diameter of the protective tube or well. In general, immersion length of thermo wells for different line sizes shall be as follows:

Table 9.5

Thermowell Immersion Length

S.N	Line Size	Immersion Length
1	From 4" to 6"	65 mm
2	From 8" & onwards	140 mm
3	Vessels	400 mm

9.7 Pressure Gauge/ Differential Pressure Gauge/Draft Gauge

Table 9.6

Specification for Pressure Gauge/ DP Gauge/ Draft Gauge

S.N	Feature	Minimum Requirement
1	Type	Bourdon / Bellows / Diaphragm
2	Sensing Element Material	AISI 316 SS
3	Movement Material	AISI 304 SS

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S.N	Feature	Minimum Requirement
4	Case Material / Protection Class	SS / IP 65
5	Dial Size	150 mm For Special application 250 mm shall be used
6	Scale	Black lettering on white background in 270 °C arc
7	Range Selection	Normally operate at 75% of its maximum pressure range. Instruments measuring varying pressures shall operate in a band of 60% of its maximum pressure range.
8	Over range Protection	150% of maximum range by internal stop. External stop below zero.
9	Adjustment	External Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment.
10	Stop at Max. Reading	Shall be provided
11	Element Connection	Argon welding
12	Process Connection	½" NPT(M) bottom connection for local mounting, back connection for panel mounting
13	Accuracy	+/- 1.0 % of full scale or better
14	Operating Ambient Temperature	50 °C (Max. continuous)
15	Safety Feature	Neoprene Safety Diaphragm (Blowout disc) at the back
16	Window	Shatter-proof glass
17	Chemical Seal Unit	SS 316 Flange and Diaphragm, PTFE coated / block, Silicon Oil filling fluid
18	Accessories	Snubbers for pulsating fluid applications / 3-way gauge cock / 2-valve manifold / Pigtail / Siphon for steam service / Gauge Saver, if maximum or Design Pressure is very high than the Operating Pressure / Counter Flanges / Bolts, Nuts, Gaskets / SS Tag Plate

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1. Directly connected pressure measuring instruments shall be diaphragm, bourdon or bellow type elements depending upon the services conditions. In general, diaphragm elements shall be used in the range of 0 to 1000 mm water column pressure, bellow type element for ranges of 0 to 1 Kg/cm² and bourdon type element for ranges greater than 1 Kg/cm².
2. Primary element material shall be corrosion resistant to process fluid or diaphragm seals shall be provided for protection.
3. For draft measurement Teflon coated beryllium copper diaphragm shall be used.



4. Snubbers shall be floating pin type, externally mounted and externally adjustable. It shall be used for all pulsating services.
5. Diaphragm seals, filled type or mechanical type shall be furnished where plugging of the element may occur or where suitable material is not available in highly corrosive services. When chemical seals are required, they shall be the clean out type with flushing connection.
6. Over-range protection shall be provided to at least 150 % of range. For vacuum service, the element shall have under-range protection to full vacuum
7. Ranges of the gauges shall be so selected that the gauge normally operates in the middle third of the scale and conform to IS 3624 standard dials, wherever necessary.
8. The sensing elements for all gauges shall be properly aged and factory tested to remove all residual stresses and shall be SS 316 with forged socket and tip of the same material. Elements above 70 Kg/sq. cm range shall be bored instead of drawn.
9. For low pressure application where long elements are used, well supported protecting tube shall be installed to prevent mechanical damage and erosion of the elements.

9.8 Temperature Gauge

Table 9.7

Specification for Temperature Gauge

S.N	Feature	Minimum Requirement
1	Type	Mercury filled
2	Sensing Element material	Bourdon AISI 316 SS
3	Movement Materials	AISI 304 SS
4	Case Material/Protection class	SS / IP65
5	Capillary Armouring	SS Flexible
6	Capillary	SS 316 (5 mtr. Length for Local & 15 metre for panel Mounting)
7	Bulb/Stem Diameter	12 mm
8	Dial Size	150 mm
9	Window	Shatterproof glass
10	Scale	Black lettering on white background in 270 °C arc
11	Adjustment	Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment.
12	Pointer	Externally Adjustable
13	Range Selection	Normal Process Temperature –

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S.N	Feature	Minimum Requirement
		approximately two third of Temperature range.
14	Stop at Max. Reading	Shall be provided
15	Over range Protection	150% of FSD
16	Instrument Connection	Bottom connection for local mounting, back connection for panel mounting.
17	Process Connection	½" NPT with Thermowell
18	Performance :-	
a	Accuracy	+/-1.0% of full scale or better
b	Repeatability	Less than 0.5% of full range
c	Response Time	30 seconds (max.) with Thermowell and 15 seconds Bare.
19	Operating Ambient Temperature	50 °C (Max. continuous)
20	Accessories	Mounting brackets, Bolts, Nuts, Gaskets / SS Tag plate, SS Thermowell etc.

- Temperature gauges shall be dial thermometers (liquid spring / steam pressure spring / metal expansion thermometer), either rigid stem or capillary tube depending upon application; if this is not possible for design reasons, industry type liquid – in – glass thermometers shall be used.
- Case shall have back or bottom connection with adjustable gland to permit adjustment of thermometer into the thermo well.
- Thermometer stem adjustable gland with union connection and bushing shall be suitable for ½ inch NPT connection.
- Bi-metallic type dial thermometer, if used, shall be hermetically sealed, back or bottom connection type, with 150 mm dial.
- The gauges shall be provided with automatic ambient temperature compensation.
- Scale ranges shall be selected so that normal process temperature in middle two – third of full scale range

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9.9 Level Gauge

**Table 9.8
Specification for Level Gauge**

S.N	Feature	Minimum Requirement
1	Sensing Element & material	Tempered toughened Borosilicate gauge glass steel Armored reflex or transparent type
2	Body Material	Forged carbon steel / 304 SS



S.N	Feature	Minimum Requirement
3	End Connection	Process connection as per ASME PTC and drain / vent 15 NB
4	Accuracy	+ /- 2 % of complete range
5	Scale	Linear vertical
6	Range Selection	Cover 125 % of max. of scale
7	Over Range Test	Test pressure for the assembly shall be 1.5 to the Maximum design pressure at 38 degree C
8	Housing	CS / 304 SS leak - proof
9	Identification	Engraved with service legend or or laminated phenolic Name plate
10	Packing	PTFE Teflon
11	Illumination	220 V, 50 Hz, 25 / 40 Watts either with deflector or diffuser (for transparent type level gauge) / 220V , 50 Hz, 25 /40 Watts with red and green filter
12	Accessories	Gasket for all KEL – F shield for transparent type vent and drain valves of CS / SS as per requirement
13	Others	Anti – Frost extension for low temperature service. Heating / cooling arrangement

- Level gauges shall be steel armoured reflex or transparent or bi –colour type, top and bottom connection as per pressure vessel standard of ASME PTC code and 15 mm NB (1/2 inch NPT) Drain and Vent connection.
- Body material and cover material shall normally be forged carbon steel, 304 stainless steel or other superior material.
- Reflex type gauges shall be used for clean and colorless liquids and transparent type for other liquids. For boiler and condensate services, treated water, the transparent type with KEL – F shields shall be used to avoid their attack on the glands.
- The gauge glass must have a rating equal to or more than the vessel design pressure and temperature. The test pressure for the complete design gauge assembly shall be as per Owner's / Consultant's recommendation.
- The maximum length of a single gauge glass shall not exceed 1400 mm. Where large range is required, multiple gauges of preferably equal lengths shall be used with 50 mm over – lapping in visibility.
- The visibility shall cover the operating level range and the maximum and minimum ranges expected considering start – up conditions as well as alarm and shut down points. Internal heating shall be provided for

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viscous liquids. Integral illuminators shall be used for transparent gauges, if necessary.

7. Stand – pipes shall be used for multi – gauge glass and level controller installation and on horizontal drum or exchanger with top and bottom connections to have visibility of the complete span. The stand pipe shall not be used with block valves.
8. Primary isolation valves shall be used In addition to the gauge glass valves unless otherwise specified. When the process fluid may create lugging or leakage problem, gauge valves may be omitted. For low temperature liquid having high vapour pressure at ambient temperature, isolation and gauge valves shall not be permissible. Safety valve shall be provided at the vent connection of the gauge glass where isolation is required.

9.10 Pressure/ Differential Pressure Switch

**Table 9.9
Specification for Pressure/DP Switch**

S.N	Feature	Minimum Requirement
1	Type	Piston for high pressure application Bellow/Diaphragm for low pressure application
2	Sensing Element material	AISI 316 SS
3	Wetted Parts material	AISI 316 SS
4	Case Material	Epoxy coated Die Cast Aluminium
5	Setter Scale	Black graduation on white linear scale. Graduation 0 – 100% with red pointer for set points.
6	Over range for Pressure / Vacuum Switch	150% of maximum pressure
7	Set Point	Adjustable throughout switch operating range.
8	Static Pressure for Differential Pressure Switch	Maximum Line Pressure or Static Pressure on either side without permanent deformation or loss of accuracy.
9	Adjustments	Internal – set point Differential adjustable feature
10	Process Connection	½" NPT(M) bottom connected
11	Switch Configuration	2 SPDT / 1 DPDT
12	Switch Rating	230 V, 5A AC / 220 V, 0.25 A DC/24 V, 2A DC
13	Switch Type	Snap acting, shock and vibration-proof
14	Cable Connection	½" ET conduit connections or compression gland
15	Enclosure Class	Weather proof as per IP 65 with corrosion resistance coating.

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S.N	Feature	Minimum Requirement
16	Accuracy	1% of span up to 3Kg/cm ² 0.5% of span for more than 3 Kg/cm ² .
17	Repeatability	0.5% of span
18	Accessories	
a)		Snubbers for pulsating fluid application.
b)		Tag Number, service engraved in SS tag plate
c)		Teflon back-up sheath protection, as required.
d)		i) Remote diaphragm seal with SS 316 armored capillary for typical application. MOC of seal material shall be as per process fluid requirement. ii) Silver coated diaphragm for corrosive services like chlorinated water.
e)		Retention ring and screws for surface mounting.
f)		3-way Gauge Cock (SS 316) for PS / 5-Valve Manifold (SS 316) for DPS.
g)		Mounting bracket / Clamp for 2" pipe, bolt & nut.

- The pressure switches shall have sensing elements made of copper alloy or stainless steel sealed diaphragm and piston actuated for high pressure service and bellows for low pressure / vacuum service.
- Low differential pressure switches for low static pressure ranges shall be diaphragm type with snap action switch elements.
- Low differential pressure switches for high static pressure shall be elbows and torque tube type and snap – action switch elements and metric scale dial indicators.
- For corrosive, viscous process fluids diaphragm sealed with completely filled inert liquid shall be provided. Material of diaphragm and wetted parts shall be selected considering the nature of process fluid.
- The sensing elements shall be properly aged and factory tested to remove all residual stresses. They shall be able to withstand at least 150 % the full scale pressure without any damage or permanent deformation.
- Actuation set point, dead band shall be internally adjustable through out the range with tamper proof facilities.
- Electrical connection for the switch devices shall be suitable for plug in type connection.
- Process connection shall be ½ inch NPT. Process piping connections shall include necessary union, nut, nipple, tail pipe, isolation valve and test connection to permit servicing, testing, calibration and removal of the instrument device.

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9. Instrument for steam & hot water service, shall be connected through siphon, of stainless steel or suitable material. Pulsation dampeners shall be provided for all pulsating fluids.
10. Pressure switches shall be tested as per BS – 6134.

9.11 Conductivity Type Level Switch

Table 9.10

Specification for Conductivity Type Level Switch

S.N	Feature	Minimum Requirement
1	Sensing elements	Conductivity type
2	Material	SS 316
3	Repeatability	± 0.5 % of full range or better
4	Accuracy	± 0.5 % of full scale or better
5	Working temperature	As per process requirement
6	Probe length	As per requirement
7	Mounting	Flanged- on external cage
8	No. of contact	2 NO. + 2 NC, SPDT, snap action type dry contact
9	Rating of contacts	5A, 240 V AC / 2A, 24 V DC / 0.25 A, 220V DC
10	Enclosure	IP 65
11	Housing	Cast aluminum epoxy coated weather proof
12	Ambient Temperature	60°C (max.)
13	Electrical Connection	Plug-in type
14	Cable connection	½ " NPT with cable gland
15	Set point	Adjustable
16	Accessories	All mounting accessories

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9.12 Capacitance Type Level Switch

Table 9.11

Specification for Capacitance Type Level Switch

S.N	Feature	Minimum Requirement
1	Type	Capacitance type
2	Probe	Rod or Suspended Electrode
3	Material	SS 316
4	Insulation	PTFE/PP/Kynar part/full as required



S.N	Feature	Minimum Requirement
5	Repeatability	± 0.5 % of full range or better
6	Accuracy	± 0.5 % of full scale or better
7	Working temperature	As per process requirement
8	Probe length	As per requirement
9	Probe Mounting	1 ½ " Flanged
10	No. of contact	2 NO. + 2 NC, SPDT, snap action type dry contact
11	Rating of contacts	5A, 240 V AC / 2A, 24 V DC / 0.25 A, 220V DC
12	Enclosure	IP 65
13	Housing	Cast aluminum epoxy coated weather proof
14	Cable connection	½ " NPT with Cable gland
15	Ambient Temperature	60°C (max.)
16	Electrical Connection	Plug-in type
17	Accessories	Counter flange, Cable gland, Prefab cable etc.
18	Set point	Adjustable
19	Accessories	All mounting accessories

9.13 Float/Displacer Type Level Switch

Table 9.12

Specification for Float/Displacer Type Level Switch

S.N	Feature	Minimum Requirement
1	Type	Float/Displacer type
2	Float/Stem/Displacer Material	SS 316
3	Repeatability	± 0.5 % of full range or better
4	Accuracy	± 0.5 % of full scale or better
5	Working temperature	As per process requirement
7	Process connection	As per requirement
8	Over-range proof	150% of max. design pressure
9	No. of contact	2 NO. + 2 NC, SPDT, snap action type dry contact
10	Rating of contacts	5A, 240 V AC / 2A, 24 V DC / 0.25 A, 220V DC
11	Enclosure	IP 65
12	Hydro Test	Chamber – 100% at 1.5 times rated pressure or as per ANSI flange rating Float – 1.1 times of operating pressure
13	Electrical Connection	Plug-in socket
14	Accessories	All mounting accessories

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1. Level Switch shall work on gland less magnetically coupled float or displacer operated mechanism having separate float chamber.
2. Float, stem and displacer shall be 316 stainless steel.
3. Level switch body, cage and process connections shall be designed to withstand the maximum pressure and temperature of the operating fluid.
4. A setting adjustment on the level set point of + / - 25 mm shall be provided. The adjustment shall be made externally to the switch.
5. The accuracy & repeatability of the switch shall be within +/- 0.5 % of full-scale range. On – Off differential shall be adjustable.
6. Process connections of the cage shall be 25 NB male plain nipples connected through socket / welded isolation valves of adequate rating.
7. Level switch connections shall also include 15 NB test and drain connections to permit servicing, testing, calibration of the instrument.
8. The switching elements shall be snap-acting, shock-proof and vibration-proof. All switches shall have two electrically isolated SPDT contacts with provision of external adjustment of set points and dead bands. The contact ratings shall be 5 amps at 240 V AC 50 Hz or 0.25 amps at 220 V DC.
9. Switch enclosures shall be cast aluminium, weather-proof, NEMA -4X type with cable entry through compression type cable glands / ¾ "NPT conduit connections. Switches located in hazardous areas shall have dust-ignition-proof enclosure as per NEC article 500 provisions.

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9.14 Ultrasonic Level Transmitter

Table 9.13

Specification for Ultrasonic Transmitter

S.N	Feature	Minimum Requirement
1	Application	Level measurement in silos, sump water level etc.
2	Medium	Coarse, hard solid materials like ash etc. Materials may be slowly falling through the detection range.
3	Type	Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic Transmitter
4	Principle	Time of flight
4	Sensor Material	Corrosion resistant material to suit individual application requirement.



S.N	Feature	Minimum Requirement
5	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 transmitters shall have adjustable damping circuitry.
7	Range	Capable of covering the complete level span of tank/vessel taking care of blocking distance, frequency, attenuation due to surface, obstructions, vapours etc
8	Output	4 – 20 mA DC with 600 ohms load with HART compatibility.
9	Display	minimum 4 characters display with Integral keypad, access protected by user code.
10	Diagnostics	Loss of echo alarm etc.
11	Resolution	+/- 0.1 % of range or better
12	Accuracy	+/- 2 mm or 0.2% of span
13	Repeatability	3 mm or better
14	Operating temperature	0 to 60 ^o C
15	Power supply	24 V DC + / - 10 %
16	Mounting	Flanged connection at top of covers / side walls as per requirement.
17	Accessories	a) All weather canopies for protection from direct sunlight and direct rain.
		b) For hazardous areas, explosion proof enclosure as per NEC article 500 shall be provided.
		c) All mounting hardware and accessories required for erection and commissioning. Mounting fittings material shall be SS 316.

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- The power and frequency of transmission for the transmitter shall be selected to assure a sufficient signal / noise ratio.
- The transmitter shall be designed with an electronic circuit having the features such as temperature compensation, rejection of unnecessary echoes and noises and adjusting 'zero' and 'span'. It shall consist of sensors, electronic unit and accessories.


9.15 Guided Wave Radar Type Level Transmitter
Table 9.14
Specification for Guided Wave Radar Type Transmitter

S.N	Feature	Minimum Requirement
1	Application	Level measurement of vessel under vacuum or low pressure application
3	Type	Guided wave radar
4	Principle	TDR (Time domain reflectometry)
5	Probe Material	SS 316
6	Accuracy	5 mm or better
7	Resolution	+/- 0.1 % of range or better
8	Signal Output	4 – 20 mA DC with 600 ohms load with HART compatibility
9	Power Supply	24 V DC + / - 10 %
10	Display	Integral
11	Mounting	External cage type
12	Transmitter housing Protection Class	IP-65 with corrosion resistance coating
13	Accessories	a) All weather canopies for protection from direct sunlight and direct rain.
		b) For hazardous areas, explosion proof enclosure as per NEC article 500 shall be provided.
		c) All mounting hardware and accessories required for erection and commissioning. Mounting fittings material shall be SS 316.

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9.16 Flow Switch
Table 9.15
Specification for Flow Switch

S.N	Feature	Minimum Requirement
1	Type	Vane actuated/Differential bellow type
2	Vane/bellow Material	SS 316
3	Repeatability	± 0.5 % of full range or better



S.N	Feature	Minimum Requirement
4	Accuracy	± 0.5 % of full scale or better
5	Working temperature	As per process requirement
7	Process connection	As per requirement
8	Over-range proof	150% of max. design pressure
9	No. of contact	2 NO. + 2 NC, SPDT, snap action type dry contact, shock & vibration proof
10	Rating of contacts	5A, 240 V AC / 2A, 24 V DC / 0.25 A, 220V DC
11	Enclosure	Cast Aluminium/IP 65
12	Cable connection	Compression type cable gland/ ½" NPT Conduit connection
13	Electrical Connection	Plug-in socket
14	Accessories	All mounting accessories

9.17 Rotameter

**Table 9.16
Specification for Rotameter**

S.N	Feature	Minimum Requirement
1	Type	Variable area Linear scale
2	Fluid media	Water/Oil
3	Float Material	SS 316
4	Accuracy	± 2 % of full scale or better
5	Working temperature	0 to 70°C
6	Process connection	As per requirement
7	Over-range proof	150% of max. design pressure
8	Enclosure	Transparent toughened glass/IP 65
9	Accessories	Flange, orifice in case of bypass Rotameter

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Rotameter shall be used for low flow & low viscosity applications of liquid.

9.18 Sight Glass Indicator (Flow Glass)

**Table 9.17
Specification for Flow Glass**

S.N	Feature	Minimum Requirement
1	Application	Online observation of fluid flow in Pipeline
2	Type	Double window for pressurized pipe with rotary wheel for installation in horizontal or vertical pipeline. Full view for non-pressurized pipeline.



S.N	Feature	Minimum Requirement
3	Size	Double window up to 12" and 600 lbs rating. Full view up to 6" and 150 lbs rating.
3	Body Material	SS 316
4	Glass	Pyrex tempered glass
	Others	Rotor & wetted parts shall be bronze All accessories shall be SS316
5	Protection class	IP-65
6	Connection	Screwed up to 50 NB size Flanged ANSI 150 RF – above 50 NB size
7	Accessories	Name plates, mating flanges with gasket, bolts & nuts etc.

9.19 Flow Elements

a) Orifice Plate

**Table 9.18 A
Specification for Orifice Plate**

S.N	Feature	Minimum Requirement
1	Type	Concentric as per ASME PTC – 19.5 (Part III); ISA RP – 3.2, 960; BS – 1042; ISO 5167
2	Material	SS 316
3	Thickness	3 mm for main pipe diameter up to 300 mm and 6 mm for main pipe diameter above 300 mm.
3	Beta ratio	0.34 to 0.7
4	Tapping's	Flanged weld neck 3 pairs of tappings.
5	Material of Branch Pipe	Same as main pipe
6	Root Valve type	Globe
7	Root Valve material	SS 316
8	Root Valve size	1"
9	Accessories	Root valves, flanges, vent / drain hole (as required)

- Contractor to provide Beta ratio calculation, Assembly drawings & flow vs DP curves.
- Each orifice plate shall be provided with a handle on which the orifice diameter, pipe diameter and pressure tap distances are stamped. This information shall be so located that it can be read without removing the orifice plate from pipe line.
- The standard primary element shall be thin plate, square-edge concentric orifice plate mounted between a pair of weld-neck type

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- orifice flanges with flange taps. The minimum pressure rating of flanges shall be 300 pounds ANSI. The material of the orifice plates shall be SS 316 in general. Orifice plates shall be not less than 3 mm thick for nominal pipe diameters up to and including 300 mm, and not less than 6 mm thick above 300 mm NB pipe.
4. Quadrant edge or quarter circle orifice plates shall be used for highly viscous liquids and for pipe Reynolds Number below 10,000. Conical entrance type of orifice plates shall preferably be used for very highly viscous liquids up to Reynolds Number below 250. Vent and drain holes shall be provided wherever necessary.
 5. Orifice diameter shall be selected, so that d/D ratio is between 0.20 to 0.70 for gas and steam and up to 0.75 for liquids.
 6. Metering orifices shall not be installed in lines less than 1 ½" (40 mm) the lines shall be blown to the 1 ½" (40 mm) size for the meter run, keeping the d/D ratio within limits.
 7. Restriction orifices and integral orifice transmitters do not require upstream or down stream straight pipe runs.
 8. The orifice plate shall be supplied and fitted in conformity with ISO. When the pipe diameter is larger than the value specified in ISO, the restriction ratio will be decided by extending the specific curve externally.
 9. The length of straight pipe run required for metering accuracy shall be in conformity with ISO. When it is extremely difficult to comply with the standard, a minimum straight length of 10D (D = pipe inner diameter) on the upper stream and a minimum length of 5D on the down stream shall be considered.
 10. All orifice plates shall be supplied with matching flanges of material and pressure rating not less than the rating of the associated pipe system.
 11. For pipeline sizes of 500 mm and less, the orifice plates shall be an integral unit comprising of carrier ring assembly, tapping arrangement on both upstream as well down stream side. For line sizes more than 500 mm, the orifice plate shall be disc type. For disc type orifice plate, suitable corner tapping arrangement on both upstream as well as down stream side shall be provided. All tapping arrangements shall be complete with a piece of impulse pipe line and a shut – off valve suitable for specified line pressure.
 12. For steam applications, orifice plate shall be supplied with a pair of steam condensation chambers suitable for specified line pressure.
 13. Data sheets, sizing calculation, fabrication & sheets for the elements shall be submitted for approval and finalization.


