3. Transmitters for pressure / DP measurements of liquid and steam shall always be installed below the sampling point, preferably with the connection at the top.

4. Transmitters for pressure / DP measurements for gases and air shall always be installed above the sampling point, preferably with the connection at the bottom.

5. Transmitters with diaphragm seal system shall be considered when

   - The process temperature is outside of the normal operating ranges of the transmitter and cannot be brought into those limits with impulse piping or
   - The process is corrosive and would require frequent transmitter replacement or unusual materials of construction or
   - The process contains suspended solids or is viscous and may plug the impulse piping or
   - There is a need to make density or interface measurements or
   - The process medium may freeze or solidify in transmitter or impulse piping.

6. Diaphragm seal shall be either capillary type or direct mounted type depending upon the application. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

7. Differential pressure type level transmitters shall be used for range above 1219 mm, for services requiring purge or where liquid might boil in external portions.

8. Differential pressure type level transmitters for use on corrosive service shall generally be diaphragm wafer with extended filled capillary type. Flush or extended diaphragm type DP transmitter shall be considered for special application. Diaphragm material shall normally be stainless steel or any other special alloy.

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

9.3 Temperature Transmitter

Table 9.2

Specifications for Temperature Transmitter

S.N	Features	Minimum Requirements
1	Type	2-Wire, Smart (HART)
2	Output Signal	4-20 mA signals superimposed with HART signal.
3	Signal Processing Unit	Microprocessor based
4	Accuracy	± 0.075 % of span or better
5	Local Indicator	To be provided (Not applicable for DIN Rail Mounted type)
6	Display	Digital LCD Integral Display (minimum 5 digit)

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S.N	Features	Minimum Requirements
		Engineering Unit
7	Input	Ohm input from Pt-100 RTD/ mV signal from thermocouples
8	Stability	± 0.1 % of reading or 0.1^{0} C, whichever is greater, for 24 months for RTDs. ± 0.1 % of reading or 0.1 ^{0}C, whichever is greater, for 12 months for thermocouples
9	Output	4-20 mA DC, linear
10	Load	600 Ohms (minimum) at 24 Volts DC
11	Power Supply	24 VDC, 2- Wire Loop Power
12	MOC of Electrical Housing	Aluminum Alloy or better
13	Enclosure Class	Weather proof as per IP 67 with corrosion resistance coating. For hazardous area explosion proof enclosure as described in NEC article 500

1. The temperature transmitter of following types (2-wire Loop Powered temperature transmitter) compatible with thermocouples shall be provided. Cold junction temperature compensation of the thermocouples shall be performed in the temperature transmitter itself. The Contractor shall use multiplexer philosophy to connect thermocouples to plant DCS. Metal thermocouples shall be terminated in Local JB and from there copper cables shall be connected upto the separate panel in the control room. For linking this panel to Plant DCS, the required communication protocol like TCP/IP, Modbus, OPC, Profibus shall be provided. The Contractor shall provide the complete system excluding the cabling between Local JBs and Control Panel and communication cable to Plant DCS.

   a. Single/multiple Input DIN-rail mounted Temperature Transmitter (Only for Metal Temperature measurement)

   These shall be suitable for mounting on DIN-rails in Panels/JBs. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail. Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.

   b. Field mounted Temperature Transmitter With Indicator

   These shall be suitable for mounting on pipes/ supports. Indicator shall be provided with these transmitters. These transmitters shall have bump-less change over facility to second sensor in case first sensor fails .This changeover is to be alarmed. Protection class shall be IP67 minimum.

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

2. Transmitters shall be provided with following features:

   - Sensor drifts alarm for sensor failure prediction

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- Differential & average temperature measurement if required.
- Automatic switch-over to back-up sensor on primary sensor failure.
- Accepts any combination of two sensor types (RTDs, T/Cs, mV or ohms)
- Ambient temperature compensation
- Fault detection for electronics & sensors with fail-safe alarming.
- Provision of built-in CJC

3. Transmitters to be used for RTD sensors shall be provided with RTD EMF correction features so that it shall detect and eliminate EMF errors which are the result of small voltage produced by RTD sensing elements.

