



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			



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



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







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 ½".

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 ½" right-left threaded fittings.

i. A ½" vent line with a ½" 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.



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

**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.



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



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.



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



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



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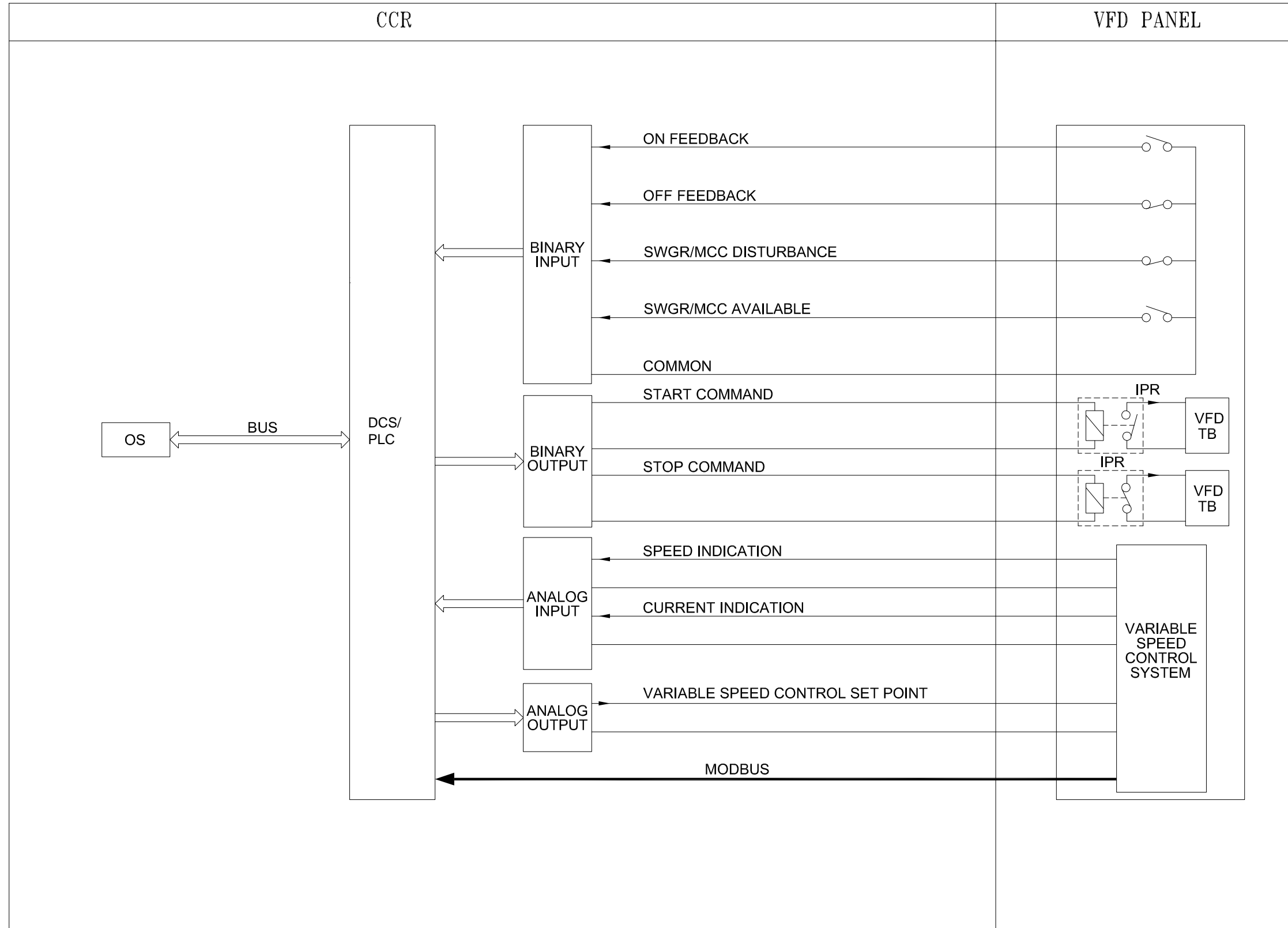
7. The VFD shall also be interfaced with control system via Modbus soft link.

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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REV. No.	DATE	DEM	DEC	DEE	DEI	CHECKED	DESCRIPTION

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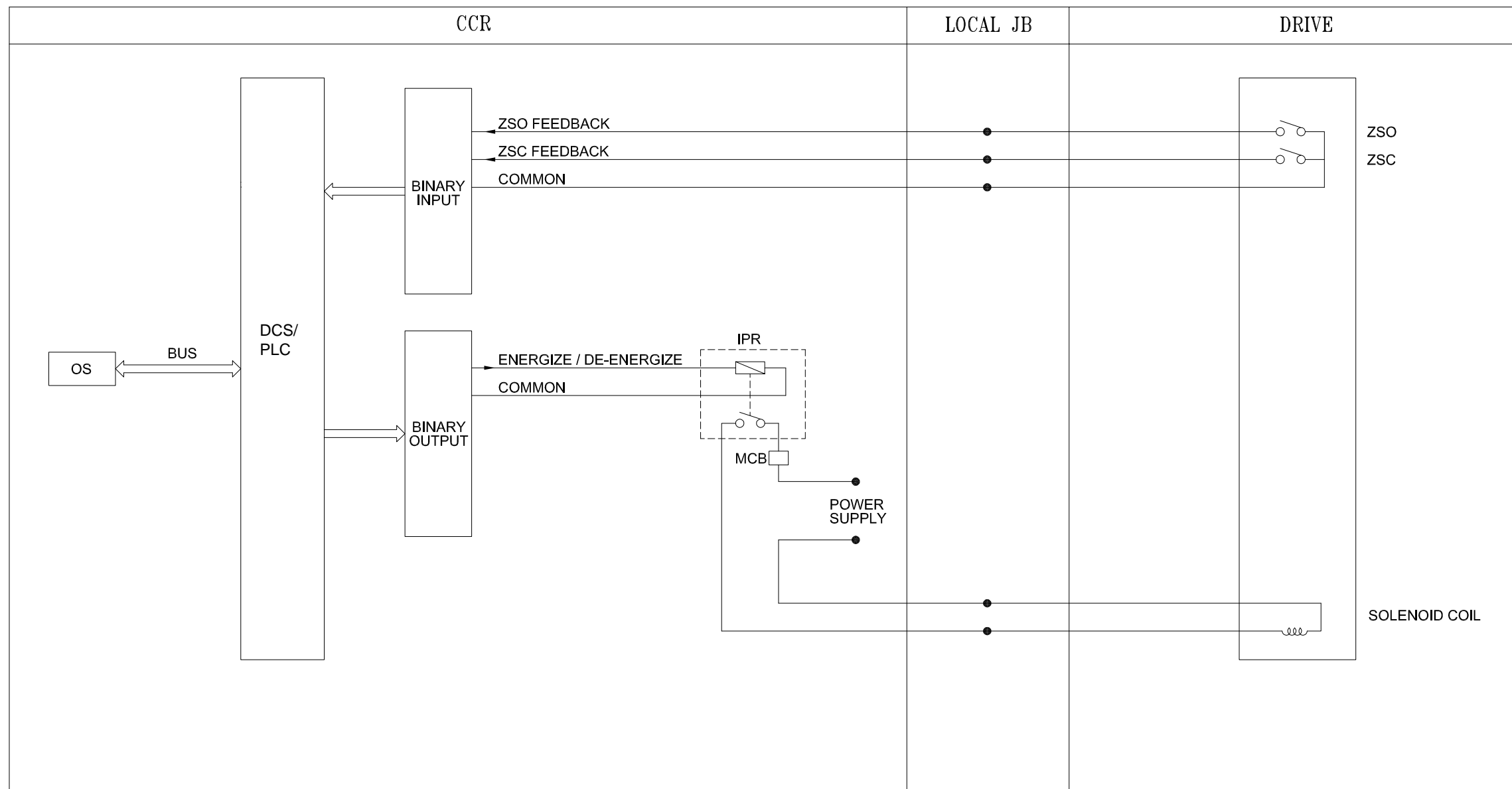
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DESIGNED BY	SM	06-JUN-11	DRIVE CONTROL PHILOSOPHY		
CHECKED BY	AJV	06-JUN-11	VFD CONTROL		
APPROVED BY	UJR	06-JUN-11	DRAWING NO :		
SHEET SIZE	A3		LIH-GEOE11019-G-00172-332		REV. 02
SCALE	NTS				SHEET 1 OF 1

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 V. Venkatesh

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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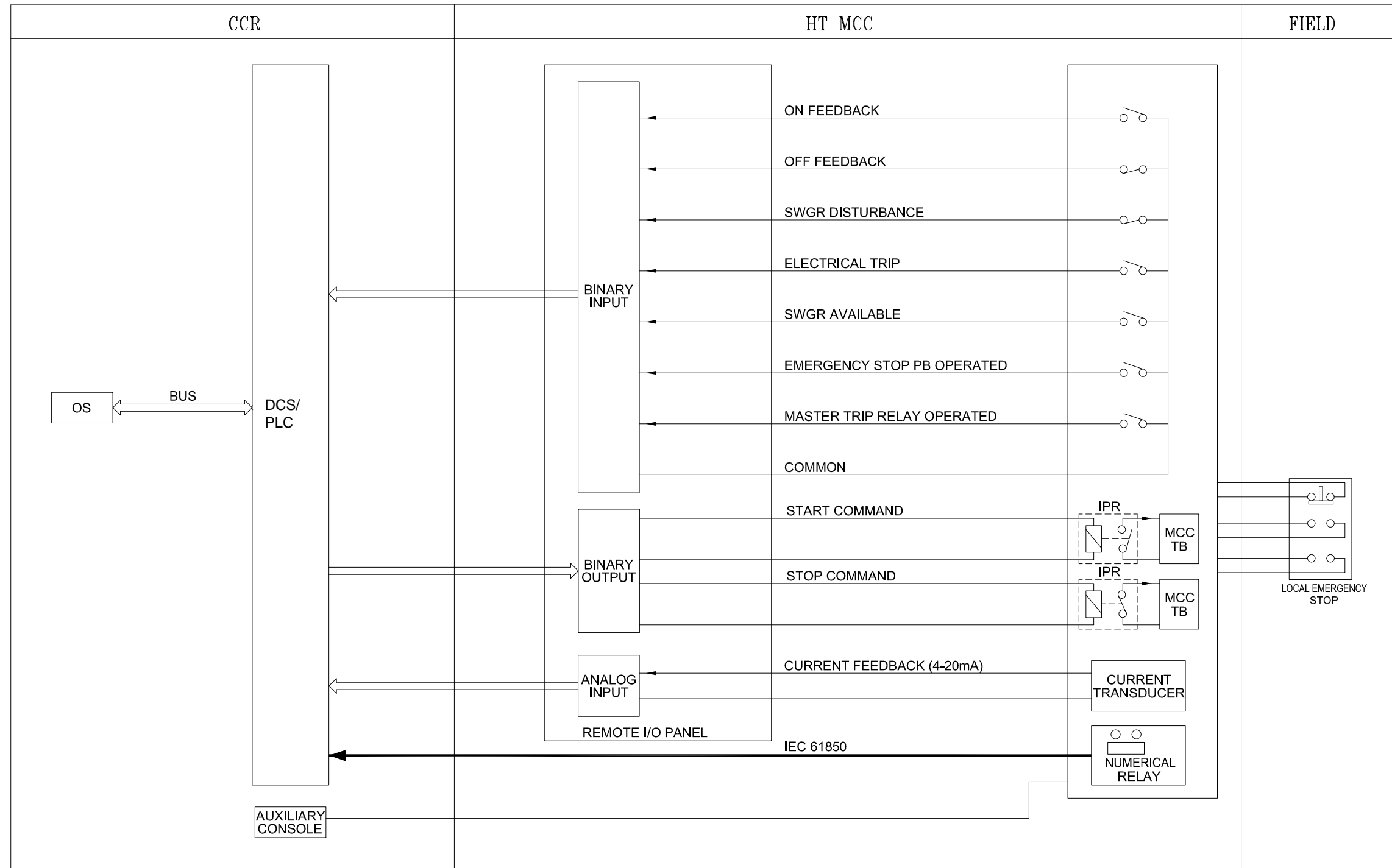
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APPROVED BY	UJR	04-APR-11	DRAWING TITLE :		
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NTS			02 1 OF 1		

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Praveen Kishore
 S A Kishore
 Vignesh Jagan

ABBREVIATIONS

- CCR - CENTRAL CONTROL ROOM
- DCS - DISTRIBUTED CONTROL SYSTEM
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- OS - OPERATOR STATION
- IPR - INTERPOSING RELAY
- I/O - INPUT/OUTPUT
- TB - TERMINAL BOX



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02	25.06.11				AJV	
01	27.05.11				AJV	
00	04.04.11				AJV	
REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
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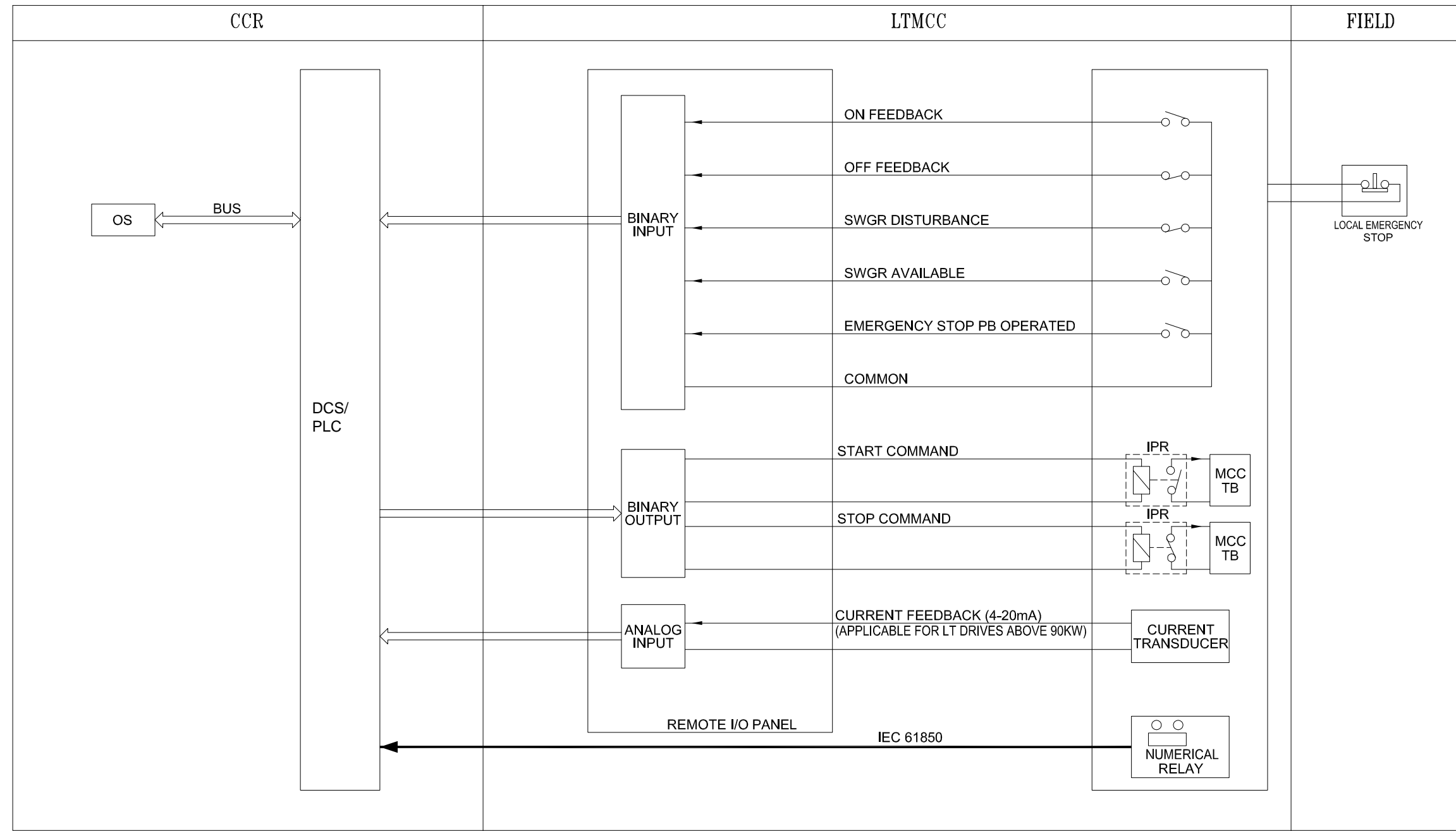
 NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

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

CONTRACT NO :			PROJECT :		
PREPARED	NAME	DATE	2 X 500 MW NEYVELI NEW THERMAL POWER STATION		
DRAWN BY	PS	04-APR-11			
DESIGNED BY	SM	04-APR-11	DRAWING TITLE : DRIVE CONTROL PHILOSOPHY UNI-DIRECTIONAL HT DRIVE		
CHECKED BY	AJV	04-APR-11			
APPROVED BY	UJR	04-APR-11			
SHEET SIZE	A3		DRAWING NO : LII-GEOE11019-G-00172-330		REV. 02
SCALE	NTS				SHEET 1 OF 1

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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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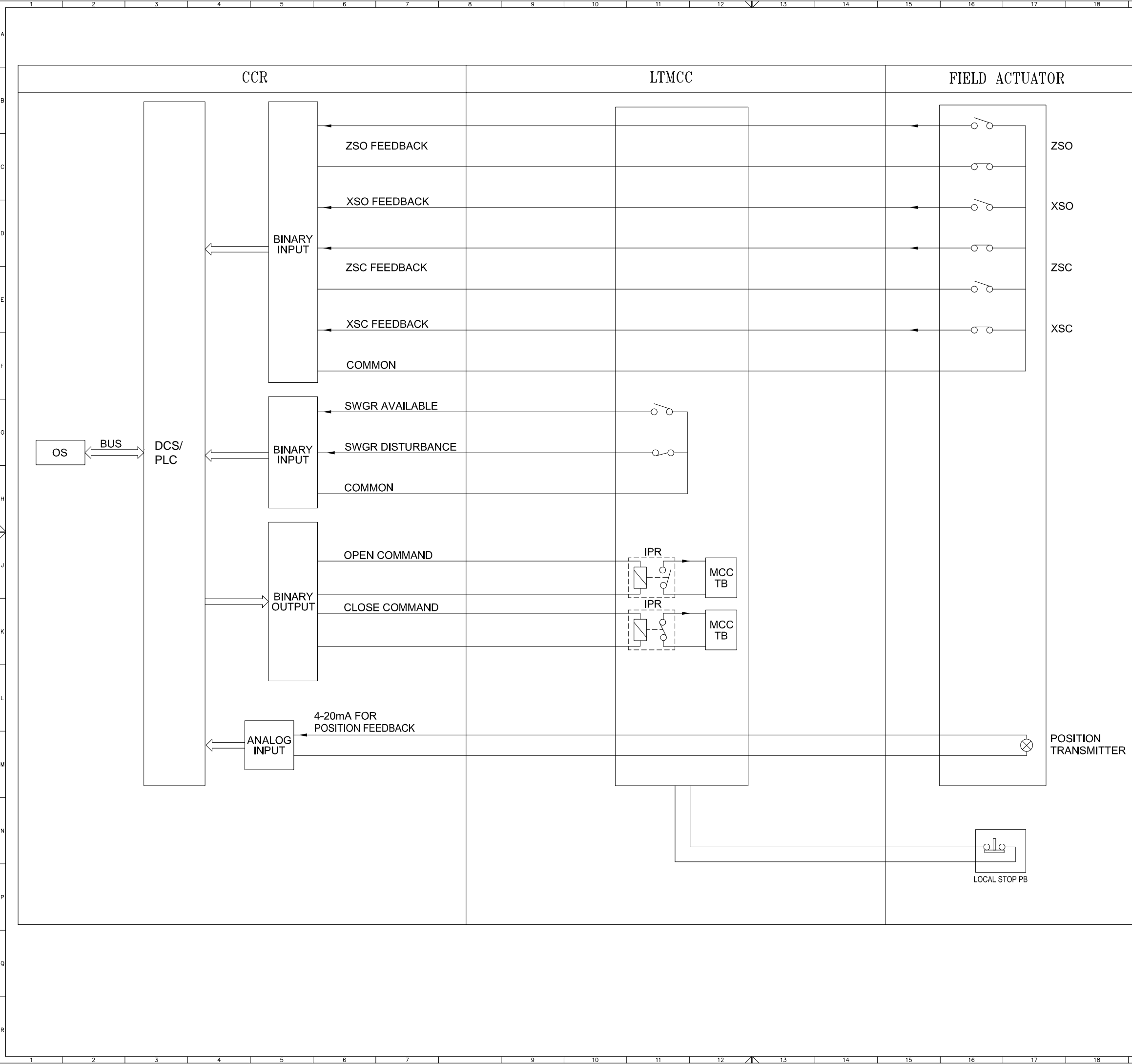
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01	27.05.11					AJV	
00	04.04.11					AJV	
REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION	
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CONSULTING ENGINEERS, GURGAON, INDIA

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DESIGNED BY	SM	04-APR-11	DRAWING TITLE: DRIVE CONTROL PHILOSOPHY UNI-DIRECTIONAL LT DRIVE				
CHECKED BY	AJV	04-APR-11					
APPROVED BY	UJR	04-APR-11					
SHEET SIZE	A3		DRAWING NO:		LIH-GEOE11019-G-00172-329		
SCALE	NTS		REV.	SHEET		02 1 OF 1	