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b) Flow Nozzle

**Table 9.18 B
Specification for Flow Nozzle**

S.N	Feature	Minimum Requirement
1	Type	Long Radius welded type ASME PTC 19.5 (Part III) or BS – 1042
2	Material	Same as Pipe material
3	Thickness	Suitable for intended application
3	Beta ratio	Around 0.7
4	Tapping's	D and D/2 (3 nos. tappings)
5	Material of Branch Pipe	Same as main pipe
6	Root Valve type	Globe
7	Root Valve material	SS 316
8	Root Valve size	1"
9	Accessories	Root Valves, Vent & Drain Hole

1. Contractor to provide Beta ratio calculation, Assembly drawings & flow vs DP curves.
2. The branch pipes for holding the flow nozzle shall also be furnished along with the flow nozzle. All nipples, welding adaptors and root valves shall also be in the scope of supply.
3. Flow nozzles in high pressure pipes shall be subject to a test according to DIN 50049, 3.1C, considering the technical guideline. The test of flow nozzles shall contain:
 - Check of drawings
 - X-ray testing of the circular bead or colour soaking or ultra-sonic testing
 - Test of sizes.
4. Flow nozzle shall be provided with a permanent mark indicating:
 - Measuring point number
 - Direction of flow
 - Plus and minus tapping
 - Material

Moreover, the actual inside pipe diameter "D" and the diameter of the flow nozzle shall be stated on the identification plate.
5. The Contractor shall provide the following documents:
 - Design drawings of the flow nozzle
 - Calculation documents

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- Fabrication, assembly and installation drawings
 - Test reports.
6. For measurements of steam, balancing vessels shall be provided. Balancing vessels shall be used for flow measurement in steam system based on the differential pressure method to ensure a defined water column. The balance vessels shall be arranged on the same geodetic level. If this is not possible for design reasons, the level difference shall be taken into account during calibration

9.20 Hydrogen Analyzer

**Table 9.19
Specification for Hydrogen Analyzer**

S.N	Feature	Minimum Requirement
1	Accuracy	+/- 0.2 % of full scale
2	Linearity	+/- 1% of full scale
3	Response time	less than 5 seconds (Up to 90% of full scale)
4	Drift	+/- 0.005% per 2 Deg. Centigrade temp. change
5	Temperature compensation	Automatic
6	Sample filter	Ceramic 3.5 micron
7	Zero & Span Adjustment	Required
8	Ambient Temperature	60°C
9	Indication	Digital
10	Enclosure Type/Material	Weather & Dust proof IP-65 SS
11	Type of Electronics	Microprocessor based with self diagnostic facility
12	Calibration	Auto & manual
13	Output signals	Analog: 4-20 mA DC Binary: 2 NO + 2 NC for Alarms
14	Digital Signal transmission	RS-232 or RS-484 OR as per requirement to suit connection protocol of Plant DCS
15	Other requirement	HART Communication protocol compatibility & suitable for connection to Smart Transmitter Maintenance system. Purging System

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9.21 Control Valves

A. Introduction

The control valves and accessories equipment furnished by the Contractor 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 or acceptable equal standards.

B. Control Valve Design & Sizing

1. The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI for dimensions, material thickness and material specification for their respective pressure classes.
2. 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 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, Contractor shall ensure that valves outlet velocity does not exceed 8 m / sec. for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Contractor 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 Consultant's / Owner's approval during detailed engineering.
3. Control valves for steam and water applications shall be designed to prevent cavitations, wire drawing, flashing on the downstream side of valve and downstream piping. Thus for cavitations / flashing service, only valve with anti-cavitations trim shall be provided. Detailed calculations to establish whether cavitations will occur or not for any given application shall be furnished.
4. Trim shall be multistage type having sufficient number of discrete pressure drop turns (stages) to ensure elimination of vibration, erosive – action, cavitations. Contractor shall identify the number of pressure drop turns in proposed equipment and shall also provide calculation demonstrating compliance to the trim exit velocity.
5. To prevent flow induced vibration and to protect the valve internals from foreign particles such as weld slag flow, direction shall be a flow to close (over the plug) configuration for liquid applications. To maximize noise attenuating benefits and to allow for constant fluid expansion, flow direction will be under the plug for steam and gas applications.
6. Control valves for applications for critical areas shall have permissible leakage rate as per leakage class V. All other control valves such as low and high range feed control valves etc shall have leakage rate as per leakage class IV.
7. The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise


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abatement shall be achieved by valve body and trim design and not by use of silencers.

8. The characteristic of the control valves shall be determined based on the application / service.
9. On supply air or electrical failure for pneumatic / electrical drive, the valve shall remain full closed, open or stay – put position as per process safety requirement.

C. Valve Construction

1. Proper selection of valve type and material of construction to meet operating requirement.
2. All valves shall be of globe body design and straightaway pattern with single or double port unless otherwise recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure or pressure drops permit.
3. Valves with high lift cage guided plugs & quick change trims shall be supplied.
4. Cast iron valves are not acceptable.
5. Bonnet joints for all control valves shall be of the flanged and bolted type for easy dis – assembly. Bonnet joints of internal threaded or union type will not be acceptable.
6. Plug shall be of one – piece construction either 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.
7. All valves connected to vacuum on downstream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing).
8. Valve characteristic shall match with the process characteristics.
9. Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280°C.
10. Flanged valves shall be rated at not less than ANSI pressure class of 300 lbs.
11. Teflon shall be used for valve gland packing to suit process requirement.
12. The valve body shall be marked to show direction of flow.

D. Valve Materials

1. The control valve body material shall be
 - Carbon steel as per ASTM – A216 GR WCB for non – corrosive, non – flashing and non – cavitations services below 275 deg c temperature like Auxiliary Steam flow to Deaerator, CRH flow to Deaerator, Condensate flow to Deaerator etc.


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- Alloy steel as per ASTM – A217 GR WC 9 for severe flashing / cavitations services like low load and full load feed water control, HP and LP heaters emergency drains, Deaerator overflow drain to Hotwell etc.
 - Alloy steel as per ASTM A – 217 GR WC 6 for low flashing / cavitations services like HP heaters & LP heaters normal drain control, drain cooler normal level control, gland steam cooler minimum flow etc.
 - 316 SS for condensate service below 300 deg C like condensate normal and emergency make – up controls etc.
2. The control valve trim material shall be
- 17 – 4 PH SS for severe services listed under item D.1, 2nd point & 3rd point above
 - 316 SS for services listed at D.1, 4th point above and
 - 316 SS with stellite faced guide parts and bushings for remaining applications.
3. However, Contractor may offer valves with body and trim materials better than specified materials and in such cases Contractor shall furnish the comparison of properties including cavitations 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 / Consultant's consideration and approval.

E. End Preparation

1. Valve body ends shall be either butt welded / socket welded, flanged or screwed as finalized during detailed engineering and as per Owner's / Consultant'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 sizes 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.

F. Valve Actuator

1. The regulating control valves shall be furnished with pneumatic actuators. The Contractor 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 °C continuously.
2. 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 / cm² per linear millimeter of seating surface, shall be


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

3. The travel time of the pneumatic actuators shall not exceed 10 seconds.
4. For quick opening / closing services (such as fuel oil shut – off valve), the actuator shall be pilot solenoid operated pneumatic drive; the rating of solenoid shall be 24 V DC.
5. Selection of actuator shall be such that it meets the requirements of thrust / torque, stroke length, angular movement, full scale travel time, repeatability & accurate positioning for successful operation of final control element.
6. All the actuators shall have also provision for manual operation during emergency / maintenance along with graduated local position indicator.

G. Control Valve Accessory Devices

All control valve accessories such as air locks, hand wheels / hand-jacks, limit switches, SMART positioners, diffusers, external volume chambers, reversible pilot for positioners, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.

**Table 9.20
Specification for E-to-P converter**

S.N	Feature	Minimum Requirement
1	Air Supply	1.5 Kg/Sq. cm
2	Input Signal	4-20 mA DC
3	Output Signal	0.2 to 1.0 Kg/ Sq. cm
4	Linearity	0.5 % of span or better
5	Hysteresis	0.1 % of span or better
6	Ambient Temperature Effect (-20 to +60 °C)	<0.2 % of span per Degree centigrade
7	Mounting	Close to Actuator
8	Protection class	IP-65
9	Enclosure	Die cast Aluminium
10	Drift	+/- 2% of set point per hour

**Table 9.21
Specification for Smart Positioners**

S.N	Feature	Minimum Requirement
1	Input	4-20 mA DC
2	Power Supply	24 V DC Loop powered
3	Type of Electronics	Microprocessor based with self diagnostic

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S.N	Feature	Minimum Requirement
		facility & digital communication by means of HART Protocol
4	Valve position sensing	Non-Contact type with 4-20 mA DC Output
5	Enclosure Type/Material	Weather & Dust proof to IP-65/ Die cast Aluminium
6	Ambient conditions	Suitable for - 30 to +80 *C temperature & 0-95% Humidity
7	Operating Range	Suitable for Full range & Split Range operation
8	Modes of operation	Suitable for Direct & reverse valve action
9	Flow characteristics	Suitable for Linear & Equal percentage Characteristics
10	Fail safe/Freeze feature	Required
11	Air Capacity	Sufficient to handle the Valves Selected/Boosters to be supplied if required.
12	Air supply pressure	To suite the Air Supply Pressure / Quality available
13	Process Connection	1/4" NPT
14	Characteristic Deviation	< =0.5% of span
15	Ambient Temperature effect	< =0.01%/Deg C or better
16	Configuration	Remote Calibration, Auto & Manual Calibration shall be possible
17	Cable Entry	½" NPT, Side or Bottom Entry to avoid water ingress
18	Accessories	a) Display with push buttons for configuration and Display on the positioner itself (Password Protected / Hardware Lock).
		b) For Supply & Output Pressure, Filter Regulator and other accessories shall be provided as on required basis for making system complete
		c) Valves Mounting Assembly For Sliding Stem / Rotary / Single Acting / Double Acting on required basis

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1. SMART positioner shall preferably be of the same make as the Control Valve, to ensure repeatability in Calibration, serviceability and proper maintenance of the Control System.
2. SMART positioner shall be a Double stage positioner. The first stage of the positioner shall be typically a flapper-nozzle that serves as a high-gain pre-amplifier. This sensitivity shall be maintained over a wide range of dynamic conditions. Second stage shall be a power amplifier that provides power to drive the actuator. Preferably this shall be a pneumatic relay. Spool Driven type SMART positioners are not preferred due to Higher Dead Band and Poor responsiveness. The SMART positioner shall have pressure sensors to measure the pneumatic outputs to the actuator.



3. The control algorithm for the positioner shall use feedback signal from the motion of the pneumatic relay beam instead of pressure feedback to minimize pneumatic related effects and for stable and smooth response of the control valve. The SMART positioner shall have user adjustable tuning sets to identify the optimum tuning for the total valve assembly. SMART Positioner with HART Communication facility shall communicate all the valve diagnostics to Plant DCS.

**Table 9.22
Specification for Air Filter Regulator (AFR)**

S.N	Feature	Minimum Requirement
1	Type	Constant Bleed type
2	Inlet Pressure	10 Kg/Sq. cm (maximum)
3	Output	Adjustable from 0-2 Kg/Sq. cm or 0-7 Kg/Sq. cm (Continuous) as required
4	Filter Element	5 microns
5	Filter Element Material	Phosphor Bronze
6	Bowl Material	Metallic
7	Drain	Automatic
8	Enclosure Protection class/ Material	IP-65/ Die cast Aluminium
9	Process connection	¼ " NPT
10	Accessories	All mounting accessories. 2" dial size Pressure gauge.

**Table 9.23
Specification for Position Transmitter**

S.N	Feature	Minimum Requirement
1	Power Supply	24 V DC Loop powered
2	Type	Non-Contact LVDT type
3	Output	4-20 mA DC/ Linear
4	Accuracy	+/- 1%
5	Enclosure Protection class/ Material	IP-65/ Die cast Aluminium
6	Cable Entry	½" NPT, Side or Bottom Entry to avoid water ingress.
7	Accessories	All mounting accessories

**Table 9.24
Specification for Limit Switch (Non Contact Type)**

S.N	Feature	Minimum Requirement
1	Type	Non-contact type inductive Proximity/Namur type
2	Sensing distance	10 mm minimum

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S.N	Feature	Minimum Requirement
3	Hysteresis	Maximum 10% of sensing distance
4	Indicator	LED indication
5	Protection class	IP 67
6	Integral Cable	1 mtr.
7	Power supply	24 V DC/ 8 V DC
8	Mounting	Flush mounting with check nut
9	Other Feature	Explosion proof enclosures shall be provided wherever required by the application. Shock & Vibration proof.

H. Test & Examination

1. All valves shall be tested in accordance with the quality assurance programme agreed between the Owner / consultant and the Contractor which shall meet the requirement of IBR and other applicable codes.
2. The tests shall include but not but limited to the following:
 - Non-destructive test as per ANSI B – 16.34.
 - Hydrostatic shell test in accordance with ANSI B16.34 prior to seal leakage test.
 - Valve closure test and seal leakage test in accordance with ANSI B16.34 and as per the leakage class indicated under clause no. B.6.
 - Functional test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.
 - All control valves shall be tested with the positioners for accuracy of positioning and reproducibility over the full range of travel.
 - CV Test : CV test shall be carried out as type test on each size, type and design of the valves as per AISA 75.02 standard and test report shall be furnished for Owner's / consultant's approval.
 - Magnetic particle inspection shall be performed on all machined surfaces of valves having ASA rating of 1500 lbs ASA or greater. All carbon steel valves with 1500 lbs ASA or greater shall receive 100% radio graphic examination in accordance with ASTM – E71.
3. Contractor shall submit test certificates for the tests mentioned in above paragraphs in accordance with ASME and ASTM requirements. In addition Contractor shall also submit for the above equipment, certificate of manufacture and test as required by the Indian Boiler Regulations. The certificate shall be in the prescribed forms III A & III C and shall be endorsed by an Inspection Authority recognized by the Indian Boiler Regulations.

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I. General Requirements

1. Contractor shall furnish all the control valves as finalized during detailed engineering stage without any price repercussions whatsoever depending on the process requirements.
2. Following documents to be furnished by the Contractor after the award of contract.
 - a. Final data sheet for all control valves.
 - b. Detailed dimensional and cross-sectional drawing of control valves, indicating end to end dimensions, various clearances required, weight etc.
 - c. Test certificate for the following :
 - Hydrostatic test for all control valves
 - Magnetic particle inspection for all control valves.
 - Radiographic examination of control valves.
 - Seal tightness test for control valves
 - Materials test certificate for control valves.


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5. DESIGN CRITERIA

This section covers the general design criteria to be adopted in designing the Control & Instrumentation system for the TG Package.

5.1 General Requirements

5.1.1 Ambient Conditions

Instruments, devices and equipment for location in outdoor / indoor / air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation in the operating environment of a Lignite fired Power plant and also during periods of air conditioning failure without any loss of function, or departure from the specification requirements covered under this specification.

**Table 5.1
Protection Class Requirement**

Ambient Temperature (outside temperature)	Pressure	Relative Humidity	Atmosphere	Required Protection class of panels /cabinets /desks to be provided by Contractor
Outdoor Location				
55 *C max	Atmosphere	100%Max	Air (dirty)	IP 65
4 *C min	Atmosphere	5% Min	Air (dirty)	IP 65
Indoor Location				
55 *C max	Atmosphere	95% Max	Air	IP 54^^
4 *C min.	Atmosphere	5% Min	Air	IP 5^^
Air-conditioned Area				
24 +/- 2 *C normal	Atmosphere	95% Max	Air	IP 42
50 *C Max. ^	Atmosphere	5 % Min	Air	IP 42
^ During Air Conditioning failure ^^ For non-ventilated enclosures. For Ventilated enclosures, protection class shall be IP 42. 1. For hazardous areas the protection class shall be in accordance with the requirements of the relevant NEC code for the location. 2. For PCs, OWS, EWS, Servers, Printers and other peripherals, maximum temperature limit shall be 35 *C. For LVS the same shall be 25 *C & for UPS the same shall be 40 *C				

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12. SYSTEM CABINETS, PANELS & JUNCTION BOX

12.1 General Requirements

1. All control panels, system cabinets, local panels and local instrument enclosures, racks shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, grounding, ventilation, space heating, anti-vibration pads and accessories as per IS:5039-1969 as required for completeness of the system.
2. All panels & cabinets shall be free standing type and have bottom entry for cables unless otherwise specified. The bottom of panels, cabinets, enclosures shall be sealed with bottom plate, compression cable glands and fire proof sealing material to prevent ingress of dust and propagation of fire. The Cabinets shall be designed for front & back access to components, terminals and wiring
3. The cabinets shall be provided with bottom glanding plate which shall be removable from inside and shall be provided with sufficient no. of knockouts. The details of knockouts shall be provided during detail engineering. All knockouts shall be provided with pluggable grommets.
4. The cabinets shall be of max. 2200mm height including base channel. The base channel shall be of 100 ISMC. All cabinets shall be of same height. Construction shall be modular. Contractor shall give the overall dimensions of each system and non-system cabinets in the format as per Schedule- 13 of this volume.
5. System & non-system cabinets shall have "look alike" appearance.
6. All electronic system cabinets shall be designed for 50 deg C operating under maximum ambient temperature without air conditioning system in service. Further cabinets, panels shall be so designed that temperature rise due to heat load does not exceed 10 deg. C above ambient temperature under all operating conditions. Necessary louvers, fans, limited packing density, adequate spacing between instruments, devices etc. shall be provided to maintain temperature rise within permissible limits.
7. Panels, cabinets enclosures wiring shall be arranged to enable the removal of modules/instruments and devices without unduly disturbing them.
8. All panels, cabinets, enclosures interiors shall be illuminated with rapid start fluorescent strip fixtures with door actuated switches. Door switch terminals shall be shrouded. All illuminated lights shall be provided with isolation switch in addition to door switch for maintenance & switching Off when not required. Illumination light shall be provided on both front & back sides if both sides are provided with equipments/instruments/terminal blocks requiring maintenance.


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9. Sufficient number of power receptacles with disconnect switches shall be installed within panels, enclosure and racks.
10. The local instrument enclosures/racks shall be provided locally for mounting of electronic transmitters and switches, etc.
11. All panels, cabinets shall be properly grounded. The grounding scheme shall be as approved by the owner.
12. Exterior steel surface shall be sand blasted, ground smooth, filed, primed, sanded and smooth enamel painted to give a good finish subject to minimum paint thickness of 65-75 microns for sheet thickness of 3 mm and 50 microns for sheet thickness of 2mm. Minimum 2 coats of primer and two sprays of final finish colour shall be applied to all surfaces.
13. The colour of the panel's interior shall be brilliant white in the panel interior. External colour of the panels will be as RAL 7032 for LIE/ LIR and RAL 7035 for control room system cabinets.
14. All panels, enclosures, system cabinets, marshalling cabinets shall be provided with a minimum of 20% spare terminations and system cabinets shall be provided with spare space for 20% additional modules fully wired with connectors etc. in excess of the total requirement of the system design when the cabinets are delivered. The spare space capacity shall be distributed evenly throughout the cabinets.

12.2 System Cabinets

**Table 12.1
Specifications for System Cabinets**

S.N	Features	Minimum Requirements
1	Application	For housing Signal conditioning cards, input/output cards, processor cards, power supply units etc.
2	Location	Indoor
3	Type	Free standing Vertical type
4	Protection class	IP-42
5	Material & Thickness	CRCA steel/3mm
6	Doors	Double door with neoprene gasket, Lockable,
7	Cable entry	Bottom with fire proof compound thickness 50 mm for sealing
8	Anti vibration pad	Required, 15mm
9	Painting	Interior- Brilliant White Exterior- RAL 7035
10	Cabinet Dimension	To be decided during detail engineering
11	Grounding	M6 earthing stud shall be provided
12	Ventilation	Fans & louvers with brass mesh

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S.N	Features	Minimum Requirements
		required
13	Lighting	rapid start fluorescent strip fixtures with door actuated switches required
14	Lifting arrangement	Removable lifting eyebolts shall be provided

- The racks in system cabinets shall have provision along with plug in sockets/back plane to house accommodate the spare slots/modules as specified elsewhere.
- The system cabinets, racks in system cabinets, slots in the racks & the terminals shall have identification numbers. A stainless steel metal tag (plate) shall be fixed to the inside of the door & the layout of the racks, slots & details of the card type/service shall be inscribed on this metal tag.
- Each cabinet shall be provided with one each 3 pin receptacles for 230 V, 1P, 50 Hz and receptacles for 24V DC.
- One of the doors shall be provided with folder to keep the relevant engineering document of the cabinet.
- All cabinets shall have common key for locks.
- Door shall have concealed type of hinges with 120 degree swing.
- Door latches shall be of the three-point type to ensure tight closing.
- Separate Power & shield earthing bus shall be provided at the front & rear side of the cabinets. The earthing bus shall be isolated from panel body by suitable insulation material.

12.3 Marshalling Cabinets

**Table 12.2
Specifications for Marshalling Cabinets**

S.N	Features	Minimum Requirements
1	Application	For termination of all cables originating from field.
2	Location	Indoor
3	Type	Free standing Vertical type
4	Protection class	IP-44
5	Material & Thickness	CRCA steel/ min. 2mm for panel sides & 3mm for gland plates
6	Doors	Double door with neoprene gasket, Lockable,
7	Cable entry	Bottom with fire proof compound thickness 50 mm for sealing
8	Terminal Blocks	Rail mounted cage-clamp fused type

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S.N	Features	Minimum Requirements
		with LED indication suitable for conductor size up to 2.5 mm ² & fused type with LED indication for power supply (24 VDC, 230 V AC, 110 V AC etc.) for instruments & equipments.
9	Anti vibration pad	Required, 15mm
10	Painting	Interior- Brilliant White Exterior- RAL 7035
11	Cabinet Dimension	To be decided during detail engineering
12	Grounding	M6 earthing stud shall be provided
13	Ventilation	Fans & louvers with brass mesh required
14	Lighting	rapid start fluorescent strip fixtures with door actuated switches required
15	Lifting arrangement	Removable lifting eyebolts shall be provided

- Separate Marshalling cabinets for the system shall be supplied for terminating all cables originating from the field and for distributing the signals to different functional panels and cubicles.
- The terminal blocks shall be cage clamp type. Fused terminal blocks hinged at one end to facilitate easy isolation shall be provided wherever necessary. All cabinets shall be provided with spare terminals for the spare inputs/outputs as specified else where in the specification. The type of terminals for terminations from cabinets/panels shall match with the pre fabricated cables and pins supplied.
- The terminals for field cables shall be arranged in a logical order of equipment/system wise and shall be worked out by Contractor, subject to approval by Owner / Consultant.
- The marshalling cabinets, the terminal blocks, the terminals and the electronic hardware if any, shall have identification numbers.
- Each cabinet shall be provided with one each 3 pin receptacles for 230 V, 1P, 50 Hz and receptacles for 24V DC.
- One of the doors shall be provided with folder to keep the relevant engineering document of the cabinet.
- All cabinets shall have common key for locks.
- Door shall have concealed type of hinges with 120 degree swing.
- Door latches shall be of the three-point type to ensure tight closing.
- Separate Power & shield earthing bus shall be provided at the front & rear side of the cabinets. The earthing bus shall be isolated from panel body by suitable insulation material

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12.4 Local Instrument Enclosure & Racks



1. Transmitters and switches, devices, etc. mounted in the field shall be suitably grouped together and mounted in local instruments enclosures in case of open areas of the plant and in local instrument racks in case of covered areas. These local instrument enclosures and racks shall be furnished as per the actual requirements finalised during detailed engineering stage. The exact grouping of instruments in a particular instrument enclosure/instrument rack shall be as finalised during detailed engineering stage subject to the owner's approval.
2. The local instrument enclosures shall be constructed of 2 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Vibration dampeners shall be installed for supporting each enclosure. The internal layout shall be such that the impulse piping/ blow down lines are accessible from back doors of the enclosure and the transmitters etc. are accessible from front side for easy maintenance. Gaskets shall be used between all mating sections to achieve protection class of IP-65.
3. The local instrument racks shall be free standing type constructed of suitable 3 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack. Bulk heads, especially designed to provide isolation from process line vibration shall be provided. Exact fabrication details shall be as finalized during detailed engineering stage. The junction box for racks also shall conform to IP 65 protection class.
4. Provision for continuous purging arrangement is to be made for all air and flue gas applications.
5. Each transmitter enclosure housing instruments i.e. for air and flue gas applications, requiring purge air for continuous air purging shall be provided with common purge air header, redundant air filter regulators of sufficient capacity, required pressure gauges, valves, fittings, SS tubing and individual purge meters for each purge line etc. as required.
6. As soon as the panel's fabrication is over, Owner shall inspect the panels and further work on the panels, namely assembly, wiring and assembly of components shall be carried out only after the inspection.
7. The junction box of Local Instrument Enclosure & Racks shall be provided with hinged type door, latch for locking & gland plates for cable entry. All terminals in junction box shall be of rail mounted cage clamp type suitable for conductor size up to 2.5 Sq. mm.

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12.5 Local Junction Box

Table 12.3



Specifications for Junction Box

S.N	Features	Minimum Requirements
1	No. of Ways	32 (2X16) with 20% spares terminals
2	Material & Thickness	3 mm thick Stainless steel
3	Protection class	IP-65 for outdoor/ IP 55 for Indoor
4	Cable entry	Bottom
5	Mounting	Suitable for Wall/column/structures mounting
6	Terminal Blocks	Rail mounted cage-clamp type suitable for conductor size up to 2.5 mm ²
7	Grounding	M6 earthing stud shall be provided
8	Gland plate	Removable type
9	Door	Single Lockable door with gasket, able to open sideways, turn able hinge based, latch type lock without handle with common key.
10	Accessories	Tag plate, clamps, fixtures, bolts (SS), nuts (SS), Gasket (Neoprene), cable glands (SS), Lugs (Brass), Fire proof compound for sealing.