4. The product and make shall be selected so that with one make of transmitter all applications with respect to measuring range, temperature sensor (resistance thermometer / thermocouple) and connection type (2/3/4) wire connection of resistance thermometers) shall be covered.

5. Field mounted Transmitters shall be capable of communication with HART (Highway Addressable Remote Transducer) communicator. HART communicator shall be provided with transmitters for tuning / configuring / diagnosing / maintenance of the transmitters. It shall meet the intrinsic safety requirement if required depending upon the application.

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

9.4 Thermocouple

Table 9.3

Specifications for Thermocouple

S.N	Features	Minimum Requirements
1	Wire Gauge	16 AWG (for K type 24 AWG (for R type)
2	Protective tube	O.D. 8 mm Material SS 316 seamless Filling – Compacted Magnesium Oxide (Purity above 99.4)
3	Loading	Shall be spring loaded to ensure positive contact with the well. Prevention of rotation of the insert with respect to head and resultant twisting of leads shall be ensured.
4	Accuracy	As per ANSI MC 96.1 / IEC 751 / IS-2054 / 2055, 1974.
5	Characteristic	Linear with respect to temperature within +/- ½ per cent of top range value.

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S.N	Features		Minimum Requirements	
6	Reference		For temperature vs. mV characteristics, following IS shall be applicable : Type K IS – 2054, 1974 Type R IS - 2055, 1974	
7	Head	Type	IP-65 universal screwed type (Explosion proof for NEC class-1, division-1 area)	
		Material	Die-cast aluminium or better material painted with black enamel paint.	
		Terminal Block	Brass screw type / silver plated on ceramic head.	
		Cable Connection	½ " NPT gland & grommet	
		Cover	Screwed cover with suitable gasket & SS Chain	
8	Instrument connection to Well		½" NPT	
9	Accessories		a)	Adjustable nipple-union-nipple {1/2" Sch. 80 X1/2" NPT (M)} with thermowell connection
			b)	Compression fittings/union
			c)	Flanges etc. (For flanged connection only)
			d)	SS 316 forged/barstock thermowell as per ASME PTC code. Process connection M33X2 (M)in general or 1½" Flanged for Flue gas/ Furnace air etc. application

1. The following types of sensors shall be used for the different temperature ranges:
   - For measurement of temperatures of up to max. 1100 °C, rapid-responded sheathed thermocouples with insulated tip, 16 AWG wire, as Chromel-Alumel (NiCr-NiAl, ISA type K) measuring element, with admissible deviation of thermo voltage of half the values stated in IS-2054, 1974 or DIN 43710.
   - For measurement of temperature between 1100°C and 1300°C, 24 AWG, Platinum Rhodium (13%) – Platinum (ISA type R) measuring elements, with admissible deviation of thermo voltage of half the values stated in IS-2055, 1974 or DIN-43710.
2. All thermocouples shall be duplex type with tip grounded. Thermoelectric properties and accuracy shall be as per ANSI MC 96.1 / IS-2054 / 2055: 1974.

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3. The design of thermocouple assemblies shall be such that replacement on line is possible.

4. Gas-tight ceramic sheaths partially reinforced with stainless steel sheath shall be used as protective tube for Pt Rh – Pt thermocouples. For other type of thermocouple stainless steel tubes shall be used as protective sheaths. For measuring temperature of high pressure process fluid, tapered protection sheath made from solid bar stock shall be used.

5. The time-constant of thermocouples shall suit the process requirement and shall be subject to approval of Owner / Consultant.

6. The thermocouples shall be supplied with factory tested and calibrated assemblies. The assemblies shall be complete with thermo well, sensing element, connection lead, duplex terminal block, extension nipple, compression fittings / unions /flanges etc. to meet all functional requirements as per Owner's / Consultant's approved drawings. The thermocouples equipped with thermo well shall be spring loaded for positive contact with the well.