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NOTE:-

- 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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REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
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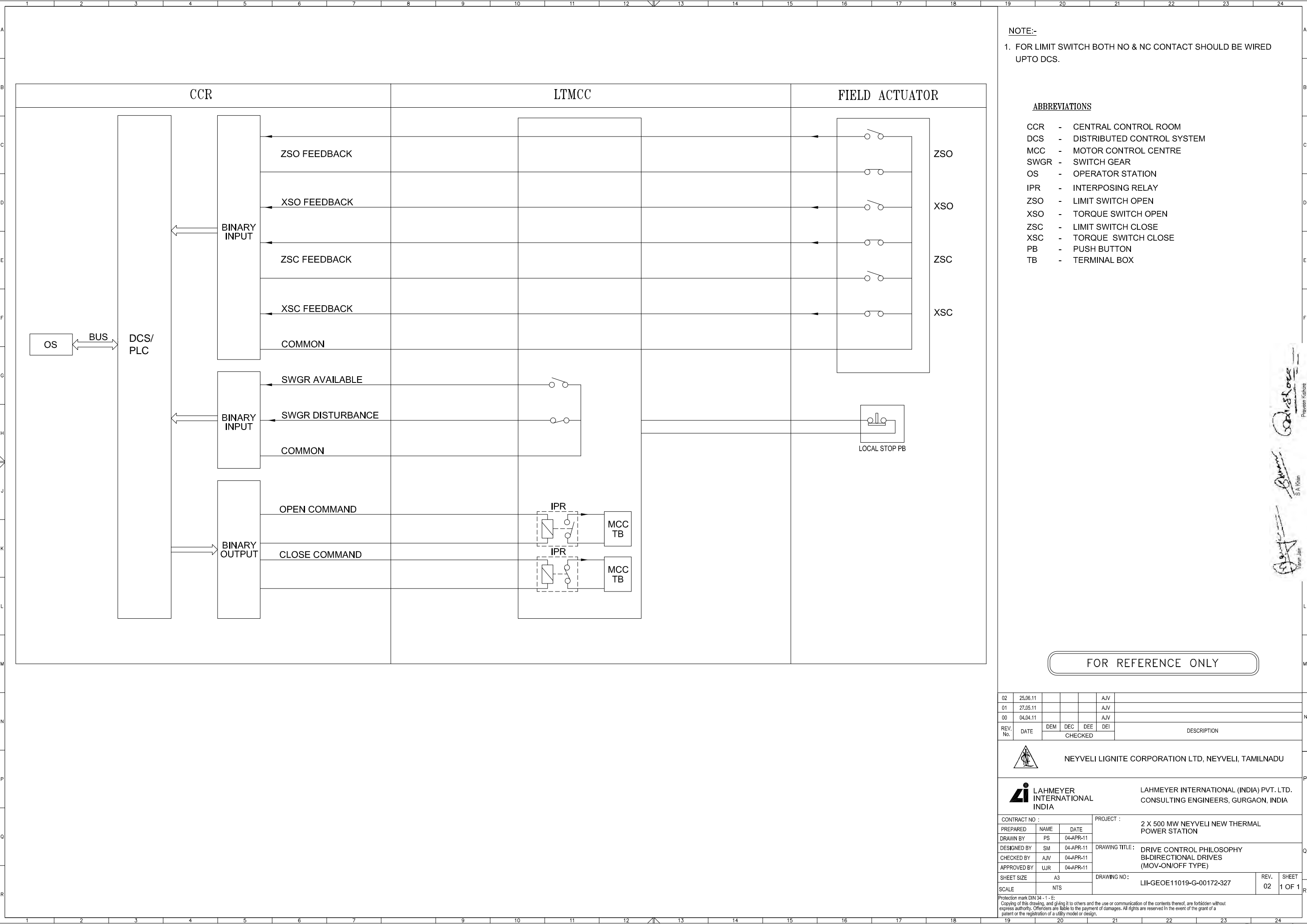
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CONSULTING ENGINEERS, GURGAON, INDIA

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

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NOTE:-
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ABBREVIATIONS

- CCR - CENTRAL CONTROL ROOM
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 **LAHMEYER INTERNATIONAL INDIA** LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :			PROJECT :		
PREPARED	NAME	DATE	2 X 500 MW NEYVELI NEW THERMAL POWER STATION		
DRAWN BY	PS	04-APR-11			
DESIGNED BY	SM	04-APR-11	DRAWING TITLE: DRIVE CONTROL PHILOSOPHY BI-DIRECTIONAL DRIVES (MOV-ON/OFF TYPE)		
CHECKED BY	AJV	04-APR-11			
APPROVED BY	UJR	04-APR-11			
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SCALE	NTS				

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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


 P. Venkatesh

 S. A. Khan

 S. A. Khan



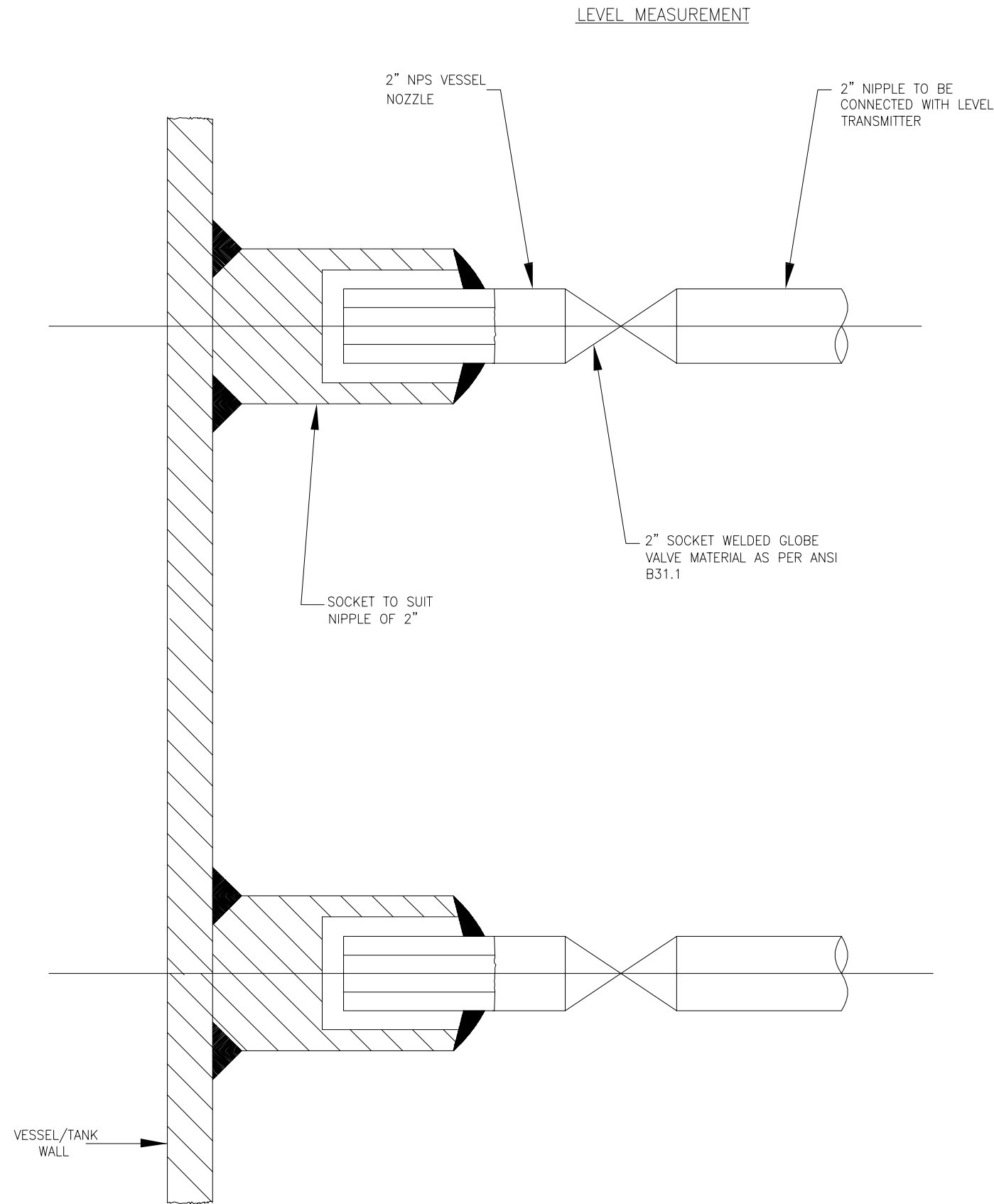
Notes:

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.

Praveen Kishore
S. A. Khan
Praveen Kishore
Praveen Kishore



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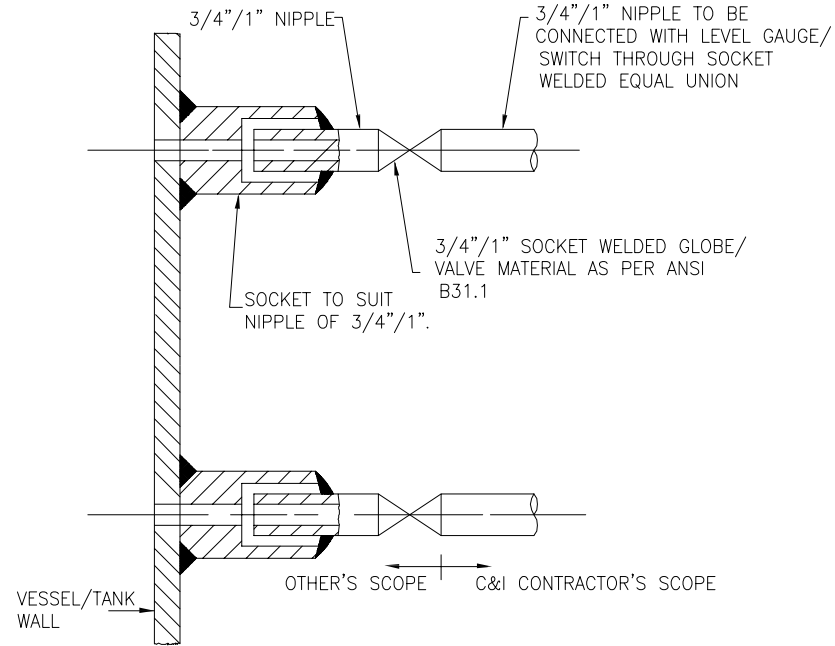
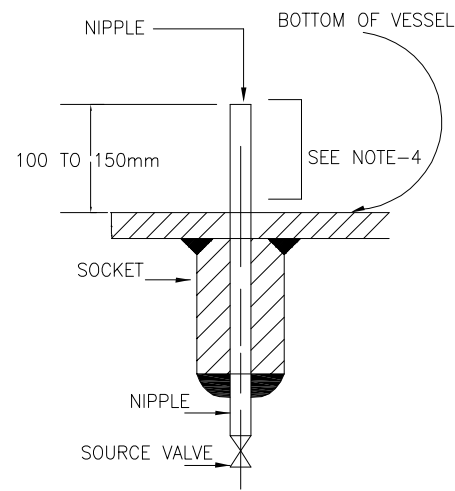
LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :			PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER STATION				
PREPARED	NAME	DATE	DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - LEVEL MEASUREMENT				
DESIGNED BY	SM	06-MAY-11					
CHECKED BY	AJV	06-MAY-11					
APPROVED BY	UJR	06-MAY-11					
SHEET SIZE	A3		DRAWING NO :			LII-GE0E11019-G-00172-317	
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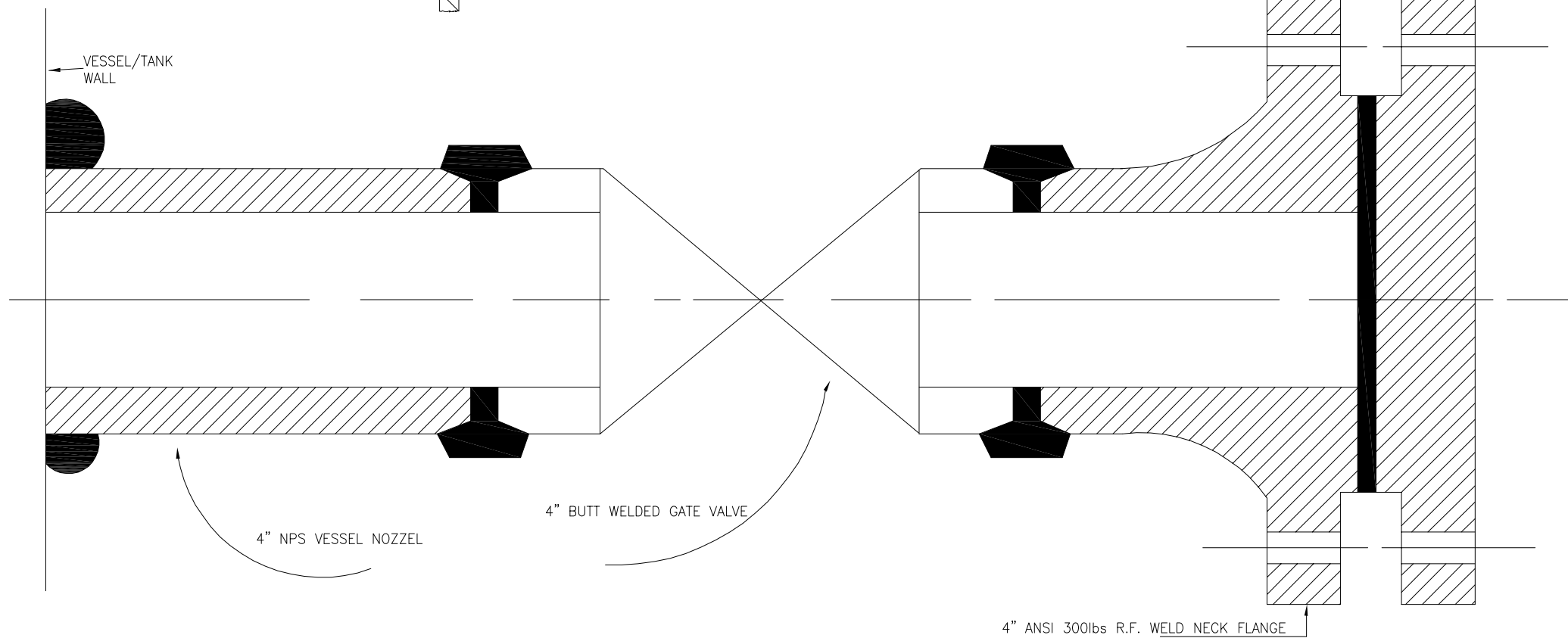
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LEVEL MEASUREMENT



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.



NOTES:-

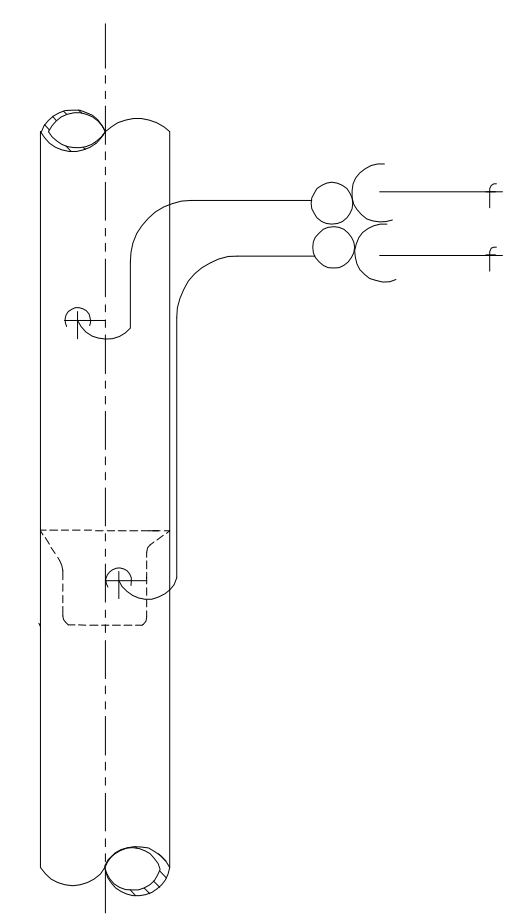
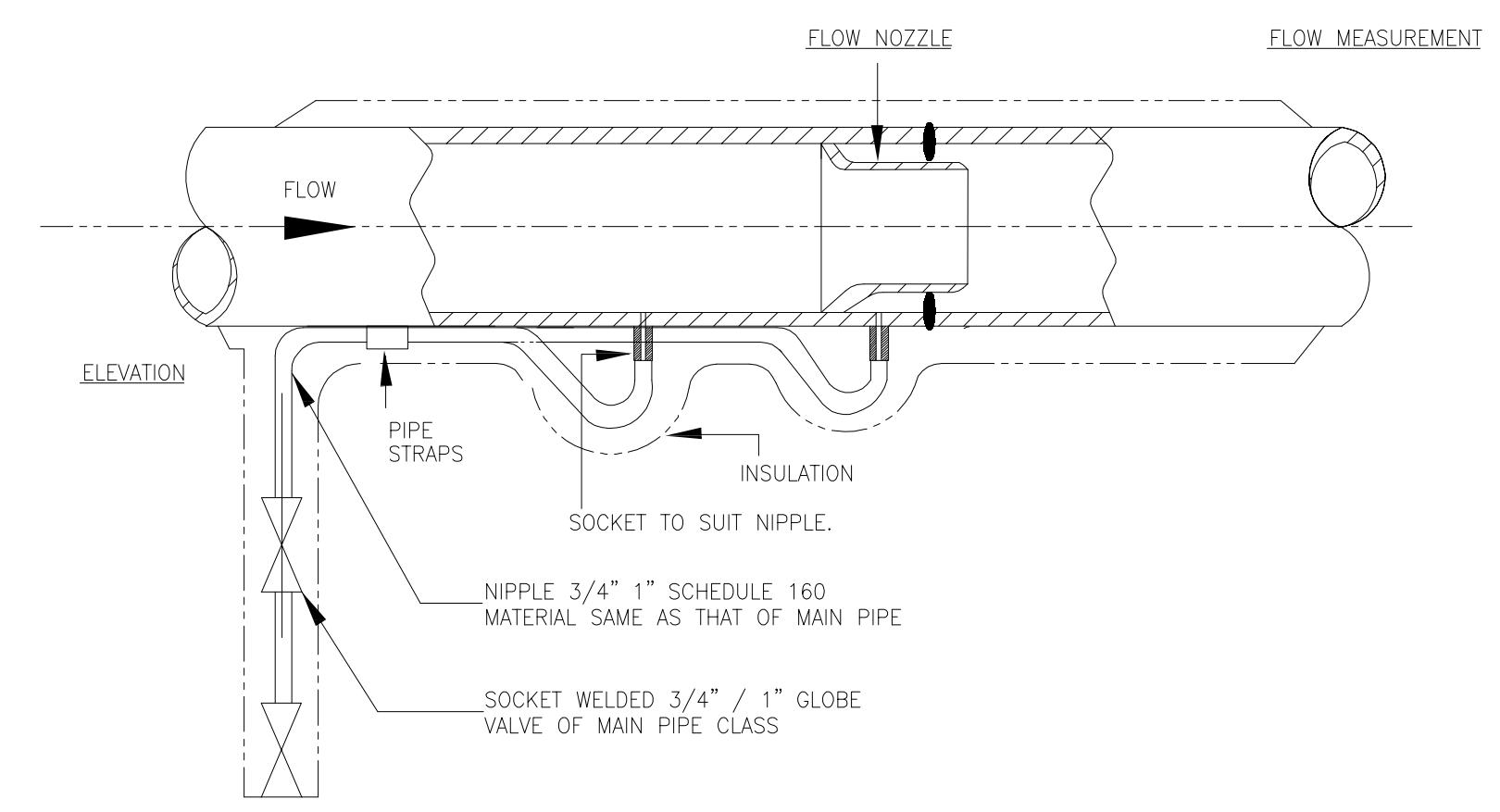
1. THIS TYPE OF PROCESS CONNECTION SHALL BE PROVIDED FOR TANK LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID USING FLASH DIAPHRAGM/WAFER TYPE LEVEL TRANSMITTER.
2. WELDING OF MATCHING FLANGE TO GATE VALVE SHALL BE DONE BY CONTRACTOR.

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NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU						
LAHMEYER INTERNATIONAL INDIA			LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, GURGAON, INDIA			
CONTRACT NO :		PROJECT :				
PREPARED	NAME	DATE	2 X 500 MW NEYVELI NEW THERMAL POWER STATION			
DRAWN BY	PS	06-MAY-11				
DESIGNED BY	SM	06-MAY-11	DRAWING TITLE :			
CHECKED BY	AJV	06-MAY-11	INSTRUMENT SOURCE CONNECTION DETAILS - LEVEL MEASUREMENT			
APPROVED BY	UJR	06-MAY-11				
SHEET SIZE	A3	DRAWING NO :		REV.		SHEET
SCALE	NTS	LII-GEOE11019-G-00172-316		02		1 OF 1

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 Praveen Kishore

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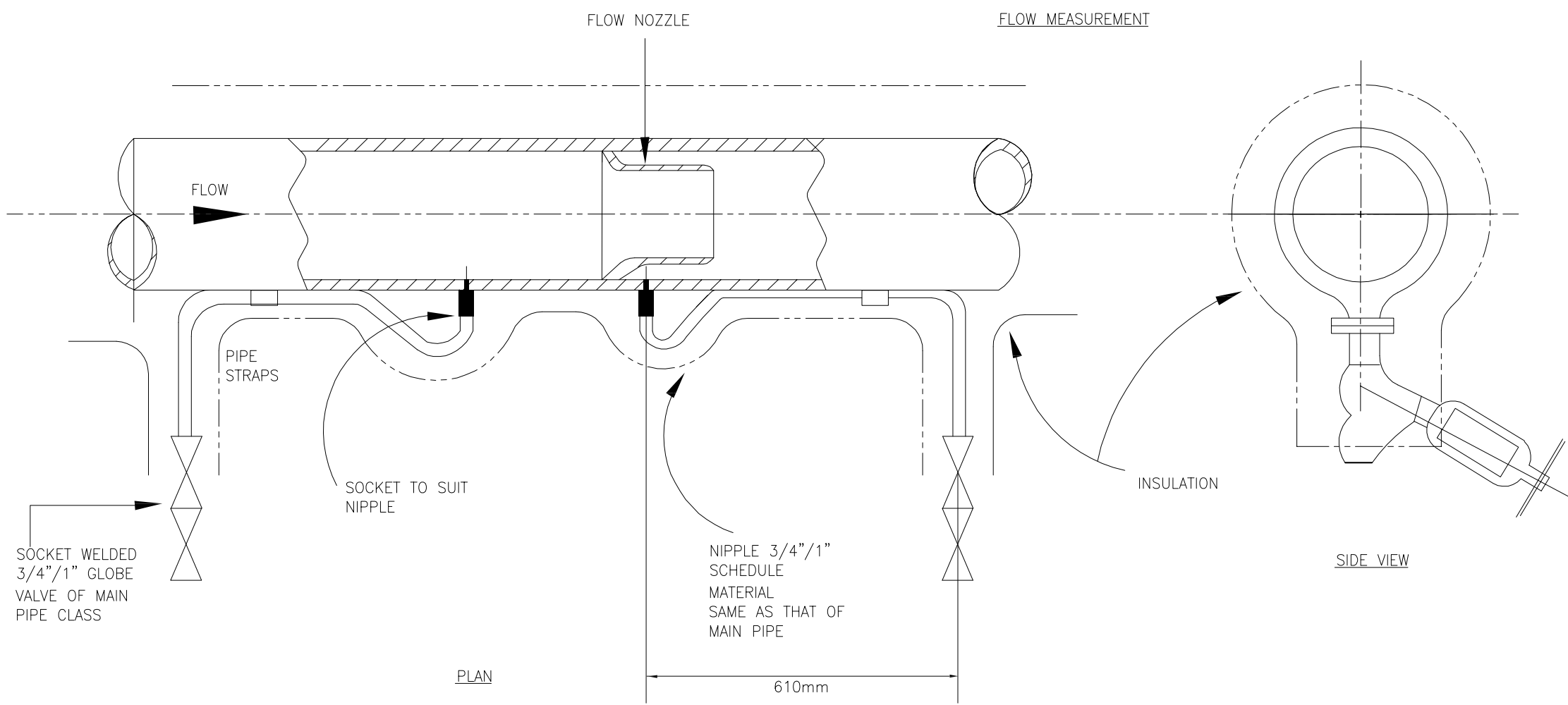
 **LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, GURGAON, INDIA**