- All JB's for outdoor application shall be provided with individual canopies to prevent ingress of water.
- All JB' shall have provision to add 10% additional TB's.
- The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams.
- Separate Terminal blocks shall be used for Analog & Digital Signals & also for signals with different voltage levels.
- The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.
- Separate shield bus shall be provided with screw connection for terminating cable shields.
- All spare cable entries shall be provided with plugs.
- All wires in JB shall be neatly dressed & ferruled.
- Double deck type terminal block shall not be used.

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**Table 12.4
Specifications for Cable Glands**



S.N	Features	Minimum Requirements
1	Type	Double compression
2	Entry Thread	½ " NPT
3	Material	Brass
4	Finish	Cadmium Plated
5	Protection	IP-54 or better
6	Accessories	Neoprene gasket, Locknut, Reducer etc.


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10. PROCESS CONNECTION PIPING

The Contractor shall provide, install and test all required material for completeness of impulse piping system, sample piping system and air piping system as per the requirements of this clause on as required basis for the connection of instruments and control equipment to the process and make the system complete. However, the Contractor shall furnish during detailed engineering all relevant drawings, material and technical specifications of various items service wise for Owner's/Consultant's approval.

Control and instrument piping & connections shall generally be designed in accordance with the following criteria and these criteria shall be closely coordinated with Mechanical Piping Contractor / Erector to fulfill the Mechanical Design Criteria also. This is a guideline for Piping design & selection. OEM standard proven practice in these regard are also acceptable if it is complying with applicable international standard & specifications as described in this section.

1. Pressure connections and piping up to the root valves for all pressure indicators, pressure switches, pressure transmitters, etc., shall be as indicated for miscellaneous piping.
2. Temperature indicators, temperature controllers, temperature switches, temperature detectors, and test well connections shall be as follows:
 - Main steam -- 40 mm NPT.
 - Extraction steam -- 40 mm NPT.
 - Boiler feed water -- 32 mm NPT.
 - Reheat steam -- 40 mm NPT.
 - Duct temperatures -- 25 mm NPT.
 - All others -- 19 mm NPT.
3. Flow transmitter connections and piping up to the root valves shall be 25 mm for all piping except orifice flanges, where 15 mm piping and valves shall be used.
4. Level switch connections and piping up to root valves shall be 25mm.
5. Level controllers and level transmitters of the displacement type shall have connections and piping up to root valves of 50 mm.
6. Level controllers and level transmitters of the differential pressure type shall have connections and piping up to root valves of 25 mm.
7. Instrument columns at tanks and pressure vessels shall generally be 65 mm minimum.

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A. Design Pressure and Temperature

Instrument primary piping design pressure and temperature shall be selected consistent with the requirements discussed in Mechanical Design Criteria of this specification, for the process pipe to which the instrument primary piping is connected. The following general criteria shall also apply:

Instrument primary piping for steam and other systems shall be designed for 1-½ times the maximum sustained process pressure and temperature (plus 20°C).


B. Sizes of Instrument Primary Piping

Instrument primary piping shall not be smaller than the connection at the process pipe root valve and/or the following (metric sizes are nominal):-

1. 20 mm for pressure measurement piping with a design pressure equal to or less than 42.0 bar and a design temperature equal to or less than 400°C.
2. 25 mm for pressure measurement piping with a design pressure greater than 42.0 bars or a design temperature greater than 400°C.
3. Flow and level measurement by differential pressure shall also use primary piping conforming to the above requirements; however, flange tap connections may be of 13 mm size.
4. Float actuated level switch devices shall be supported on connecting piping not smaller than 25 mm.
5. Level controllers and transmitters of the displacement float type shall be supported on connecting piping not smaller than 50 mm.
6. Instrument columns for float actuated level switches and displacement float devices shall be piping of not less than 65 mm.
7. Primary piping internal diameter shall not be less than 8 mm between the process connection and instrument blow down valve.

C. Materials for Instrument Primary Piping

Material for instrument primary piping connecting to the root valve shall preferably be the same as that used in the process system to which it is connected. Higher strength materials may be substituted in the interest of standardization; however, welding procedures at the point of joining the instrument primary piping to the process piping must be appropriate to the combination of materials involved. Copper may be used only for compressed air services that use copper process piping.


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D. Insulation of Instrument Primary Piping

Instrument primary piping connecting to high temperature systems, which might become hot enough to injure personnel during blow down of the instrument line, shall be insulated where such hazard exists. Insulation materials, exterior finish, and metal lagging shall conform to the standards adopted for the process piping.

All materials supplied shall be suitable for intended service, process, operating conditions and type of instruments used and shall fully conform to the requirements of this specification. The material offered by the Contractor shall be from reputed, proven manufacturer.

E. Process Connection Size

Size of tapping point, Stub No. and size of Root valves for different type of measurements.

These shall be as follows:

Table 10.1
Process Connection Stub & Root valve

S. N.	Quantity of root valves (Nos.)	Size of stub and root valves	Service condition
A. Pressure and Differential pressure measurement			
1	2	25NB	> = 62 bar or 425degree C
2	1	15NB	< 62 bar and 425 degree C
B. Level Gauge and Switch			
1	2	25 NB	> = 62 bar or 425 degree C
2	1	25NB	< 62 bar and 425 degree C
C. Level Transmitter (Displacement Type)			
1	2	40NB	> = 62 bar or 425degree C
2	1	40NB	< 62 bar and 425 degree C
D. Stand pipe for Level measuring instrument			
1	2	80 NB	> = 62 bar or 425degree C
2	1	80 NB	< 62 bar and 425 degree C
E. Flow measurement			

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S. N.	Quantity of root valves (Nos.)	Size of stub and root valves	Service condition
1	2	25NB	> = 62 bar or 425degree C
F. Level measurement			
1	1	25NB	< 62 bar and 425 degree C
G. Sampling system measurement (system and water service)			
1	2	25 NB	> = 62 bar or 425degree C
2	1	25 NB	< 62 bar and 425 degree C

10.1 Impulse Piping, Tubing, Fittings, Valves & Valve Manifolds

All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers, sizes and dimensions etc. The material of the impulse pipe shall be same as that of main process pipe. For various applications specification of impulse pipe materials and associated fittings and valves shall be as given in Table –10.2 (Process Connection Piping).

**Table 10.2
Process Connection piping**

S. N	Service	Size		Impulse tube material	Impulse Pipe material	Impulse line fitting material	valves material
		Pipe	Tube			ANSI rating	ANSI Rating
1	Main steam / Saturated steam	SCH. XXS 21.3 4mm OD	1.7 mm ODX 1.65 HK	SS 316	ASTM-A-335-Gr-P-22 (alloy steel)	ASTM-A-182-Gr-F-22	ASTM-A-182-Gr-F-22
						9000 LBS	2500 SPL. Class
2	Hot reheat / extraction to HPH	SCH. 80 21.3 4mm OD	12.7 mm ODX 1.65 mm THK	SS 316	ASTM-A-335-Gr-P-22 (alloy steel)	ASTM-A-182-Gr-F-22	ASTM-A-182-Gr-F-22
						9000 LBS	2500 SPL. Class

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S. N	Service	Size		Impulse tube material	Impulse Pipe material	Impulse line fitting material	valves material
		Pipe	Tube			ANSI rating	ANSI Rating
3	Cold reheat / extraction / heater drains / condensate system; aux. steam	SCH. 80 21.3 4mm OD	12.7 mm ODX 1.65 mm THK	SS 316	ASTM-A-106-Gr-B (carbon steel)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	400LBS
4	Water system	SCH. 80 21.3 4mm OD	12.7 mm ODX 1.65 mm THK	SS316	ASTM-A-106-Gr-B (carbon steel)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	400LBS
5.	Instrument air system	SCH. 40 21.3 4mm OD(p ipe throu gh out)	12.7 mm ODX 1.65 mm THK	SS316	IS 1239 Heavy Class (Galvanised)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	150LBS
6.	Service air system	SCH. 40 21.3 4mm OD	12.7 mm ODX 1.65 mm THK	SS 316	IS 1239 Heavy Class (Black)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	150LBS
7.	Vacuum	SCH. 40 21.3 4mm OD	7 mm ODX 1.65 mm THK	SS 316	ASTM-A-106-Gr-B (carbon steel)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	150LBS


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S. N	Service	Size		Impulse tube material	Impulse Pipe material	Impulse line fitting material	valves material
		Pipe	Tube			ANSI rating	ANSI Rating
8.	Make up water system	SCH. 40 21.3 4mm OD	12.7 mm ODX 1.65 mm THK	SS 316	ASTM-A-312-TP-316 (SS)	ASTM-A-182-Gr-IF6a	ASTM-A-182-Gr-IF6a
						3000LBS	150LBS

Notes:-

1. Impulse pipe thickness will be selected as per ANSI B 36.10. based on the schedule indicated against each service.
2. Wherever impulse tubes are provided, all the fittings required for these shall be SS316.

The following guidelines shall also be considered along with the Table 10.1 & 10.2 for size, material and rating for impulse line/tube fittings and accessories:

a. Impulse line / tube fittings and accessories

1. Nipple shall be provided for root valve size more than ½ inch and the nipple size shall be same as the root valve size. Reducer / adapter shall be provided to suit instrument connection, where nipple, root valve size is more than ½ inch.
2. Bulk head fitting socket welded type to be provided at instrument rack / enclosure.

b. Fittings

1. All fittings except the last fitting connecting to the instrument shall be socket welded. The size of the fittings shall be same as the impulse line size.
2. The fitting connecting to the instrument shall have a size and thread to suit the instrument connection.

c. Drain

Drain shall be provided for all water / steam and non-inflammable / non-corrosive fluids only.

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d. Drain Valve

1. Two numbers of globe drain valves shall be provided for process conditions of 425 degree C or 62 bar and higher.
2. One number globe drain valve shall be provided for process conditions of less than 425 degree C and 52 bar.
3. The valve size shall be same as impulse piping / tubing size.

e. Funnel with drain header

1. This shall be provided in the racks for blowing / draining out the process fluid in the impulse tubings.
2. The size of drain header shall be 1"
3. When instruments are mounted local to the tapping point and are not mounted in rack, or panel or enclosure. The drains shall be connected to the nearest floor level or plant drain.

f. Instrument Valves

1. Type of the valve shall be needle valve with built in drain valve.
2. Sizing of the valve shall be 1/2".

g. Right / left threaded fittings

1. This shall be provided for installation / removal of instruments without disturbing the tubing / piping.

h. A suitable adapter shall be provided to install the instruments on 1/2" right-left threaded fittings.

i. A 1/2" vent line with a 1/2" isolation valve shall be provided in the instrument rack for air and compressible fluids or other wise if the installation call for eg., for liquid service where the transmitter is located at a higher elevation than the tapping point.

j. For air / flue gas measurement a drain pot with plug shall be provided in place of drain valves.


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Stainless steel tube shall be provided inside enclosures and racks from tee connection to valve manifold and then to instrument. For high pressure/temperature applications (piping class A,B,C & D of the Table 10.1) the material shall be ASTM A 213 TP 316H and for other applications material shall be ASTM A 213 TP 316L. The wall thickness of the tube shall be in accordance with the ANSI B31.1 standard.

All fittings shall be forged steel and shall conform to ANSI B16.11. The material of forged tube fittings for shaped application (e.g. tee, elbow etc.) shall be ASTM A182 Gr. 316 H for high pressure/ temperature applications (as defined above) and ASTM A182 Gr. 316L for other applications. The material for bar stock tube fitting (for straight application) shall be 316 SS. Metal thickness in the fittings shall be adequate to provide actual bursting strength equal to or greater than those of the impulse pipe or SS tube, with which they are to be used.

The source shut-off (primary process root valve) and blow down valve shall be as per Table 10.1. The disc and seat ring materials of carbon steel and alloy steel valves shall be ASTM A-105 and ASTM A-182, Gr. F22, hard faced with stellite (minimum hardness - 350 BHN.) The surface finish of 16 RMS or greater is required in the area of stem packing. The valve design shall be such that the seats can be re-conditioned and stem and disc may be replaced without removing the valve body from the line.

The valve manifolds shall be of 316 SS with pressure rating suitable for intended application. 2 valve manifold and 3 valve manifold shall be used for pressure measurements using pressure transmitters/ pressure switches and differential pressure transmitters/ switches respectively. 5 valve manifold shall be used for remaining applications like DP, flow and level measurements.

For Pressure/D.P gauges in fluid application two-way globe valve on each impulse line to the instrument and in air/flue gas application two way gate valve on each impulse line to the instrument shall be provided near the instrument. These shall be in addition to the three way gauge cock provided along with the pressure/D.P gauges.

**Table 10.3
Specification for Seamless SS Pipe**

S.N	Property	Requirement
1	Reference	ASTM A-312 TP-316
2	Material Grade	TP-316
3	Type	Seamless/Plain end
4	Size	½" NB
5	Schedule	40/60/80
6	Standard Length	5 metre

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**Table 10.4
Specification for Seamless SS Pipe Fittings**

S.N	Property	Requirement
1	Reference	ASTM A-182 F-316
2	End Connection	Socket welded
3	Type	Forged conforming to ANSI B16.11
4	Size	½" NB
5	Rating	3000/6000/9000 lbs
6	Type of Fittings	Reducing coupling, Male-Female reducer, Straight coupling, Equal Tee, Three Piece Union, Elbow, Cap etc.

**Table 10.5A
Specification for Seamless SS Tube (1/2")**

S.N	Property	Requirement
1	Reference	ASTM A-213 TP-316
2	Material Grade	TP-316
3	Type	Cold Drawn annealed, pickled, passivated, descaled, hydraulically cleaned seamless tube.
4	Size	½" OD X 2.1 mm thick
5	Properties	Tube shall be free from scratches & suitable for bending & capable of being flared by hardened & tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80
6	Test Pressure	400 Kg/Sq mm minimum
7	Tolerance	+/- 0.13 mm for outside dia. +/- 15% for wall thickness
8	Test	Flare, Hardness, Ball & Bubble test
9	Standard Length	5 metre

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**Table 10.5B
Specification for Seamless SS Tube (1/4")**

S.N	Property	Requirement
1	Reference	ASTM A-269 TP-316
2	Material Grade	TP-316
3	Type	Cold Drawn annealed, pickled, passivated, descaled, hydraulically cleaned seamless tube.
4	Size	1/4" OD X 1.2 mm thick



S.N	Property	Requirement
5	Properties	Tube shall be free from scratches & suitable for bending & capable of being flared by hardened & tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80
6	Test Pressure	400 Kg/Sq mm minimum
7	Tolerance	+/- 0.13 mm for outside dia. +/- 15% for wall thickness
8	Test	Flare, Hardness, Ball & Bubble test
9	Standard Length	5 metre

**Table 10.6
Specification for Seamless SS Tube Fittings**

S.N	Property	Requirement
1	Reference	ASTM A-182
2	Material Grade	SS 316 forged
3	Type	Double ferrule double compression
4	Ferrule	SS 316
5	Size	To suit SS tubing & NPT end connection
6	Type of fittings	Male/Female connectors, elbow, Equal & Unequal Tee, Cross, Straight connector, bulk head unions, etc. as required to suit the installation.

**Table 10.7
Specification for Instrument Valve Manifolds**

S.N	Property	Requirement
1	Type	Two valve manifold/Three Valve Manifold Five valve manifold
2	Mounting	Remote 2" pipe mounting
3	Construction	Single Block (Bar Stock)
4	Material	Forged body & bonnet AISI 316 SS
5	Ports	½" NPT
6	Rating	420 Kg/ cm2 at ambient
7	Packing	PTFE Wafer
8	Seat & Stem	AISI 316 SS
9	Plug	AISI 316 SS free to turn on stem/ 17-4 PH
10	Handle	AISI 316 SS
11	Connection	Straight
12	Accessories	Plug for all ports Mounting Bracket, nut, bolts etc.

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10.2 Air Supply Piping

1. All pneumatic piping, fittings, valves, air filter cum regulator and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided.

This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements of Local Instrument Enclosures (LIE) etc.
2. For individual supply line and control signal line to control valve, 1/4 inch size light drawn tempered copper tubing conforming to ASTM B75 shall be used. The thickness of copper tubing shall not be less than 0.065 inch and shall be PVC coated. The fittings to be used with copper tubes shall be of cast brass, screwed type.
3. All other air supply lines of 1/2 inch to 2 inch shall be of carbon steel hot dipped galvanized inside and outside as per IS-1239, heavy duty with threaded ends. The threads shall be as per ASA B.2.1. Fittings material shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs.
4. Instrument air filter cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply. The filter regulators shall be suitable for 10 kg/ sq.cm max. inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2 inch size pressure gauge and built in filter housing blow down valve. The end connection shall be as per the requirement to be finalised during detailed engineering.
5. All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be 1/2 inch to 2 inch.

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**Table 10.8
Specification for Instrument Air Header**

S.N	Property	Requirement	
		For Panel	For Field
1	Material	SS 316	SS 316
2	Inter Connection	2" NPT (M)	1" NPT (M)
3	Header Take-Off	SS 316	SS 316
4	Take-Off Connection	½" NPT (M)	½" NPT (M)
5	Take-Off Valve	½" Ball Valve SS 316	½" Ball Valve SS 316
6	Drain	½" Ball Valve SS 316 at the lowest point	½" Ball Valve SS 316 at the lowest point



**Table 10.9
Specification for CS Pipe**

S.N	Property	Requirement
1	Reference	ASTM A-106 Gr. C
2	Material	Cold Drawn Seamless CS
3	Type	Seamless/ threaded ends as per ASA B2.1/ Hot dip Galvanised from Inside & outside as per IS-1239
4	Size	½" to 2" NB
5	Schedule	80/160
6	Standard Length	5 metre

**Table 10.10
Specification for CS Pipe Fittings**

S.N	Property	Requirement
1	Reference	ASTM A-234/ ASA B16.11
2	Type	Forged/ hot dip galvanised from inside & outside
3	Size	½" to 2" (as required)
4	Rating	3000/6000/9000 lbs.
5	End Connection	Threaded as per ASA B2.1
6	Type of Fittings	Reducing Coupling, Male-Female reducer/ Straight Coupling/ Equal Tee/ Three piece Union/ Elbow/ Cap etc.

**Table 10.11
Specification for CS Globe Valve**

S.N	Property	Requirement
1	Reference	ASTM A-105/ASTM B62
2	Type	Globe
3	Construction	Forged body cadmium plated
4	Rating	PN 40/PN 160/ PN 320/ PN 400
5	End Connection	Screwed Female ends as per ASA B2.1
6	Material	Body- Carbon steel Stem- Hardened Steel Plug- AISI 316 SS Seat- SS Stellite
7	Size	½" to 2" as required
8	Packing	Teflon/Grafoil as required
9	Hand wheel	CS
10	Yoke	ASTM A105
11	Design Standard	As per ANSI B16.34

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interferences and power line borne surges especially encountered in power plant environment. Contractor's equipment, which is vulnerable to electrical noise interference or surge, shall be suitably immunized to eliminate possible problems.

Contractor shall be fully responsible for detailed implementation of the type, size, shielding, input balancing, ripple amplitude and grounding for field inputs and for equipment furnished by Contractor to achieve an installation with minimum noise coupling from all sources.

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

5.10 Surge Protection for Microprocessor based Equipments

All microprocessor-based system / equipment shall be able to withstand the noise and surges inherent in a powerhouse. The system / equipment shall be designed to successfully withstand without damage to components and / or wiring, application of surge withstand capability (SWC) wave whose shape and characteristics are defined in ANSI publication C37.90a, 1974 entitled "Guide for Surge Withstand Capability (SWC) Tests".

Details shall be provided of production tests being carried out to fully satisfy Owner/Consultant that the proposed system / equipment meets the above requirement and to assure that the products furnished shall be of the desired grade. To immunize the system against surge or coupling it is preferred that freewheeling diodes, surge suppressors, opto / galvanic isolators be used as required.

5.11 Drive Control Philosophy

The Drive control & measurement philosophy for the project is detailed in this section.

5.11.1 Bi-directional drives (inching or open/close)

1. All bi-directional drives shall be operable from Remote i.e. from CCR.
2. Remote manual operation of all drives shall be carried out from OWS.
3. Remote Open/Close commands, generated in control system shall be issued to MCC module through interposing relays located in respective MCC module in the MCC room. Latching of commands shall be provided in control system logic which shall be reset by Limit/Torque switch feedback. The Limit/Torque switch feedback from drive shall be directly wired to Control System.


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4. Necessary Electrical protections shall be realized at MCC module whereas process interlocks & protections shall be realized in Control system.
5. Following signal exchange shall be envisaged between Drive & Control system:
 - Open Limit Switch (Both NO & NC contacts)
 - Close Limit Switch (Both NO & NC contacts)
 - Open Torque Actuation
 - Close Torque Actuation
 - Position feedback (4-20 mA, two wire electronic type) for inching drive
6. Following signal exchange shall be envisaged between MCC & Control system (Remote I/O cabinet of control system located in/near MCC room):
 - Switchgear available
 - Switchgear disturbance
 - Open Command
 - Close Command

The block diagram of the bidirectional drive (On-Off type & Inching type) controls is shown in drawing no. LII-GEOE11019-G-00172-327 & LII-GEOE11019-G-00172-328.

5.11.2 Unidirectional LT drives

1. Unidirectional LT drives shall be operable only from Remote i.e. from CCR. In addition, Local pushbutton shall be provided only for emergency stopping of drive. Local start operation of the drive is not envisaged.
2. Remote manual operation of all drives shall be carried out from OWS.
3. Remote Start/Stop commands shall be generated in Control system & shall be issued to MCC module through interposing relays located in respective MCC modules.
4. Emergency stop of the drive shall be envisaged from the local pushbutton provided near the drive. The stop push button (Stay put


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type) shall be provided with a press to lock & turn to release type keyless mechanism. Under locked position the drive operation is inhibited from remote. The local emergency stop push button shall be wired directly to MCC.

5. Necessary Electrical protections shall be realized at MCC module whereas process interlocks & protections shall be realized in Control system.
6. Current transducer with 4-20 mA type outputs shall be provided in the MCC for monitoring the current in Control System for all Drives greater than 90 KW. Auxiliary power supply to these transducers shall be from the control supply of the respective MCC modules.
7. Following signal exchange shall be envisaged between MCC & Control system (Remote I/O cabinet of control system located in MCC room):
 - Switchgear available
 - Switchgear disturbance
 - On Feedback
 - Off Feedback
 - Start Command
 - Stop Command
8. All Numerical relays/Intelligent controllers for LT drives shall be interfaced to Control System through IEC 61850 protocol.

The block diagram of the Unidirectional LT drive controls is shown in drawing no. LII-GEOE11019-G-00172-329.

5.11.3 Solenoid Operated drives

1. Solenoid operated drives shall be operable only from Remote i.e. from CCR.
2. Remote manual operation of all drives shall be carried out from OWS.
3. Remote Open/Close commands shall be generated in Control system & shall be issued to the Solenoid through interposing relays, located in Relay Panel.
4. Necessary process interlocks shall be realized in Control system.
5. Following signal exchange shall be envisaged between solenoid drive & Control system:
 - Open Limit Position
 - Close Limit Position
 - Open Command
 - Close Command


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The block diagram of the Solenoid drive controls is shown in drawing no. LII-GEOE11019-G-00172-331

5.11.4 HT drives

1. HT drives shall be operable only from Remote i.e. from CCR. In addition, Local pushbutton shall be provided only for emergency stopping of drive. Local start operation of the drive is not envisaged.
2. Remote manual operation of all drives shall be carried out from OWS.
3. Remote Start/Stop commands shall be generated in Control system & shall be issued to MCC module through interposing relays located in respective MCC modules.
4. Emergency stop of the drive shall be envisaged from the local pushbutton provided near the drive. The stop push button (Stay put type) shall be provided with a press to lock & turn to release type keyless mechanism. Under locked position the drive operation is inhibited from remote. The local emergency stop push button shall be wired directly to MCC.
5. Necessary Electrical protections shall be realized at MCC module whereas process interlocks & protections shall be realized in Control system.
6. Current transducer with 4-20 mA type outputs shall be provided in the MCC for monitoring the current in Control System for all Drives. Auxiliary power supply to these transducers shall be from the control supply of the respective MCC modules
7. Following signal exchange shall be envisaged between MCC & Control system (Remote I/O cabinet of control system located in MCC room):
 - Switchgear available
 - Switchgear disturbance
 - Master Trip relay Operated
 - On Feedback
 - Off Feedback
 - Trip Feedback
 - Emergency stop feedback
 - Start Command
 - Stop Command
 - Current Feedback



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8. All Numerical relays/Intelligent Controllers for HT drives shall be interfaced to Control System through IEC 61850 protocol.