7. The duplex terminal block shall be constructed with high temperature ceramic base with brass screw type terminals.

8. Thermocouple shall be suitable for steam, water or any other liquid application. For air & flue gas service, suitable protection tubes shall be provided for the thermocouples.

9. All thermocouples (except metal thermocouples) shall be terminated to the nearest junction boxes. The cold junction compensation shall be implemented within the measuring module level, no local/ field cold junction compensation box is allowed.

9.5 Resistance Temperature Detector (RTD)

Table 9.4

Specifications for RTD

S.N	Features	Minimum Requirements
1	Type	3 / 4 wire , Pt-100 (100 ohm at 0 deg C) (as per DIN 43760)
2	No. of Element	Duplex
3	Housing/Head	IP-65/Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection
4	Sheathing of RTD	Metal sheathed , mineral insulated, Compacted MgO packed
5	Calibration and accuracy	As per DIN-43670 Class-A for RTD
6	Stability	Zero & span drift within 0.1% of span for a 6 month period.
7	Characteristic	Linear with respect to temp, within ±1/2percent of top range value
8	Standard	As per DIN-43670 for RTD & ASME PTC-19.3 for

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S.N	Features	Minimum Requirements	
		Thermowell	
9	Accessories	a)	Adjustable Nipple-Union-Nipple with thermo well connection / plug in connectors
		b)	Compression fittings / unions
		c)	Flanges etc.
		d)	Thermowell as per requirement

1. RTDs shall be of duplex, platinum three / four wire type with a nominal resistance of 100 ohms at 0°C and conform to DIN 43760 / BS 1904.

   Stability of RTD over full range shall be better than 0.05 ohms and the repeatability figure shall be better than 0.02 ohms. Accuracy shall be of the order of 0.15% or better and response time shall be less than 20 seconds with thermo well.

2. The protective-sheath material shall be SS 316, seamless tubes using compacted magnesium oxide packing for insulation. The insulation resistance at 540°C shall not be less than 5 mega-ohms.

3. The time constant of the RTD shall suit the process requirements and shall be subject to approval of Owner / Consultant.

9.6 Metal Temperature Thermocouple

Table 9.5

Specifications for Metal Temperature Thermocouple

S.N	Features	Minimum Requirements
1	Measuring medium	Metal Temperature
2	Type	K-Type
3	Wire Gauge	16 AWG
4	No. of Element	Duplex with separate hot junctions, ungrounded type
5	Sheathing/Insulation/Dia.	Metal sheathed (SS 321) , mineral insulated (Magnesium oxide), ceramic packed, 8 mm Dia.
6	Bending Radius	30 mm (minimum)
7	Cold End Sealing	SS pot seal with color coded PTFE headed sleeve insulated flexible tails. Sealing compound – Epoxy Resin
8	Standard	ANSI MC 96.01.1975
9	Thermocouple Length	30 Mtrs. (minimum)
10	Accessories	1/2" NPT SS sliding end connector, weld pad, weld on clamps of heat resistant steel SS310.

1. For metal temperature measurement, care shall be taken for proper contact with metal surface. The thermocouples sheath for metal temperature measurement shall have to be thermally insulated to avoid radiation /

conduction / convection loss. Thermocouple assembly for metal temperature measurement shall suit the functional requirement.

2. The thermocouple shall be attached to the heater tube surface by being furnished with stainless steel welding pads or by the use of thermocouple attachment blocks. The multiple holes in these blocks shall allow for spare thermocouple element for quick replacement.
3. For boiler metal temperature measurement, the lead wires shall have to be brought into nearest Junction Boxes which are located in accessible safe zones, using suitable protection pipes.
4. For measurement of wall temperatures at boiler tubes, sheathed thermocouples, dia 3.0 mm NiCr-Ni single thermocouples shall be used. The thermocouple line shall be designed as Teflon-insulated stranded conductor, provided with glass filament insulation and stainless steel wire braiding. The thermocouple shall be welded to the compensation line outside of the boiler insulation, with the welding point spilled hermetically in a coupling element. The area of the boiler penetration shall be designed with an anti-kink spring of stainless steel and a line-fixing sleeve of stainless steel, encapsulated in synthetic resin.
5. The differential temperature "inside / centre" of the wall shall be measured by means of sheathed thermocouples NiCr-Ni, dia 3.2 mm. For this special protective sleeve shall be used. Particular emphasis shall be put on compliance with the stipulated depth of the bores in the tube wall material.
6. For SH, RH, metal temperature measurement thermocouples shall be provided as per the specification in Table 9.5.