CONTRACT NO :			PROJECT :		
PREPARED	NAME	DATE	2 X 500 MW NEYVELI NEW THERMAL POWER STATION		
DRAWN BY	PS	06-MAY-11	DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - FLOW MEASUREMENT		
DESIGNED BY	SM	06-MAY-11			
CHECKED BY	AJV	06-MAY-11	DRAWING NO : LII-GE0E11019-G-00172-315		
APPROVED BY	UJR	06-MAY-11	SHEET	REV. 02 1 OF 1	
SHEET SIZE	A3		SCALE NTS		




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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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00	06.05.11				AJV	
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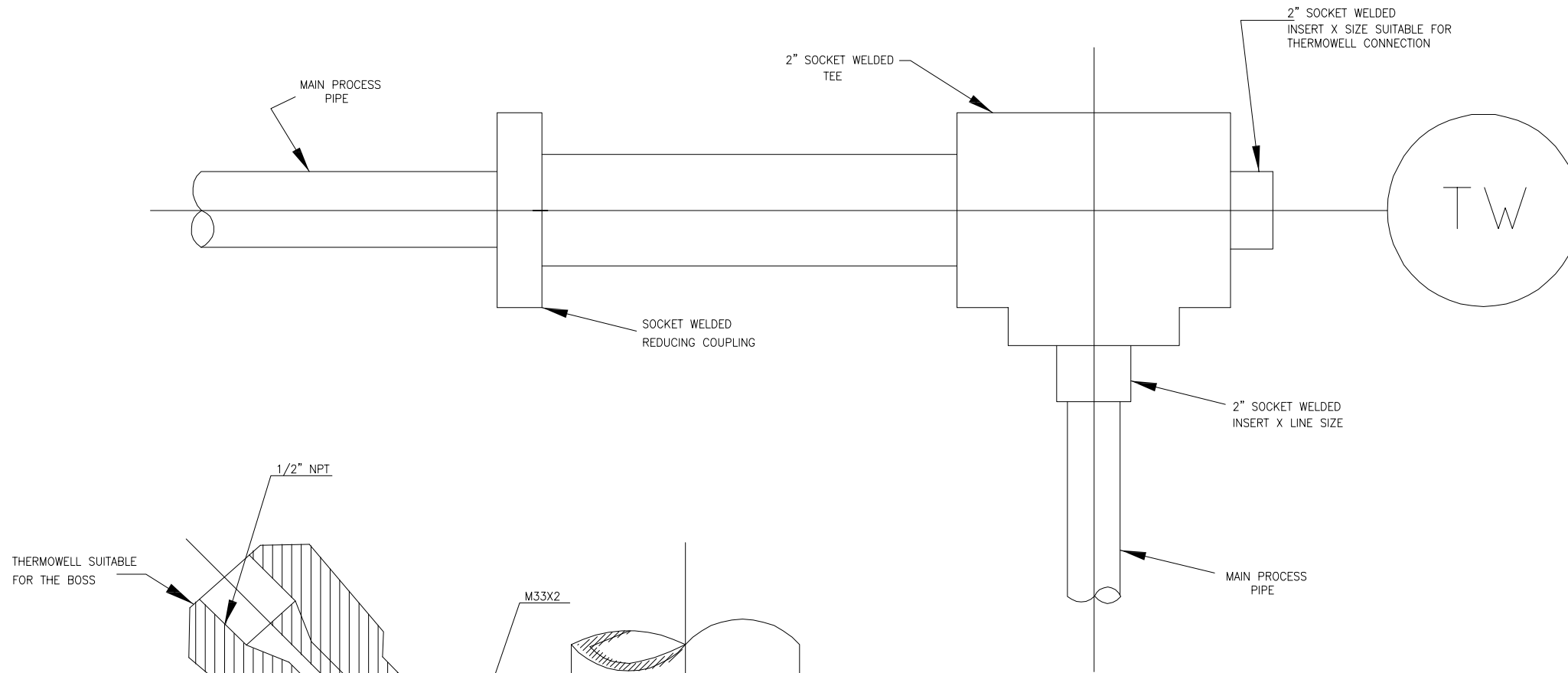
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CHECKED BY	AJV	06-MAY-11				
APPROVED BY	UJR	06-MAY-11	DRAWING TITLE :			
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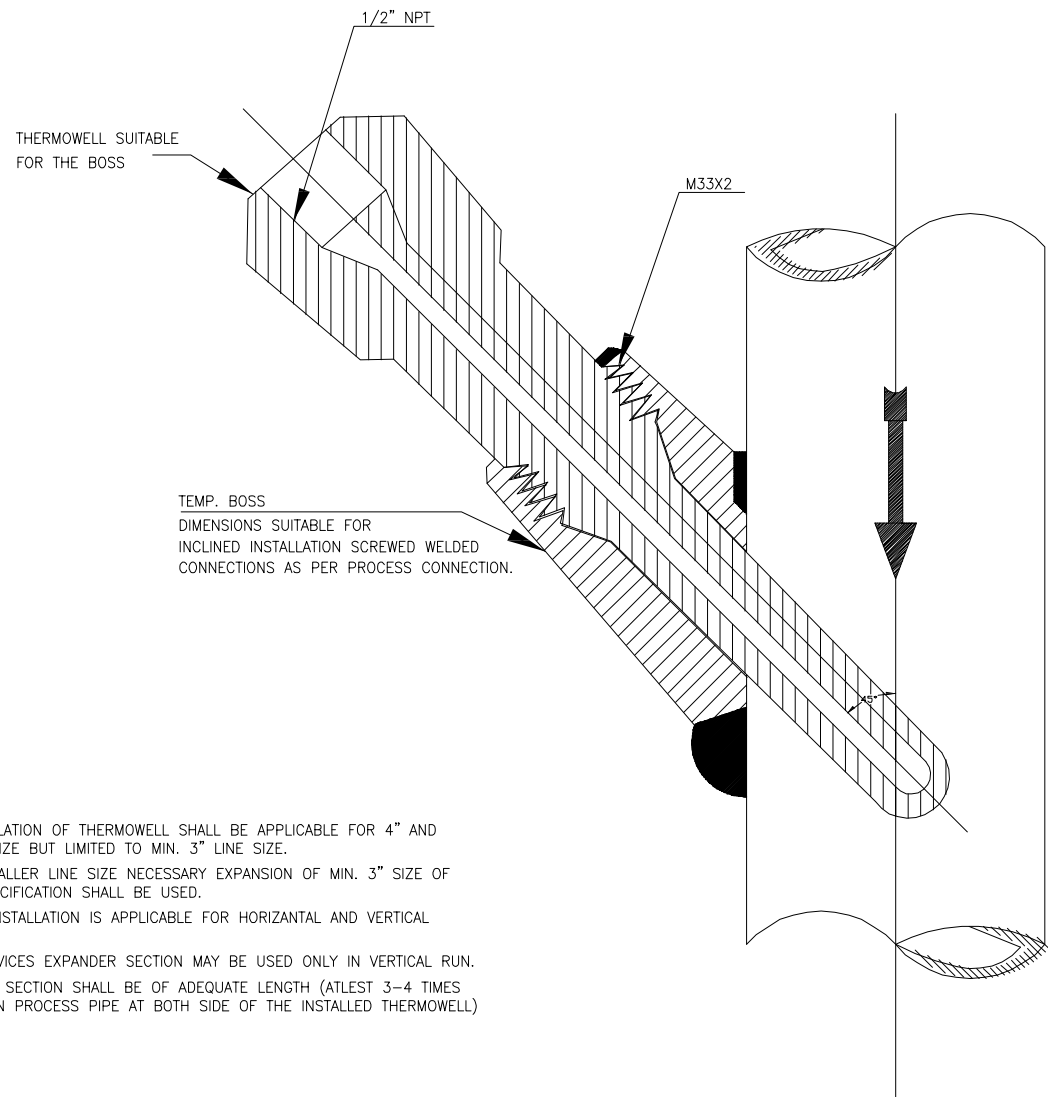
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TEMP. MEASUREMENT



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 (ATLEST 3-4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDE OF THE INSTALLED THERMOWELL)

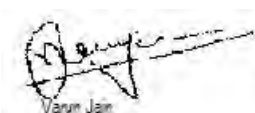

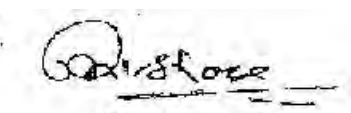
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NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

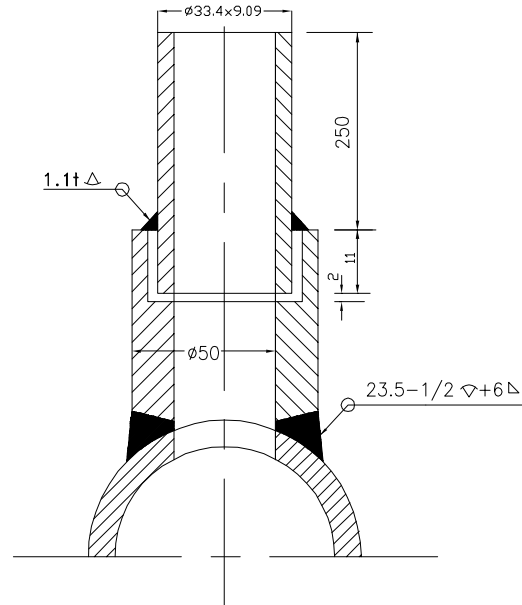
LAHMEYER INTERNATIONAL INDIA LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :	PROJECT :	2 X 500 MW NEYVELI NEW THERMAL POWER STATION
PREPARED NAME DATE	DESIGNED BY SM 06-MAY-11	DRAWING TITLE :
CHECKED BY AVJ 06-MAY-11	APPROVED BY UJR 06-MAY-11	INSTRUMENT SOURCE CONNECTION DETAILS - TEMP. MESUREMENT
SHEET SIZE A3	DRAWING NO :	LII-GE0E11019-G-00172-312
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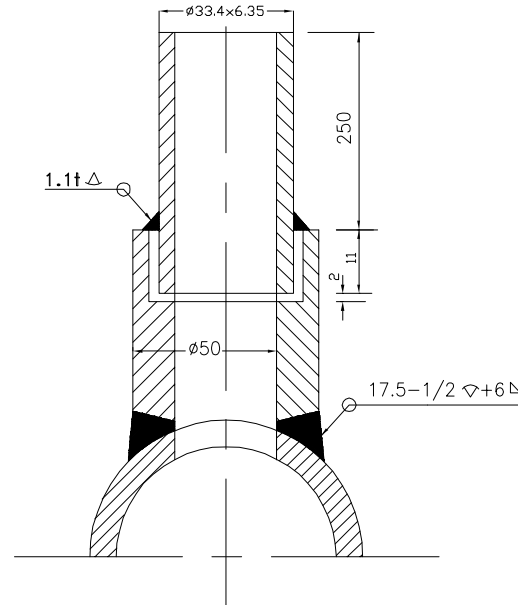



 Varun Jain S A Khan Praveen Kishore

PRESSURE MEASUREMENT

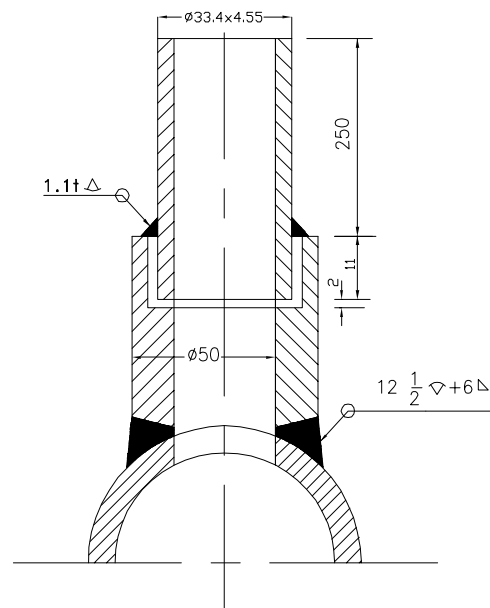
(SYSTEM PR.>40Kg/Sq cm CL 9000)



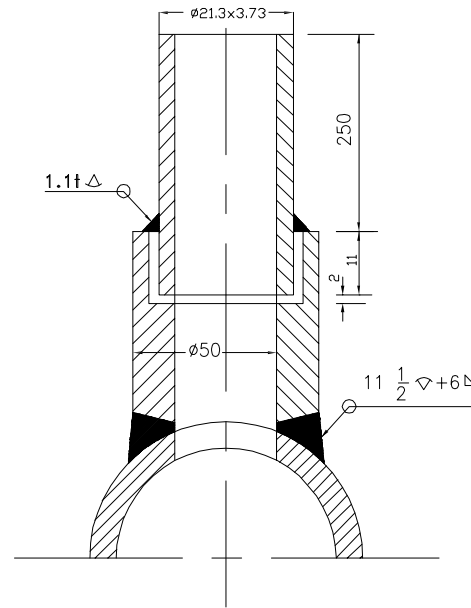
(SYSTEM PR.>40Kg/Sq cm CL 6000)



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



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



NOTES:-

1. MATERIAL OF THE BOSS AND NIPPLE BE THE SAME AS PIPE INTO WHICH IT IS WELDED AND CONFIRM TO ANSI B 16.11.
2. THE LENGTH OF THE NIPPLE SHOULD BE 250mm
3. THE OTHER END OF THE NIPPLE SHALL BE SOCKETWELDED WITH 1" GLOBE VALVE OF MATERIAL AS PER ANSI B16.1.
4. TWO ISOLATED VALVES ARE TO BE USED FOR PRESSURE=>62KgMcm2 & TEMP.-=>425°C
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64"RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
6. ORIENTATION OF TAP WILL VARY WITH TYPE OF PROCESS FLUID AND NATURE OF RUN OF THE PIPE.
7. ACTIVITES TO BE COMPLETED AT THE SHOP, WELD THE COUPLING(OR BOSS) ON THE PIPE AND DRILL PRESSURE CONNECTION HOLE (SAME AS I D OF NIPPLE) IN THE PIPE IN ALLIGNMENT WITH HOLE IN THE COUPLING.
8. ALL DIMENSIONS ARE IN mm UNLESS AND OTHERWISE STATED.

FOR REFERENCE ONLY

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



NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

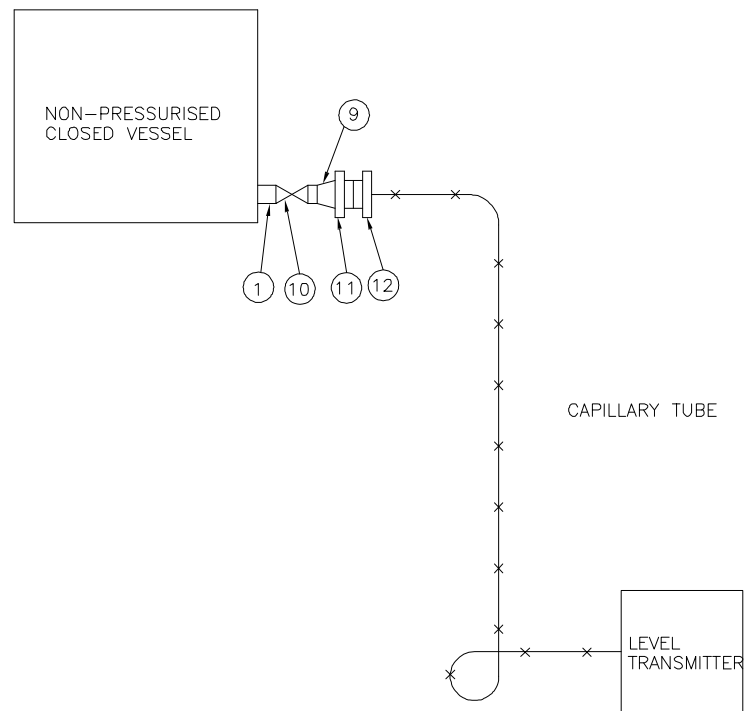


LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :			PROJECT :		
PREPARED	NAME	DATE	2 X 500 MW NEYVELI NEW THERMAL POWER STATION		
DESIGNED BY	SM	06-MAY-11	DRAWING TITLE :		
CHECKED BY	AJV	06-MAY-11	INSTRUMENT SOURCE CONNECTION DETAILS - PRESSURE MEASUREMENT		
APPROVED BY	UJR	06-MAY-11	DRAWING NO :		
SHEET SIZE	A3		LII-GE0E11019-G-00172-310		
SCALE	NTS		REV.	SHEET	
			02	1 OF 1	

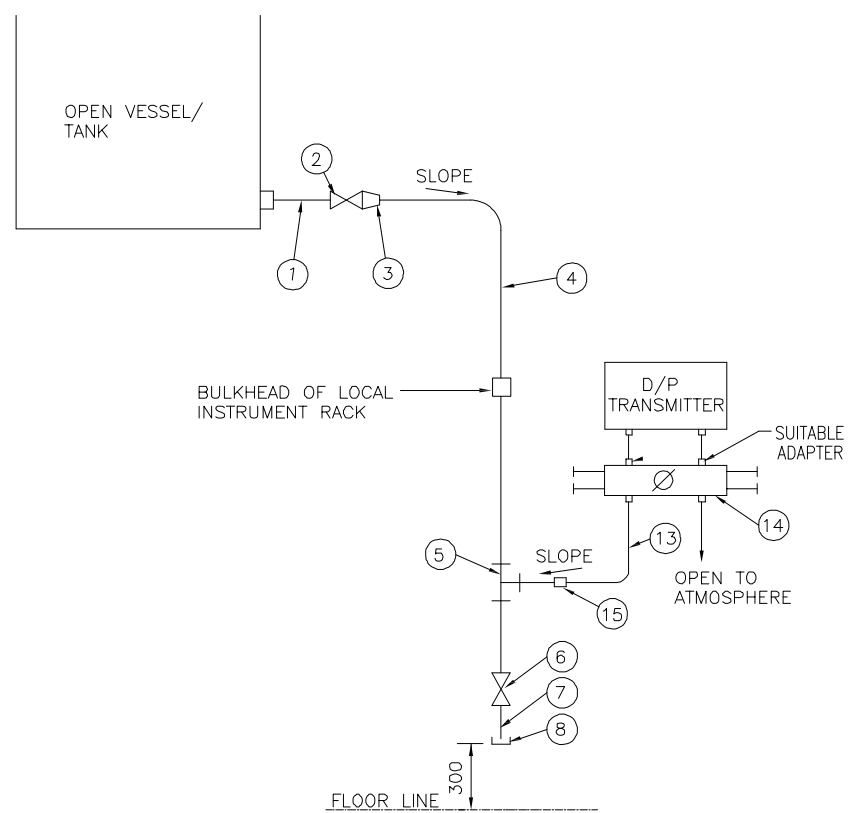



 Varun Jain S A Khan Praveen Kishore



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

LIST OF MATRERIALS

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 VACCUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.