The block diagram of the HT drive controls is shown in drawing no. LII-GEOE11019-G-00172-330

5.11.5 Variable Frequency Drive (VFD) [If Applicable]

1. VFD shall be operable from Remote i.e. from CCR & from VFD Local Display unit. In addition, Local pushbutton shall be provided only for emergency stopping of drive.
2. Remote manual operation of VFD shall be carried out from OWS.
3. Remote Start/Stop commands shall be generated in Control system & shall be issued to VFD Panel through interposing relays located in VFD Panel.
4. Emergency stop of the drive shall be envisaged from the local pushbutton provided in the field. The stop push button (Stay put type) shall be provided with a press to lock & turn to release type keyless mechanism. Under locked position the drive operation is inhibited from remote. The local emergency stop push button shall be wired directly to VFD panel.
5. Necessary Electrical protections shall be realized at VFD module whereas process interlocks & protections shall be realized in Control system.
6. Following signal exchange shall be envisaged between VFD & Control system:
 - Switchgear available
 - Switchgear disturbance
 - On Feedback
 - Off Feedback
 - Trip Feedback
 - Emergency stop feedback
 - Start Command
 - Stop Command
 - Current Feedback
 - Speed feedback
 - Speed Setpoint


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7. The VFD shall also be interfaced with control system via Modbus soft link.

The block diagram of the Variable Frequency drive controls is shown in drawing no. LII-GEOE11019-G-00172-133

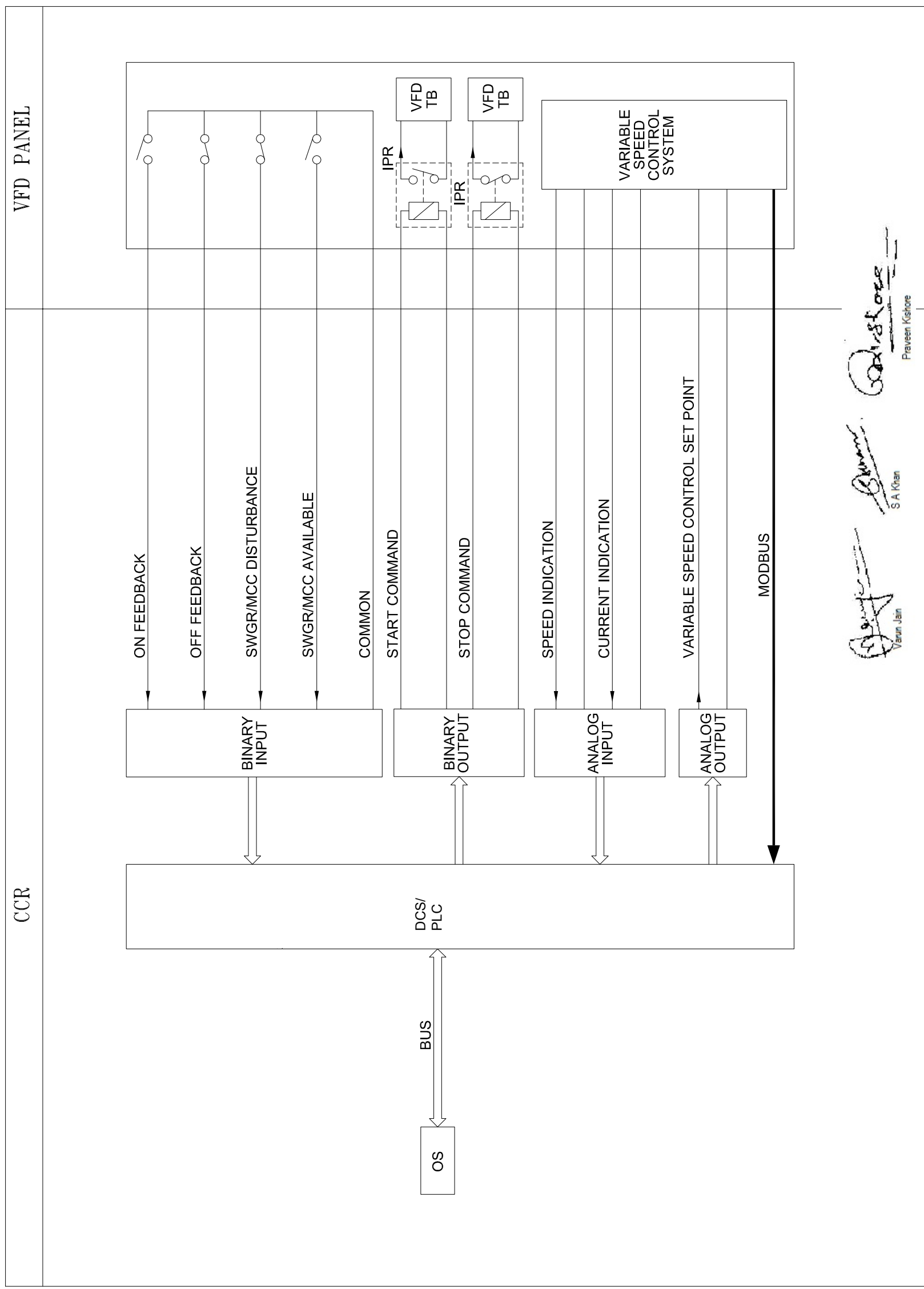

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ABBREVIATIONS

- CCR - CENTRAL CONTROL ROOM
- DCS - DISTRIBUTED CONTROL SYSTEM
- MCC - MOTOR CONTROL CENTRE
- OS - OPERATOR STATION
- IPR - INTERPOSING RELAY
- PB - PUSH BUTTON
- SWGR - SWITCHGEAR
- TB - TERMINAL BOX
- VFD - VARIABLE FREQUENCY DRIVE



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 S. A. Khan
 Praveen Kishore

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02	25.06.11	AJV
01	06.06.11	AJV

PREPARED	NAME	DATE
PS	PS	06-JUN-11

DESIGNED BY	SM	06-JUN-11
SM	SM	06-JUN-11

CHECKED BY	AJV	06-JUN-11
AJV	AJV	06-JUN-11

APPROVED BY	UJR	06-JUN-11
UJR	UJR	06-JUN-11

SHEET NO.	A3	06-JUN-11
A3	A3	06-JUN-11

SCALE	NTS
NTS	NTS

CONTRACT NO.	PROJECT :
	2 X 500 MW NEYVELI NEW THERMAL POWER STATION

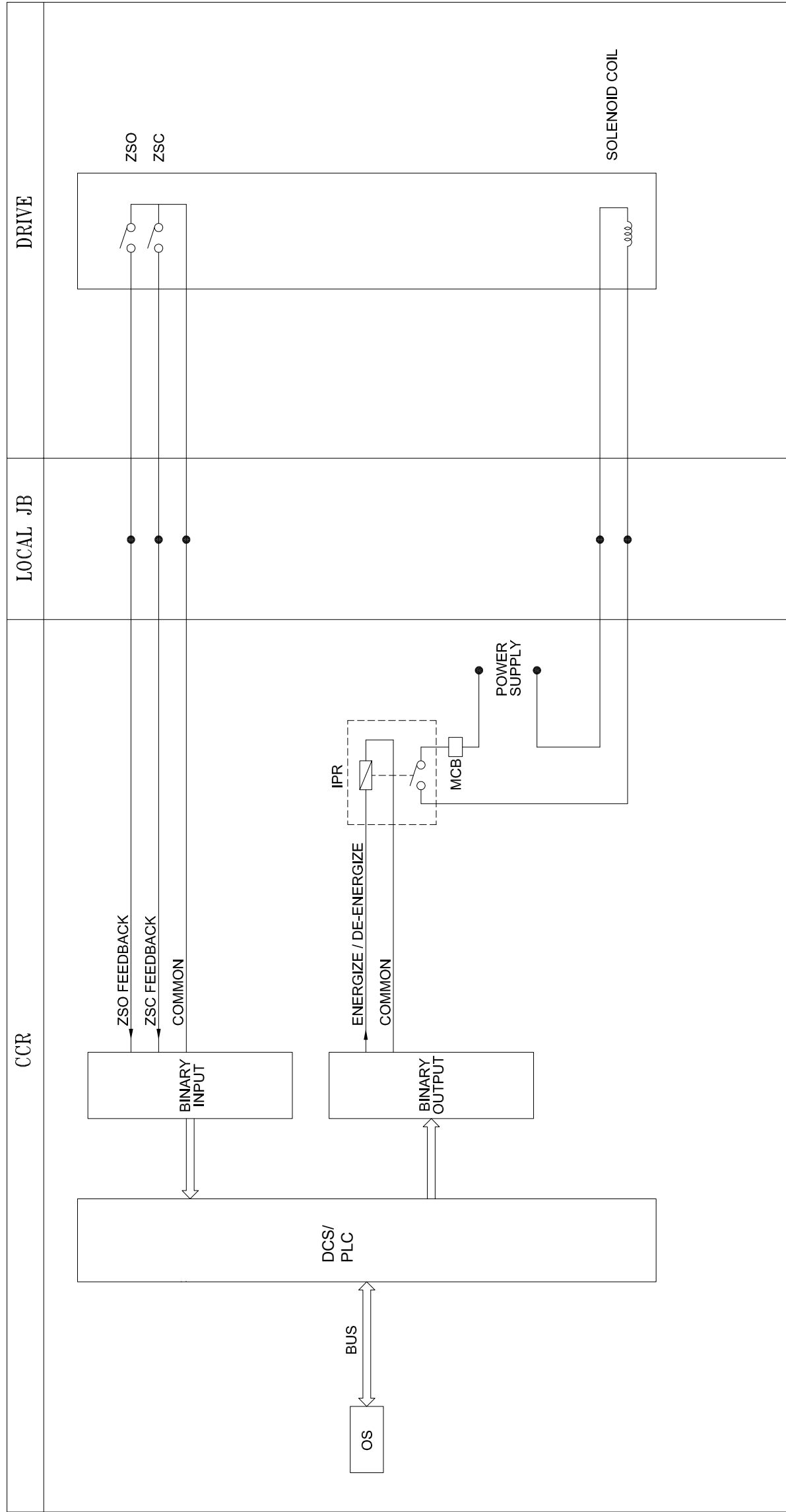
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NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU	

DRAWING TITLE :	DRIVE CONTROL PHILOSOPHY VFD CONTROL
REVISIONS	REV. SHEET 02 1 OF 1

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ABBREVIATIONS

- CCR - CENTRAL CONTROL ROOM
- DCS - DISTRIBUTED CONTROL SYSTEM
- MCC - MOTOR CONTROL CENTRE
- MCB - MINIATURE CIRCUIT BREAKER
- OS - OPERATOR STATION
- IPR - INTERPOSING RELAY
- I/O - INPUT/OUTPUT
- ZSO - LIMIT SWITCH OPEN
- ZSC - LIMIT SWITCH CLOSE
- JB - JUNCTION BOX



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DRAWN BY	PS	04-APR-11	
DESIGNED BY	SM	04-APR-11	
CHECKED BY	AJV	04-APR-11	
APPROVED BY	UJR	04-APR-11	
SHEET SIZE	A3	DRAWING NO :	LIH-GEOE11019-G-00172-331
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ABBREVIATIONS

- CCR - CENTRAL CONTROL ROOM
- DCS - DISTRIBUTED CONTROL SYSTEM
- MCC - MOTOR CONTROL CENTRE
- SWGR - SWITCH GEAR
- OS - OPERATOR STATION
- IPR - INTERPOSING RELAY
- I/O - INPUT/OUTPUT
- TB - TERMINAL BOX

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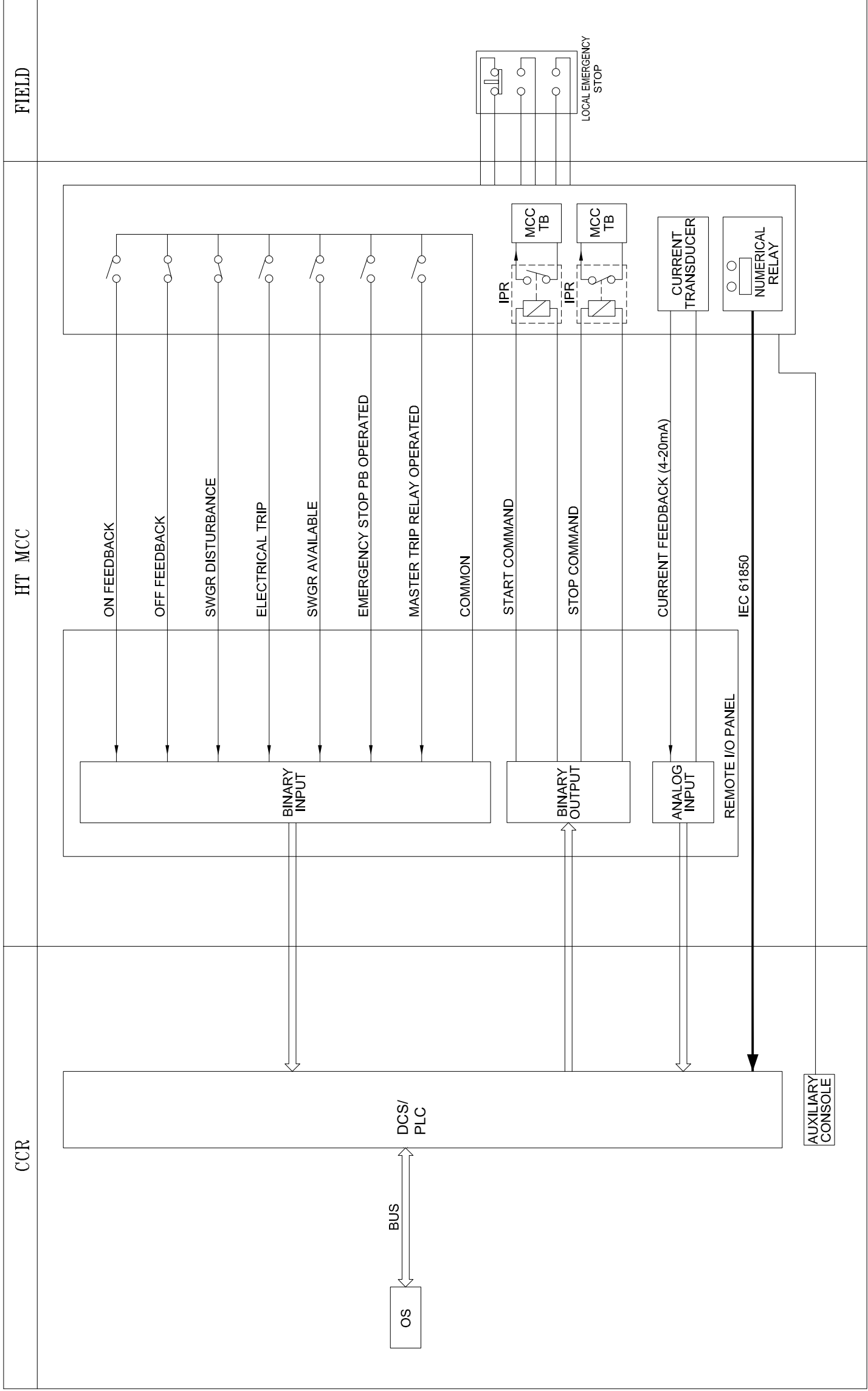
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APPROVED BY	U/R	04-APR-11	
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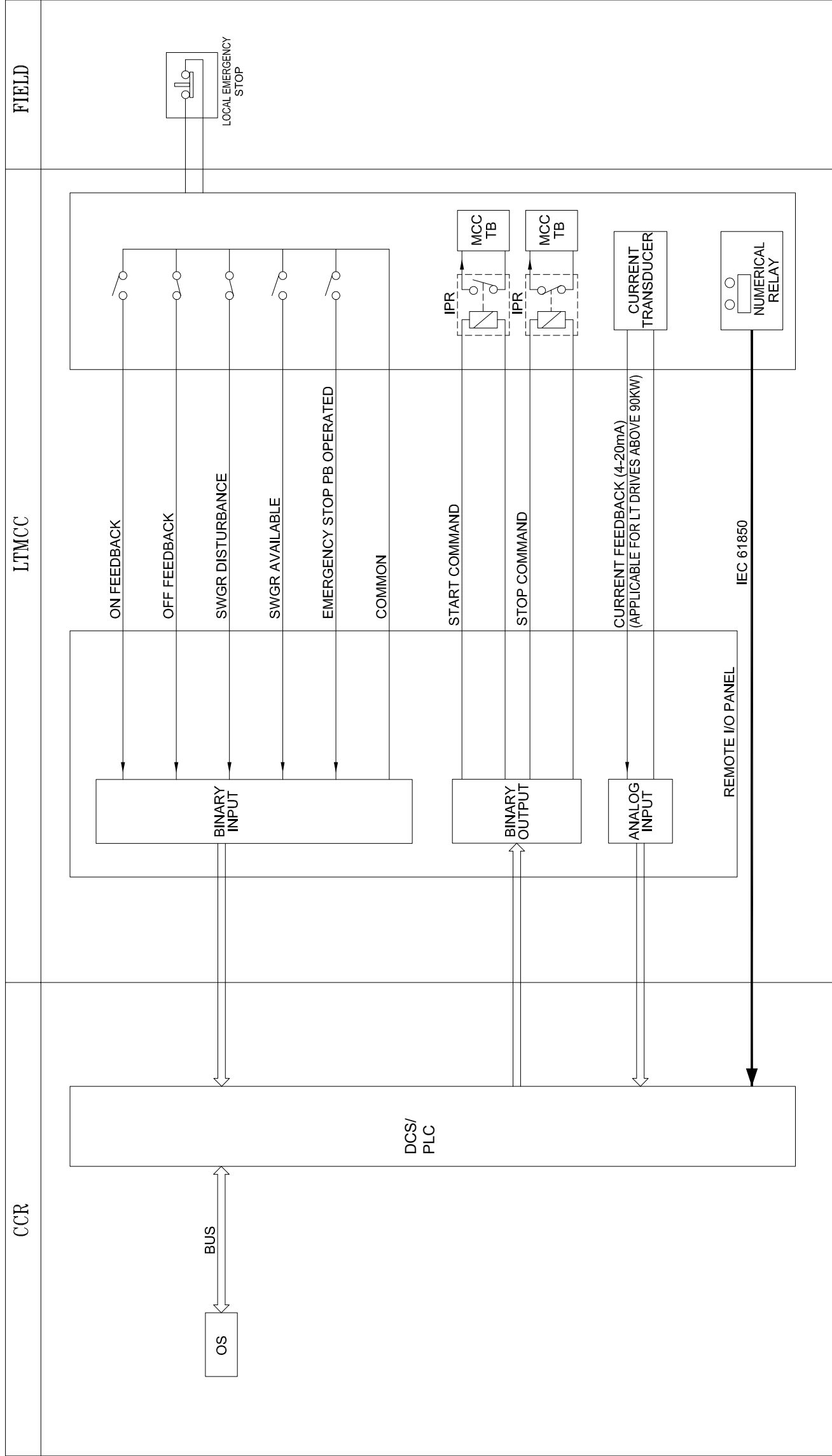


V. S. A. Khan

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ABBREVIATIONS

- CCR - CENTRAL CONTROL ROOM
- DCS - DISTRIBUTED CONTROL SYSTEM
- MCC - MOTOR CONTROL CENTRE
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PREPARED	NAME	DATE	
DRAWN BY	PS	04-APR-11	
DESIGNED BY	SM	04-APR-11	
CHECKED BY	AJV	04-APR-11	
APPROVED BY	UIR	04-APR-11	
SHEET SIZE	A3	DRAWING NO :	LIH-GEOE 11019-G-00172-329
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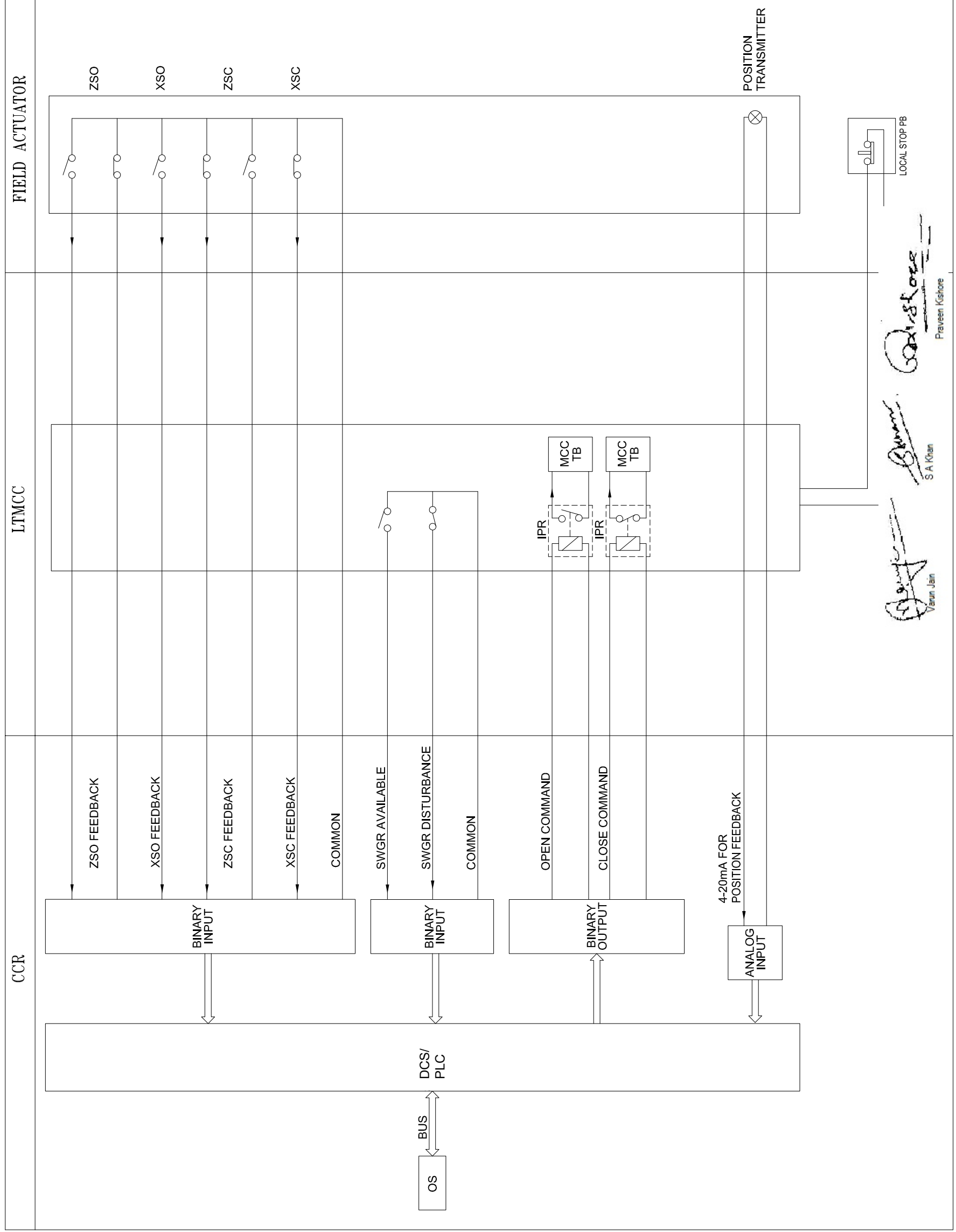
(Signature)
 S A Khan
 Praveen Kishore

NOTE:-

1. FOR LIMIT SWITCH BOTH NO & NC CONTACT SHOULD BE WIRED UPTO DCS.

ABBREVIATIONS

- CCR - CENTRAL CONTROL ROOM
- DCS - DISTRIBUTED CONTROL SYSTEM
- MCC - MOTOR CONTROL CENTRE
- SWGR - SWITCH GEAR
- OS - OPERATOR STATION
- IPR - INTERPOSING RELAY
- ZSO - LIMIT SWITCH OPEN
- XSO - TORQUE SWITCH OPEN
- ZSC - LIMIT SWITCH CLOSE
- XSC - TORQUE SWITCH CLOSE
- PB - PUSH BUTTON
- TB - TERMINAL BOX



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CONTRACT NO :		PROJECT :	
PREPARED	NAME	DATE	DESCRIPTION
DRAWN BY	PS	04-APR-11	2 X 500 MW NEYVELI NEW THERMAL POWER STATION
DESIGNED BY	SM	04-APR-11	
CHECKED BY	AJV	04-APR-11	DRAWING TITLE : DRIVE CONTROL PHILOSOPHY
APPROVED BY	UJR	04-APR-11	BIDIRECTIONAL DRIVES (MOV-INCHING TYPE)
SHEET SIZE	A3	DRAWING NO :	LIH-GEOE11019-G-00172-328
SCALE	NTS	REV.	SHEET
		02	1 OF 1