9.7 Thermowell for Temperature Elements

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

2. Thermo wells shall, in general, be of SS 316 and shall be drilled from bar stock except for air and flue gas services. However, selection of thermo well material shall be as per following guideline.

Table 9.6A

Thermowell MOC Selection

S.N	Medium	MOC
1	Lignite-Air mixtures	SS 304
2	Flue gases	Black steel, SS 446
3	Preheater	Black steel, SS 446
4	Steam lines	SS 316 and pipe material compatible for high temperature steam
5	Water lines	Low carbon steel/ SS316
6	Boiler tubes	SS 304 / SS 309 / SS 310

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3. Welded type thermo wells with 38 mm O.D. for welding & ½" NPT internal threads shall be used for pressure above 100 kg / sq cm cm or temperature above 400 deg C. Socket weld type thermo well with 34 mm O.D. for welding & ½" NPT internal thread, shall be used for pressure between 40-100 kg/cm2 and temperature up to 400°C. Screwed type thermo wells with ½" NPT internal threads & M33X2 (M) outer threads shall be used for pressure below 40 kg/cm2 and temperature below 400°C. For pipes having probability of prolonged vibration, seal welding may be done all around after tightening the thermo well within the base.

4. Thermocouples / RTD used in air / flue gas path shall be supported by suitable protection tube of adequate strength with welded cap at the end. The connection size of the temperature detector with the protection pipe shall be adjustable flange type, the ratings of which shall have to be approved by Owner / Consultant. The length of the protection pipe shall be such that it supports at a distance nearly 2/3rd length of the immersed temperature detector inside the duct using a heat insulated ring support in between. The protection pipe details shall have to be approved by Owner / Consultant during detailed engineering stage. If any support is necessary for protection pipe the Contractor shall have to arrange the same.

5. Thermo wells used in Mill classifier Outlet area shall be made of suitable material of sufficient abrasion resistance such as alloy cast iron / `Ni-hard' /Tungsten Carbide of hardness approx. 400 BHN. The connection shall be flanged type, the details to be approved by Owner / Consultant. Protection rod in front of thermo wells for mill classifier if required shall be provided.

6. Thermo well manufacturing drawing covering material specification, dimensional details, details of special treatment, finish etc. as well as test procedure shall be subject to Owner's / Consultant's approval. Material certificate shall have to be furnished for each thermo well.

7. Wherever any approval is necessary from any recognized body / authority during manufacturing of high pressure wells, the same shall have to be arranged by the Contractor.

8. The thermo well immersion depth (U) shall be sufficient to eliminate conduction error. A general rule which may be followed is to use an immersion length equalling a minimum of 10 times the diameter of the protective tube or well. In general, immersion length of thermo wells for different line sizes shall be as follows:

Table 9.6B

Thermowell Immersion Length

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

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S.N	Line Size	Immersion Length
3	Vessels	400 mm