FOR REFERENCE ONLY

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

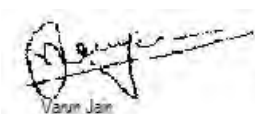

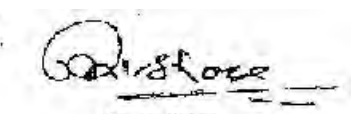


NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

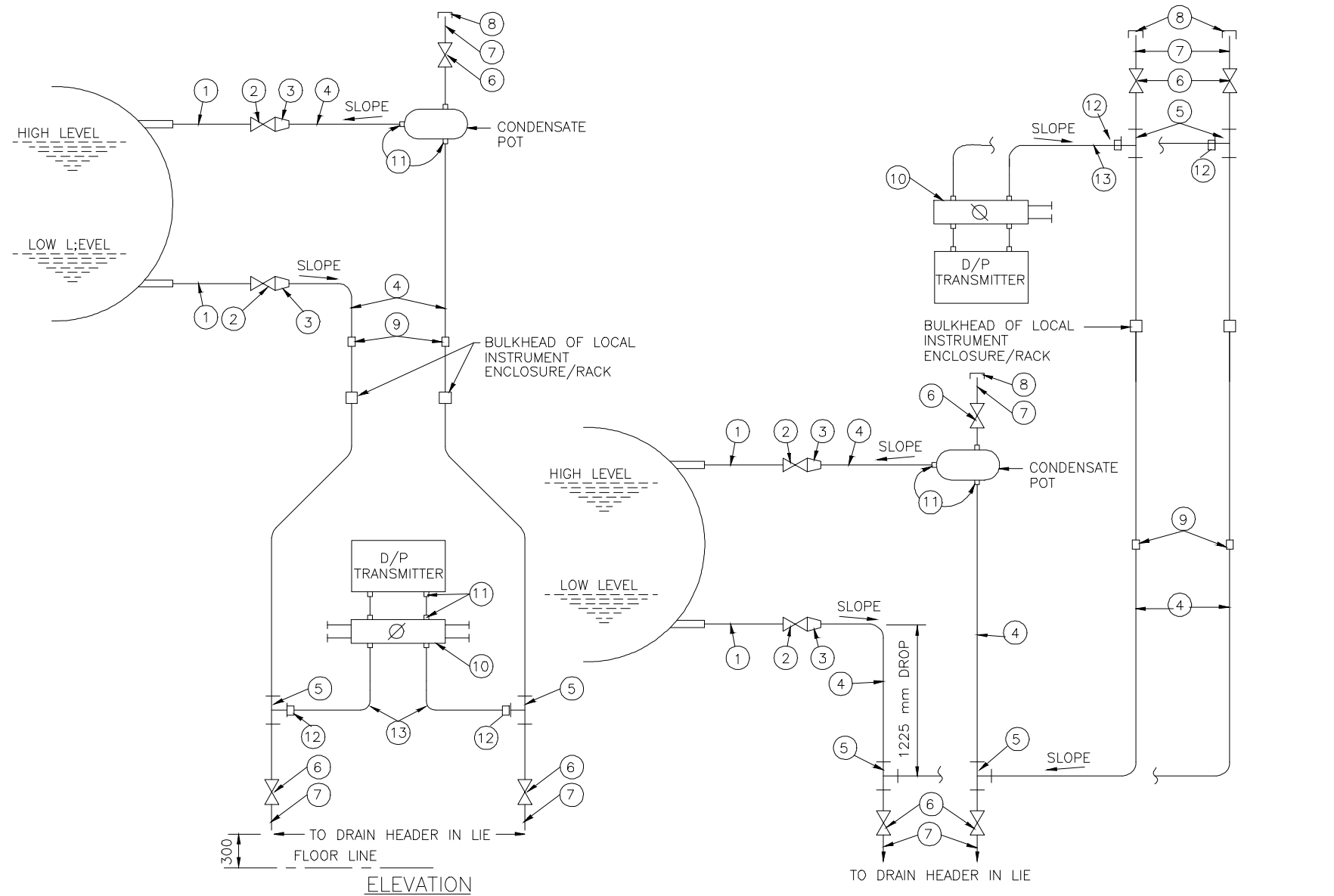


LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :	PROJECT :	2 X 500 MW NEYVELI NEW THERMAL POWER STATION	
PREPARED NAME DATE	DESIGNED BY SM 06-MAY-11	DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM (LEVEL MEASUREMENT- CLOSED/OPEN VESSEL)	
CHECKED BY AVJ 06-MAY-11	APPROVED BY UJR 06-MAY-11	DRAWING NO : LII-GE0E11019-G-00172-309	
SHEET SIZE A3	SCALE NTS	REV. 02	SHEET 1 OF 1




 Varun Jain S A Khan Praveen Kishore

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ELEVATION
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

ELEVATION
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

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

LIST OF MATRERIALS

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

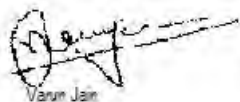

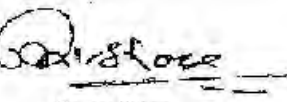
FOR REFERENCE ONLY

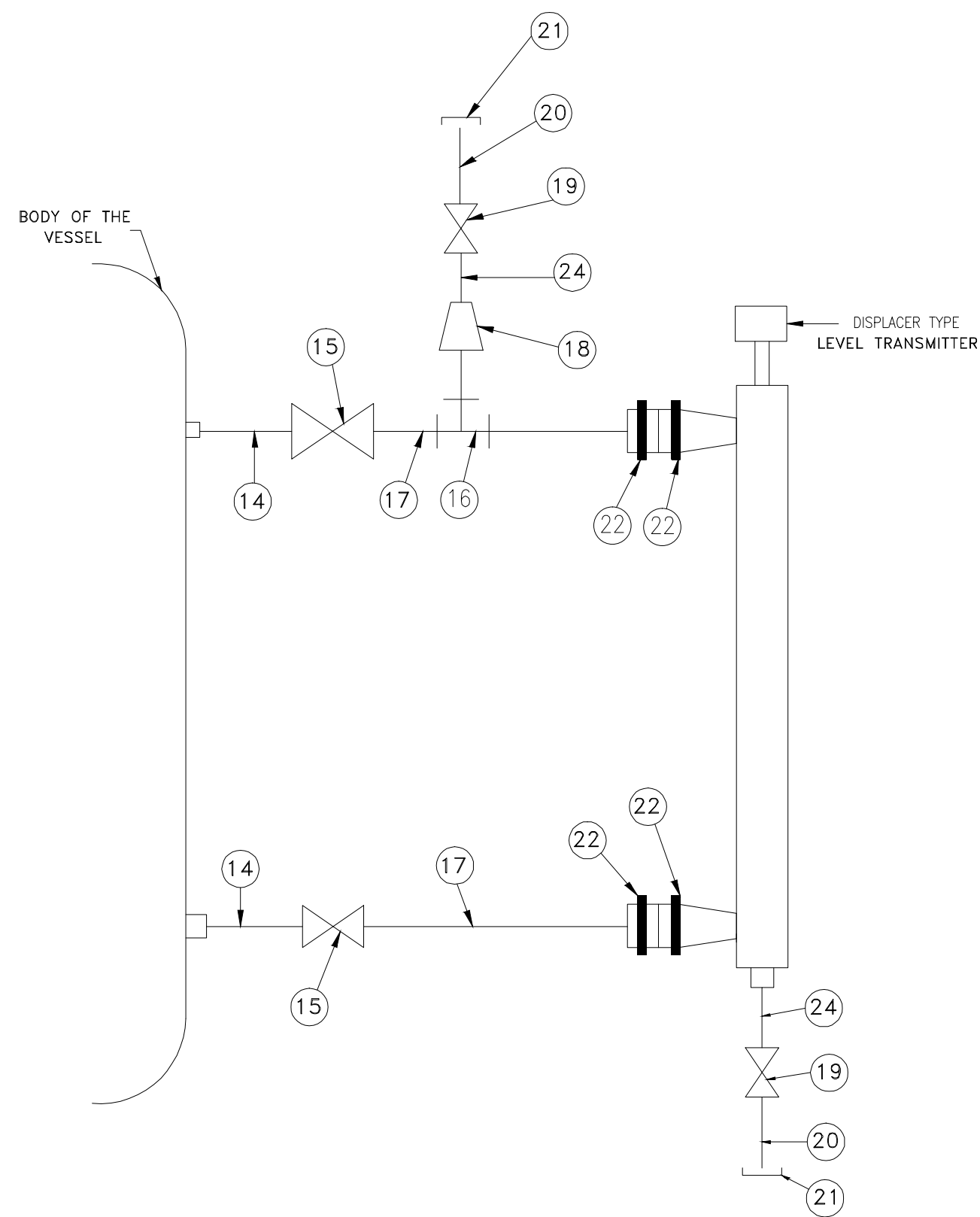
REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
02	25.06.11				AJV	
01	27.05.11				AJV	
00	06.05.11				AJV	

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 NAME DATE	DESIGNED BY	SM 06-MAY-11
DRAWN BY	CHECKED BY	AJV 06-MAY-11
CHECKED BY	APPROVED BY	UJR 06-MAY-11
SHEET SIZE	DRAWING NO :	LII-GE0E11019-G-00172-308
SCALE	REV.	02
	SHEET	1 OF 2




 Varun Jain S A Khan Praveen Kishore



ELEVATION
DISPLACER TYPE LEVEL TRANSMITTER WITH SIDE CONNECTION




 Varun Jain S A Khan 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

FOR REFERENCE ONLY

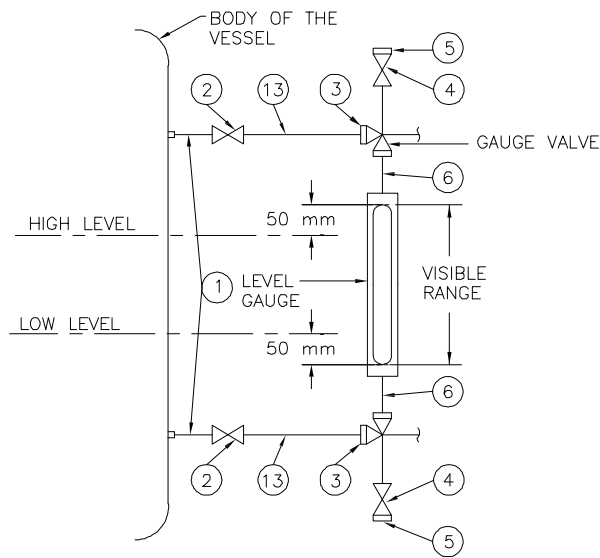
REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
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01	27.05.11				AJV	
00	06.05.11				AJV	


 NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU


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

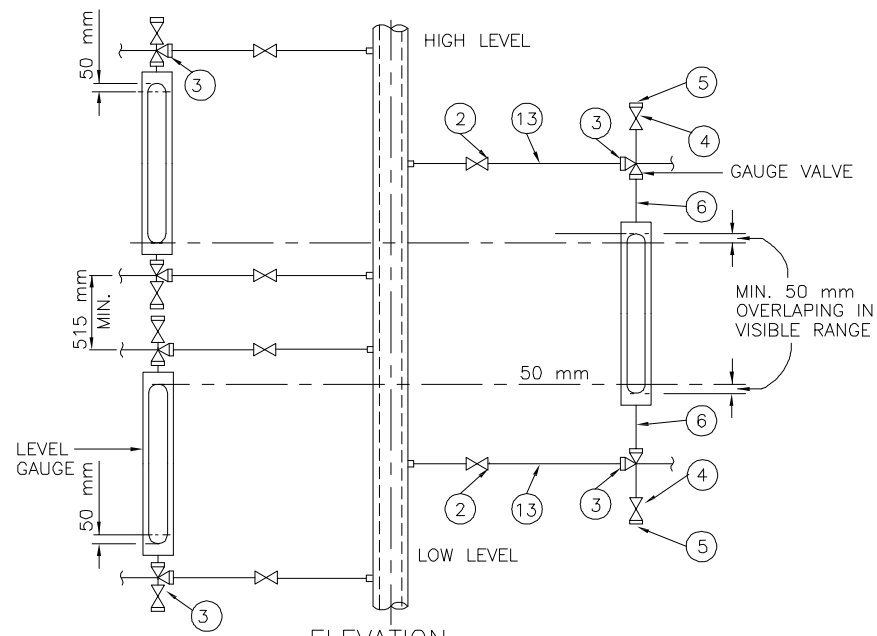
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PREPARED NAME DATE	DESIGNED BY	SM	06-MAY-11
DRAWN BY	PS	06-MAY-11	
CHECKED BY	AJV	06-MAY-11	
APPROVED BY	UJR	06-MAY-11	
SHEET SIZE	A3	DRAWING NO :	LII-GE0E11019-G-00172-308
SCALE	NTS	REV.	02
		SHEET	2 OF 2

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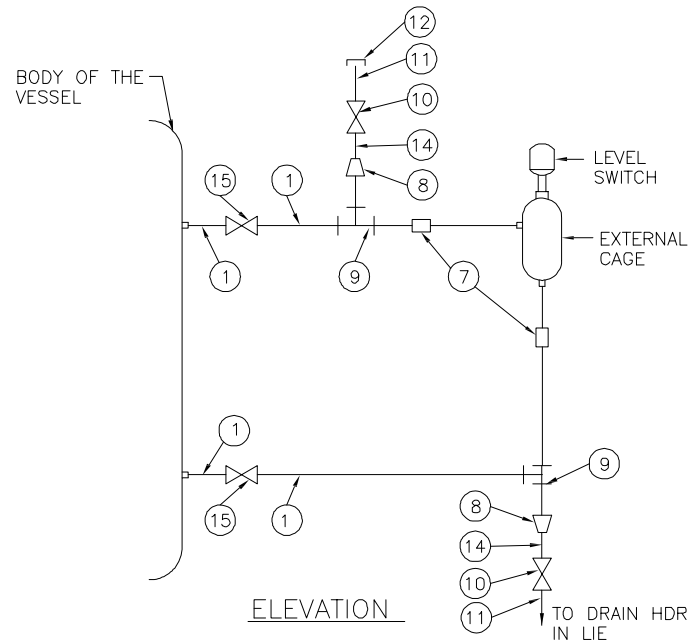
ELEVATION

LOCAL LEVEL INDICATION USING GAUGE GLASS



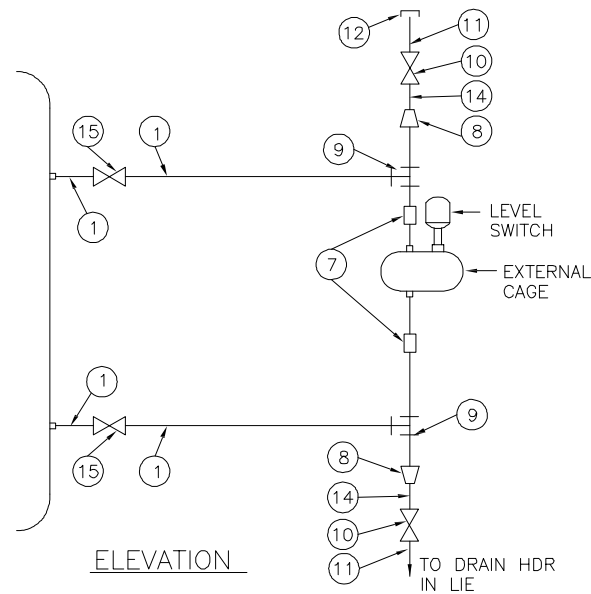
ELEVATION

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

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.

FOR REFERENCE ONLY

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



NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

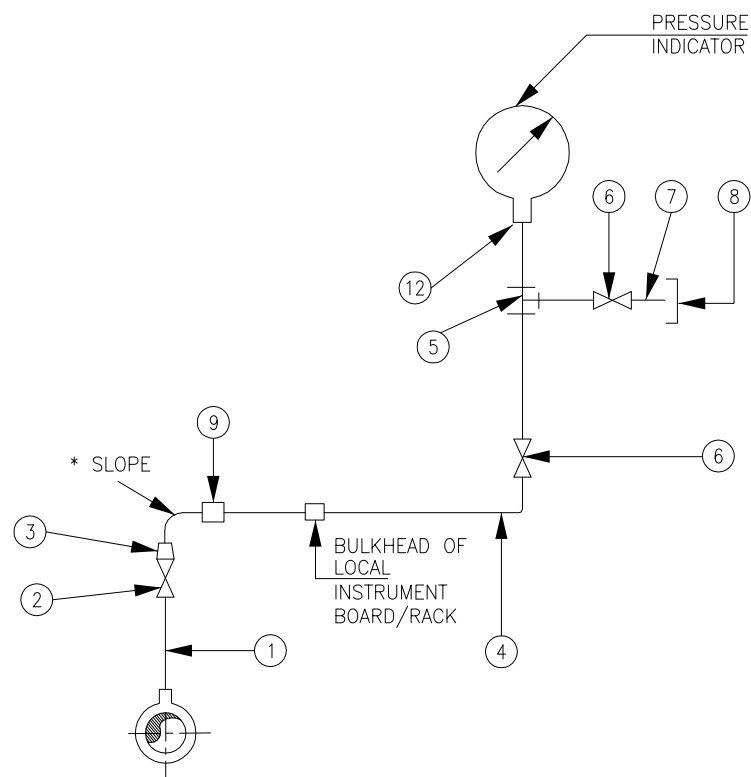


LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

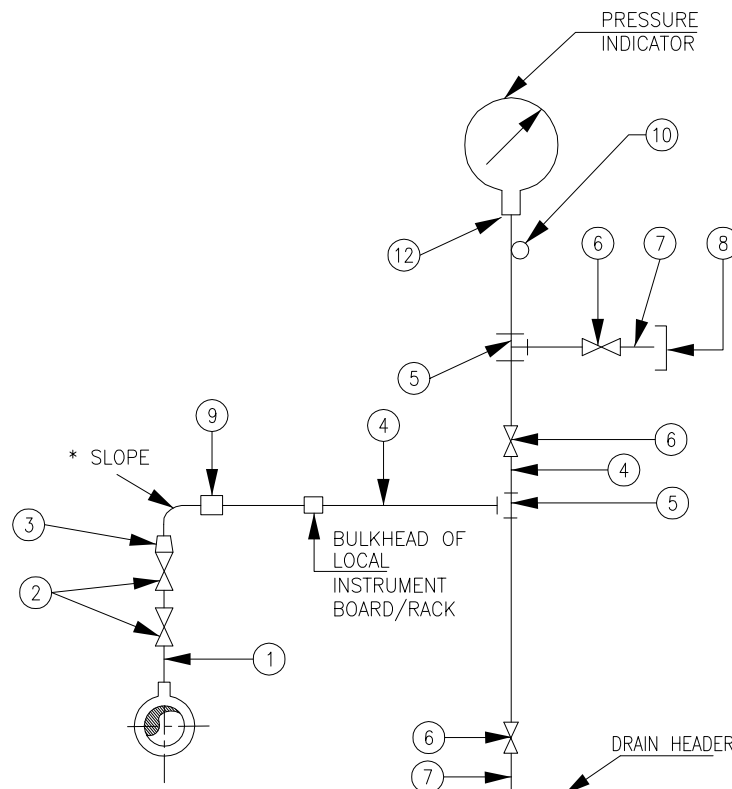
CONTRACT NO :	PROJECT :	2 X 500 MW NEYVELI NEW THERMAL POWER STATION	
PREPARED NAME DATE	DESIGNED BY SM 06-MAY-11	DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM (LEVEL GAUGE AND SWITCHES)	
DRAWN BY PS 06-MAY-11	CHECKED BY AVJ 06-MAY-11	DRAWING NO : LII-GEOE11019-G-00172-307	
APPROVED BY UJR 06-MAY-11	SHEET SIZE A3	SCALE NTS	REV. 02 SHEET 1 OF 1



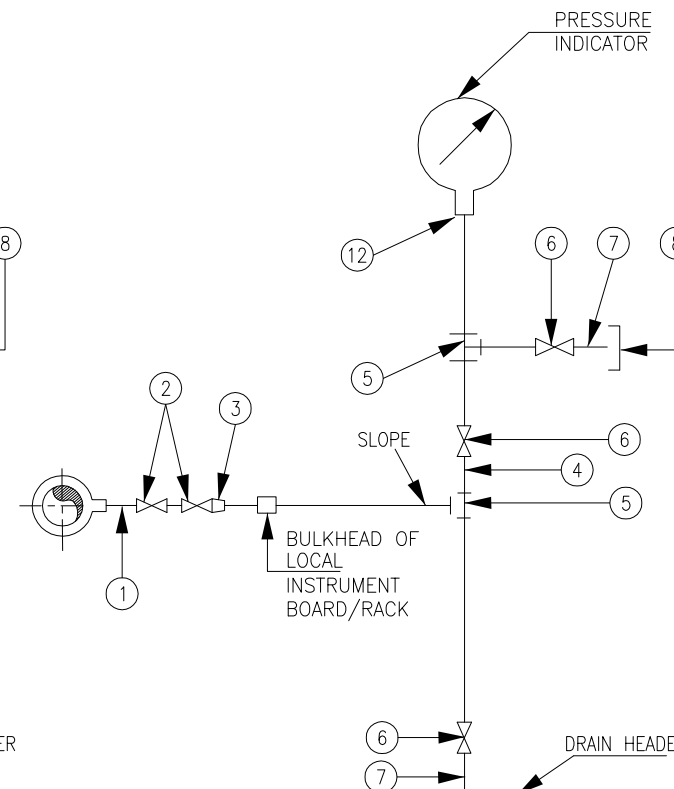




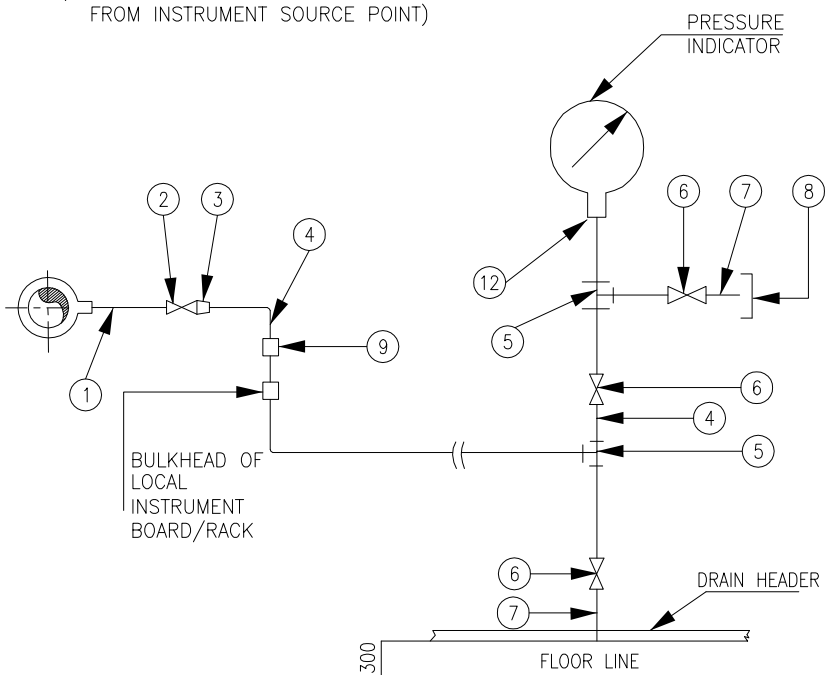
ELEVATION INST./SERVICE AIR
(PRESSURE INDICATORS MOUNTED REMOTE FROM INSTRUMENT SOURCE POINT)



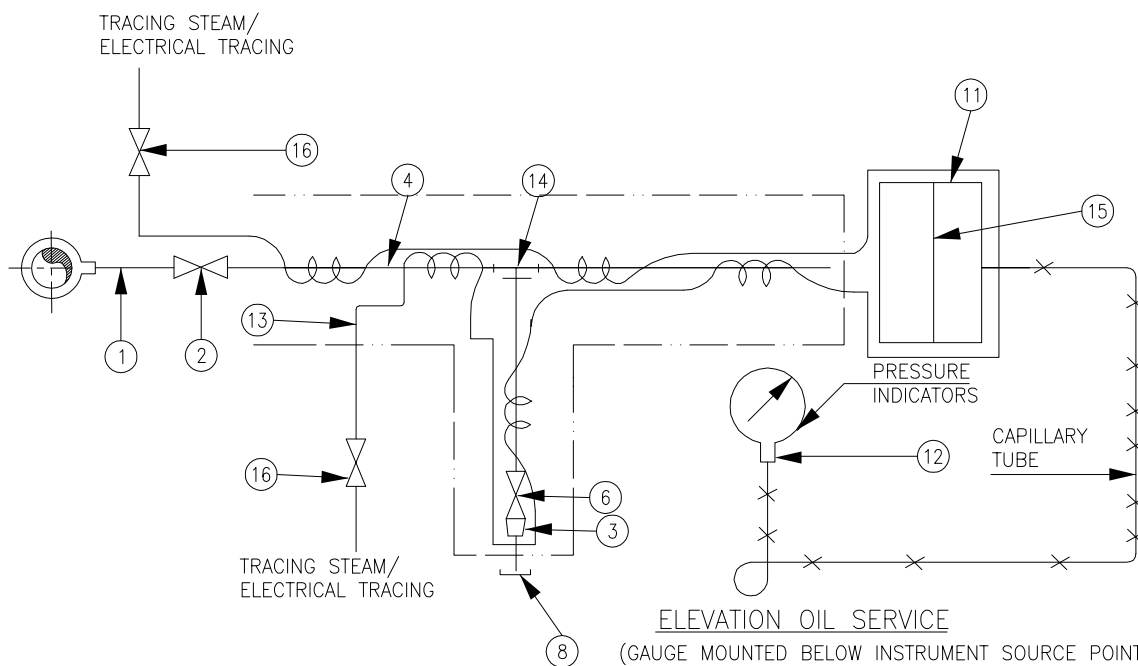
ELEVATION STEAM SERVICE
(PRESSURE INDICATORS MOUNTED REMOTE FROM INSTRUMENT SOURCE POINT)