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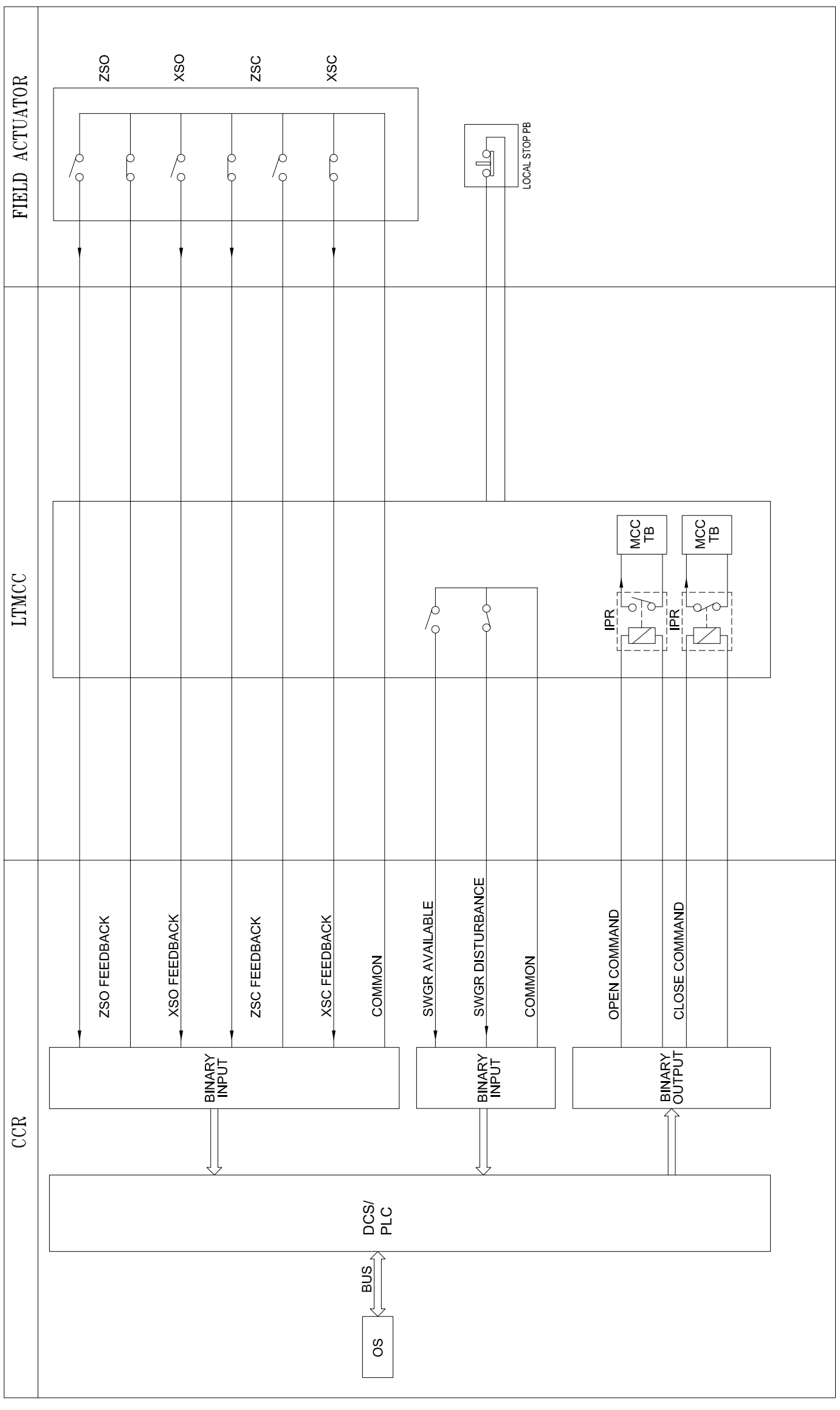
(Signatures)
S A Khan
Praveen Kishore

NOTE:-

1. FOR LIMIT SWITCH BOTH NO & NC CONTACT SHOULD BE WIRED UPTO DCS.

ABBREVIATIONS

- CCR - CENTRAL CONTROL ROOM
- DCS - DISTRIBUTED CONTROL SYSTEM
- MCC - MOTOR CONTROL CENTRE
- SWGR - SWITCH GEAR
- OS - OPERATOR STATION
- IPR - INTERPOSING RELAY
- ZSO - LIMIT SWITCH OPEN
- XSO - TORQUE SWITCH OPEN
- ZSC - LIMIT SWITCH CLOSE
- XSC - TORQUE SWITCH CLOSE
- PB - PUSH BUTTON
- TB - TERMINAL BOX



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DESCRIPTION									

CONTRACT NO :	PROJECT :	DRAWING TITLE :	DRAWING NO :
PREPARED BY : PS	DATE : 04-APR-11	2 X 500 MW NEYVELI NEW THERMAL POWER STATION	
DESIGNED BY : SM	DATE : 04-APR-11	DRIVE CONTROL PHILOSOPHY	
CHECKED BY : AJV	DATE : 04-APR-11	BH-DIRECTIONAL DRIVES (MOV-ON/OFF TYPE)	
APPROVED BY : UJR	DATE : 04-APR-11		
SHEET SIZE : A3	SCALE : NTS		
			REV. SHEET
			02 1 OF 1


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S.N	Test Requirement	Standard
		(EIA/TIA-455-168A,169A,175A) (IEC-793-1-C5A,B,C)
4	Frequency Response	IEC-793-1-C2B
5	Mode Field Diameter	IEEE STD. 1138 IEEE STD. P1222 (EIA/TIA-455-164A,165A,167A) (EIA-455-174) (IEC 793-1-C9A,B,C,D)
6	Temperature Cycling	IEEE STD. 1138 IEEE STD. P1222 (EIA/TIA-455-69A) (IEC 793-1-D1)
B	Mechanical Characteristics of Fibres	
1	Abrasion	IEC 793-1-B4
2	Core Concentricity	IEC 793-1-A3
3	Macro Bending	EIA/TIA-455-62A (IEC 793-1-C11)
4	Micro Bending	IEC-793-1-C3
C	Proof Test	IEC-793-1-B1
D	Strippability	IEC 793-1-B6
E	Visual Examination	EIA/TIA-455-13 (IEC 793-1-B5)

11.4 Instrumentation Cable Interconnection & Termination Philosophy

The cable interconnection philosophy to be adopted shall be such that expensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations. (where large concentrations of signals are available, e.g. valves limit and torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the following Table:

**Table 11.5
Instrumentation Cable Interconnection & Termination Philosophy**

S.N	Application		Type of Termination		Type of Cables
	From (A)	To (B)	End A	End B	
1.	Limit, Torque switches of valves / dampers / drives (integral junction box)	Marshalling cubicle / Marshalling cum Termination Cubicle / Local group	Plug-in connector	Posts mount cage clamp type	G



S.N	Application		Type of Termination		Type of Cables
	From (A)	To (B)	End A	End B	
		JB			
2.	Transmitters, E/P converters, process actuated switches mounted in LIE / LIR	Integral junction box of LIE / LIR	Plug-in connector	Cage clamp (rail mount)	F, G
3.	RTD heads	Local junction Box	Plug-in connector	Cage clamp (Rail mount) type	F
4.	Thermocouples	Junction Box	Plug in connector	Cage clamp (Rail mount) type	A, B, C*
5.	Other Field Mounted Instrument	Local JB / Group JB	Plug in connector	Screwed, Cage clamp (Rail mount) type	F (For analog signals) G (For Binary Signals)
6.	Junction Box (For Thermocouples for interlock and protection)	Marshalling Cubicle / Marshalling cum Termination Cabinet	Cage clamp (Rail mount) type	Screwed, Cage clamp (Rail mount) type	A, C*. These signals shall preferably through 6 pair cable
7.	Local junction box, Instrument Junction box of LIE / LIR / Group JB / MCC / SWGR	Group JB	Cage clamp (Rail mount) type	Cage clamp (Rail mount) type	F, G
8.	Local junction box, Instrument Junction box of LIE / LIR / Group JB / MCC / SWGR	Marshalling Cubical / Marshalling cum termination Cabinet	Cage clamp (Rail mount) type	Posts mount cage clamp type	F, G
9.	Marshalling Cubical / Termination Cabinet	Electronic system cabinet	Cage clamp post mounted type	Plug-in connector / Other System as per manufacturer's Standard	Internal Wiring

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Notes:

1. Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs.
2. For analog signals, individual pair shielding & overall shielding & for binary signals only overall shielding of instrumentation cables shall be provided.
3. * For high temperature applications only.
4. Instrument Cabling for instruments / equipment of specialized / proprietary Control System shall be as per manufacturer's standard.

11.4.1 Terminal Blocks

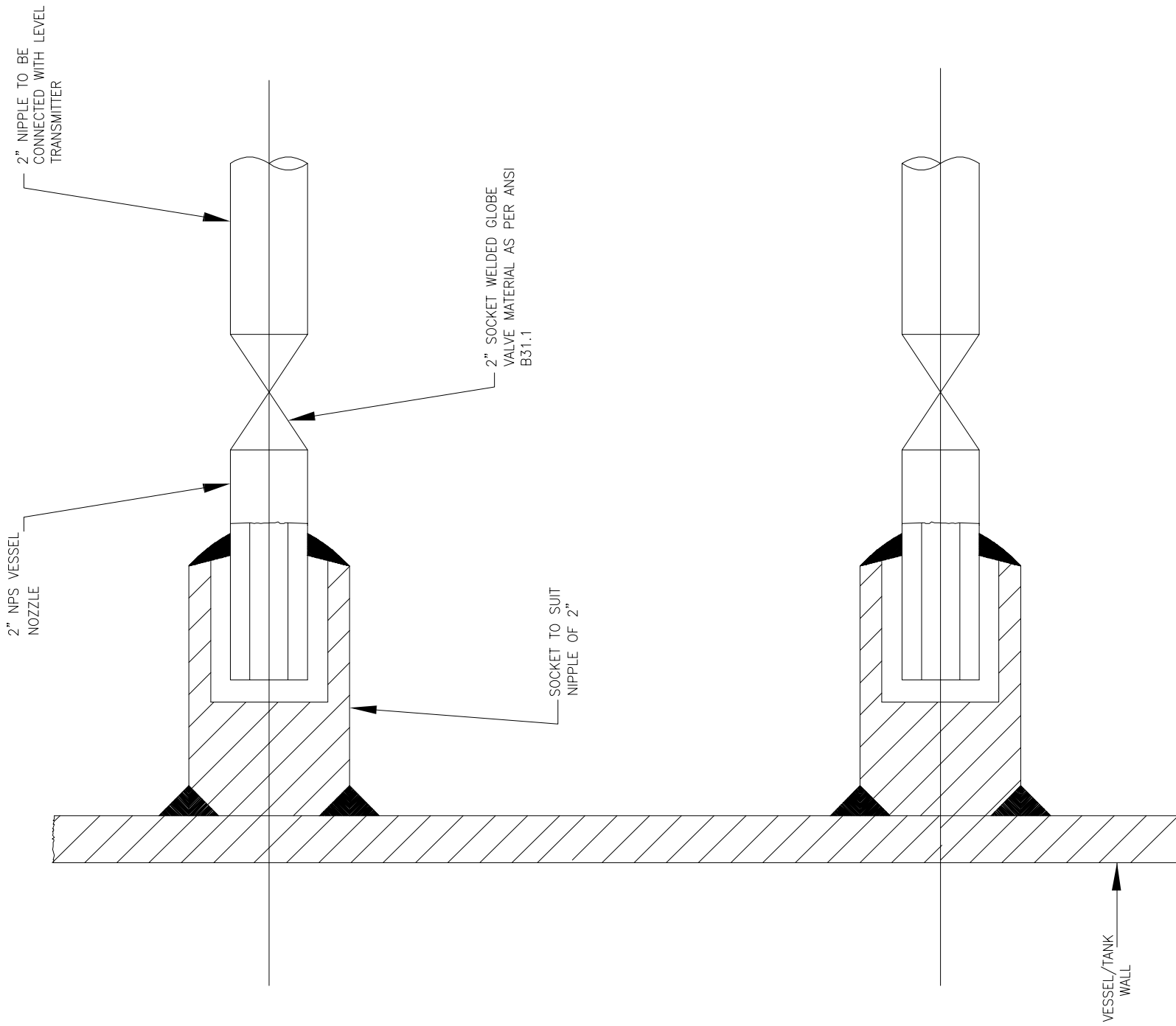
1. All terminal blocks shall be rail mounted/post mounted cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg. C. The terminal blocks in field mounted junction boxes, temperature transmitters, instrument enclosures/racks, etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic / termination / marshalling cubicles shall be suitable for the post mounted cage clamp connection at the field input end. The terminal blocks for TG integral control system Input/Output connections from/to SWGR/MCC, shall be provided with built in test and disconnect facilities complete with plug, slide clamp, test socket etc. The exact type of terminal blocks to be provided by the Contractor and the technical details of the same including width etc shall be subject to Owner's / Consultant's approval.
2. All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, test plug bolts and test plug (as specified above for SWGR connections), transparent covers, support brackets, distance sleeves, warning label, marking , etc.
3. The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks.
4. The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.
5. For ensuring proper connections, Contractor shall provide suitable accessories along with insulation sleeves. The exact connecting accessory shall be finalized as per application during detail engineering stage subject to Owner's / Consultant's approval without any cost repercussions.


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LEVEL MEASUREMENT



NOTES:-

1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR DISPLACER TYPE LEVEL TRANSMITTER.
2. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECTED TO INTERFACE
3. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100mm TO 150mm ABOVE THE BOTTOM OF THE VESSEL.

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CONTRACT NO : PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER STATION

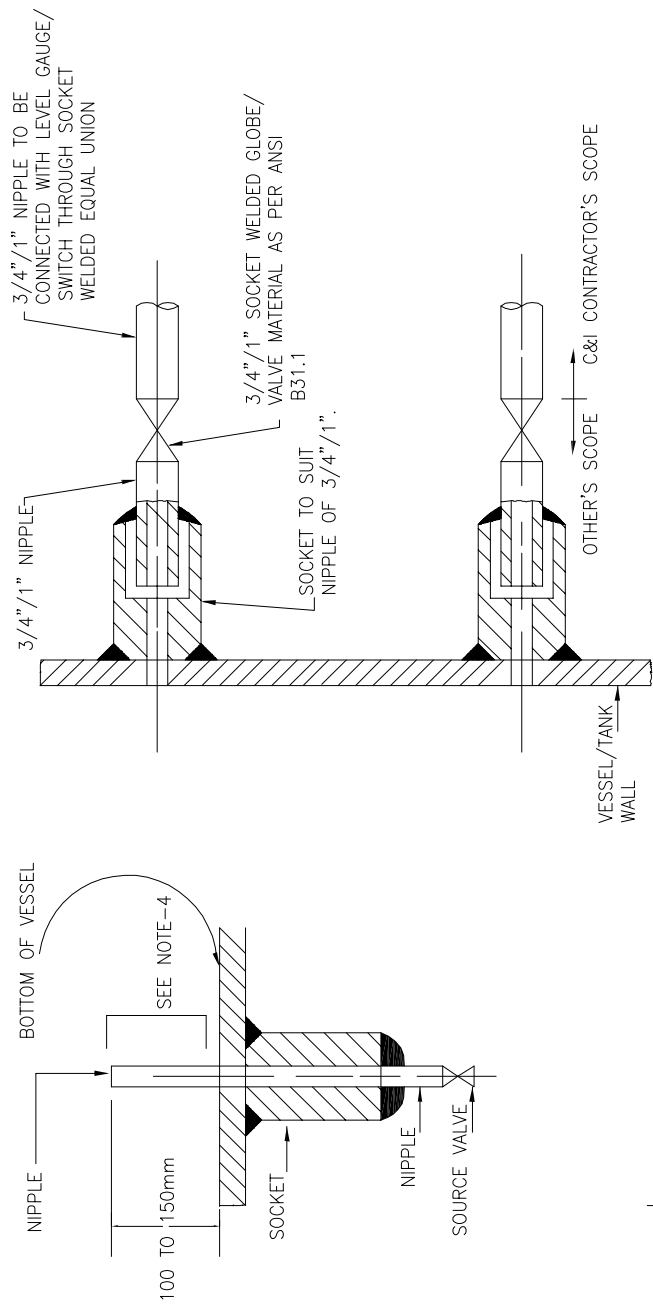
DESIGNED BY : SM 06-MAY-11 DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - LEVEL MEASUREMENT

CHECKED BY : AVJ 06-MAY-11
APPROVED BY : UJR 06-MAY-11
SHEET SIZE : A3 DRAWING NO : LI-GE0E11019-G-00172-317 REV. SHEET 02 1 OF 1

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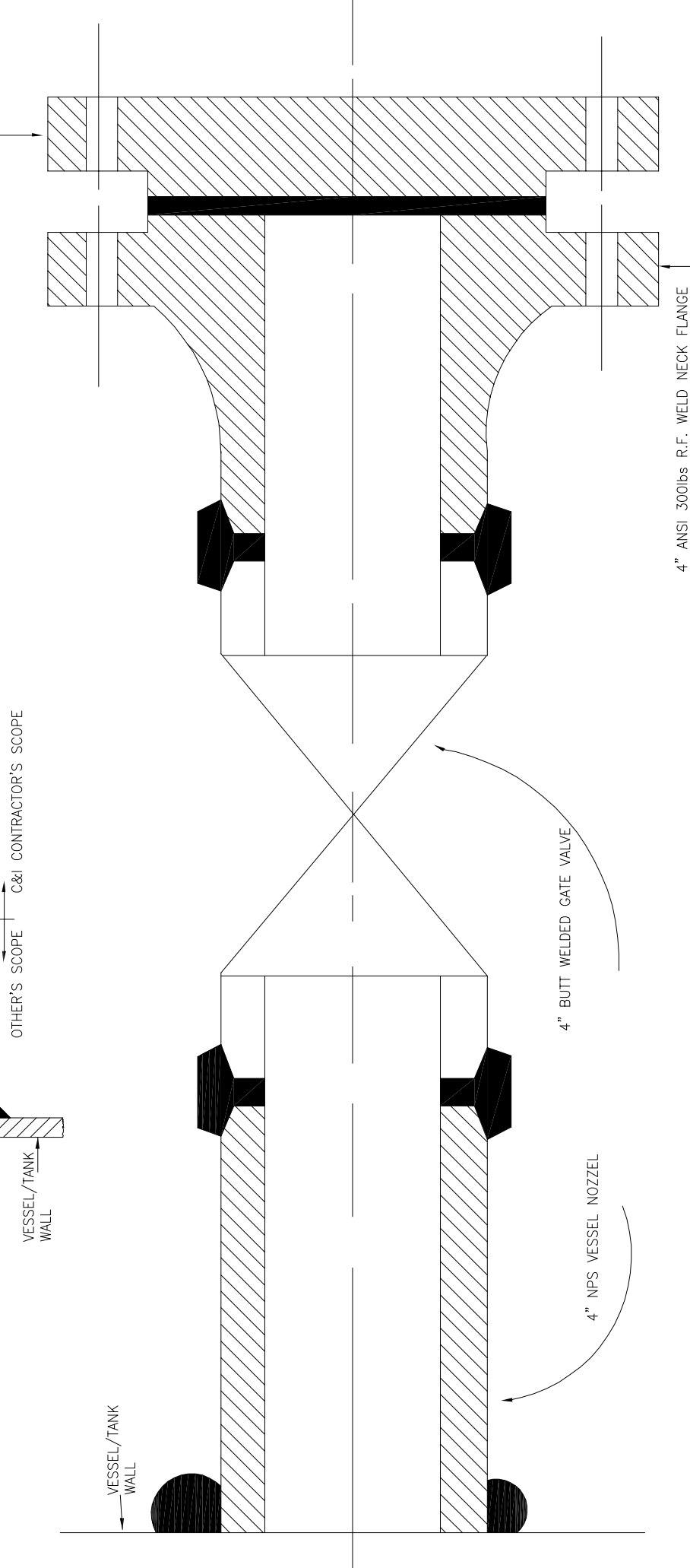
LEVEL MEASUREMENT



NOTES:--

1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR LEVEL GAUGE AND EXTERNAL GAGE TYPE FLOAT OR DISPLACER OPERATED LEVEL SWITCH.
2. FOR GAUGES 3/4" NIPPLE ALONG WITH 3/4" SW SOURCE VALVE AND FOR SWITCHES 1" NIPPLE ALONG WITH 1" SW SOURCE VALVE SHALL BE PROVIDED AS PROCESS CONNECTION.
3. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECTED TO INTERFACE AND TURBULANCE FROM INLETS AND OUTLETS.
4. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100mm TO 150mm ABOVE THE BOTTOM OF THE VESSEL.

4" ANSI MATCHING FLANGE ATTACHED WITH FLUSH DIAPHRAGM OF LEVEL TRANSMITTER



4" ANSI 300lbs R.F. WELD NECK FLANGE

NOTES:--

1. THIS TYPE OF PROCESS CONNECTION SHALL BE PROVIDED FOR TANK LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID USING FLASH DIAPHRAGM/WAFER TYPE LEVEL TRANSMITTER.
2. WELDING OF MATCHING FLANGE TO GATE VALVE SHALL BE DONE BY CONTRACTOR.

FOR REFERENCE ONLY

REV. No.	DATE	DEM	DEC	DEE	DEI	CHECKED	DESCRIPTION
02	25.06.11					AVJ	
01	27.05.11					AVJ	
00	06.05.11					AVJ	



NEVELI LIGNITE CORPORATION LTD, NEVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

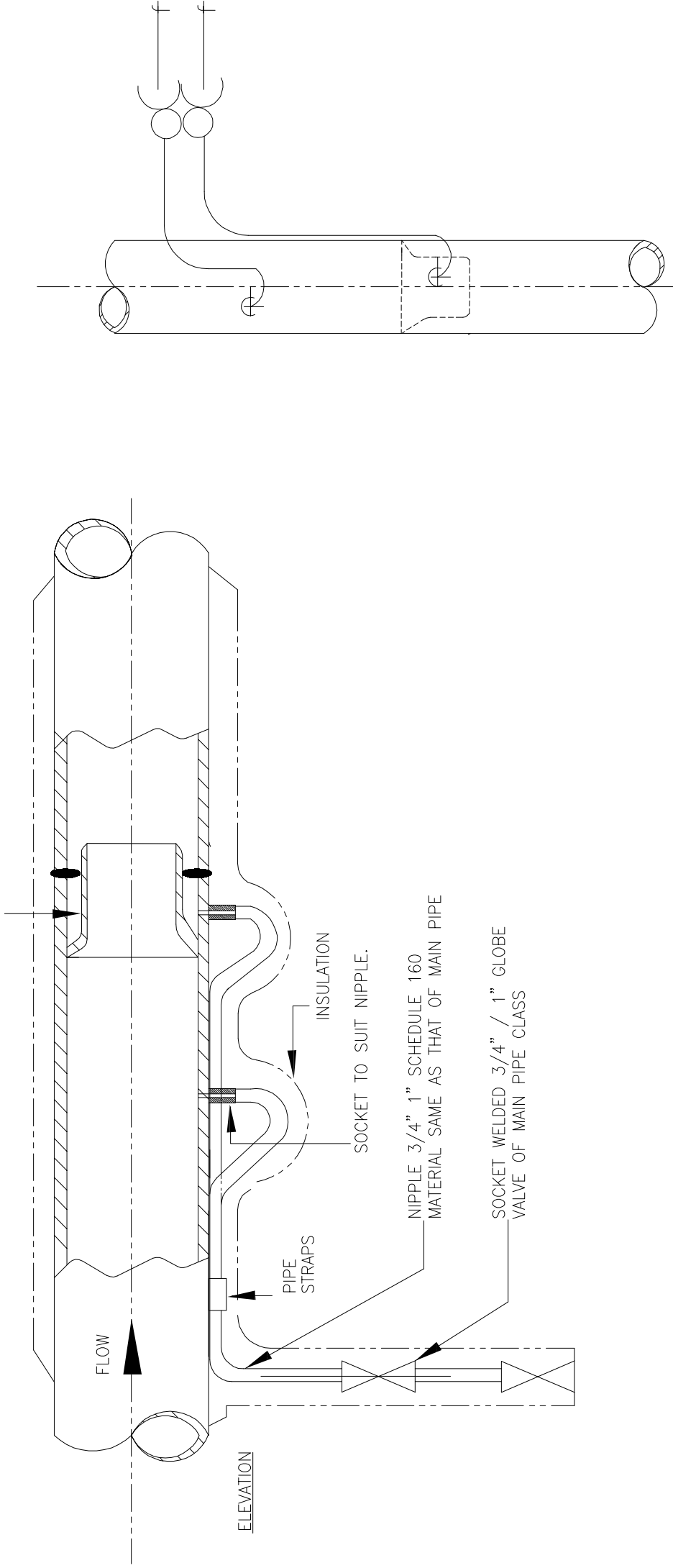
LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :	PROJECT :	2 X 500 MW NEVELI NEW THERMAL POWER STATION
PREPARED NAME PS	DATE	06-MAY-11
DRAWN BY SM	DATE	06-MAY-11
CHECKED BY AVJ	DATE	06-MAY-11
APPROVED BY UUR	DATE	06-MAY-11
SHEET SIZE A3	DRAWING NO :	LII-GE0E11019-G-00172-316
SCALE NTS	REV.	02
	SHEET	1 OF 1

Varun Jain
 S A Khan
 Praveen Kishore

FLOW MEASUREMENT

FLOW NOZZLE



NOTES:-

1. THIS METHOD OF CONNECTING NIPPLES AND VALVES ON THE VERTICAL STEAM PIPE IS APPLICABLE FOR MEASUREMENT OF STEAM AT TEMP. ABOVE 425°C
2. THE ENTIRE LENGTH OF THESE NIPPLES AS WELL AS SHUT OFF VALVES SHOULD BE LAGGED IN WITH STEAM LINE AS SHOWN IN THE DRAWING.
3. ON VERTICAL STEAM PIPE BOTH HIGH TEMPERATURE (SPECIAL VENTS) NIPPLES WILL BE LONG ENOUGH SO THAT HIGH AND LOW PRESSURE CONNECTION NIPPLES WILL BE AT SAME LEVEL.
4. UP STREAM AND DOWN STREAM PRESSURE CONNECTIONS MUST BE INSTALLED IN DIFFERENT PLANES PASSING THROUGH THE CENTRE OF THE PIPE.
5. FLOW ELEMENTS SHALL BE PROVIDED WITH 3 PAIRS OF TAPPING POINTS.