9.8 Pressure Gauge/ Differential Pressure Gauge/Draft Gauge

Table 9.7

Specification for Pressure Gauge/ DP Gauge/ Draft Gauge

S.N	Feature	Minimum Requirement
1	Type	Bourdon / Bellows / Diaphragm
2	Sensing Element Material	AISI 316 SS
3	Movement Material	AISI 304 SS
4	Case Material / Protection Class	AISI 304 SS / IP 65
5	Dial Size	150 mm For Special application like drum pressure, Main Steam pressure etc. 250 mm shall be used
6	Scale	Black lettering on white background in 270 °C arc
7	Range Selection	Normally operate at 75% of its maximum pressure range. Instruments measuring varying pressures shall operate in a band of 60% of its maximum pressure range.
8	Over range Protection	130% of maximum range by internal stop. External stop below zero.
9	Adjustment	External Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment.
10	Stop at Max. Reading	Shall be provided
11	Element Connection	Argon welding
12	Process Connection	½" NPT(M) bottom connection for local mounting, back connection for flush panel mounting
13	Accuracy	+/- 1.0 % of full scale or better
14	Operating Ambient Temperature	50 °C (Max. continuous)
15	Safety Feature	Neoprene Safety Diaphragm (Blowout disc) at the back
16	Window	Shatter-proof glass
17	Chemical Seal Unit	SS 316 Flange and Diaphragm, PTFE coated / block, Silicon Oil filling fluid
18	Accessories	Snubbers for pulsating fluid applications / 3-way gauge cock / 2-valve manifold / Pigtail / Siphon for steam service / Gauge Saver, if maximum or Design Pressure is very high than the Operating Pressure / Counter Flanges / Bolts, Nuts, Gaskets / SS Tag Plate

1. Directly connected pressure measuring instruments shall be diaphragm, bourdon or bellow type elements depending upon the services conditions. In

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general, diaphragm elements shall be used in the range of 0 to 1000 mm water column pressure, bellow type element for ranges of 0 to1 Kg/cm2 and bourdon type element for ranges greater than 1 Kg/cm2.

2. Primary element material shall be corrosion resistant to process fluid or diaphragm seals shall be provided for protection.

3. For draft measurement Teflon coated beryllium copper diaphragm shall be used.

4. Snubbers shall be floating pin type, externally mounted and externally adjustable. It shall be used for all pulsating services.

5. Diaphragm seals, filled type or mechanical type shall be furnished where plugging of the element may occur or where suitable material is not available in highly corrosive services. When chemical seals are required, they shall be the clean out type with flushing connection.

6. Over-range protection shall be provided to at least 130 % of range. For vacuum service, the element shall have under-range protection to full vacuum

7. Ranges of the gauges shall be so selected that the gauge normally operates in the middle third of the scale and conform to IS 3624 standard dials, wherever necessary.

8. The sensing elements for all gauges shall be properly aged and factory tested to remove all residual stresses and shall be SS 316 with forged socket and tip of the same material. Elements above 70 Kg/sq. cm range shall be bored instead of drawn.

9.9 Temperature Gauge

Table 9.8

Specification for Temperature Gauge

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

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S.N	Feature	Minimum Requirement
13	Range Selection	Normal Process Temperature – approximately two third of Temperature range.
14	Stop at Max. Reading	Shall be provided
15	Over range Protection	130% of FSD
16	Instrument Connection	Bottom connection for local mounting, back connection for flush panel mounting.
17	Process Connection	½" NPT with Thermowell
18	Performance :-	
a	Accuracy	+/-1.0% of full scale or better
b	Repeatability	Less than 0.5% of full range
c	Response Time	30 seconds (max.) with Thermowell and 15 seconds Bare.
15	Operating Ambient Temperature	50 °C (Max. continuous)
16	Accessories	Mounting brackets, Bolts, Nuts, Gaskets / SS Tag plate, SS Thermowell etc.

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

9.10 Level Gauge

Table 9.9A

Specification for Gauge Glass Type Level Gauge for vessels

S.N	Feature	Minimum Requirement
1	Sensing Element & material	Tempered toughened Borosilicate gauge glass steel Armored reflex or transparent type
2	Body Material	Forged carbon steel / 304 SS
3	End Connection	Process connection as per ASME PTC and drain / vent 15 NB