ELEVATION LIQUID SOURCE
(GAUGE MOUNTED ABOVE INSTRUMENT SOURCE POINT)



ELEVATION LIQUID SOURCE
(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)



ELEVATION OIL SERVICE
(GAUGE MOUNTED BELOW INSTRUMENT SOURCE POINT)

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"x1/2" 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

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



NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU



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

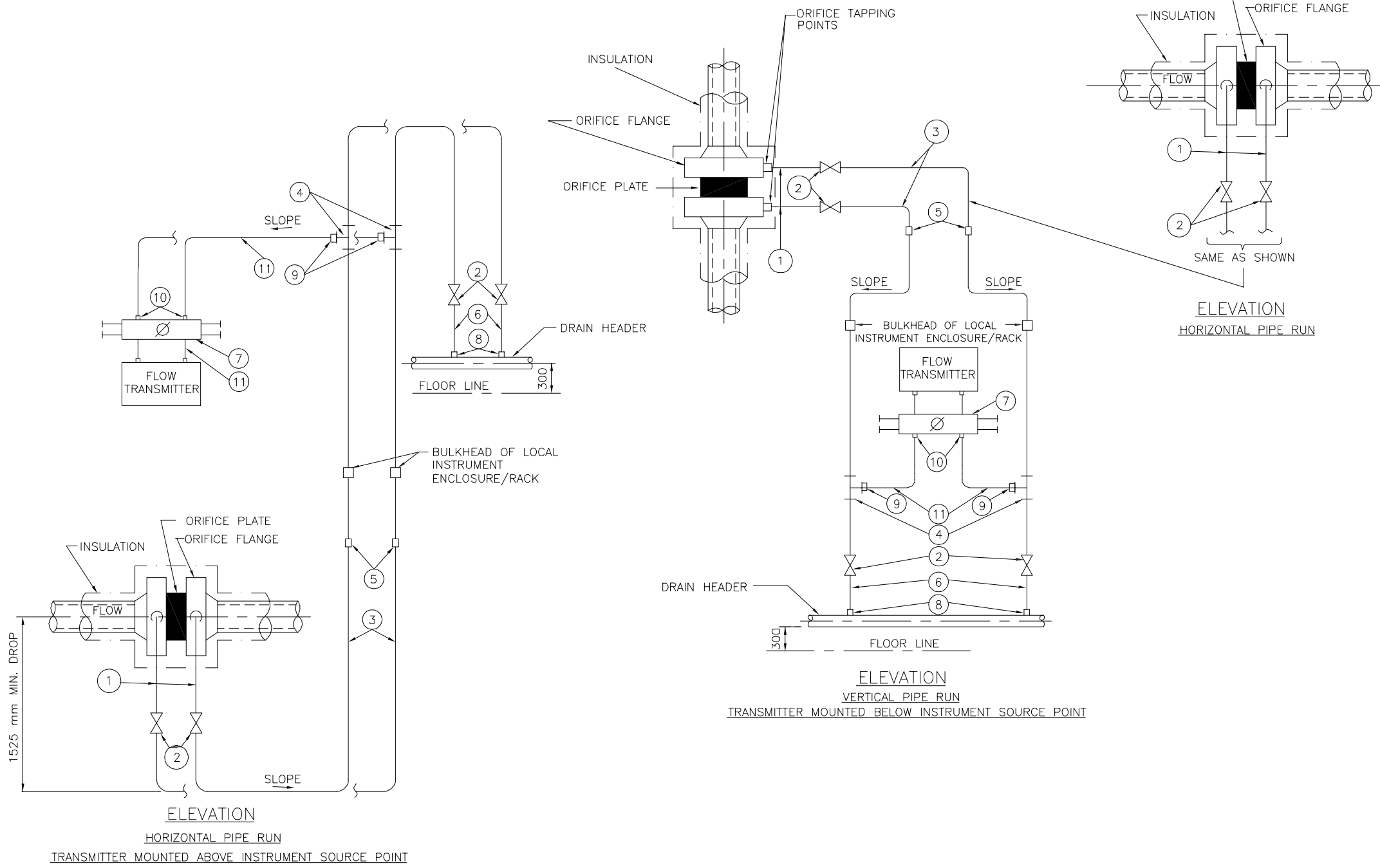
CONTRACT NO :	PROJECT :	2 X 500 MW NEYVELI NEW THERMAL POWER STATION	
PREPARED NAME DATE	DESIGNED BY SM 06-MAY-11	DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)	
CHECKED BY AVJ 06-MAY-11	APPROVED BY UJR 06-MAY-11	DRAWING NO : LII-GEOE11019-G-00172-305	
SHEET SIZE A3	SCALE NTS	REV. 02	SHEET 1 OF 1





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	DEM	DEC	DEE	DEI	DESCRIPTION
02	25.06.11				AJV	
01	27.05.11				AJV	
00	06.05.11				AJV	
CHECKED						

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 NAME DATE	DESIGNED BY SM 06-MAY-11	DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM FLOW MEASUREMENT (USING ORIFICE PLATES) CONDENSATE & SERVICE WATER
CHECKED BY AVJ 06-MAY-11	APPROVED BY UJR 06-MAY-11	
SHEET SIZE A3	DRAWING NO :	LII-GE0E11019-G-00172-304
SCALE NTS	REV. 02	SHEET 1 OF 1

Protection mark DIN 34 - 1 - E:
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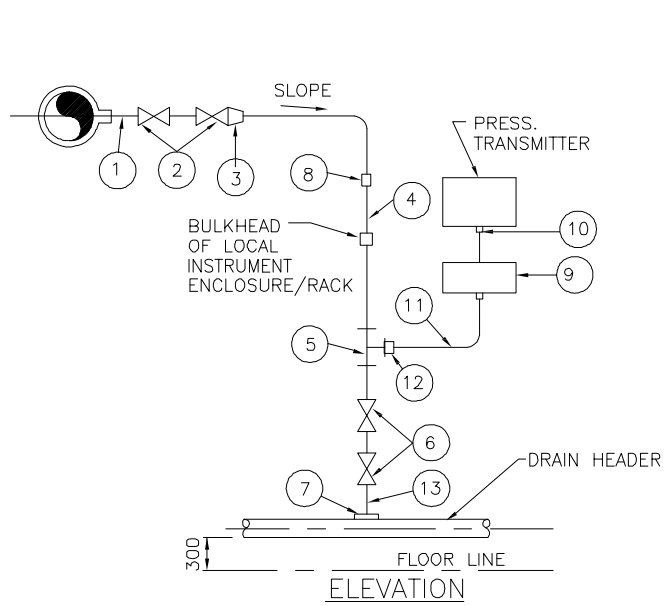
Varun Jain
S A Khan
Praveen Kishore

LIST OF MATRERIALS

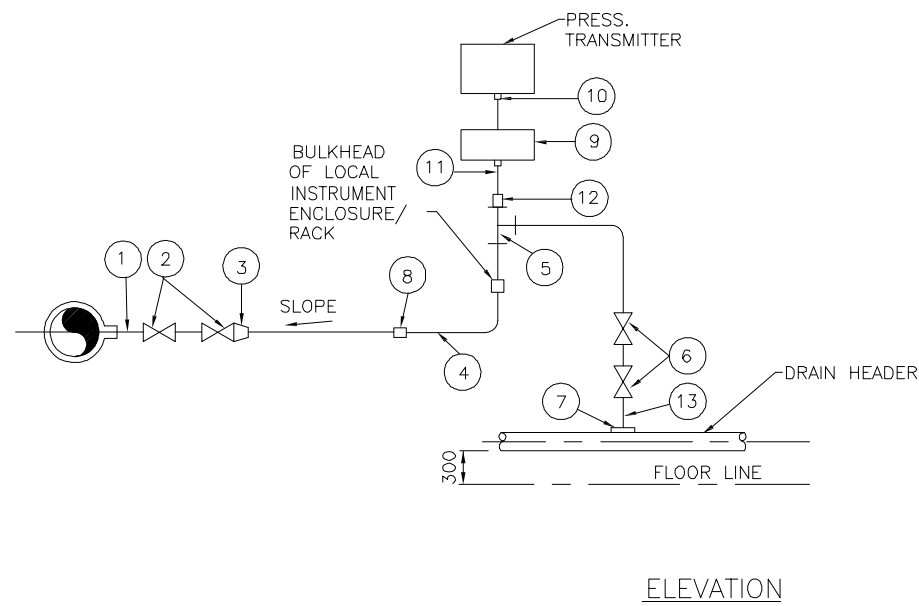
ITEM NO	DESCRIPTION
1	1/2" / 3/4" / 1" NPS SCH. 40/80/160/XXS/P91 NIPPLE OF MATERIAL AS THAT OF MAIN PIPE
2	3/4" / 1" SW GLOBE VALVE
3	3/4" / 1" TO 1/2" REDUCING INSERT
4	1/2" NPS PIPE
5	1/2" SW EQUAL TEE
6	1/2" SW GLOBE VALVE
7	1/2" NPS SCH. 80/160 SW x 1/2" CS/AS COUPLER
8	1/2" PIPE UNION
9	2/3 VALVE 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:-

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

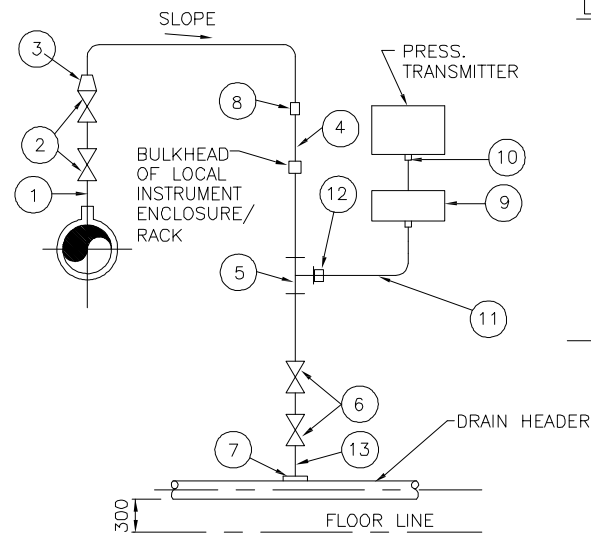


ELEVATION
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

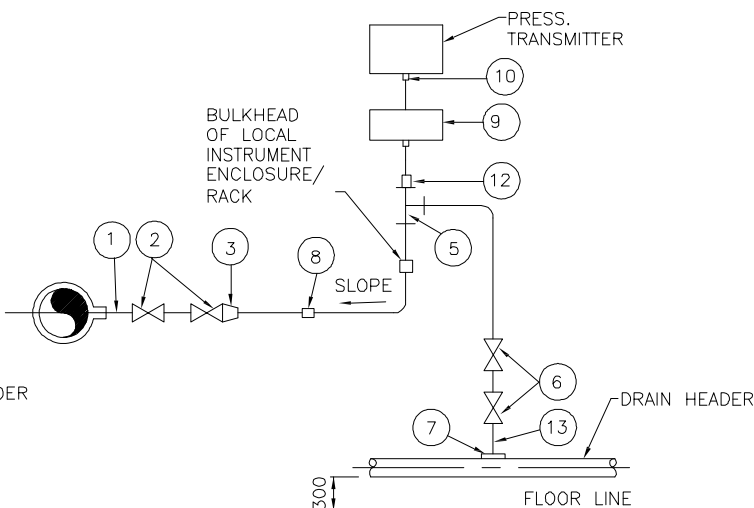


ELEVATION
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

LIQUID PRESSURE MEASUREMENT

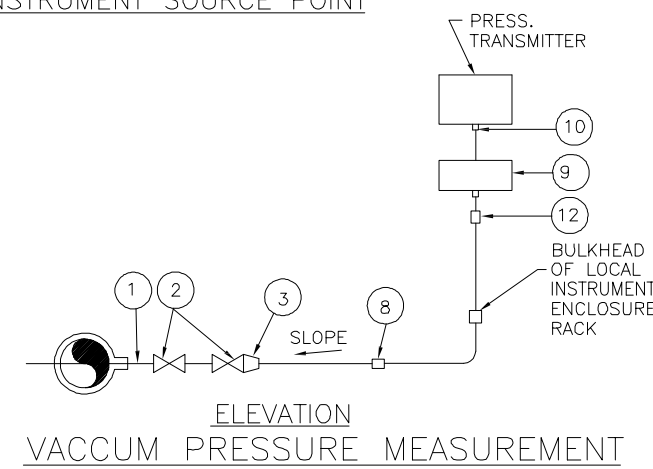


ELEVATION
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

STEAM PRESSURE MEASUREMENT



ELEVATION
VACCUM PRESSURE MEASUREMENT

FOR REFERENCE ONLY

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

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 NAME DATE	DESIGNED BY SM 06-MAY-11	DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM (PRESSURE MEASUREMENT USING PRESS/DP TRANSMITTER STEAM/LIQUID VACCUM)
CHECKED BY AVJ 06-MAY-11	APPROVED BY UJR 06-MAY-11	
SHEET SIZE A3	DRAWING NO : LII-GEOE11019-G-00172-303	REV. SHEET 02 1 OF 1
SCALE NTS		




 Varun Jain S A Khan Praveen Kishore



TECHNICAL SPECIFICATION
2X500 MW NEW NEYVELI

SPECIFICATION NO. PE-TS-400 & 402-553-A001

VOLUME II B

REV 00

DATE: NOV 2014

SHEET 1 OF 4

ANNEXURE-I
LIST OF MAKES


Praveen Kothare

S.A. Joshi

V. Srinivas



TECHNICAL SPECIFICATION
2X500 MW NEW NEYVELI

SPECIFICATION NO. PE-TS-400 & 402-553-A001

VOLUME II B

REV 00

DATE: NOV 2014

SHEET 2 OF 4

S.No.	Description	Makes
1.	SCREW CHILLER	YORK / TRANE / CARRIER / KIRLOSKAR / DUNHAM BUSH / MCQUAY (DAIKIN) / BLUE STAR / VOLTAS
2.	VAPOUR ABSORBTION MACHINE	VOLTAS / THERMAX
3.	PRECISION PACKAGE UNITS	STULZ / UNIFLAIR / EMERSON / BLUEBOX / CLIMADENTA
4.	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
5.	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
6.	AIR HANDLING UNITS	VOLTAS / BLUE STAR / ZECO / CARRYAIRE (FLAKT) / EDGETECH / ETHOS / SYSTEM AIR / WAVES AIRCON
7.	AHU FAN (CENTRIFUGAL FAN)	CB.DOCTOR / FLAKT / KRUGER / NICOTRA / COMEFRI / MARATHON / PATEL AIR
8.	CHILLED & CONDENSER WATER PUMP	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO
9.	COOLING TOWER	PAHARPUR / MIHIR / PCT / FLOWTECH / BELL
10.	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF / JYOTI / LHP
11.	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
12.	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
13.	INSULATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT / ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
14.	BALANCING VALVE	ADVANCE
15.	BUTTERFLY VALVE	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE
16.	NON RETURN VALVE	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
17.	GATE/GLOBE VALVES	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
18.	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY / JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC
19.	MOTORIZED BUTTERFLY VALVE	ANERGY / ADVANCE / BELIMO / JOHNSON / HONEYWELL / SIEMENS
20.	Y / POT STRAINER	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA PVT LTD / SUNGOV ENGINEERING
21.	PIPING - ERW	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL


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 S.A. Mohan

 Vignesh Jais



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22.	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS
23.	GI SHEETS FOR DUCTING	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL
24.	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
25.	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)
26.	STRIP HEATER	ESCORTS / RACOLD / DASPASS/ ALCO/ HEATCO / HOTSET
27.	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO
28.	RELIEF / PURGE VALVE	BRASSOMATIC
29.	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL /RANUTROL
30.	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN
31.	ANTI FREEZE THERMOSTAT	RANCO / HONEYWELL / PENN / DANFOSS / INDFOSS
32.	PRESSURE GAUGE	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
33.	TEMPERATURE GAUGE	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)
34.	LEVEL GAUGE	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR
35.	PRESSURE SWITCH / DP SWITCHES	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT
36.	TEMPERATURE SWITCH	INDFOSS/ SEIMENS / DANFOSS/ DK INSTRUMENTS/ SOR INC / VASU / DRESSER / TOSHNIWAL / SWITZER
37.	FLOW SWITCH	SWITZER / LEVCON / DK INSTRUMENT / SBEM / V. AUTOMATE/ SIEMENS
38.	LEVEL SWITCH	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V ATUOMATE /CHEMTROLS / SIMENS / FLOW STAR / TRAC
39.	TRANSMITTERS	TAYLOR / ABB/BRISTOL BABCOCK / BIRLA KENT TAYLOR / BLISS ANAND /SBEM/ SMART INST / V AUTOMATION & INST / FISHER-ROSEMOUNT/ SIEMENS/ TATA HONEYWELL
40.	SIGHT FLOW INDICATORS	SIGMA / LEVCON /V AUTOMAT / TELLACE /EUREKA / TATA HONEYWELL/BLISS
41.	FLOW ELEMENT	BRISTOL BABCOCK / BALIGA /LIGHTING EQUIP /ENGINEERING SPECIALITIES /IL / MINCO/ MICRO PRECISION / STAR MECH
42.	TEMPERATURE ELEMENT	GENERAL INST CONSORTIUM/ PYRO ELECTRIC /WAAREE INSTRUMENTS/ DETRIVE INST & ELECTRONICS / TOSHNIWAL

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43.	FLOW METER	EUREKA / INSTRUMENTATION ENGINEERS PVT LTD / PLACKA / TRAC / FLOW STAR/ SCIENTIFIC DEVICE
44.	RH SENSOR/TEMP SENSOR	HONEY WELL /JOHNSON /SIEMENS / GENERAL INSTRUMENTS
45.	CONTROL PANEL	INDUSTRIAL CONTROL & APPLIANCE/ PYROTECH /POSITRONICS / CONTROL & SWITCHGEAR /SIEMENS / L&T /GE POWER /RITTAL / HOFFMAN
46.	PLC BASED PANEL	SIEMENS / SCHENIEDER / ROCKWELL / GE INTELLIGENT / HONEYWELL AUTOMATION / ABB
47.	OWS / PC	HP / COMPAQ / DELL / HCL / IBM / LENOVO
48.	PRINTER	HP / CANON / EPSON / XEROX / IBM / LEXMARK
49.	UPS	HITACHI-HIREL / APC / DELTA / EMERSON / DB POWER / APLAB
50.	FIBRE OPTIC CABLE	BIRLA ERICSON / FINOLEX / AKSH FIBRE
51.	ANNUNCIATOR FOR PANEL	ICC / PECON/ PROCON
52.	LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR	CONTROL DEVICE / SYSTEM POWER CONTROL / JACKSON / UNILEC / ELECTRIC ALLIED PRODUCT
53.	METERING PUMP	SHAPO TOOLS / VK PUMPS
54.	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE / DOSI ION
55.	PRESSURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL / FUJI
56.	TEMPERATURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL
57.	ROTAMETER	CHEMTROLS SAMIL / EUREKA IND / IL / TRANSDUCERS AND CONTROL
58.	BATTERY CHARGER	AMARARAJA/ CHHABI ELECTRICAL / DUBAS ENGG. / HBL POWER SYSTEM / STATCON / CALDYNE
59.	BATTERY (NI -Cd)	HBL POWER / AMCO SAFT / SAFT

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

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ANNEXURE-II
MANDATORY SAPRE LIST TG PACKAGE


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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	
9	PLC cards (i.e. all types of cards/modules of PLC including CPU, power supply modules, interface modules, converter modules, I/O modules, relays, MCBs, fuses, terminal blocks, converters etc.)	%	10	
9.1	Power supply unit of each type	%	10	
9.2	Graphic Interface Unit for each type	No	1	
9.3	Cooling Fan in PLC system/Cabinet	No	2	
9.4	TFT Monitor for each type & size	No	1	
9.5	Printer for each type	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.


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ANNEXURE-III
MANDATORY SAPRE LIST SG PACKAGE


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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


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SECTION D

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TITLE
CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A

SPECIFICATION NO. PE-TS-400 & 402-553-A001
VOLUME II-B
SECTION D
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DESCRIPTION

DATA

1. GENERAL

- 1.1 Type of AC plant : Chilled Water Type.
- 1.2 Plant configuration/capacity. : Refer to Section-C of Specific Technical Requirements.
- 1.3 Location of AC plant rooms : As per Tender drawings.
- 1.4 Type of lifting facility provided. : Chain Pulley block with monorail (by BHEL)
- 1.5 Electrical work scope: -
 - i) MCC for AC plant : By Others
 - ii) Power cables / Control cables. : By Others
 - iii) Drives : By Bidder.
 - iv) Whether separate alarm/annunciation Panel/control panels required : Yes (By bidder), Refer to Section-C of Specific Technical Requirements.
 - v) Termination of cabling & earthing at Equipment end. : By Bidder for bidder supplied equipment.