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02	25.06.11		AVJ
01	27.05.11		AVJ
00	06.05.11		AVJ
REV. No.	DATE	CHKD	BY
		DEC	DEE
		DEC	DEI
		CHECKED	
			DESCRIPTION



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CONSULTING ENGINEERS, GURGAON, INDIA

LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

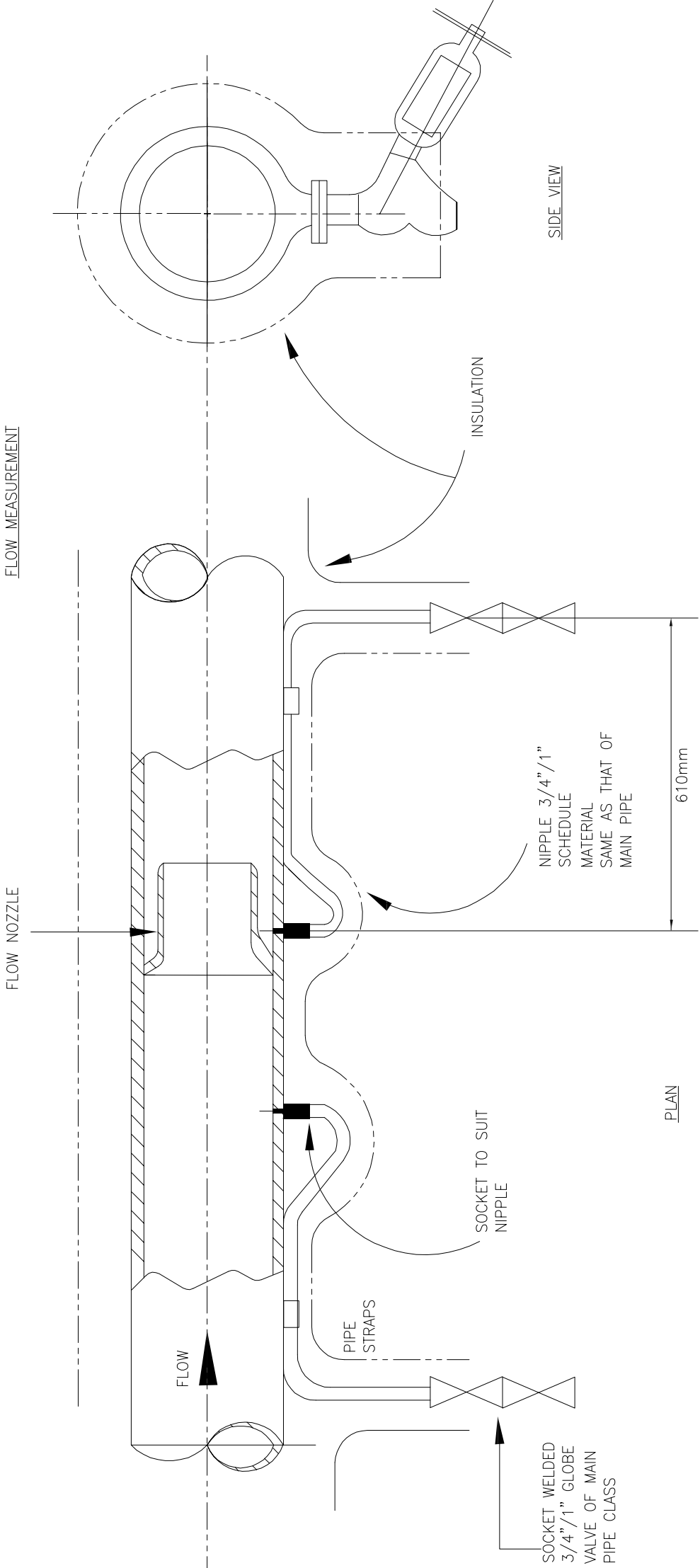
CONTRACT NO :		PROJECT :	
PREPARED	NAME	DATE	
DRAWN BY	PS	06-MAY-11	
DESIGNED BY	SM	06-MAY-11	
CHECKED BY	AVJ	06-MAY-11	
APPROVED BY	UR	06-MAY-11	
SHEET SIZE	A3	DRAWING NO :	LII-GE0E11019-G-00172-315
SCALE	NTS	REV.	02
		SHEET	1 OF 1

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Varun Jain

 S A Khan

 Praveen Kishore



NOTES:-

1. THIS METHOD OF CONNECTING NIPPLES AND VALVES ON THE HORIZONTAL PIPE IS APPLICABLE FOR MEASUREMENT OF STEAM TEMP. ABOVE 425°C.
2. FOR STEAM SERVICE IN HORIZONTAL PIPE THE PRESSURE HOLES AND CONNECTING NIPPLES SHOULD BE IN THE HORIZONTAL PLANE OF THE PIPE CENTRE LINE.
3. THE ENTIRE LENGTH OF THESE NIPPLES AS WELL AS SHUT OFF VALVES SHOULD BE LAGGED IN WITH STEAM LINE AS SHOWN IN THE DRAWING.
4. FLOW ELEMENTS SHALL BE PROVIDED WITH 3 PAIRS OF TAPPING POINTS.

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02	25.06.11		AM
01	27.05.11		AM
00	06.05.11		AM
REV. No.	DATE	DESIGNED BY	DESCRIPTION
		SM	
		AM	
		UR	
		A3	
		NTS	



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LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :	PROJECT :
PREPARED BY :	2 X 500 MW NEYVELI NEW THERMAL POWER STATION
DRAWN BY :	DESIGNED BY :
PS	SM
CHECKED BY :	APPROVED BY :
AM	UR
SHEET SIZE :	SCALE :
A3	NTS
DRAWING NO :	REV. SHEET
LII-GE0E11019-G-00172-314	02 1 OF 1

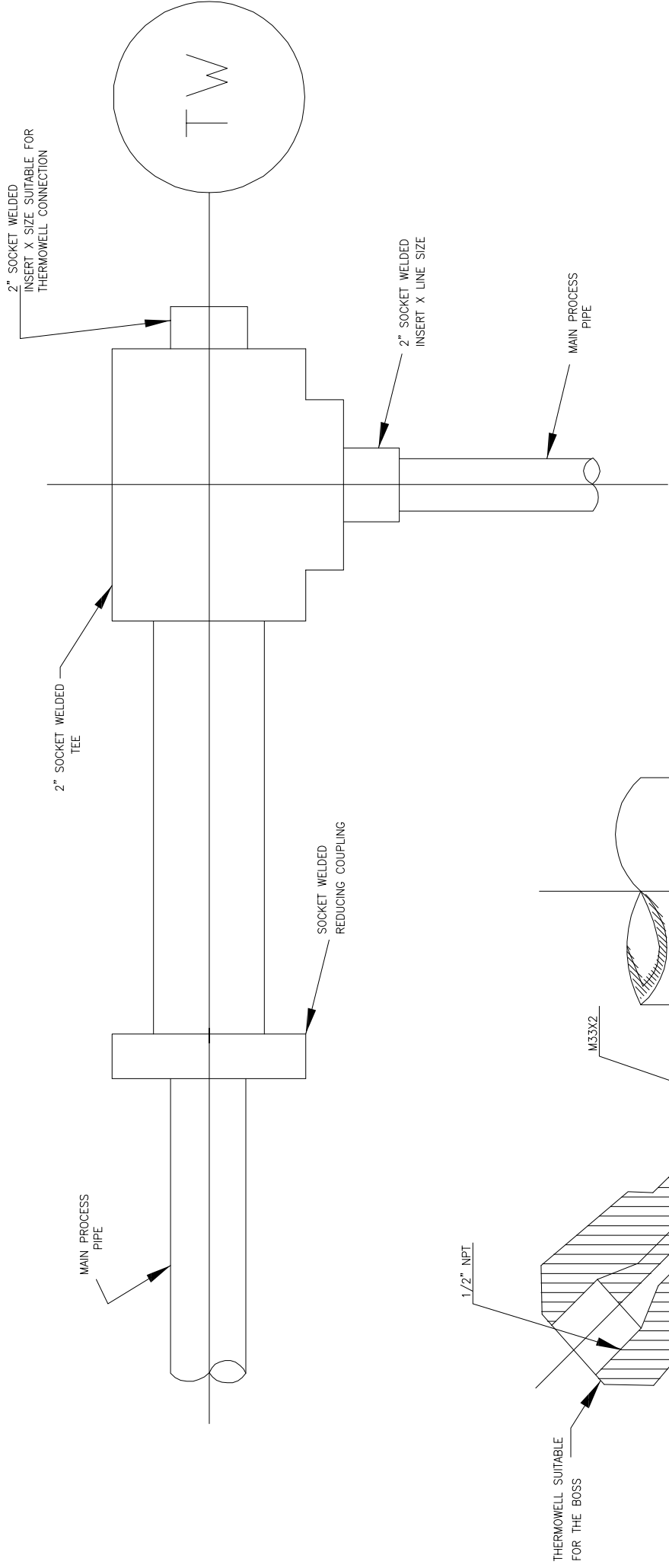
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Varun Jain

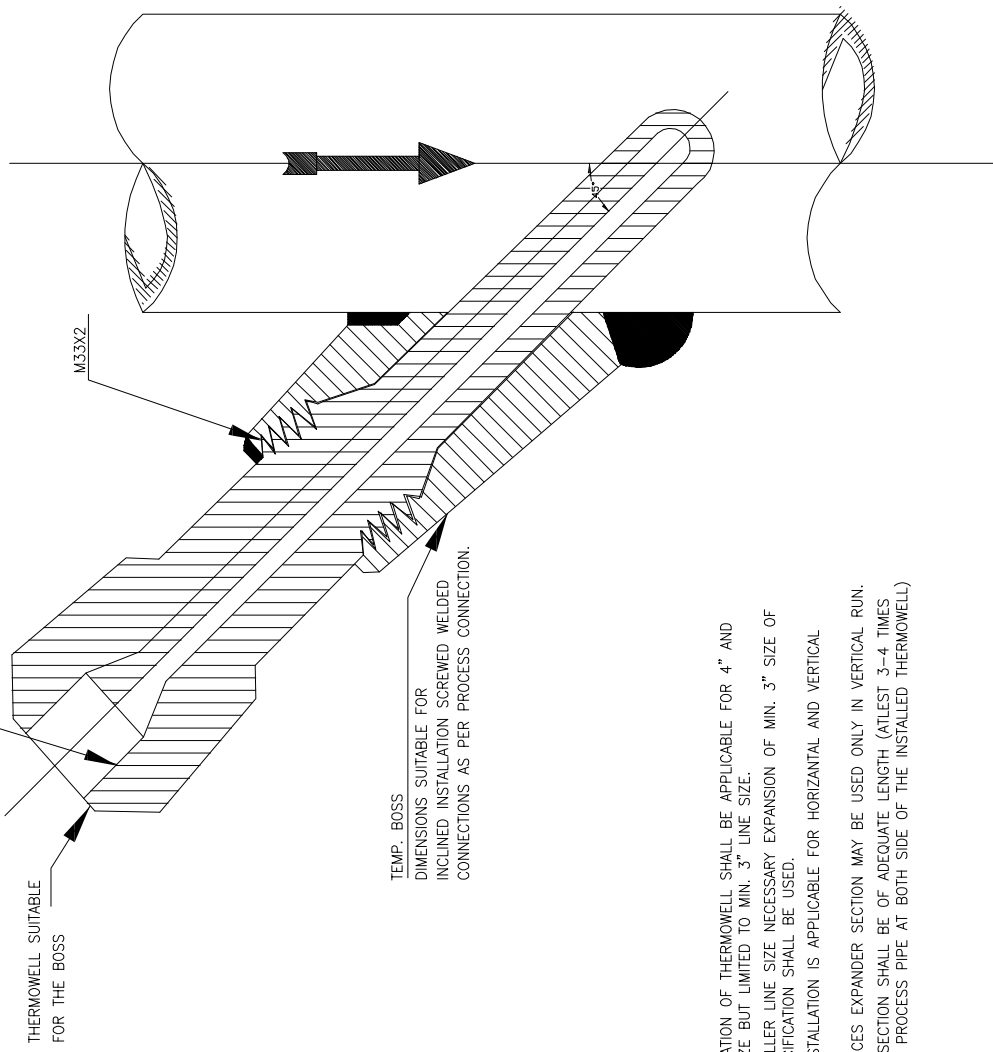
 S A Khan

 Praveen Kishore

TEMP. MEASUREMENT



ELEVATION LIQUID SOURCE



NOTES:-

1. THIS TYPE OF THERMOWELL INSTALLATION IS SUITABLE FOR PROCESS PIPE OF 2" NPS AND SMALLER.
2. FOR STEAM SERVICE THIS TYPE OF THERMOWELL INSTALLATION 90° BEND MAY BE USED ONLY IN VERTICAL PLANE.
3. THE LENGTH OF THE LARGER PIPE SECTION SHALL BE MINIMUM 150 mm (IT MUST BE GREATER THAN THERMOWELL LENGTH)

NOTES:-

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

FOR REFERENCE ONLY

REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
02	25.06.11					AMV
01	27.05.11					AMV
00	06.05.11					AMV
CHECKED						



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LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS, GURGAON, INDIA

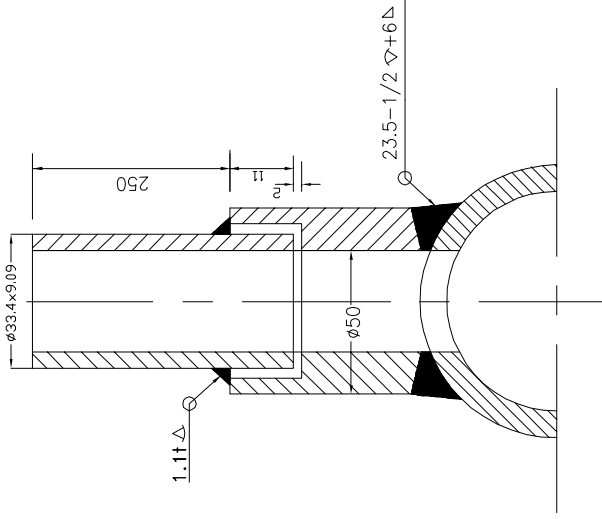
PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER STATION
DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - TEMP. MEASUREMENT

CONTRACT NO. :	PREPARED	DESIGNED BY	CHECKED BY	APPROVED BY	SHEET SIZE	SCALE	REVISION	NO.	OF	TOTAL
	PS	SM	AMV	UR	A3	NTS	REV.	02	1	1

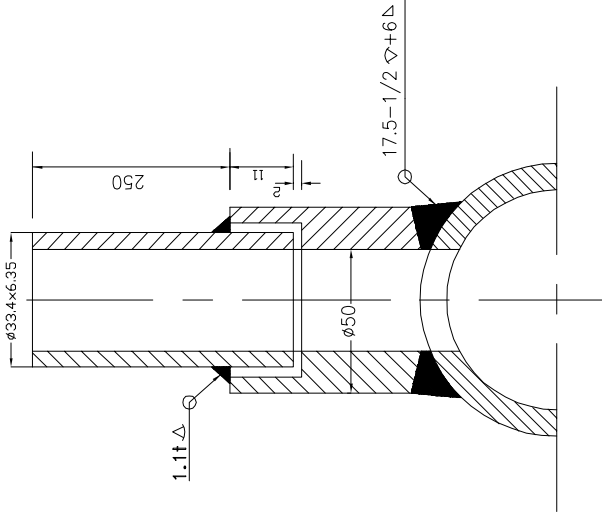
Praveen Kishore
Praveen Kishore
S A Khan
S A Khan
Varun Jain
Varun Jain

PRESSURE MEASUREMENT

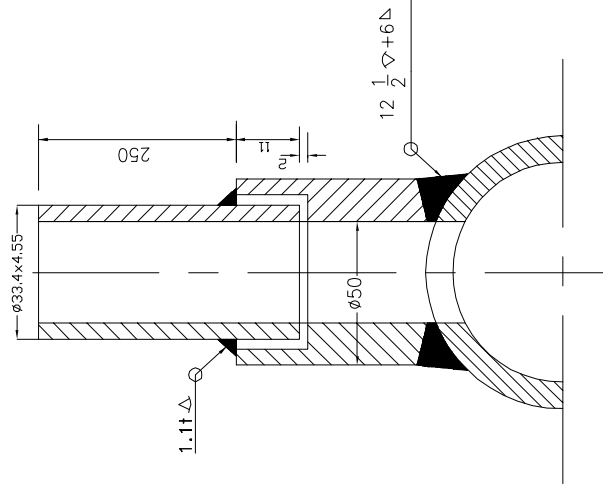
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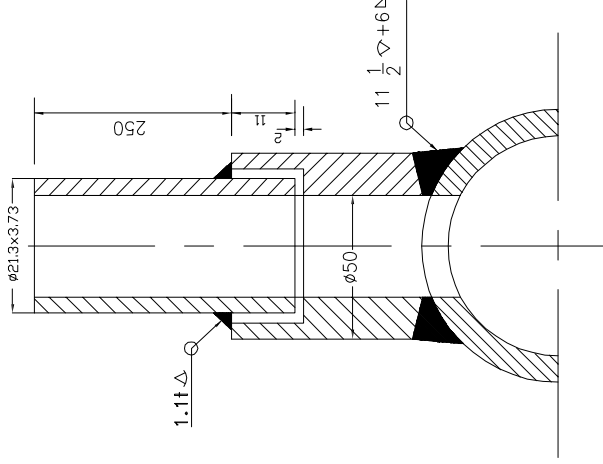
(SYSTEM PR.>40Kg/Sq_cm CL 6000)



(SYSTEM PR.<40Kg/Sq_cm Nb 25 CL 3000)



(SYSTEM PR.<40Kg/Sq_cm Nb 15 CL 3000)



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02	25.06.11		AVJ
01	27.05.11		AVJ
00	06.05.11		AVJ
REV. No.	DATE	DEM	DEC
		DEE	DEI
		CHECKED	
		DESCRIPTION	



NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU



LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS, GURGAON, INDIA

LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :		PROJECT :	
PREPARED	NAME	DATE	
DRAWN BY	PS	06-MAY-11	
DESIGNED BY	SM	06-MAY-11	
CHECKED BY	AVJ	06-MAY-11	
APPROVED BY	UJR	06-MAY-11	
SHEET SIZE	A3	DRAWING NO :	
SCALE	NTS	REV.	SHEET
		02	1 OF 1

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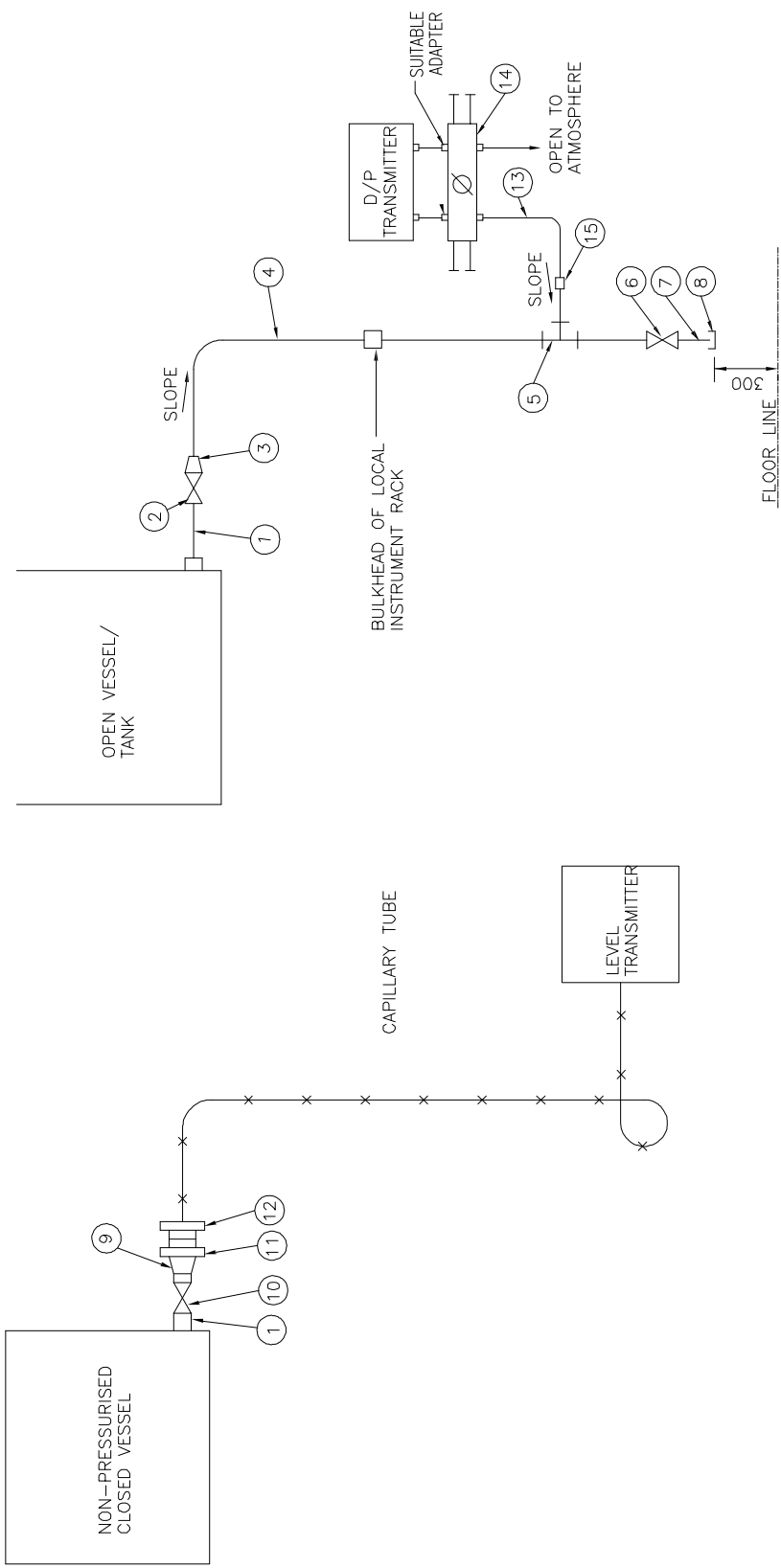
 S A Khan
 Praveen Kishore

LIST OF MATERIALS

ITEM NO	DESCRIPTION
1	3/4" / 1" NPS 40/80 CARBON STEEL PIPE
2	3/4" SW GLOBE VALVE
3	3/4" / 1/2" SW REDUCING INSERT
4	1/2" NPS SCH 40/80 CS PIPE
5	1/2" SW EQUAL TEE
6	1/2" SW GLOBE VALVE
7	1/2" NPS SW X 1/2" NPT(M) CS NIPPLE
8	1/2" NPT (F) CS CAP
9	3/4" TO 4" EXPANDER
10	3/4" BUTT WELDED GATE VALVE
11	4" ANSI 300lbs RF WELDED NECK FLANGE
12	4" ANSI MATCHING FLANGE WITH FLUSH DIAGRAM OF LEVEL TRANSMITTER
13	SS TUBE
14	3-VALVE MANIFOLD
15	1/2" PIPE X 1/2" TUBE UNION

NOTES:-

- FOR VACUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.