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

1. Level gauges shall be steel armoured reflex or transparent or bi –colour type, top and bottom connection as per pressure vessel standard of ASME PTC code and 15 mm NB (1/2 inch NPT) Drain and Vent connection.
2. Body material and cover material shall normally be forged carbon steel, 304 stainless steel or other superior material.
3. Reflex type gauges shall be used for clean and colorless liquids and transparent type for other liquids. For boiler and condensate services, treated water, the transparent type with KEL – F shields shall be used to avoid their attack on the glands.
4. The gauge glass must have a rating equal to or more than the vessel design pressure and temperature. The test pressure for the complete design gauge assembly shall be as per Owner's / Consultant's recommendation.
5. The maximum length of a single gauge glass shall not exceed 1400 mm. Where large range is required, multiple gauges of preferably equal lengths shall be used with 50 mm over – lapping in visibility.
6. The visibility shall cover the operating level range and the maximum and minimum ranges expected considering start – up conditions as well as alarm and shut down points. Internal heating shall be provided for viscous liquids. Integral illuminators shall be used for transparent gauges, if necessary.
7. Stand – pipes shall be used for multi – gauge glass and level controller installation and on horizontal drum or exchanger with top and bottom connections to have visibility of the complete span. The stand pipe shall not be used with block valves.
8. Primary isolation valves shall be used In addition to the gauge glass valves unless otherwise specified. When the process fluid may create lugging or

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leakage problem, gauge valves may be omitted. For low temperature liquid having high vapour pressure at ambient temperature, isolation and gauge valves shall not be permissible. Safety valve shall be provided at the vent connection of the gauge glass where isolation is required.

9. For high pressure service such as boiler water etc., the gauge glass shall be multi – port illuminated type (Bi – colour type). Indication of water space shall be `green' and indication of steam space shall be `red'.

10. Bi – colour level gauges shall have following features:

- Temperature equalizing column expansion bend and chain patterned hand – wheel
- Certification by Inspectorate of Boiler

Table 9.9B

Specification for Float & Tape Type Level Gauge for Tanks

S.N	Feature	Minimum Requirement
1	Type	Float & Tape type
2	MOC of Float & Tape	SS 316
3	MOC of Pulley	Aluminium
4	Guide Wire	SS 316
5	Accuracy	+/- 5 mm
6	Indication	Arrow on Circular or Vertical scale Board

9.11 Pressure/ Differential Pressure Switch

Table 9.10

Specification for Pressure/DP Switch

S.N	Feature	Minimum Requirement
1	Type	Piston for high pressure application Bellow/Diaphragm for low pressure application
2	Sensing Element material	AISI 316 SS
3	Wetted Parts material	AISI 316 SS
4	Case Material	Epoxy coated Die Cast Aluminium
5	Setter Scale	Black graduation on white linear scale. Graduation 0 – 100% with red pointer for set points.
6	Over range for Pressure / Vacuum Switch	130% of maximum pressure
7	Set Point	Adjustable throughout switch operating range.
8	Static Pressure for Differential Pressure Switch	Maximum Line Pressure or Static Pressure on either side without permanent deformation or loss of accuracy.
9	Adjustments	Internal – set point

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S.N	Feature	Minimum Requirement
		Differential adjustable feature
10	Process Connection	½" NPT(M) bottom connected
11	Switch Configuration	2 SPDT / 1 DPDT
12	Switch Rating	230 V, 5A AC / 220 V, 0.25 A DC/24 V, 2A DC
13	Switch Type	Snap acting, shock and vibration-proof
14	Cable Connection	½ " ET conduit connections or compression gland
15	Enclosure Class	Weather proof as per IP 65 with corrosion resistance coating.
16	Accuracy	1% of span up to 3Kg/cm2 0.5% of span for more than 3 Kg/cm2.
17	Repeatability	0.5% of span
18	Accessories	
a)		Snubbers for pulsating fluid application.
b)		Tag Number, service engraved in SS tag plate
c)		Teflon back-up sheath protection, as required.
d)		i) Remote diaphragm seal with SS 316 armored capillary for typical application. MOC of seal material shall be as per process fluid requirement. ii) Silver coated diaphragm for corrosive services like chlorinated water.
e)		Retention ring and screws for surface mounting.
f)		3-way Gauge Cock (SS 316) for PS / 5-Valve Manifold (SS 316) for DPS.
g)		Mounting bracket / Clamp for 2 '' pipe, bolt & nut.