2. REFRIGERATION COMPRESSOR

- 2.1. Type : VAM/SCREW/SCROLL CHILLER
- 2.2. Nos. (working + standby) : Refer to Section-C of Specific Technical Requirements.
- 2.3. Type of capacity control : Automatic.
- 2.4. Type of drive : Direct driven.
- 2.5. Restart after tripping : Manual.
- 2.6. Type of start : As per manufacturing standard.
- 2.7. Shaft Seal : Mechanical shaft seal.
- 2.8. Purge Recovery unit : As per manufacturing standard.
- 2.9. Type of lubrication : As per manufacturing standard.
- 2.10. Refrigerant used : Environment friendly HCFC, (CFC is not acceptable)

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Praveen Khatwa
Vishal Jain



TITLE

**CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A**

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3. DESIGN REQUIREMENTS

- 3.1. Minimum capacity at Design conditions : Refer to Section-C of Specific Technical Requirements.
- 3.2. Capacity control : Microprocessor based Control Panel sheet metal panel, located on each Compressor/chiller unit including protection devices
- 3.3. Vibration isolator : Neoprene rubber pads/Equivalent approved to suit chiller package.
- 3.4. Type of foundation : Floating / As per manufacturing standard

4.0 CONDENSER

- 4.1 Type : Horizontal shell & tube type water-cooled
- 4.2 Number required : One no. for each machine.
- 4.3 Design requirements
- 4.3.1 Fluid : Refrigerant (Shell side) Water (tube side)
- 4.3.2 Cooling Water Quantity : To suit requirement.
- 4.3.3 Capacity of condensers : To match compressor & to provide at least 2°C sub cooling.
- 4.3.4 Cooling water inlet temp. : Refer to Section-C of Specific Technical Requirements.
- 4.3.5 Leaving Water Differential. : Refer to Section-C of Specific Technical Requirements.
- 4.3.6 Max. flow velocity through tubes. : 2.5 m/sec.
- 4.3.7 Design fouling factor : 0.0002 (MKS Unit)
- 4.3.8 Maximum pressure drop. : 0.6 Kg/cm² (g)
- 4.3.9 Tube wall Thickness : Not less than 18 SWG
- 4.4 Materials of construction
- i/ Shell : M.S. Plate fusion welded.
- ii/ Tube : Integrally bonded Seamless copper

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S A Khan

Vishal Jain
Vishal Jain



TITLE
CENTRAL AIR-CONDITIONING PLANT
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- iii/ Head ends : Cast Iron.
- iv/ Tube sheet material : Steel
- v/ Baffle plate : Steel.
- 4.5 Accessories required
- i/ Purge & drain connections with valves. : Yes
- ii/ Relief valves : Yes
- iii/ Liquid line shut off valve. : Yes
- iv/ Isolating valves on water side. : Yes
- v/ Flow switch : Yes (interlocked with control of individual refrigeration system)
- vi/ Pressure/temperature gauges at inlet/outlet : Yes
- vii/ Descaling tee : Yes
- viii/Charging valve : Yes
- ix/ MS supporting frame work : Yes
- viii/Cooling thermostat : Yes
- ix/ MS supporting frame work. : Yes
- 5.0 **CHILLER** (Applicable for chilled water type plant only.)
- 5.1 Type : Horizontal shell & tube flooded type
- 5.2 Number required/standby : One no. for each chiller package.
- 5.3 Design requirements
- 5.3.1 Fluid to be cooled : Water
- 5.3.2 Water flow rate (Inside tube) : To suit requirement.
- 5.3.3 Water inlet temperature : 12 °C approx.
- 5.3.4 Water outlet temperature : 7 °C approx.
- 5.3.5 Super heating of refrigerant material : By at least 3 deg. C.
- 5.3.6 Insulation /thickness/finish : As per the manufacture standard.
- 5.3.7 Design fouling factor : 0.00010(MKS Unit)


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TITLE CENTRAL AIR-CONDITIONING PLANT <u>DATA SHEET - A</u>	SPECIFICATION NO. PE-TS-400 & 402-553-A001	
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- 5.3.8 Maximum pressure drop. : 0.6 Kg/cm² (g)
- 5.3.9 Tube wall Thickness : Not less than 22 SWG.
- 5.4 Materials of construction
- i/ Shell : M.S. Plate fusion welded.
 - ii/ Tube : Integrally Seamless copper (internally Corrugated)
 - iii/ Head ends : Cast Iron.
 - iv/ Tube sheet material : Steel.
 - v/ Baffle plate : Steel.
- 5.5 Accessories required
- i/ Purge & drain : Yes
 - ii/ Gate valves at water inlet/outlet. : Yes
 - iii/ Flow switch : Yes
 - iv/ Pressure/temperature gauges at inlet/outlet : Yes
 - v/ Anti-freeze thermostat : Yes
 - vi/ Thermostatic expansion valves : Yes
 - vii/ Pilot solenoid valve : Yes
 - viii/ Cooling thermostat : Yes
 - ix/ MS supporting frame work. : Yes

Note :-

The system shall also incorporate:

- 1) Auto operation of chilling plant for operation of the whole AC system.
- 2) A Central Control Panel with fault annunciators with provision for remote extension besides local control kiosks.
- 3) Water Chiller package shall be skid-mounted unit with microprocessor based control panel complete with all accessories and controls are assembled at manufacturing works on single unit.
- 4) Screw chiller shall be suitable for 415V \pm 10 %/50 Hz \pm 3%/3 phase operation with voltage & frequency variation as specified with built in starter etc.
- 5) Only supply feeders shall be provided for chillers.

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STANDARD TECHNICAL SPECIFICATION
CENTRAL AIR-CONDITIONING PLANT

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SECTION-D
CENTRAL AIR CONDITIONING PLANT


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TECHNICAL SPECIFICATION
CENTRAL AIR-CONDITIONING

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1. GENERAL

1.1 This specification covers the design, manufacture, testing at Manufacturer's works, delivery to site, handling at site, installation, commissioning and carrying out acceptance tests and final painting at site of various equipment of the central air conditioning plant, as specified hereinafter.

2. CODES & STANDARDS

2.1 The design, manufacture and performance of air conditioning equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment are to be installed. The equipment shall also conform to the latest applicable Indian/British/American standards. Nothing in this specification shall be construed to relieve the tenderer of this responsibility. In particular the equipment shall conform to the latest editions of the following standards.

- | | | | |
|--------|------------------------|---|--|
| 2.1.1 | IS-660 | : | Safety code for Mechanical Refrigeration. |
| 2.1.2 | ARI 520-90 | : | Standard for Positive Displacement Refrigerant compressors and condensing units. |
| 2.1.3 | IS-5111 | : | Code of Practice of Measurement for Testing Refrigeration compressors. |
| 2.1.4 | ASHRAE/23-93 | : | Method of Testing for Rating Positive Displacement Refrigerant compressors and condensing units. |
| 2.1.5 | ARI-450 | : | Standard for water-cooled Refrigerant condensers, Remote Type. |
| 2.1.6 | ASME
(Section VIII) | : | Unfired pressure Vessels Code. |
| 2.1.7 | IS-2825 | : | -do- |
| 2.1.8 | IS-4503 | : | Shell and tube type heat exchangers. |
| 2.1.9 | ASHRAE/22-92 | : | Method of Testing for rating of Water Cooled refrigerant condensers. |
| 2.1.10 | IS-659 | : | Safety code for Air conditioning. |
| 2.1.11 | IS-2379 | : | Color Code for Identification of pipe lines. |
| 2.1.12 | TEMA | : | Standards of Tubular Exchanger manufacturers Association. |
| 2.1.13 | IS-1239 (Part-I) | : | Seamless steel tubes (Up to & including 168.2 mm OD.). |
| 2.1.14 | IS-3589 | : | For piping above 168.2mm to 2032mm Outside Diameter. |
| 2.1.15 | IS-778 | : | Valves up to 50 MM. |
| 2.1.16 | IS-780 | : | Valves 50 MM to 300 MM. |
| 2.1.17 | ASHRAE 24 | : | Method of Testing for Rating liquid coolers. |
| 2.1.18 | ARI-480 | : | Standard for refrigerant cooled liquid coolers-Remote type. |

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Praveen Kishore
Vishnu Jais



TECHNICAL SPECIFICATION

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3. DESIGN & CONSTRUCTION REQUIREMENTS

3.1 The components of Central air conditioning plant comprising compressor, chiller refrigerant piping, valves and fittings etc. Shall be as given in Data sheet A. The type of all accessories, controls and instrumentation shall also be as indicated in data sheet A.

3.2 The various equipments supplied under this specification shall be fully compatible with each other & capable of operating as fully balanced integrated system to deliver the specified output under design conditions.

4. TESTING AND INSPECTION

(Refer standard quality plan)

4.1 Hydrostatic, Volumetric and refrigerant leak tests etc. shall be carried out at manufacturers works before dispatch of equipment in accordance with the applicable codes and standards.

Following minimum tests amongst others shall be conducted.

4.1.1 Material analysis, testing and identification (Data sheet/ Drg. Shall clearly indicate the specification, grade, class and Heat treatment condition of material for which TC will be furnished)

4.1.2 Hydrostatic pressure test of all pressure parts.(Testing pressure shall be clearly indicated for each component/ subassembly/ assembly)

4.1.3 Static and Dynamic balancing test of rotating parts at rated and over speed and to determine vibration & noise level.(Grade of balancing, type- whether dynamic or single plane balancing for components/ subassembly/ assembly shall be clearly indicated in data sheet/ approved drg.. Permissible vibration (velocity and displacement –peak to peak and noise level in dB(A) to be indicated in Data Sheet/Approved Drg.)

4.1.4 Radiography & magna-flux examination of materials & welds.(Components to be subjected to NDT with applicable, procedures and acceptance norms to be clearly indicated in Data sheet/ approved drg. If in a component only certain areas are to be subjected to NDT same shall be clearly brought out else it will be understood that the entire component is subject to NDT)

4.1.5 Ultrasonic test of castings & forgings.(Procedure and acceptance norms with areas subject to NDT to be clearly indicated in Quality Plan).

4.1.6 Performance test including determination of capacity, efficiency & characteristics etc.(Applicable standard, Acceptance norms, Procedure for test (if not covered in applicable standard),performance characteristics with applicable tolerances and drive to be used during shop test to be clearly indicated in Quality Plan). Performance data to be indicated in Approved Drg./ Data Sheet)

4.1.7 Functional checks and adjustments of controls & instrumentation. (Functional checks required to be clearly indicated with extent of check and applicable standard in approved check list / Quality plan. Class of instruments / tolerances and performance data to be incorporated in Approved Data Sheet / Drg.)

4.1.8 Checking of working clearances.(desired working clearances to be indicated in approved Drg.)

4.1.9 Examination after selective opening up after testing.(basis/ reasons for selective opening up, areas to be examined and parameters to be checked to be brought out in Quality Plan)

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4.2 TESTS AT SITE

Tests to prove guaranteed performance of the air conditioning plant, shall also be carried out at site after proper installation. The site test shall include performance testing (as per FQP) of equipment for 72 continuous hours each in all three seasons i.e. Summer, Winter and Monsoon. Unless specified elsewhere. All instruments, tools etc. as may be required to carry out site tests shall be arranged by the tenderer.

5. PERFORMANCE GUARANTEE

5.1 Each equipment of air conditioning system shall be guaranteed for its rated capacity under the specified site conditions.

5.2 If the shop/site performance tests indicate failure of equipment to meet specified requirement, it would be tenderer's responsibility to carry out required alterations at no extra cost to purchaser. Tests shall be repeated after carrying out the modifications to demonstrate the performance.

5.2 The air conditioning plant before being taken over by purchaser shall be subjected to running test for a minimum period of one week during which all readings shall be recorded. Any deficiencies noted during this period, shall be rectified by the tenderer /at no extra cost to purchaser. These running tests shall be in addition to the seasonal performance test specified under clause 4.2. The inside design conditions shall be guaranteed throughout the year.


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- 6. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT**
- 6.1 Final version of all drawings & data submitted with the along with technical schedules enclosed in Volume III.
- 6.2 Drawings including equipment layout, foundation & loading details etc. for civil works for the entire plant. These drawings must cover sufficient details so that design of civil works can be completed.
- 6.3 Inspection, operation & Maintenance Manuals.
- 6.4 Manuals for method of testing & calibration of all instruments.
- 6.5 Equipment description giving complete design calculations, basis of design, selection criteria etc.
- 6.6 Schematic piping diagrams.
- 6.7 Layout of piping.
- 6.8 Electrical drawings.
- 6.9 Test Certificates.
- 6.10 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.


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TITLE

**AIR HANDLING UNIT
DATA SHEET - A**

SPECIFICATION NO. PE-TS-400 & 402-553-A002.

VOLUME - II-B

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DESCRIPTION**DATA**

- | | |
|--|--|
| 1. Nos. required/working | : Refer to Section-C of Specific technical requirement. |
| 2. Location | : Refer to Section-C of Specific technical requirement. |
| 3. Service/type | : Air Conditioning /Double skin. |
| 4. Fan type | : Centrifugal (forward/backward curve Blade) limit load. |
| a) Capacity | : To Suit as per calculation. |
| b) Static pressure | : To suit but not less than 60 mm wc for AHU's Micro-V filters. |
| c) Discharge direction | : To suit layout. |
| d) Motor | : By Bidder, |
| e) Local push button station (Start/Stop) | : By Others |
| f) Motor location | : Inside AHU Casing. |
| g) Drive | : Belt, pulley, belt guard. |
| 5. Face and Bypass Damper | : Required (Opposed blade type) DX AHU's having |
| 6. Cooling coil | : Required (Opposed blade type) DX AHU's having |
| a) Duty sensible heat | : To suit as per calculations |
| b) Duty latent heat | : -do- |
| c) Type of coil | : Chilled Water/DX/Hot Water. |
| d) No. of rows | : To suit but not less than four (4) |
| e) Material of tube /Thickness | : Seamless Copper to ASTM E-75/Equivalent. |
| f) Material of fins | : Aluminium to SAE-1100-/1145-0 |
| g) Number of fins | : Not greater than 5 per cm (13 per inch). |
| h) Max. face velocity | : 2.5 m/sec. |
| i) Air flow quantity | : To suit as per tender drawings/documents. |
| 7. 3 - way motorised mixing valve with thermostat. | : Required with thermostat & actuator for chilled water system for each AHU. |


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- | | | |
|-----|------------------------------|---|
| 8. | Damper at discharge | : Manually operated at discharge of each AHU outlet. |
| | a) Material of construction | : Mild Steel, galvanised. |
| 9. | Filters (Pre-filters) | |
| | a) Type & thickness | : Dry panel type/ 50 mm |
| | b) Filter area. | : To suit as per velocity requirements. "V" - Bank. |
| | c) Filter efficiency | : Average arrestance efficiency of 65-80 % |
| | d) Press drop (Clean) | : Not to exceed 2.5 mmwc when clean & 6.5 mmwc while dirty. |
| 10. | Humidification section | : As per the System requirement. |
| | a) Type | : Pan type, unless otherwise specified. |
| | b) Operation | : Automatic with Humidification. |
| 11. | Fresh air arrangement | : Required. |
| | a) Fresh air fan | : Tube axial flow fans with motor. |
| | b) Accessories | : i) Inlet cone with Bird screen.
: ii) Dry panel pre-filters,
: iii) High efficiency filters for control room areas.
: iv) Volume Control Dampers,
: v) Supports etc. |
| 12. | Vibration isolator required. | : Yes |
| 13. | Type of vibration isolator. | : Neoprene ribbed Rubber for AHU's. |
| 14. | Any other requirement | : i) In addition to dry panel filters on AHU, High efficiency filters (average arrestance efficiency of 80-90 %) shall be provided in supply air duct side of AHU for all control room and allied areas.

: ii) Bidder to also provide suitable electrical strip heaters for winter heating & monsoon reheating with Contactor box etc. Heaters to be interlocked with airstat. |
| 15. | Instrument & controls | : Lot.(including Control box for strip heaters, pan humidifiers etc. in each AHU room.) |
| 16. | Insulation of drain piping | : Lot. |


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SECTION-D
AIR HANDLING UNITS


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1. GENERAL

1.1 This specification covers the design, manufacture, Construction features, installation, commissioning, inspection and performance testing at site of AHUs.

2. CODES AND STANDARDS

2.1 The design manufacture and performance of AHU shall comply with all currently applicable statutes, regulations and safety codes in the locality where the AHU is to be installed. The equipments shall also conform to the requirements of the latest editions of applicable Indian/British/US standards. Nothing in this spec. shall be construed to relieve vendor of this responsibility. In particular the equipment shall conform to the latest editions of the following standards:

2.1.1 IS-659 : Safety code for air conditioning

2.1.2 IS-660 : Safety code for mechanical refrigeration

2.1.3 ASHRAE : Method of testing forced circulation air-cooling and air heating coils.
standard 33

2.1.4 ARI 41 : Standard for forced circulation air cooling and air heating coils.

2.1.5 ARI 430/435 : Air-cooling and air heating coils Central Station AHU / Application
of Central Station AHU.

2.1.6 AMCA : 211 and 311

In case of any conflict in the standards and this specification the decision of PEM,BHEL shall be final and binding.

3. CONSTRUCTION FEATURES

3.1 The casing of AHU shall be made of insulated double wall construction of min. 24 gauge galvanized sheet steel - IS 277 Gr. 120 (parent sheet: D/DD-IS-513) ribbed and reinforced for structural strength and rigidity with 25 mm thick polyurethane insulation of minimum 40 kg/m³ density in between. The external wall will be pre-plasticised over GI coating on the outside. Angle irons or channel sections made of 16 gauge galvanized sheet steel shall be used for reinforcing. The casing shall be of sectionalized construction with proper sealing at the joints to make them air tight. Fan section and panels with bearing support shall be reinforced with heavy gauge channels (min. 5 mm thick). Suitable number of forged hot dip galvanized (610 gm/sq.m) U brackets shall be provided for AHU suspended from ceiling/roof.

Necessary arrangement shall be provided on the casing for measuring temperature and pressure in cooling/heating coil. Class of instruments shall be min. 2.

3.2 Fan impeller shall be forwardly/backwardly inclined curved blade centrifugal type. Impeller shall be double width double inlet type. Fans shall be preferably low rpm (≤ 1500) to minimize vibration and noise. Noise shall be within 85 dB(A) at 1 metre distance from AHU casing. Max. Vibration level shall be acceptance and norms to be specified. Two to three wheels (impellers) shall be provided for each AHU. Impeller blades shall be fabricated from (min. 1.0 mm) galvanized/ epoxy powder coated sheet steel. Fan shall be of epoxy powder coated / galvanized sheet steel (min. 1.6 mm) scroll with die formed inlets for uniform air flow. Fan shafts shall be solid cold rolled carbon steel (EN8 normalised), ground and polished. Fan shaft bearings shall be of heavy duty type selected for average operating life of 100,00 hours. Bearings shall be self-aligning, permanently lubricated type. Make of Brgs(SKF/FAG/NORMA/TATA) to be specified. Bearing Housing shall be of casting of min. IS Gr. 210, split type and

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suitably supported. The V-belt drive with belt guard shall be provided. Motors shall have minimum 15% margin over maximum BHP in working range.

- 3.3 DX or chilled water cooling coils and steam/hot water coils shall be internally corrugated copper/ cupronickel tubes (as per manufacturer's standard) with smooth non corrugated external fins of aluminium (thickness 0.14 mm and grade 1100 as per spec) unless specified otherwise in specification. At least 5 fins /per cm. shall be provided. The chilled water/hot water coils shall have suitable (standardize class, size, threading) drain and vent connections.
- 3.4 The filters in the filter section shall be provided as detailed in data sheet A.
- 3.5 Humidifier shall be Pan type/as specified in the specification.

Pan type Humidifier consisting of SS304/316 tank, heater, geyserstat with piping connection to supply air duct shall be provided unless specified otherwise in data sheet A.

Heaters and branch line shall be of galvanized steel and nozzles shall be of brass (matl. grade) /SS 304.
- 3.6 Condenser water from coil or surplus water from spray humidifier shall be collected in 16 gauge SS-304 pan. Minimum 50mm dia GI pipe nipple shall be provided on each end for drain connection. The drains for these points shall be extended to the main drain in AHU room. Condensate drain pipe (GI) of required length with sealing loop shall be provided and insulated as specified in the specification for insulation. Minimum requirement For GI Pipes and fittings shall be ERW/Seamless of medium thickness as per IS-1239/3589 and Hot dip galvanized
- 3.7 Suitable number of Spring type vibration isolators shall be provided for fan and motor assembly. Neoprene rubber pads shall be provided below the AHU.

The AHU shall be provided with 18 G SS drain pan.

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4.

TESTING AND INSPECTION AT MANUFACTURERS WORKS:

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection.

4.1

Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.

4.2

Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating. For pipes and fittings compliance report shall be furnished by Manufacturer for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

4.3

Shaft: Mechanical and chemical.

4.4

Motors (of approved make): Routine TC.

4.5

Workmanship and dimensional check as per manufacturing drg. and approved Drgs.

4.6

Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked to avoid loosening. Balancing weights and fasteners used shall be galvanized.

4.7

Performance test of one Centrifugal fan/per type/per size as per AMCA standard (for indigenous make).

4.8

Centrifugal fans for AHUs will be 100% run tested by main contractor of BHEL. One centrifugal fan/per type/per size will be run tested. Vibration shall be within good zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.

4.9

Complete assembly of one AHU/per type/ per size (excluding cooling coil and filter) shall be witnessed.

4.10

Run test of one complete assembly/per type/per size (excluding cooling coil and filter). Vibration shall be within satisfactory zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.

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5. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

- 5.1 GA drawing of AHU & data- sheet to be submitted along with technical schedules enclosed in Volume III.
- 5.2 Drawing including equipment layout, foundation & loading details etc. for civil works. These drawings must cover sufficient details so that design of civil works can be completed.
- 5.3 Inspection, operation & Maintenance Manuals.
- 5.4 Equipment description giving complete design calculations, basis of design, selection criteria etc.
- 5.5 Test Certificates.
- 5.6 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.
- 5.7 Performance Test Certificates.


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TITLE

**COOLING TOWER
DATA SHEET - A**

SPECIFICATION NO. PE-TS-400 & 402-553-A003.

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SECTION D

REV 00

DATE: AUGUST 2014

SHEET 1 OF 2

A. GENERAL DATA

- 1) Service : Cooling of condenser water of AC plant.
- 2) Type : Fibreglass reinforced plastic construction induced draught.
- 3) Quantity : Refer to Section-C of Specific Technical Requirements.
- 4) Place of installation : Refer to Section-C of Specific Technical Requirements.

B. DESIGN DATA

- 1) Capacity at specified conditions. : To suit the system requirement.
- 2) Water flow rate : To suit the system requirement.
- 3) Design wet bulb temperature : As per relevant section
- 4) Hot water inlet temperature : To suit requirement.
- 5) Cooled water temperature : To suit requirement.
- 6) Depth of sump Tank : As per manufacturer's standard.

C. MATERIAL

- 1) Sump tank & Casing : FRP
- 2) Louvers : FRP/PVC/Aluminium.
- 3) Type of fill : Non-combustible PVC/Eq.
- 4) Nozzles : Brass with chrome plating/polypropylene.
- 5) Ladder : Hot dip galvanized steel ladder for each tower.
- 6) Bird screen : 25 mm square made of GI/SS wire mesh of 16 gauge.
- 7) Fan impeller : Cast Aluminium Alloy/FRP propeller type and multi-blade aerofoil construction with adjustable pitch..
- 8) Supporting structure : MS with spray galvanization of epoxy painting.
- 9) Strainer : Plant strainer made of GI/SS wire mesh of 16 gauge.

D. ACCESSORIES

- 1) Make up connection : Yes.
- 2) Quick fill connection : Yes.
- 3) Overflow & drain & blow down connection : Yes.
- 4) Access door in louvers/fan deck : Yes (if applicable).