ELEVATION

LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID
IN CLOSED VESSEL USING FLUSH DIAPHRAGM/WAFER TYPE
LEVEL TRANSMITTER WITH REMOTE SEAL

ELEVATION

LEVEL MEASUREMENT OF CLEAN LIQUID IN AN OPEN VESSEL
USING D/P TRANSMITTER

FOR REFERENCE ONLY

REV. No.	DATE	CHKD	APPD	DESCRIPTION
02	25.06.11	AVJ		
01	27.05.11	AVJ		
00	06.05.11	AVJ		



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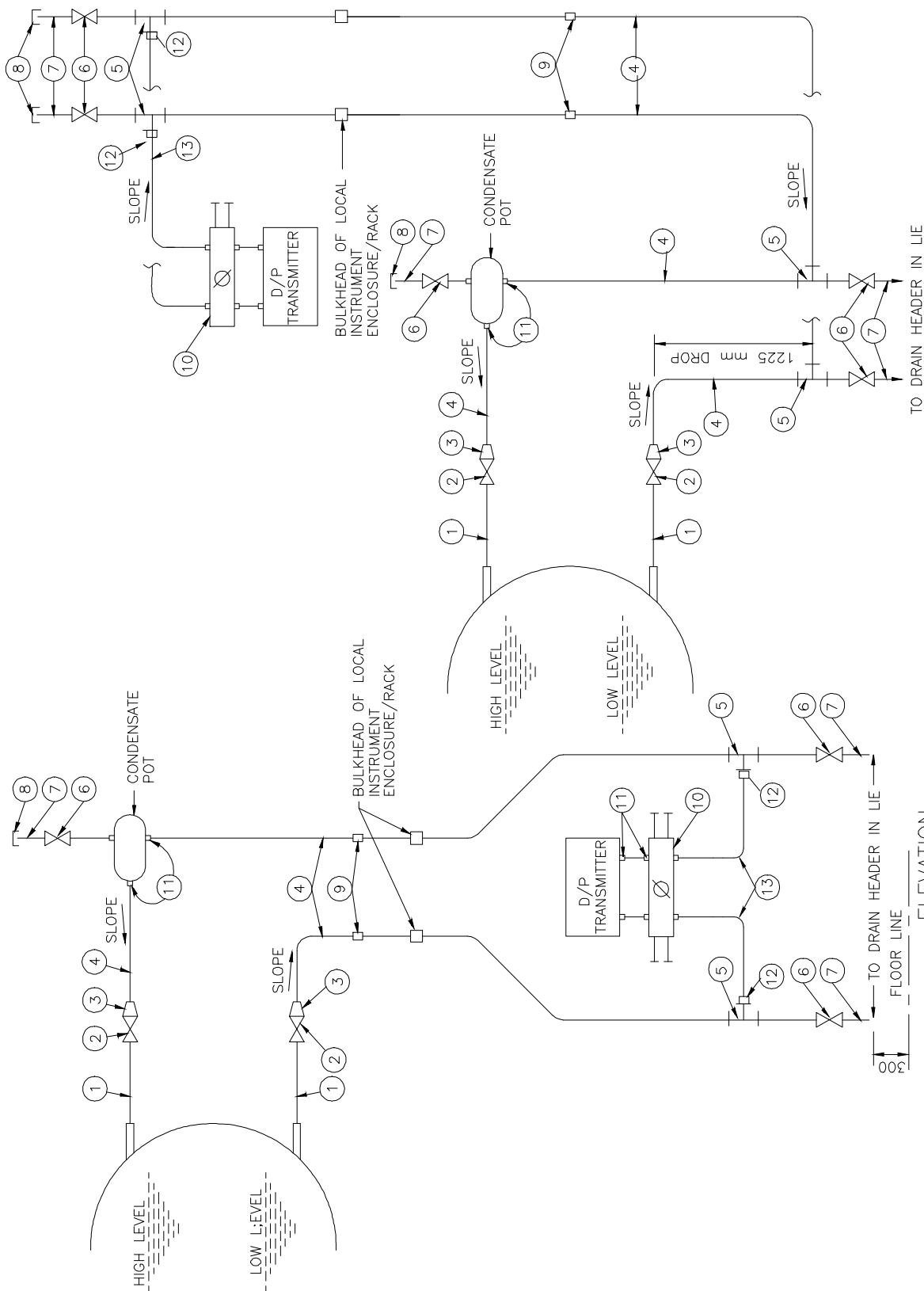
LAHMEYER INTERNATIONAL
INDIA

LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :	PROJECT :
PS	2 X 500 MW NEVELI NEW THERMAL POWER STATION
DESIGNED BY : SM	06-MAY-11
CHECKED BY : AVJ	06-MAY-11
APPROVED BY : UR	06-MAY-11
SHEET SIZE : A3	DRAWING NO : LI-GE0E11019-G-00172-309
SCALE : NTS	REV. SHEET : 02 1 OF 1

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(Signatures)
S A Khan
Praveen Kishore



TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

ELEVATION

LEVEL MEASUREMENT OF CLEAR NON-VISCOUS OR NON-CORROSIVE LIQUID IN CLOSED VESSEL WITH CONDENSABLE ATMOSPHERE USING D/P TRANSMITTER

FOR REFERENCE ONLY

LIST OF MATERIALS

ITEM NO	DESCRIPTION
1	1/2" 3/4", 1"NPS SCH 40/80/160/XXS/P91(AS PER PROCESS REQUIREMENT) CARBON/ALLOY STEEL PIPE
2	1" SW GLOBE VALVE
3	3/4" 1" TO 1/2" REDUCING INSERT
4	1/2" NPS SCH.80/160/XXS(AS PER PROCESS REQ.)CS/AS PIPE
5	1/2" SW EQUAL TEE
6	1/2" SW GLOBE VALVE
7	1/2" NPS SW X 1/2" NPT(M) CS/AS NIPPLE
8	1/2" NPT (F) CS CAP
9	1/2" PIPE UNION
10	5-VALVE MANIFOLD
11	SUITABLE ADAPTER
12	1/2" PIPE X 1/2" TUBE UNION
13	S.S. TUBE

REV. No.	DATE	CHKD	DEE	DEI	DESCRIPTION
02	25.06.11				
01	27.05.11				
00	06.05.11				



NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU



LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :	PROJECT :	2 X 500 MW NEYVELI NEW THERMAL POWER STATION
PREPARED BY :	NAME :	
DRAWN BY :	PS :	06-MAY-11
DESIGNED BY :	SM :	06-MAY-11
CHECKED BY :	AV :	06-MAY-11
APPROVED BY :	U/R :	06-MAY-11
SHEET SIZE :	A3	
SCALE :	NTS	
DRAWING NO :	LI-GE0E11019-G-00172-308	
REV. SHEET	02	1 OF 2

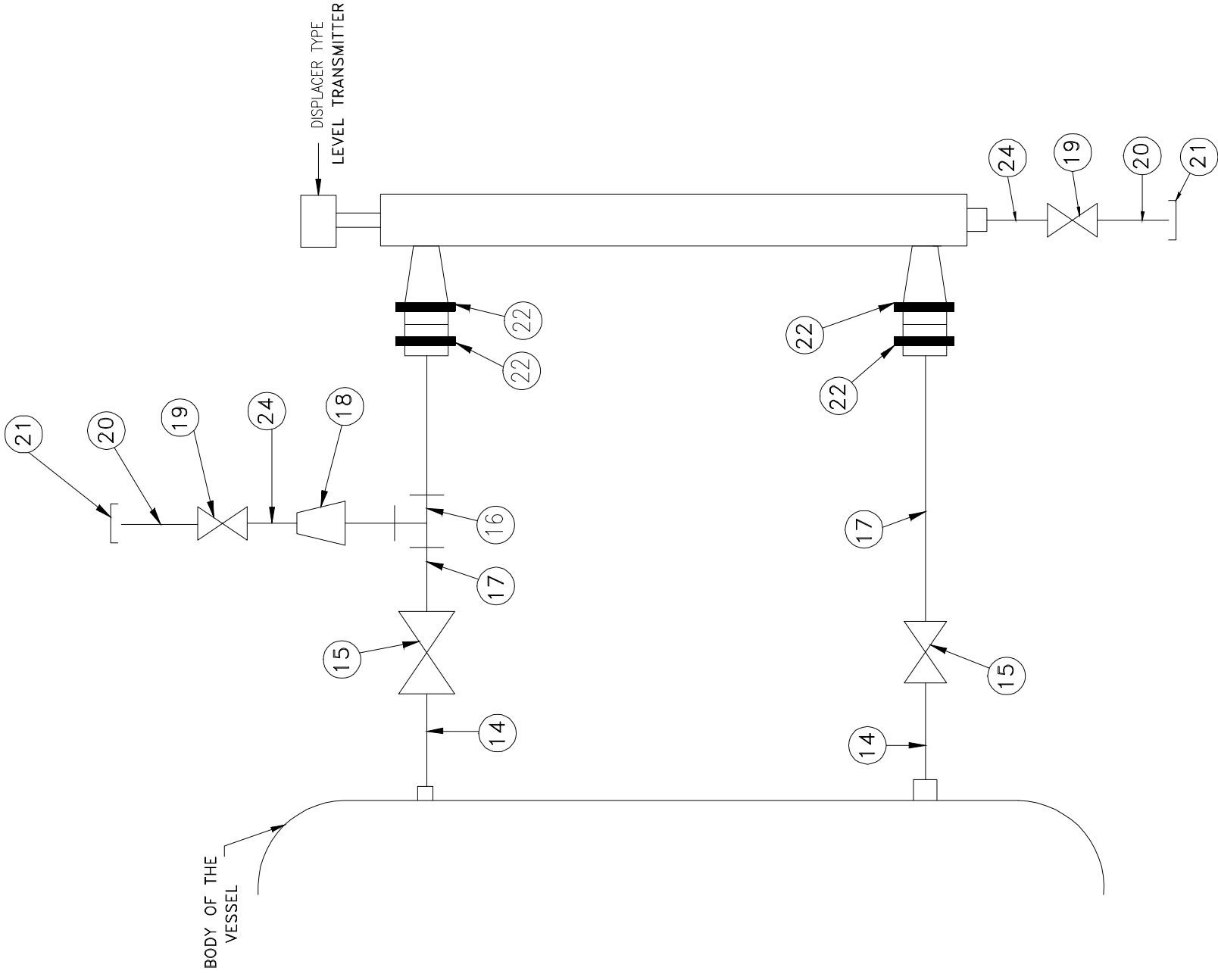
Protection mark DIN 34 - 1 - E. Copping of this drawing, and giving it to others and the use or communication of the contents thereof, are forbidden without the written consent of the designer or the registration of a utility model of design.

(Signature)
S A Khan

(Signature)
Praveen Kishore

LIST OF MATERIALS

ITEM NO	DESCRIPTION
14	2" NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) VESSEL NOZZLE
15	2" SW GLOBE VALVE
16	2" SW EQUAL TEE
17	2" NPS SCH. 40/80 CS/AS PIPE
18	2" X 3/4" SW REDUCING AGENT
19	3/4" SW GLOBE VALVE
20	3/4" NPS SW X 3/4" NPT (M) CS/AS NIPPLE
21	3/4" NPT (F) CS CAP
22	2" ANSI 300lbs RAISED PHASE WELD NECK FLANGE
23	2" ANSI FLANGE OF LEVEL TRANSMITTER
24	3/4" NPS SCH. 40/80 CARBON STEEL PIPE



ELEVATION
DISPLACER TYPE LEVEL TRANSMITTER WITH SIDE CONNECTION

FOR REFERENCE ONLY

REV. No.	DATE	DESCRIPTION
02	25.06.11	AJV
01	27.05.11	AJV
00	06.05.11	AJV

REV. No.	DATE	DESCRIPTION
DEM	DEC	DEE
DEE	DEE	DEI

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LAHMEYER INTERNATIONAL
LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :	2 X 500 MW NEHYVELI NEW THERMAL POWER STATION
PROJECT :	2 X 500 MW NEHYVELI NEW THERMAL POWER STATION
PREPARED NAME :	PS
DATE :	06-MAY-11
DRAWN BY :	SM
DESIGNED BY :	AVJ
CHECKED BY :	AVJ
APPROVED BY :	UUR
SHEET SIZE :	A3
SCALE :	NTS
DRAWING NO :	LI-GE0E11019-G-00172-308
REV. :	02
SHEET :	2 OF 2

Praveen Kishore
S A Khan
Varun Jain

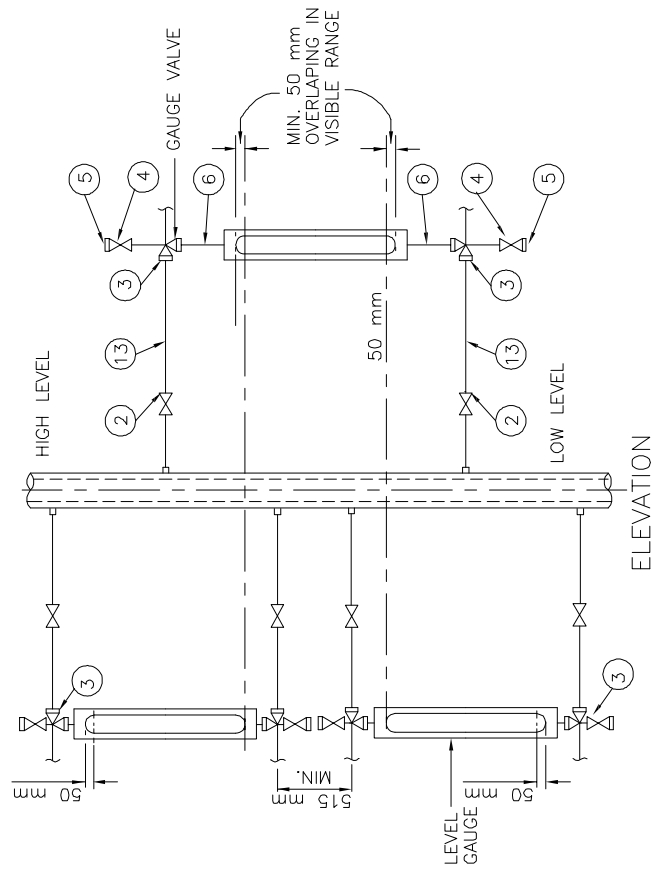
Protection mark DIN 34 - 1 - E.
Copying of this drawing, and giving it to others and the use or communication of the contents thereof, are forbidden without the written consent of the author or the registration of a utility model or design.

LIST OF MATERIALS

ITEM NO	DESCRIPTION
1	3/4" / 1" NPS SCH. 40/80/160/XXS/P91(AS PER PROCESS REQUIREMENT) CARBON/ALLOY STEEL PIPE.
2	3/4" SW GLOBE VALVE
3	3/4" SW UNION
4	3/4" NPT GLOBE VALVE
5	3/4" NPT (M) CAP
6	3/4" NPT (F) UNION CONNECTION
7	1" SW EQUAL UNION
8	1" X 1/2" SW REDUCING INSERT
9	1" SW EQUAL TEE
10	1/2" SW GLOBE VALVE
11	1/2" NPS SW X 1/2" NPT(M) CS/AS NIPPLE
12	1/2" NPT (F) CS CAP
13	3/4" X 1/2" NPS SCH. 40/80 CS/AS PIPE
14	1/2" NPS SCH. 80/160 CS/AS NIPPLE
15	1" SW GLOBE VALVE

NOTES: -

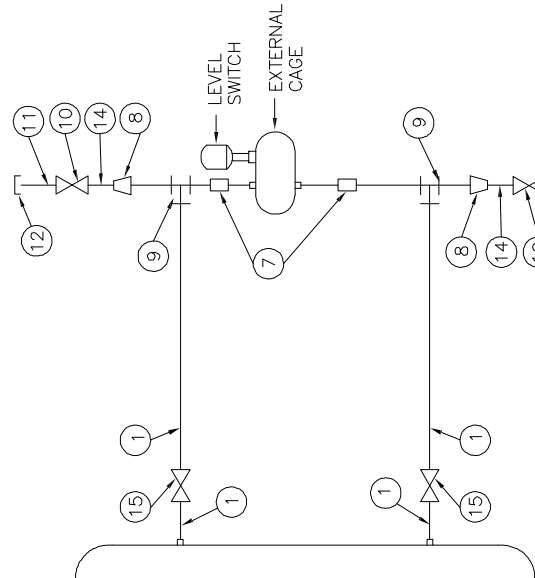
- FOR LEVEL GAUGE 3/4" AND FOR LEVEL SWITCH 1" PROCESS CONNECTION SHALL BE PROVIDED.



ELEVATION

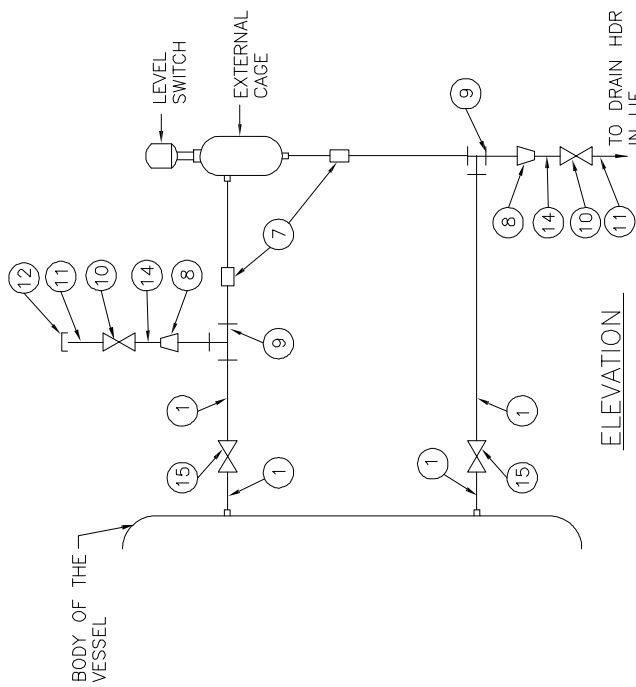
LOCAL LEVEL INDICATION USING GAUGE GLASS

LOCAL LEVEL INDICATION USING MULTIPLE GAUGES FOR INCREASED RANGE NOT COVERED IN A SINGLE UNIT



ELEVATION

FLOAT OR DISPLACER OPERATED EXTERNAL CAGE TYPE LEVEL SWITCH INSTALLATION



ELEVATION

FOR REFERENCE ONLY

REV. No.	DATE	DESCRIPTION
02	25.06.11	AV
01	27.05.11	AV
00	06.05.11	AV



NEVELI LIGNITE CORPORATION LTD, NEVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :	PROJECT :	2 X 500 MW NEVELI NEW THERMAL POWER STATION
PREPARED BY PS	DATE	06-MAY-11
DRAWN BY SM	DATE	06-MAY-11
CHECKED BY AV	DATE	06-MAY-11
APPROVED BY UR	DATE	06-MAY-11
SHEET SIZE A3	DRAWING NO :	LII-GE0E11019-G-00172-307
SCALE NTS	REV.	02
	SHEET	1 OF 1

Praveen Kishore
S A Khan
Varun Jain

NOTES:-

1. THE MATERIAL SPECIFICATION AND SCHEDULE NO. OF IMPULSE PIPE AND NIPPLE AS LISTED HEREIN SHALL BE AS PER TECHNICAL SPECIFICATIONS.
2. THE MATERIAL SPECIFICATION AND RATING OF FITTINGS AS LISTED SHALL BE AS PER SPECIFICATION. WELDED /THREADED FITTING SHALL CONFIRM TO ANSI-B.16-11
3. INSTRUMENTS VALVES BODY STEM MATERIAL AND PRESSURE CLASS SHALL BE AS PER TECHNICAL SPECIFICATIONS.
4. FOR BOILER AIR/FLUE GAS SERVICES SOURCE CONNECTIONS IMPULSE PIPING AND ALL FITTING SHALL BE OF 3/4" NB SIZE.
5. GAUGES SHALL NOT BE MOUNTED ON THE PIPE. IT WILL BE MOUNTED ON CHANNEL, FRAME OR RACK.
6. *SLOPE APPROX 40MM/METRE.

LIST OF MATERIALS

ITEM NO	DESCRIPTION
1	1/2" 3/4", 1"NPS SCH 40/80/160/XXS/P91(AS PER PROCESS REQUIREMENT) NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE
2	1/2" 3/4"/1" SW GLOBE VALVE/GATE VALVE
3	3/4" 1" X 1/2" SW REDUCING INSERT
4	1/2" 3/4" PIPE
5	1/2" 3/4" SW EQUAL TEE
6	1/2" 3/4" SW GLOBE VALVE
7	1/2" 3/4" NPS SW X 1/2" 3/4" NPT (M) CARBON/ALLOY STEEL NIPPLE
8	1/2" 3/4" NPT (F) CS CAP
9	1/2" 3/4" PIPE UNION
10	6" SS SYPHON
11	1/2" BLIND 300lbs RF ANSI FLANGE DRILLED AND TAPED FOR 1" NPT PIPE
12	SUITABLE ADAPTER
13	1/4" CHROME MOLY STEEL TUBE
14	1" 3/4" SW EQUAL TEE
15	DIAPHRAGM (WATER ELEMENT)
16	ISOLATION VALVE 316 SS. 1/4" SW

FOR REFERENCE ONLY

REV. No.	DATE	DESCRIPTION
02	25.06.11	AV
01	27.05.11	AV
00	06.05.11	AV



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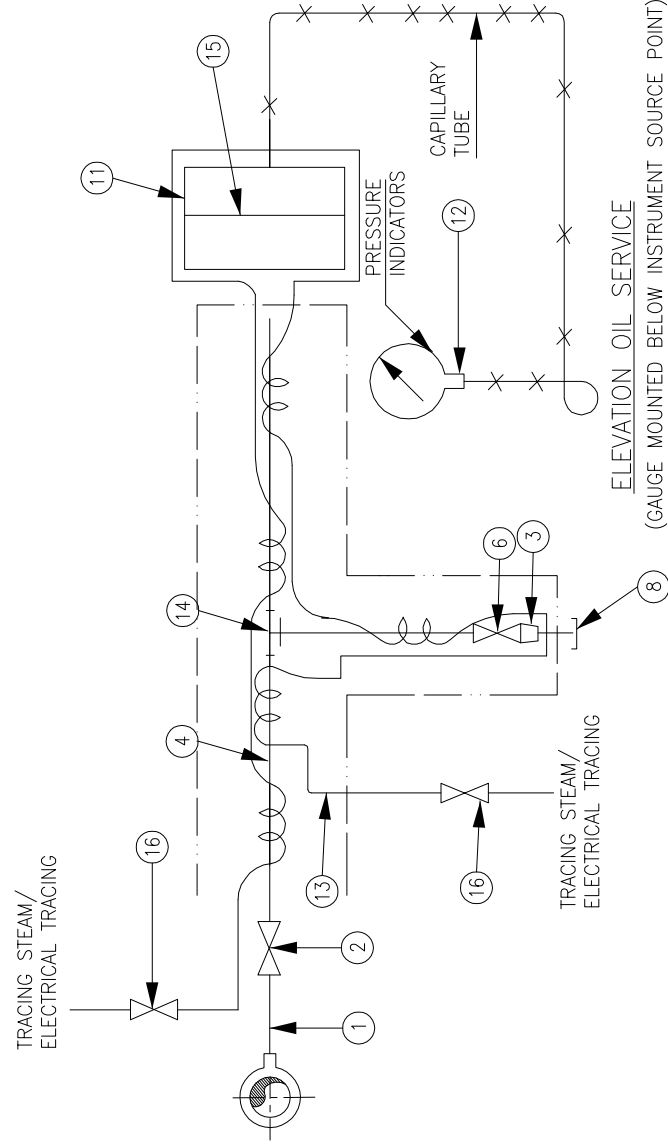
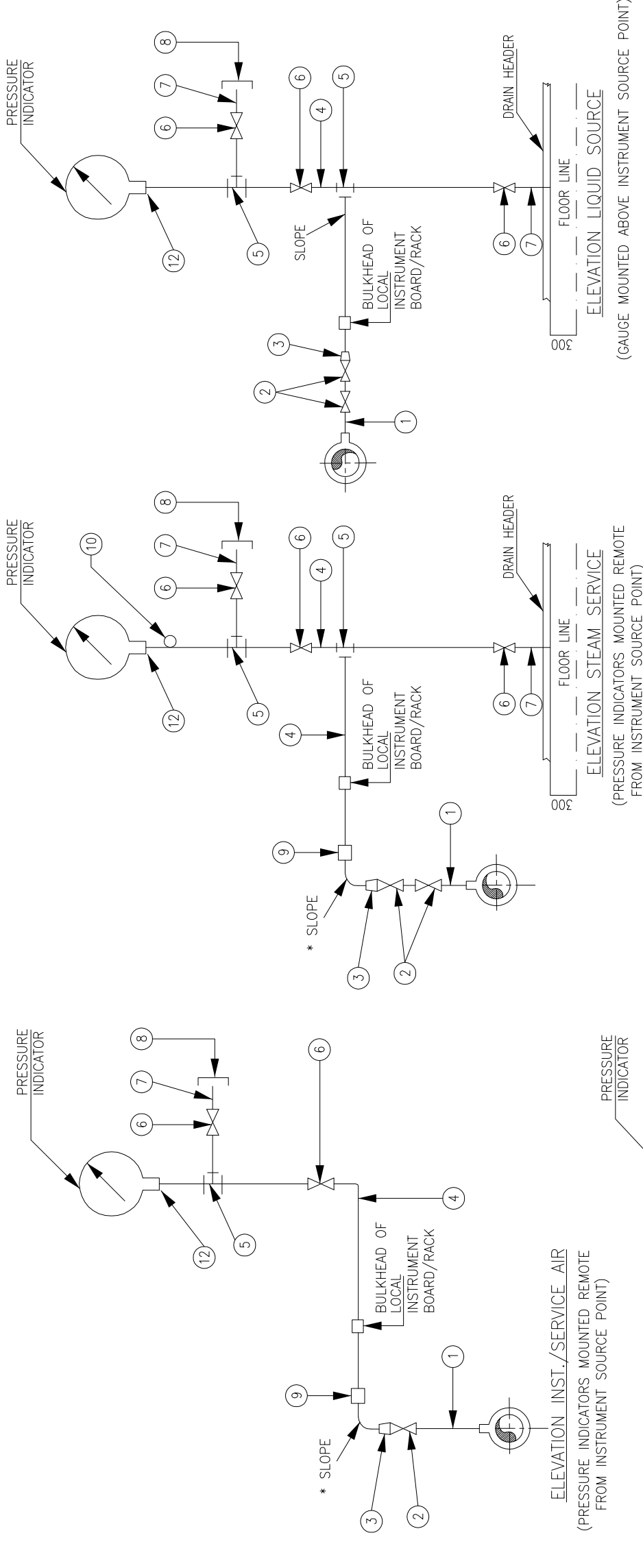
LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO : PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER STATION

DESIGNED BY : SM 06-MAY-11 DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)

CHECKED BY : AV 06-MAY-11
APPROVED BY : UR 06-MAY-11
SHEET SIZE : A3 DRAWING NO : LI-GE0E11019-G-00172-305 REV. 02 1 OF 1

SCALE : NTS
Protection mark DIN 34 - 1 - E. It is forbidden to use or communication of the contents thereof, or forbidden without copying of this drawing, and giving credit to the author, without the written permission of the copyright holder or the registration of a utility model or design.