1. The pressure switches shall have sensing elements made of copper alloy or stainless steel sealed diaphragm and piston actuated for high pressure service and bellows for low pressure / vacuum service.
2. Low differential pressure switches for low static pressure ranges shall be diaphragm type with snap action switch elements.
3. Low differential pressure switches for high static pressure shall be elbows and torque tube type and snap – action switch elements and metric scale dial indicators.
4. For corrosive, viscous process fluids diaphragm sealed with completely filled inert liquid shall be provided. Material of diaphragm and wetted parts shall be selected considering the nature of process fluid.
5. The sensing elements shall be properly aged and factory tested to remove all residual stresses. They shall be able to withstand at least 130 % the full scale pressure without any damage or permanent deformation.
6. Actuation set point, dead band shall be internally adjustable throughout the range with tamper proof facilities.
7. Electrical connection for the switch devices shall be suitable for plug in type connection.

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8. Process connection shall be ½ inch NPT. Process piping connections shall include necessary union, nut, nipple, tail pipe, isolation valve and test connection to permit servicing, testing, calibration and removal of the instrument device.

9. Instrument for steam & hot water service, shall be connected through siphon, of stainless steel or suitable material. Pulsation dampeners shall be provided for all pulsating fluids.

10. Pressure switches shall be tested as per BS – 6134.

9.12 Conductivity Type Level Switch

Table 9.11

Specification for Conductivity Type Level Switch

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

9.13 Capacitance Type Level Switch

Table 9.12

Specification for Capacitance Type Level Switch

S.N	Feature	Minimum Requirement
1	Type	Capacitance type
2	Probe	Rod or Suspended Electrode
3	Material	SS 316
4	Insulation	PTFE/PP/Kynar part/full as required
5	Repeatability	± 0.5 % of full range or better
6	Accuracy	± 0.5 % of full scale or better

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

9.14 Float/Displacer Type Level Switch

Table 9.13

Specification for Float/Displacer Type Level Switch

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

1. Level Switch shall work on gland less magnetically coupled float or displacer operated mechanism having separate float chamber.
2. Float, stem and displacer shall be 316 stainless steel.

3. Level switch body, cage and process connections shall be designed to withstand the maximum pressure and temperature of the operating fluid.

4. A setting adjustment on the level set point of + / - 25 mm shall be provided. The adjustment shall be made externally to the switch.

5. The accuracy & repeatability of the switch shall be within +/- 0.5 % of full-scale range. On – Off differential shall be adjustable.

6. Process connections of the cage shall be 25 NB male plain nipples connected through socket / welded isolation valves of adequate rating.

7. Level switch connections shall also include 15 NB test and drain connections to permit servicing, testing, calibration of the instrument.

8. The switching elements shall be snap-acting, shock-proof and vibration-proof. All switches shall have two electrically isolated SPDT contacts with provision of external adjustment of set points and dead bands. The contact ratings shall be 5 amps at 230 V AC 50 Hz or 0.25 amps at 220 V DC.

9. Switch enclosures shall be cast aluminium, weather-proof, NEMA -4X type with cable entry through compression type cable glands / ¾ "NPT conduit connections. Switches located in hazardous areas shall have dust-ignition-proof enclosure as per NEC article 500 provisions.

9.15 Ultrasonic Level Transmitter

Table 9.14

Specification for Ultrasonic Transmitter

S.N	Feature	Minimum Requirement
1	Application	Level measurement in silos, sump water level etc.
2	Medium	Coarse, hard solid materials like ash etc. Materials may be slowly falling through the detection range.
3	Type	Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic Transmitter. Transmitter shall be remote type or shall be configurable from remote controller/Configurator.
4	Principle	Time of flight
4	Sensor Material	Corrosion resistant material to suit individual application requirement.
5	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank / sumps obstructions such as pipes, heating coils or agitator blades. Also transmitters shall have adjustable damping circuitry.
7	Range	Capable of covering the complete level span of tank/vessel taking care of blocking distance, frequency, attenuation due to surface, obstructions, vapours etc.