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- 5) Supports & supporting structure for mounting : Yes.
- 6) Level switch : Yes.
- 7) Rain protection for motor : Yes (suitable Canopy by Bidder)
- E. ELECTRICAL DATA
- i) Power supply : As per specification attached.
- ii) Motor : As per specification attached.
- F. INSPECTION & TESTING : As per approved quality plan.


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TECHNICAL SPECIFICATION

COOLING TOWER

SPECIFICATION NO.PES-553-03

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SECTION-D
COOLING TOWER


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TECHNICAL SPECIFICATION

COOLING TOWER

SPECIFICATION NO.PES-553-03

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SHEET 2 OF 5

1. GENERAL

- 1.1 this standard specification covers the design, manufacture assembly, inspection & testing at manufacturer's works, suitable painting & packing, delivery, erection & commissioning at site of all materials and equipments for mechanical induced draught cooling tower complete with all accessories as specified hereinafter.

2. CODES & STANDARDS

- 2.1 the design, manufacture, inspection & testing and performance of the cooling tower as specified hereinafter shall comply with the requirements of all applicable latest Indian/British/American standards and codes of practice. the latest editions of the following standards & publications shall be followed in particular:
- 2.1.1 Cooling tower institute USA bulletin ATP-10S: Acceptance test procedure for industrial water-cooling tower.
- 2.1.2 PTC-23 ASME performance test code for Atmospheric water-cooling equipment.
- 2.1.3 In case of any conflict between the above codes & standards and-this specification, the later shall prevail.

3. DESIGN REQUIREMENTS

- 3.1 the cooling tower shall be designed for continuous operation to cool not less than design flow of water from specified inlet temperature to the outlet temperature at a design ambient wet bulb temperature as indicated under data sheet a.
- 3.2 all the components shall be capable of safe, proper and continuous operation at all cooling water flows upto & including those specified under data sheet a & shall be designed with regard to case of maintenance, repair, cleaning & inspection.
- 3.3 the cooling tower shall be of induced draught cross flow or counter flow type and with multiple cells (if specified in data sheet a.) the cooling tower shall be suitable for handling the fluid and also for achieving the specified parameter as per data sheet a. the cooling tower shall be designed such that the drift losses & evaporation losses are minimum.

4. CONSTRUCTIONAL FEATURES

4.1 CASING & LOUVERS

- 4.1.1 The cooling tower casing shall be made of FRP/as specified in data sheet A. The louvers shall be made of FRP/as specified. Louvers, if provided, shall be designed for air entry to the tower with low velocity for minimum pressure drop & less chance of recirculation of moist air. To eliminate splash out, louvers shall slope to shed water inwards. Air intake shall be all along the base circumference of the casing & hotdip galvanised expanded metal mesh shall be provided to protect the air intake.

4.2 FILL

- 4.2.1 Cooling tower fills shall be made of noncombustible PVC/as specified in data sheet A. The design & arrangement of the fills shall be so as to expose maximum air/water surface with minimum pressure drop.


4.3 Drift Eliminators

- 4.3.1 Multi-pass drift eliminators with minimum two pass zig-zag path shall be provided so to minimise the drift losses.


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- 4.3.2 In case of FRP cooling tower the drift eliminators shall be of multi-blade rotary type.
- 4.4 Fans & Accessories
- 4.4.1 The fans shall be multiple blade, low speed, high efficiency axial flow type located above the top deck level of the cooling tower. Fan rotating assembly shall be statically & dynamically balanced. The fan blades shall be preferably adjustable in stand still condition for propeller action. The fan shall be either directly mounted on the shaft of a totally enclosed weather proof motor or shall be suitable for V-belt drive.
- 4.4.2 The rating of drive motor shall have at least 15% margin over maximum fan power consumption. The design & construction of the drive motor shall be in accordance with enclosed specification for LVAC motors.
- 4.5 Water basin
- 4.5.1 The material of construction of water basin shall be FRP or RCC as specified in data sheet A. The basin shall be provided as a part of cooling tower in case of FRP construction. The sump shall have sufficient storage capacity for safe operation of AC plant.
- 4.6 Hot water distribution system
- 4.6.1 Manually operated flow control valves shall be provided in hot water distribution piping such that each cooling tower can be isolated without affecting the operation of other cells.
- 4.6.2 The nozzles shall be spaced to give even distribution of water over entire space occupied by top row of fills. The nozzles shall be made of brass /SS 304/316/316L (brass shall be as per manufacturer's standard) unless specified in data sheet A:
- 4.6.3 In case of FRP tower water shall be distributed over the fill by means of a multiple area fail safe rotary sprinkler made of PVC pipes fitted on a aluminium alloy (as per manufacturers standard) rotary head and mounted on sealed ball bearings (make) .
- 4.7 Access
- 4.7.1 A stair case paddle ladder (as per manufacturer's standard) shall be provided external to the cooling tower at one end of each tower along with stairways hand rails etc give safe & convenient access to the top deck from ground level.
- 4.8 Painting
- 4.8.1 The cooling towers shall be painted with suitable anti-corrosive paint as per approval of purchaser. All galvanized external surfaces shall be painted to match colouring scheme. Before painting galvanized surfaces -etch primer to be applied.


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5. SHOP INSPECTION & TESTING

- 5.1 Compliance certificates for nozzles (Or rotary sprinkler), piping, fill material, drift eliminator, louvers components etc.
- 5.2 Certificate of conformance for all other material components.
- 5.3 Balancing report for Static & dynamic balancing of fan assembly.

6. TESTS AT SITE

- 6.1 Hydrostatic testing of complete hot water distribution piping at site.

7. PERFORMANCE GUARANTEE

- 7.1 The cooling tower shall be guaranteed to meet the performance requirements as specified & when tested in accordance with ATP-105.
- 7.2 The vendor shall furnish performance curves for the cooling tower showing variations in performance from design duty point with change in approach to wet bulb temperature, cooling range, water loading of cooling tower.


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8. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT

- 8.1 General arrangement drawing of complete cooling tower (showing plan, front elevation and side elevation) incorporating principal dimensions, limits of scope of supply of piping, limits of civil works included showing extent of platforms, walkways, handrails, access doors, staircase etc. and the limits of scope of supply of electrical works.
- 8.2 General arrangement and sectional assembly drawings pertaining to the following components of the cooling tower:
 - i) Tower fill with supporting arrangement.
 - ii) Drift eliminator installation and details.
 - iii) Complete hot water distribution system including flow regulating valves, distribution basin/pipes and nozzles etc.
- 8.3 Cooling tower performance curves showing WBT Vs cold-water temperature for design cooling range, 90% cooling range and 110% cooling range at 100%, 90%, and 110% design flow.
- 8.4 Performance curves of cooling tower fans.
- 8.5 Test procedure along with details of tests to be conducted for the offered cooling tower.
- 8.6 Quality Plan along with complete details of the testing and inspection requirements of mechanical and electrical items of the cooling tower in BHEL format.
- 8.7 Operation and maintenance instructions.

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TITLE CENTRIFUGAL PUMPS <u>DATA SHEET - A</u>	SPECIFICATION NO. PE-TS-400 & 402-553-A004	
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DESCRIPTION**DATA**

- | | |
|------------------------------------|---|
| 1. Designation | : Condenser water and Chilled Water pumps for AC plant. |
| 2. Type | : Horizontal, Centrifugal pump or vertical split type casing pump . |
| 3. Quantity | : Refer to section-C of Specific Technical Requirements |
| 4. Installation | : On floating type foundation. |
| 5. Fluid to be handled | : Water |
| 6. Temperature of fluid | : To suit. |
| 7. Capacity M3/hr and TDH at rated | : To suit system requirements but head shall not be less than 25 MWC. |
| 8. Duty | : Continuous (24 hours / day) |
| 9. Suction condition | : Flooded |
| 10. Type of drive | : Direct |
| 11. Prime Mover | : LV AC motor |
| 12. Maximum speed | : 1500 RPM |
| 13. Type of lubrication | : Grease Lubrication |
| 14. Material | |
| a) Impeller | : Bronze to Grade IS: 318 Grade 2 |
| b) Pump shaft | : EN - 8 / Equivalent (Approved). |
| c) Casing | : CAST IRON TO IS: 210 Grade - 260. |
| d) Wearing ring | : Bronze to Grade IS:318 GR-2, Renewable type. |
| e) Shaft Sleeve | : -do- |
| f) Base plate | : Cast Iron to Grade FG-200 IS-210/M.S. fabricated. |
| g) Bolt and nuts. | : MS |
| h) Stuffing Box gland/bush | : Deep Bronze packing to be renewable with case. |
| i) Stuffing box Packing. | : Flexible Graphite or PTFE (Asbestos shall not be used) |
| j) Pump motor coupling. | : Flexible. |


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15. ACCESSORIES REQUIRED:-

The following accessories shall be provided by the bidder for each pump:

- | | |
|--|---|
| a) Suction & Discharge pressure gauges. | : Yes. |
| b) Vent connection | : Yes. |
| c) Drain piping up to common drain point
in plant room. | : Yes |
| d) Companion flanges. | : Yes |
| e) Common base plate. | : Yes. |
| f) Suction strainer. | : Yes |
| g) Isolating valve | : Yes |
| h) NRV at pump outlet at inlet/outlet | : Yes |
| i) Any special requirements | : The Chilled Water pumps shall be suitably
insulated as per spec. |
| j) Inspection & Testing | : As per specification enclosed elsewhere. |


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CENTRIFUGAL PUMPS


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1. GENERAL

- 1.1 This specification covers the design, material, constructional features, manufacture, assembly, inspection and testing at manufacturer's or his subcontractor's works, suitable painting requirements of centrifugal pumps and drives complete with all accessories as specified hereinafter.

2. CODES AND STANDARDS

- 2.1 The design, manufacture, inspection, testing & performance of the pumps as specified hereinafter, shall comply with the requirements of the latest revision of the following standards as indicated below (as applicable):

- 2.1.1 IS-1520 : Horizontal centrifugal pumps for clear, cold and fresh water.
2.1.2 IS-5120 : Technical requirements - Rotodynamic special purpose pump.
2.1.3 IS-1710 : Vertical turbine pumps for clear, cold and fresh water.
2.1.4 BS - 599 : Method of testing Pumps.
2.1.5 PTC - '6' : Centrifugal Pumps Power test code
2.1.6 API - 610
2.1.7 Hydraulic Institute Standards of USA

Wherever standards for certain aspects materials etc., not mentioned, the same shall be as per the applicable Indian or International standards.

- 2.2 In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in this matter, the decision of Purchaser's engineering shall be final and binding.

3. DESIGN REQUIREMENTS

- 3.1 The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability.
- 3.2 The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards..
- 3.3 All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.
- 3.4 The pump shall be suitable for handling the fluid as specified in Data Sheet-A.

4. CONSTRUCTION FEATURES:


4.1 PUMP CASING

- 4.1.1 Pump casing may be axially or radially split or barrel type construction as specified in the pump data specification sheet. The casing shall be designed to withstand 1.5 times the maximum pressure developed by the pump at the pumping temperature.


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4.1.2 Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self venting & priming. Casing drain, as required, shall be provided complete with drain valves or plugged with threaded plugs as required.

4.1.3 Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.

4.1.4 Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610

4.2 IMPELLER

4.2.1 Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be checked for eccentricity and statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity. Supplier shall ensure during balancing that wall thickness of impeller vane, shroud etc is maintained above the minimum thickness requirement as per design.

4.3 WEARING RING

4.3.1 Renewable wearing rings for the casing and/or the impellers and renewable shaft sleeves, shall be provided for all pumps. Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.

4.4 SHAFT

4.4.1 Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runaway speed.

4.5 BEARING

4.5.1 Bearings and hydraulic devices, of approved make, (if provided for balancing axial thrust) of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its Range of Operation and also at the shut off condition. The bearing shall be designed on the basis of 20,000 working hrs minimum for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid being pumped. Where there is a possibility of liquid entering the bearing, suitable arrangement in the form of deflectors or otherwise shall be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly.

4.6 STUFFING BOX

4.6.1 Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer. Tubings used for connections shall be flexible metallic type preferably SS-304/316. PVC/ rubber tubings are not acceptable.

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4.7 SHAFT COUPLING

4.7.1 The pumps shall be directly coupled to their drives through heavy-duty flexible coupling. Suitable sturdy coupling guards of min. 1.5 mm MS sheet/ Aluminium sheet shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.

4.8 BASE PLATE AND SOLE PLATE

4.8.1 Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided. The external corners of the base plate shall be rounded to avoid sharp corners. Drilled holes shall have sufficient space around for proper seating of washer with nut. If required in the data specification sheet, steel sole plates shall be provided, below the base plate.

4.9 PRIME MOVER

4.9.1 The drive motor selected shall conform to the requirements of the enclosed motor specifications.

4.10 LIFTING ARRANGEMENT

4.10.1 Each pump and motor shall incorporate suitable lifting attachments e.g. lifting lugs or eye bolts etc., to facilitate erection and maintenance..


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5. PERFORMANCE REQUIREMENTS

- 5.1 The pump shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the Range of Operation as stipulated in the data specification sheets.
- 5.2 Pump shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off. Power capacity characteristic will be non-overloading type i.e. 110% of the design flow the power required to drive the pump will be practically the same as that at the design flow.
- 5.3 Wherever specified in data sheet, pumps of each category shall be suitable for parallel operation. The head vs capacity, input power vs. capacity characteristics, etc., shall match to ensure equal load sharing and trouble free operation throughout the range.
- 5.4 The pump motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any malfunction of the system.

6. DRIVE RATING

- 6.1 The power rating of the drive shall be selected such that a minimum margin of 15% is available over the pump input power required at the rated duty point. However, the drive rating shall not be less than the maximum power requirement at any point within the 'Range of Operation' specified.
- 6.2 In cases where parallel operation of the pumps are specified the actual drive rating is to be selected by the bidder considering overloading of the pumps in the event of tripping of one of the operating pumps.
- 6.3 The bidder under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.

7. SCOPE OF INSPECTION AND TESTING


7.1 CASTING

- 7.1.1 The Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers. Castings shall have 'as cast' heat numbers unless they require overall machining. For partially machined components manufacturer shall ensure availability of as cast heat nos. on unmachined area.
- 7.1.2 Identification and correlation with test reports for all tests as per the relevant material specifications for castings of 'Major' nature such as suction bell, discharge elbow, stuffing box, gland, wearing rings, shaft sleeves etc.
- 7.1.3 Foundry's conformity certificate for castings of 'Minor' nature such as base plates, covers etc.
- 7.1.4 Verification of Heat treatment charts (as applicable)
- 7.1.5 Castings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.
- 7.1.6 Surface finish of Steel castings shall meet MSS SP-55.


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- 7.2 **FORGING**
- 7.2.1 Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.
- 7.2.2 Verification of heat treatment charts (time temperature) (as applicable).
- 7.2.3 Forgings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.
- 7.3 **FABRICATED ITEMS**
- 7.3.1 Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.
- 7.3.2 Approval of welding procedure specifications and qualifications of weld procedures and personnel as per ASME Sec IX.
- 7.3.3 Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8
- 7.3.4 Verification of heat treatment charts (time temperature), (as applicable)
- 7.3.5 **Note:** For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating original test certificates are not available, material shall be identified by Main Vendor and test conducted at NABL approved Laboratory.
- 7.4 **IN PROCESS INSPECTION AND TESTING**
- 7.4.1 Identification Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. Permissible defects and acceptance norms need to be specified. On static parts acceptance norms are as per ASME Sec.III NB 2546.
- 7.4.2 Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness) as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder. Probe shall be of min. 2 MHz frequency.
- 7.4.3 Acceptance norms for UT for dynamic duty components. the following defects are unacceptable
- a) Cracks, flakes, seams and laps
 - b) Defects giving indications longer than that from a 4mm equivalent flaw.
 - c) Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%.
 - d) Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.
- 7.4.4 For static duty components - as per NB 2542.2 of ASME Sec. III
- 7.4.5 Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage.
- Note :** In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures
- 7.4.6 Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.


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7.5 PERFORMANCE TEST

7.5.1 Pump testing with unit supply motor as per specifications and acceptance norms cited elsewhere, in absence of which as per IS 5120 latest edition. Performance shall be checked for minimum of 7 points (including shut off head and over load) following characteristics shall be checked.

- a) Capacity V/s Head
- b) Capacity V/s Power absorbed by pump
- c) Capacity V/s pump efficiency

Note : For pump of fire protection system, performance test shall be conducted up to 150% of rated capacity.

7.5.2 NPSH test in case specifically mentioned elsewhere.

7.5.3 Vibration, noise level and temperature rise measurement. Noise level shall be within 85dB(A) at 1 metre distance. Vibration within satisfactory zone of VDI 2056 Group G machines. Temperature shall not exceed ambient + 40 deg. C.

7.5.4 Overall dimensions as per GA drawings. One pump/type/size assembly with job motor shall be mounted on base plate, provided the components are ordered on the same manufacturer.

7.5.5 Examination after selective opening up after running for pumps operating at speed over 1800 rpm and capacity exceeding 68M3/hr.

7.5.6 Painting and packing as per technical specification.

7.6 TEST AT SITE

7.6.1 The pumps will be tested at site by the purchaser to verify their performance. If the pumps fail to operate smoothly or within the required performance all such deficiencies shall be rectified by the manufacturer by making suitable alternatives in the pump set and additional tests required to show the effect of such alterations shall be performed by him.


7.7 PERFORMANCE GUARANTEE

7.7.1 The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification. The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head

8. CLEANING, PROTECTION , PAINTING & PACKING

8.1 Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere shall be done to remove all dirts, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere. Flanges, inlet and outlet pipe, etc shall be protected. Packing shall be done as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere.

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9. DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL

- 9.1 Fully dimensioned outline GA drawings of the pump motor assembly unit for each type and size offered. This drawing should include:
- a) Foundation base plate and sole plate details as applicable
 - b) Civil foundation and anchor bolts details and loading data
 - c) Minimum submergence required for the pump (if applicable)
- 9.2 Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction and/ make with standard applicable codes.
- 9.3 Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.
- 9.4 Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.
- 9.5 Experience list about the supply and successful operation of similar pumps for similar application.
- 9.6 A comprehensive write up or brochure on the details of manufacturing and testing facilities in the shop of the manufacturer.
- 9.7 Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer's works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.
- 9.8 Data sheet-B with all the particulars filled in.

10. MANUFACTURERS NAME AND TAG. PLATES

- 10.1 Each pump shall have a permanently attached brass/ Stainless steel tag on the body indicating the following information both in Hindi and English:
- a) Manufacturer's name and trade mark.
 - b) Design Capacity and Head.
 - c) Design.
 - d) Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

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11. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

- 11.1 Certified GA drawings of pump motor assembly weights, crane.
- 11.2 Detailed cross sectional drawings of the pump and motor assembly and all equipment & accessories supplied under the this specification along with details of material of construction with applicable standard codes.
- 11.3 Foundation drawings with details of foundation pocket indicating static as well as dynamic load and other data with dimensions.
- 11.4 Certified characteristics curves (discharge capacity vs. head, BHP and efficiency) of each type of pump and motor.
- 11.5 Material and other test certificates as required by the application clauses of this specification.
- 11.6 Motor speed torque curves super imposed on pump speed torque curves.
- 11.7 Quality plan along with complete details of testing and inspection requirements of centrifugal pumps in BHEL format. Vendor shall also furnish Field Quality Plan.
- 11.8 Installation , operation and maintenance manual.
- 11.9 Other drawings and data, if necessary.


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TITLE

**PACKAGE-CONDITIONING UNIT
DATA SHEET - A**

SPECIFICATION NO. PE-TS-400 & 402-553-A00.

VOLUME II-B

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DESCRIPTION**DATA**

- | | |
|--|---|
| 1) Capacity of the unit at operating conditions. | : As specified |
| 2) Numbers required | : Refer to Section-C of Specific Technical Requirements |
| 3) Designation of the unit | : Package AC Unit |
| 4) Whether air cooled/water cooled | : Refer to Section-C of Specific Technical Requirements |
| 5) The plant shall be suitable for maximum-ambient temp. | : Refer outdoor design condition as specified. |
| 6) Whether a plenum Chamber required | : Units shall be connected to fresh air ducts. |
| OR | |
| Whether to be connected duct system. | : Yes. |
| 7) Whether Humidifier required for humidity-control. | : Refer to Section-C of Specific Technical Requirements |
| 8) Whether strip heaters required for winter heating. | : Refer to Section-C of Specific Technical Requirements |
| 9) Whether strip heater required for Humidity control. | : Refer to Section-C of Specific Technical Requirements |
| 10) Final painting colour shade stage. | : Subject to approval / during detail engineering |
| 11) Whether fan static pressure is to be designed for filters arrangement shown. | : Yes. |
| 12) Installation supporting structure/drain piping, insulation. | : Required. Drain piping with insulation up to the nearest drain point. |
| 13) Controls & Instruments | : Yes (Lot) |
| 14) Isolation Switch | : Yes |

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SECTION-D
PACKAGE CONDITIONING UNIT


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PACKAGE CONDITIONING UNIT**

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1 GENERAL

1.1 This specification covers the design, manufacture, inspection and testing at the manufacturer's works and suitable packing delivery and testing of the packaged air conditioning unit.

2 CODES AND STANDARDS

2.1 The design, manufacture, inspection, testing and performance of the packaged type air conditioning unit shall comply with all statutes, regulations and safety codes currently applicable in the locality where the equipment will be installed. The equipment shall also conform to the latest editions of the codes and standards specified herein under. Nothing in this specification shall be construed to relieve the vendor of this responsibility.

In particular, the packaged air conditioning Unit (max 7.5 TR capacity, ductable or non ductable type) or cassette type (up to 5 TR) shall conform to the latest editions of the following standards:

- 2.1.1 I.S.660 : Safety code for Mechanical Refrigeration.
- 2.1.2 I.S.5111 : Code of practice for measurement, and testing of refrigerant compressor.
- 2.1.3 I.S.659 : Safety code for air conditioning.
- 2.1.4 I.S.2494 : V Belt for industrial purpose.
- 2.1.5 I.S.3142 : V grooved pulleys for V Belts.
- 2.1.6 I.S.4503 : Shell and tube type heat exchanger.
- 2.1.7 ARI 210 : Standard for/unitary air conditioning equipment
- 2.1.8 ARI 270 : Standard for application installation and servicing of unitary equipment.
- 2.1.9 ASHRAE-37 : Standard methods of testing for rating unitary air conditioning and heat pump / equipment.
- 2.1.10 ANSI-B9-1 : Safety code for mechanical refrigeration.