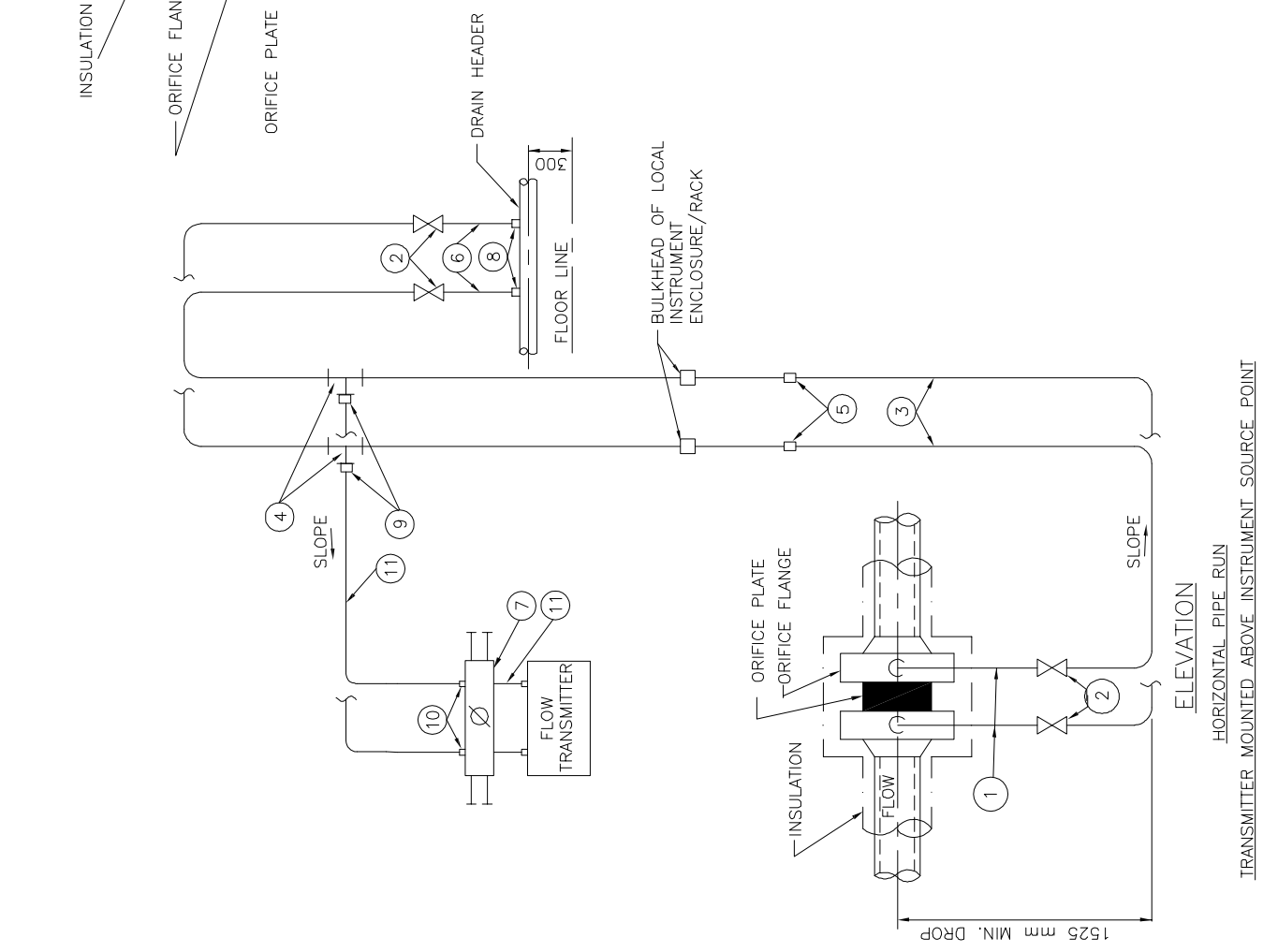
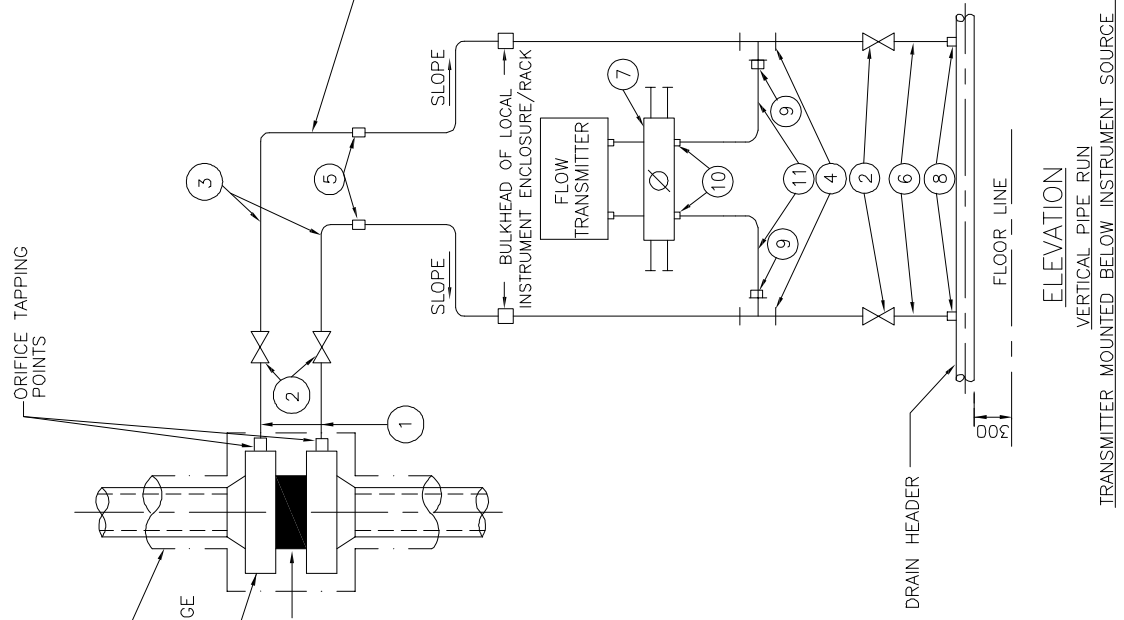
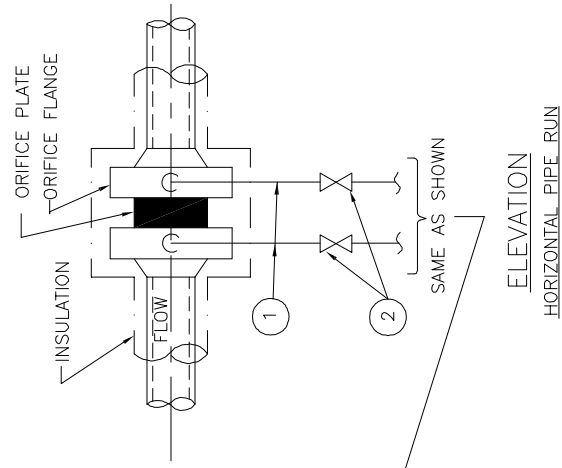
Praveen Kishore
Praveen Kishore

S A Khan
S A Khan

Varun Jain
Varun Jain

LIST OF MATERIALS

ITEM NO	DESCRIPTION
1	1/2" NPS SCH. 80 NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE WITH NECESSARY ATTACHMENT TO FLANGE OF ORIFICE
2	1/2" SW GLOBE VALVE
3	1/2" NPS PIPE
4	1/2" SW EQUAL TEE
5	1/2" PIPE UNION
6	1/2" NPS SCH. 80 SW x 1/2" NPT (M) S.S. NIPPLE
7	5 VALVE MANIFOLD
8	1/2" T SW HALF COUPLER CS
9	1/2" PIPE x 1/2" TUBE UNION
10	SUITABLE ADAPTER
11	SS TUBE



FOR REFERENCE ONLY

REV. No.	DATE	DESCRIPTION
02	25.06.11	AV
01	27.05.11	AV
00	06.05.11	AV

NEVELI LIGNITE CORPORATION LTD, NEVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA
 LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
 CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :
 PROJECT : 2 X 500 MW NEVELI NEW THERMAL POWER STATION

PREPARED :
 DRAWN BY : PS
 DESIGNED BY : SM
 CHECKED BY : AV
 APPROVED BY : UR

DATE :
 DATE :
 DATE :
 CHECKED :

DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM
 FLOW MEASUREMENT (USING ORIFICE PLATES)
 CONDENSATE & SERVICE WATER

SHEET SIZE : A3
 DRAWING NO : LI-GE011019-G-00172-304
 SCALE : NTS
 SHEET : 02
 OF : 11

(Signature)
 S A Khan

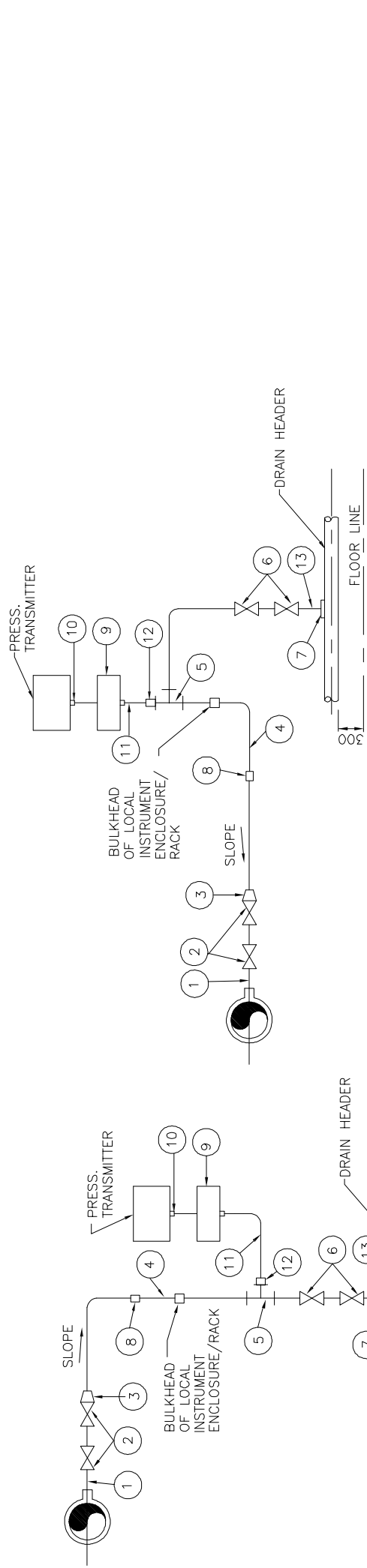
(Signature)
 Praveen Kishore

LIST OF MATERIALS

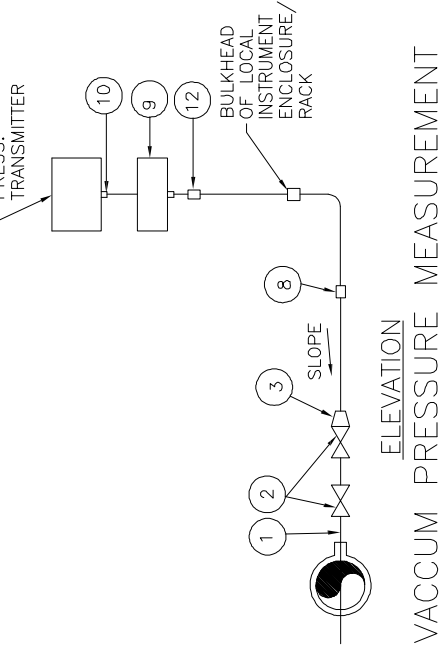
ITEM NO	DESCRIPTION
1	1/2" / 3/4" / 1" NPS SCH. 40/80/160/XXS/P91 NIPPLE OF MATERIAL AS THAT OF MAIN PIPE
2	3/4" / 1" SW GLOBE VALVE
3	3/4" / 1" TO 1/2" REDUCING INSERT
4	1/2" NPS PIPE
5	1/2" SW EQUAL TEE
6	1/2" SW GLOBE VALVE
7	1/2" NPS SCH. 80/160 SW x 1/2" CS/AS COUPLER
8	1/2" PIPE UNION
9	2/3 VALVE MANIFOLD
10	SUITABLE ADAPTER
11	SS TUBE
12	1/2" PIPE x 1/2" PIPE UNION
13	1/2" NPS SCH. 80/160 SW x 1/2" NPT (M) CS/AS NIPPLE

NOTES:-

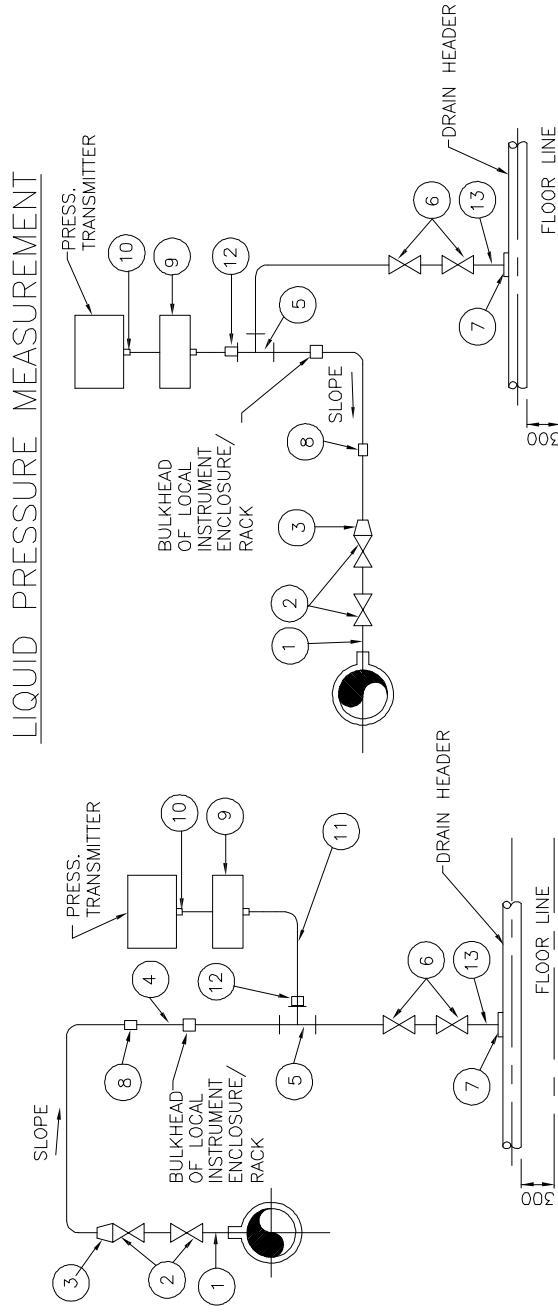
1. FOR VACUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.



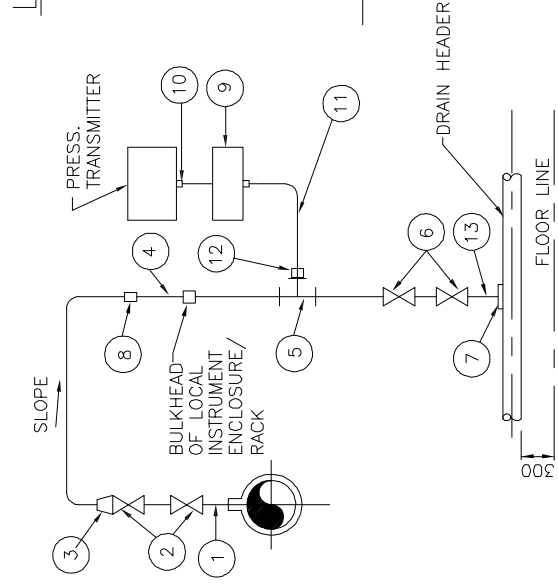
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT
ELEVATION



TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
ELEVATION



LIQUID PRESSURE MEASUREMENT



TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT
ELEVATION

STEAM PRESSURE MEASUREMENT

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
ELEVATION

VACUUM PRESSURE MEASUREMENT
ELEVATION

FOR REFERENCE ONLY

REV. No.	DATE	DESCRIPTION
02	25.06.11	AV
01	27.05.11	AV
00	06.05.11	AV



NEVELI LIGNITE CORPORATION LTD, NEVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :	PROJECT :	2 X 500 MW NEVELI NEW THERMAL POWER STATION
PREPARED NAME :	DATE :	06-MAY-11
DRAWN BY :	SM	06-MAY-11
CHECKED BY :	AV	06-MAY-11
APPROVED BY :	UR	06-MAY-11
SHEET SIZE :	A3	
SCALE :	NTS	
DRAWING NO :	LI-GE0E11019-G-00172-303	
REV. :	02	
SHEET :	02	
OF :	1	

(Signature)
S A Khan

(Signature)
Praveen Kishore



TECHNICAL SPECIFICATION
2X500 MW NEW NEYVELI

SPECIFICATION NO. PE-TS-400 & 402-554-A001

VOLUME II B

REV 00

DATE: AUGUST 2014

SHEET 1 OF 3

ANNEXURE-I
LIST OF MAKES


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TECHNICAL SPECIFICATION
2X500 MW NEW NEYVELI

SPECIFICATION NO. PE-TS-400 & 402-554-A001

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DATE: AUGUST 2014

SHEET 2 OF 3

S.No.	Description	Makes
1.	AIR WASHER & UAF*	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
2.	CENTRIFUGAL FAN	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
3.	AXIAL FLOW FANS/RE UNITS	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE
4.	CENTRIFUGAL WATER PUMP	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
5.	INDUCTION MOTORS (LT)	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
6.	AIR FILTER	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
7.	INSULTATION MATERIAL	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL
8.	FIRE DAMPER	JHONSON CONTROL / HONEYWELL / PENN
9.	BUTTERFLY VALVE	GENERAL INST CONSORTIUM / BELL / H.GURU INST / WAAREE INSTRUMENTS / H. GURU IND / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES
10.	NON RETURN VALVE	H. GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA/ ASHCROFT / H GURU (SI)
11.	GATE/GLOBE VALVES	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR
12.	PIPING - ERW	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
13.	GI SHEETS FOR DUCTING	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
14.	HUMID STAT	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE
15.	PRESSURE GAUGE	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
16.	TEMPERATURE GAUGE	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
17.	LEVEL GAUGE	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
18.	PRESSURE SWITCH / DP SWITCHES	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT
19.	LEVEL SWITCH	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V ATUOMATE /CHEMTROLS / SIMENS / FLOW STAR / TRAC

Praveen Kishore
S A Khan
Vishnu Jain



TECHNICAL SPECIFICATION
2X500 MW NEW NEYVELI

SPECIFICATION NO. PE-TS-400 & 402-554-A001

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DATE: AUGUST 2014

SHEET 3 OF 3

20.	Y / POT STRAINER	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTRATION ENGINEERS INDIA PVT LTD / SUNGOV ENGINEERING
21.	CONTROL PANEL	INDUSTRIAL CONTROL & APPLIANCE/ PYROTECH /POSITRONICS / CONTROL & SWITCHGEAR /SIEMENS / L&T /GE POWER /RITTAL / HOFFMAN

* Designed by C.Doctor / Blue Star / Voltas / Hyderabad Pollution Controls / SK System /Advance Ventilation / Draft Air / Sterling & Wilson / Roots cooling and fabricated by their approved fabricators.

Note: Above makes are subject to Customer / BHEL approval during detailed engineering stage.


Praveen Kothare

S A Khan

Vikram Jain



TECHNICAL SPECIFICATION
2X500 MW NEW NEYVELI

SPECIFICATION NO. PE-TS-402-554-A001

VOLUME II B


REV 00

DATE: AUGUST 2014

SHEET 1 OF 2

ANNEXURE-II
MANDATORY SAPRE LIST TG PACKAGE


Praveen Kothare


S A Khan


Varun Jain



TECHNICAL SPECIFICATION
2X500 MW NEW NEYVELI

SPECIFICATION NO. PE-TS-402-554-A001

VOLUME II B

REV 00

DATE: AUGUST 2014

SHEET 2 OF 2

S.No.	Description	Unit	Qty	Remarks
1	Humidistat	No	2	Applicable items considered. Applicable items are those which are installed in the system.
2	Pr. Gauge of each type and range	%	5	
3	Temperature gauge of each type and range	%	5	
4	Level switches of each type and range	No	2	
5	Solenoid valves of each type and range	No	2	
6	Flow meter of each type and range	No	2	
7	Flow Switch of each type	No	2	
8	Thermostat of each type	No	2	

NOTE: - Any other equipment not specifically mentioned but necessary for operation of the plant shall be finalized at the end of detail engineering.


Praveen Kishore

S A Khan

Vikram Jain



TECHNICAL SPECIFICATION
2X500 MW NEW NEYVELI

SPECIFICATION NO. PE-TS-400-554-A001

VOLUME II B

REV 00

DATE: AUGUST 2014

SHEET 1 OF 2

ANNEXURE-III
MANDATORY SAPRE LIST SG PACKAGE


Praveen Kothare

S A Khan

Varun Jain



TECHNICAL SPECIFICATION
2X500 MW NEW NEYVELI

SPECIFICATION NO. PE-TS-400-554-A001

VOLUME II B

REV 00

DATE: AUGUST 2014

SHEET 2 OF 2

S.No.	Description	Unit	Qty	Remarks
1	Contractor (For each type and rating)	No.	Minimum 1 no. of each type	Applicable items considered. Applicable items are those which are installed in the system.
2	Over load relay (For each type and rating)	No.	2 no. of each type	
3	Relay/Timer (For each type and rating)	No.	3 no. of each type	
4	Fan motor (For each type and rating)	No.	30% of each rating	
5	Electronics cards (For each type and rating)	No.	20% of each rating	
6	Switch fuse unit/MCCB/ELCB (For each type and rating)	No.	2 no. of each rating	
7	Blower motor (For each type and rating)	No.	30% of each rating	
8	Pumps (For each type and size)			
8.1	Impeller (For each type and size)	No.	2	
8.2	Shafts (For each type and size)	No.	1	
8.3	Shaft sleeve (For each type and size)	Set	3	
8.4	Casing wear ring (For each type and size)	Set	6	
8.5	Impeller bearing (For each type and size)	Set	2	
8.6	Motor bearing (For each type and size)	Set	2	
8.7	Thrust bearing (For each type and size)	Set	2	
8.8	Radial bearing (For each type and size)	Set	2	
8.9	Gland packing (For each type and size)	Set	2	
8.10	Fasteners (For each type and size)	Set	1	
8.11	Complete coupling (pump & motor) (For each type and size)	Set	1	
8.12	Motor (For each type and rating)	No.	1	

NOTE: - Any other equipment not specifically mentioned but necessary for operation of the plant shall be finalized at the end of detail engineering.

 Praveen Kishore
 S.A. Khan
 Vikram Jain