3 DESIGN AND CONSTRUCTIONAL REQUIREMENTS

3.1 Compressor

The compressor shall be hermetic or semi-hermetic or screw rotary type or scroll type. The same shall be suitable for R410A/R407C/R134A refrigerant. The compressor shall be mounted on anti-vibration spring/rubber pads and shall be positioned in such a way that it is freely accessible with sufficient space all around for easy maintenance. Safety controls like High and Low pressure cut-out overload and single phasing protection for the motors shall be provided. A crankcase heater shall also be provided, if considered necessary by the vendor.

3.2 CONDENSING UNIT

Shell and tube type water cooled condenser or air cooled condenser with adequate area shall be provided as specified in Data Sheet-A. The condensing unit shall be complete with multipass heads and shall be fitted with the following:

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- 3.2.1 Hot gas inlet and liquid outlet connection with shut off valve for liquid.
- 3.2.2 Drain plug, air vent and test valve.
- 3.2.3 Water inlet and outlet connection with thermowell and suitable cocks respectively.
- 3.2.4 Relief valve and air purge valve (Fusible plug in place of relief valve not acceptable)
- 3.2.5 Any other accessory as recommended by the manufacturer for proper functioning of the equipment.

3.3 AIR HANDLING FAN

The air handling fan shall be of the centrifugal type and with forward curved blades. This shall be driven by means of a three phase induction motor through V belt drive. The fan static pressure shall be selected for passing air through high efficiency absolute filters, if specified in Data Sheet-A.

3.4 FILTERS

Filters shall be of dry panel type and shall be cleanable. The velocity of air across the filters shall not exceed 1.75m/sec (350FPM).

3.5 COOLING COIL

The cooling coil shall be of direct expansion type and shall be made of heavy gauge copper with aluminium fins. The fins shall be bonded to the copper tubes under hydraulic pressure. A distributor shall be provided for feeding the refrigerant to different sections of the coil. Rows shall be staggered in the directions of airflow. The velocity of air across coil shall not exceed 2.5M/Sec. (500 FPM).

3.6 CONTROLS

All necessary controls and accessories like thermostatic expansion valve, refrigerant solenoid valve, distributor, filter drier in the liquid lines, shut off valves, HP/LP cut out for compressor, thermostat with adjustable settings, overload and single phasing preventer for motor etc. are to be provided. The microprocessor based control panel shall be provided outside the packaged unit on one side. The control panel shall generally be in line with the specification for control panels given elsewhere.

The control shall be so interlocked that the fan shall be started independently first, and then only the compressor. Tripping of the compressor by the thermostat or compressor cut outs shall not trip the fan. The thermostat setting shall be adjustable

3.7 REFRIGERANT PIPING

The refrigerant piping shall be either heavy gauge copper as furnished in Data Sheet-A. The piping shall be completely factory assembled, pressure tested, dehydrated and initially charged with FREON gas and compressor oil. The line accessories shall include liquid line shutoff valve dehydrator, strainer, flow indicator and distributor etc.

3.8 CABINET

All the equipments, except control panel, mentioned above shall be provided within a heavy gauge sheet metal cabinet, of floor/ wall mounted type. This shall be given two coats of anti-corrosive and rust proof paint, finished with two coats of final paint . Painting shall be as per manufacturers std unless specified otherwise in data sheet 'A'. The interior of the cabinet shall be provided with thermal and acoustic insulation of minimum 25mm thick. The insulating material shall be fire proof.

The front and back side of the cabinets shall be easily removable providing maintenance to all the interior parts.

All the electric wires within the cabinet shall run in flexible conduits and carry

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identification tags. The bottom side of the panel shall be specially ribbed to take care of the transportation.

3.9 OTHER ACCESSORIES

Each packaged air conditioner shall be provided with required number of neoprene rubber isolating pads.

4 CONTROL AND INTERLOCK REQUIREMENTS

The compressor shall have all protective devices like HP/LP cutouts, overload protection for the motor, single phasing preventor for motor etc.

The interlocking requirement shall be as indicated below:

4.1 The compressor shall not start, unless condenser water flow is achieved for water cooled condenser. The condenser flow shall be sensed by means of a flow switch.

4.2 The compressor shall not start unless the evaporator fan is started.

4.3 The tripping of compressor on HP/LP, overload or on thermostat shall not trip the fan.

4.4 Strip heater (if provided in the ducting system) shall not be switched on, unless the evaporator fan is started and airflow is established. For this purpose, an air stat on flow switch shall be used. The heater shall be separately controlled by humidistat/thermostat

4.5 A humidifying package, if specified in data sheet A, shall be controlled by humidistat.

5 TEST AND INSPECTION

5.1 Inspection and Testing at Manufacturer's Works

5.1.1 static and dynamic test for fans

5.1.2 Hydrostatic static test on condenser and cooling coil.

5.1.3 vacuum/pressure test for the complete refrigeration circuit.

5.1.4 Visual and Free running test of the packaged unit on test bed.

5.1.5 Free running test on compressor.

5.1.6 AIR CAPACITY WITH ANEMOMETER.

5.1.7 NOISE LEVEL- ≤ 85 dB(A).

5.1.8 Other tests as per approved qualities plan/scope of inspection.

5.2 Inspection and Testing at Site

5.2.1 Performance testing of the packaged unit for 72 hours in summer / monsoon & 24 hours in winter. Up-to 3 TR (individual M/c capacity) inside room temperature (Dry & wet bulb) will be checked with all machines in the room operating.

The actual days of testing shall be mutually agreed. During the above testing, the following readings shall be taken to compare the same with guaranteed performance data.

5.2.1.1 Condenser inlet and outlet pressure and temperature

5.2.1.2 Entering and leaving air temperature of the cooling coil air filters.

5.2.1.3 Motor current for the compressor and blower.

5.2.1.4 Air quantity delivered by the fan. This shall be computed by adding air quantity leaving all the grilles entering the air filters.

Handwritten signatures and initials on the right margin, including names like 'S A Mohan' and 'Praveen Khatwa'.



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- 5.2.1.5 Room temperature (Dry & wet bulb)
Test to ensure all controls and safety instruments are working properly.
During the above testing, noise level also will be checked to ensure that the same are within acceptable limits. Any undue vibration detected physically will be corrected.
All tools and instruments required for the above testing will be provided by the vendor.
- 6 PAINTING:**
The packaged unit shall be given two coats of primer paint finished with two coats of finish paint as per Manufacturers std. unless specified otherwise elsewhere/ Data sheet 'A'. The colour of finish paint will be as specified in Data Sheet-A.
- 7 GUARANTEES**
The package unit shall be guaranteed for performance measured in terms of the inside temperature maintained.
The packaged unit shall also be free from any manufacturing defects and shall be guaranteed as per contract after the first test as per 5.0 is successfully carried out, and the plant taken over by the purchaser.
- 8 NAME PLATES**
Suitable Name plate as per Data Sheet 'A', depicting the equipment number as designated in Data Sheet A shall be provided for each packaged unit and screwed to a prominent position on the packaged unit.


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9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

- 9.1 Final technical data as per Data Sheet-B
- 9.2 G.A. and interior view of packaged unit
- 9.3 Electrical wiring diagram
- 9.4 Catalogues for all controls
- 9.5 O & M Manual
- 9.6 Erection Manual


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TITLE	AIR FILTER DATA SHEET - A	

SPECIFICATION NO. PE-TS-400 & 402-553-A006	
VOLUME II-B	
SECTION D	
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DESCRIPTION

DATA

1) **General**

- | | |
|---|--|
| <p>1.1 Service</p> <p>1.2 Location</p> <p>1.3 Nos.</p> <p>1.4 Total air flow/type</p> <p>1.5 Temperature</p> <p>1.6 Relative Humidity</p> <p>1.7 Gas Composition</p> <p>1.8 Filter Media</p> <p>1.9 Efficiency</p> <p>1.10 Allowable pressure drop</p> <p>1.11 Frame Work</p> <p>1.12 Mounting</p> <p>1.13 Size</p> | <p>: Air Conditioning.</p> <p>: Central Air conditioning plant, & package AC plant, fresh air fan system. Also for split AC.</p> <p>: Refer Section 'C' of Specification.</p> <p>: Refer Section 'C' of Specification.</p> <p>: As per project information.</p> <p>: 100%</p> <p>: Atmospheric Air (Dusty) as prevalent in power Station.</p> <p>: Synthetic non-woven</p> <p>: Average arrestance efficiency of 65-80 % for Dry Panel filter (pre-filters) and average arrestance Efficiency of 80-90 % for fine filters.</p> <p>: 2.5 mm & 6.5 mm in clean and dirty condition respectively for dry panel filters(prefilters).
12 mm in clean condition for fine filters.</p> <p>: 18 G, GSS.</p> <p>: Ladder Type M.S Angles (galvanised)</p> <p>: 600 x 600 mm</p> |
|---|--|

Note:-

- 1) Face velocity of air across the filters shall not exceed 2.5 m/sec.

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SECTION-D

AIR FILTER


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TECHNICAL SPECIFICATION

AIR FILTER

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1. GENERAL

This specification covers the design, manufacture, inspection and testing at manufacturer's work or his sub-contractor's works of Air filters to be used for air-conditioning and ventilation system.

2. CODES AND STANDARDS

This design, manufacture and performance of AIR FILTERS shall comply with all currently applicable statutes, regulation and safety codes in the locality where the equipment will be installed. The equipment shall also conform to latest applicable Indian/British/USA standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. The following standards, in particular, shall be applicable for certified ratings of filters and for conducting performance test, if required.

a) BS EN - 779 -Methods of test for air filters used in air conditioning and general ventilation.

3. GENERAL

The enclosed Data sheet A gives the type and other particulars of filters required.

3.1 POLY FIBRE AIR FILTERS

Filtering media shall consist of a suitable fibrous material (e.g. polyethylene extruded sections coir etc.) packed into a 20 gauges GSS framework, complete with handles etc. The filter element shall be supported by galvanised steel wire mesh of 10mm. sq. on either side, Velocity across the filters shall not exceed 2.5 M/sec. Average efficiency Em (%) shall be ≥ 80 as per BS EN - 779.

3.2 DRY FABRIC AIR FILTERS

Filter element shall be pressed felt filter fabric or suitable material recommended by the manufacturer, stitched on to galvanised wire gauge support and crimped to form deep folds. Suitable aluminium spacers shall be provided to ensure uniform distribution of air flow through filters. Filter casing shall be provided with neoprene sponge rubber sealing, The filter shall have Average efficiency Em (%) of ≥ 95 as per BS EN - 779.

3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

Filter shall consist of V-fold galvanised wire mesh interspaced with flat layers of galvanised wire mesh. The density of media shall increase in the direction of air flow. Edges of wire mesh shall be suitably hemmed to prevent abrasion during handling. The media shall be supported on either side by galvanised expanded metal casing. The framework shall be at least 18 gauge GSS. Filter shall be either dry or wetted type as per data sheet=A. The oil shall be mineral oil of approved quality and make. As a the filter frame made of Aluminium alloy conforming to IS:737 can be considered unless use of aluminium is prohibited otherwise due to site conditions being saline/corrosive.

All filters shall be capable of being cleaned of their accumulated dust by tap water flushing. The dry metallic filter shall have Average arrestance Am (%) shall be ≥ 90 . However oil wetted air filters shall have Average Efficiency Em (%) ≥ 90 as per BS EN - 779.

3.4 AUTOMATIC CLEANING FILTERS

This shall consist of a filter mat and drop eliminator, driven by a suitably rated geared

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motor unit being supported on a steel framework. The filter mat shall consist of an endless steel wire mat insets of steel mesh held between an upper & a lower shall drop eliminator shall consist of an endless steel wire without insets of steel mesh. The unit shall include a suitable oil pump, gludge raking mechanism and sludge container and tensioning device. Pressure drop shall be limited to 0.5 / mm WG when clean & 10 mm when dirty. Air velocity across filter shall not exceed 3 M/sec.

3.5 ABSOLUTE FILTERS

Filters shall be constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by heavy corrugated aluminium spacers. They shall be individually tested and certified to have an efficiency of not less than 99.97% when tested with 0.3 micron dioctylphalate smoke as per IS:2831. The clean filter initial static pressure drop shall not be greater than 25mm WC at rated capacity. A neoprene sponge rubber sealing shall be provided on either face of filter frame.

3.6 WATER REPELLANT NYLON FILTERS

This shall be constructed of water repellent nylon fabric with continuous water spraying on it from a header for keeping it clean. Efficiency of this filter shall be 85% down to 10 microns. This filter shall be used for unitary air filtration system only.

4. INSPECTION & TESTING

The scope of inspection for air filters shall be as below:

- 4.1 Dimensional inspection of frame & filter media.
- 4.2 Witnessing of type tests on one per type per size air filters for the following properties.
 - a) Gravimetric efficiency.
 - b) Pressure drop in clean & dirty (choked - %age to be specified) condition.
 - c) Efficiency as per BS EN - 779.
- 4.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet).


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5. DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

- 5.1 GA Drawing.
- 5.2 Drawing showing material/construction detail
- 5.3 Installation and service manual
- 5.4 Rating curves/charts
- 5.5 Test certificates
- 5.6 Elect. diagrams (when automatic cleaning type)


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TITLE

LOW PRESSURE AIR DISTRIBUTION SYSTEM**DATA SHEET - A**

SPECIFICATION NO. PE-TS-400 & 402-553-A007

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Description**Data**

- | | |
|---|---|
| 1. General (List of areas) | : As per Specification/Tender drawing. |
| 2. GSS Duct Work
a) Type | : GSS as per IS: 277
(Zinc coating as per Section-C of
Specific Technical Requirements.) |
| b) Size | : As per Section-C of Specific Technical
Requirements and bill of quantity. |
| 3. Acoustic lining | : Up to 5m length from AHU Outlet. |
| 4. Special painting | : Galvanised. |
| 5. Thermal Insulation | : Required in supply air duct in AC
entire length. |
| 6. Diffusers (Circular/Square)
300 mm size
350 mm size
450 mm size
550 mm size
600 mm size
Any other size | : Bidder to estimate as per
drawings./specification.
All grille frame and louvers shall be
manufactured of at least 16 SWG Aluminium |
| 7. SA grilles (for each size) | : To suit air flow as per System
requirements / Tender Drawings. |
| 8. RA grilles (for each size) | : -do- |

NOTE:

1. Duct sheet thickness shall be as per IS-655
2. Opposed blade type volume control damper shall be provided at each supply air diffusers/grilles.
3. Bidder to provide suitable gasketing at each duct flange.
4. Fire damper shall be motor operated type, when otherwise specified under Section-C.
5. Access door in ducting system shall be provided as required.
6. MS Angle (painted) shall be used for duct supports etc.
7. Velocity thru duct shall normally not exceed 9.0 M/sec for Air conditioning system. Maximum velocity (outlet) for supply air diffuser shall not exceed 2.5 m/sec.
8. All Grilles & diffusers shall be supported with frame. Frame etc. shall be supplied by bidder.


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SECTION-D
LOW PRESSURE AIR DISTRIBUTION SYSTEM


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1. GENERAL

1.1 This specification covers the design, manufacture, construction features, installation, inspection testing and air balancing of air distribution system upto a total pressure of 95mm w.g. The specification is intended to cover the air distribution for air conditioning system and ventilation system not involving localised exhaust.

2. CODES AND STANDARDS

2.1 The design, construction and performance of complete system shall conform to all currently applicable statutes, regulations, safety codes in the locality where the equipment are to installed

2.2 Unless specified otherwise the equipments shall generally conform to latest applicable Indian Standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall generally conform to latest editions by the following standards:-

- a) IS: 655 - Specifications for metal air ducts.
- b) IS:277 - Specifications for galvanised steel sheets.
- c) IS:737 - Specification for wrought aluminium and aluminium alloy sheet and strip.

3. MATERIAL

3.1 Metal air ducts shall be either of galvanised steel sheets or aluminium sheets, as indicated in data sheet-A.

3.2 The rolled steel sheets before galvanising shall be properly annealed or normalised so as to allow fabrication of ducts without developing cracks. Zinc coating on the steel shall be as per technical requirement refer to Section-C of Specific Technical Requirements.

3.3 The aluminium sheets shall be of grade S1C or NS3 and shall be suitable for duct fabrication work as per IS-737 latest

4. CONSTRUCTION/FABRICATION

4.1 The thickness of sheets, the type of bracing and other fabrication details shall generally conform to requirements given hereunder unless specified otherwise in data sheet A and/or indicated on drawings.

4.2 RECTANGULAR DUCTS

4.2.1

S.No.	Max Side	Sheet Thickness		Type of transverse Joint connections	Bracings
		(mm) GI	(mm) Al		
a)	Up to 600	0.63 (24G)	0.80	S-drive, pocket or bar slips or flanged joints on 2.5m centres	None

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b)	601 to 750	0.63 (24G)	0.80	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
c)	751 to 1000	0.80 (22G)	1.00	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
d)	1001 to1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips with 35x3mm bar reinforcing on 2.5m centres	40x40x3 mm MS angles, 1.2m from joints
e)	1501 to2250	1.00 (20G)	1.50	40x40x3mm MS angle, flanged connections or 40mm pocket or40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing	40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints
f)	2251 & above	1.25 (18G)	1.80	50x50x3mm MS angles,connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.	50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints.
g)	No bracing is required if transverse joints are less than 600mm apart				
h)	For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser				

- 4.2.2 All rectangular ducts having either dimension larger than 450mm shall be cross broken except these ducts which are insulated with sand cement plaster. Air outlet connections on ducts need not be cross broken.
- 4.2.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.
- 4.2.4 The flanges used for transverse joints shall be joined together with GI bolts (grade 4.6) and nuts spaced at 125mm centres as per following:
- Upto 1000mm - 6 mm dia GI bolts
 - 1001 to 1500 - 8 mm dia GI bolts
 - 1501 and above - 10mm dia GI bolts
- 4.2.5 The MS angle flanges shall be connected to ducts with rivets at approx. 100mm centres. The flanged joints shall have 6mm thick felt packing stuck to flanges with shellac varnish. The holes in the felt packing shall be burnt through. The ducts are to be tapped 6mm across the MS flanges.
- 4.2.6 MS angles used for bracings shall be tack welded to the ducts or rivetted at 125mm centres, as applicable.


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4.3 ROUND DUCTS

4.3.1

S.No.	Duct dia-mm	Sheet Thickness		Reinforcing
		(mm) GI	(mm) AI	
a)	Up to 150	0.63 (24G)	0.80	None
b)	151 to 600	0.80 (22G)	1.00	None
c)	601 to 1000	1.00 (20G)	1.50	40x40x3mm girth MS
d)	1001 to 1250	1.00 (20G)	1.50	40x40x3mm girth MS angles at 2.0 meter centres
e)	1251 & above	1.25 (18G)	1.80	40x40x3mm girth MS angles at 1.2m centres

4.3.2 The seams on round ducts may be continuously welded or grooved longitudinal seam. In case of welding of GI sheet, zinc rich paint shall be applied on the welded zone.

4.3.3 Round ducts shall either be joined by welding or the ducts shall be swedged 40mm from the ends such that larger end will butt against the swedge and is held in place with sheet metal screws.

4.4 DUCT SUPPORTS

Unless specified otherwise on drawings, rectangular ducts with larger side of 2250mm or above shall be supported by 15mm MS rods and 50x50x3mm and MS angles while those below 2250 mm shall be supported by 10mm MS rods and all angles shall be given a coat of primer paint. The duct supports shall be at a distance not exceeding 1800mm. The MS rods shall be fixed to MS angle cleats, which in turn are fixed to ceiling slab by suitable anchor fasteners. All anchor fasteners, MS angle cleats, coach screws, hooks and other supporting material required shall be provided by vendor.

However, If ducts are thermally insulated, the MS angles and supports shall not be in direct contact with ducts, for which purpose wooden pieces/ Resin bonded fibre glass sheets (50 mm thick) shall be used in between.


4.5 FLEXIBLE CONNECTIONS

Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of at least 150mm width made by closely woven double layer Fire resistant or canvas shall be provided. The same shall be attached to angle iron frames on equipment and to similar frame on duct or casing by means of a steel band 9r (or) collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.

4.6 TRANSFORMATIONS AND BREACHES

All curves, bends, offsets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have a velocity not exceeding that in the main duct to which the branch is connected.

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- 4.7 CAULKING**
Wherever duct passes through wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.
- 4.8 EASEMENT**
Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.
- 4.9 ACCESS DOORS**
Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc.


All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.
- 4.10 DAMPERS AND SPLITTERS**
- 4.10.1** Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.
- 4.10.2 FIRE DAMPERS**
Fire dampers shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal sensor or fusible link type.
- 4.10.3 VANES**
Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.
- 4.10.4 FLASHING**
For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.
- 4.11 DIFFUSERS AND GRILLS**
The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor's reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The diffusers/grills shall be approved by purchaser.

Unless specified otherwise the diffusers/grills shall be of mild steel land painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be


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single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers.

Suitable vanes shall be provided in duct collars to have uniform air distribution. Blank-off baffles wherever required, shall also be provided.

4.12

PLENUMS AND RA BOXING

All plenum chambers and/or connections to fans, dampers etc. shall be constructed in 18 gauge GI sheet. supported on 40x40x6mm MS angle frames. All vertical angles shall be riveted at approx. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonry construction to which angles are fastened.

Return air boxing requirements if any are indicated in data sheet-A and the same shall be provided by vendor. The return air box shall be fabricated out of GI sheets shall be insulated with 25mm thick fibre-glass.

4.13

ACCOUSTIC LINING

The ducts shall be lined acoustically from inside as given in data- sheet A and/or section C of the specification.

4.14

PAINTING

Wherever specified the ducts shall be painted or lined with suitable anti-corrosive paint/ lining as per approval of purchaser. In particular the ducts coming in contact with acid fumes shall be epoxy coated, inside and outside.

4.15

THERMAL INSULATION

Thermal insulation shall be as per data sheet - A and the insulation shall conform to enclosed spec. no. PES-553-08.

5.

INSPECTION AND TESTING

5.1

INSPECTION & TESTING DURING FABRICATION

5.1.1

Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.

5.1.2

Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

5.1.3

Check for dimensions & mass as per latest IS-277.

5.1.4

Check for defect, twists, ungalvanised spots as per IS-2629.

5.1.5

Bend test & wrapping test as per IS-277.

5.1.6

Zinc coating test on samples as per IS-6745.

5.2

INSPECTION & TESTING AT SITE.

5.2.1

The duct branches, elbows etc. shall be inspected and the joints and connections etc, are to be checked before they are assembled in position.

5.2.2

After completion, all duct systems shall be checked and tested for air leakage, tightness, velocity, pressure drop, vibration and noise etc.

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