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

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

9.16 Radar Type Level Transmitter

Table 9.15

Specification for Radar Type Transmitter

S.N	Feature	Minimum Requirement
1	Application	Level measurement of vessel under vacuum or low pressure application/ Fuel oil storage tanks
3	Type	Guided wave radar for vessel under vacuum or low pressure and Radar type for Fuel oil storage tanks
4	Principle	TDR (Time domain reflectrometry)
5	Probe Material	SS 316

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

9.17 RF Type Level Switch

Table 9.16

Specification for RF Type Level Switch

S.N	Feature	Minimum Requirement
1	Application	Solids
2	Particle size	Fine dust to 400 mm
3	Process Temperature	0 – 100^{0}C
4	Vessel pressure	up to 60 bar
5	Insertion length	As required
7	Mounting	Side or top or top vertical at ± 15^0
8	Process connection	40 NB thread or flanged
9	Protection Class	IP 67
10	Electronics	Remote
11	Cable connection	½ "NPT cable gland Plug-in cable connector

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9.18 Flow Switch

Table 9.17

Specification for Flow Switch

S.N	Feature	Minimum Requirement
1	Type	Vane actuated/Differential bellow type
2	Vane/bellow Material	SS 316
3	Repeatability	± 0.5 % of full range or better
4	Accuracy	± 0.5 % of full scale or better
5	Working temperature	As per process requirement
7	Process connection	As per requirement
8	Over-range proof	150% of max. design pressure
9	No. of contact	2 NO. + 2 NC, SPDT, snap action type dry contact, shock & vibration proof
10	Rating of contacts	5A, 240 V AC / 2A, 24 V DC / 0.25 A,220V DC
11	Enclosure	Cast Aluminium/IP 65
12	Cable connection	Compression type cable gland/ ½" NPT Conduit connection
13	Electrical Connection	Plug-in socket
14	Accessories	All mounting accessories

9.19 Rotameter

Table 9.18

Specification for Rotameter

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

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

9.20 Coriolis Flow meter

Table 9.19

Specification for Coriolis Flow meter

S.N	Feature	Minimum Requirement
1	Service	Fuel Oil (LDO/HFO) flow measurement

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S.N	Feature	Minimum Requirement
2	Primary Element	Flow tube of SS316 or better
3	Heating arrangement	Integral with flow element
4	Temperature control	To be provided
5	Allowable pressure drop	<0.5 Kg/Sq. cm.
6	End Connection type /size	Flanged WMRF to ANSI 300
7	Cable entry	½" NPT (F)
8	Accuracy	+/- 0.2% of Flow rate or better
9	Power supply	230 V 50 Hz
10	Drain	Self draining facility
11	Enclosure	SS 316
12	Display	LCD display
13	Output	2 nos. isolated output of 4-20 mA.
14	Load	<750 ohms
15	Turn down Ratio	100:1
16	Housing	IP 65 or better
17	Hazardous duty Version	FM standard
18	Accessories	Counter flanges, Nuts, Bolts, Gaskets, U clamps, prefab cables etc.

9.21 Sight Glass Indicator (Flow Glass)

Table 9.20

Specification for Flow Glass

S.N	Feature	Minimum Requirement
1	Application	Online observation of fluid flow in Pipeline
2	Type	Double window for pressurized pipe with rotary wheel for installation in horizontal or vertical pipeline. Full view for non-pressurized pipeline.
3	Size	Double window up to 12" and 600 lbs rating. Full view up to 6" and 150 lbs rating.
3	Body Material	SS 316
4	Glass	Pyrex tempered glass
	Others	Rotor & wetted parts shall be bronze All accessories shall be SS316
5	Protection class	IP-65
6	Connection	Screwed up to 50 NB size Flanged ANSI 150 RF – above 50 NB size
7	Accessories	Name plates, mating flanges with gasket, bolts & nuts etc.

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9.22 Flow Elements

a) Orifice Plate

Table 9.21 A

Specification for Orifice Plate

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

1. Contractor to provide Beta ratio calculation, Assembly drawings & flow vs DP curves.
2. Each orifice plate shall be provided with a handle on which the orifice diameter, pipe diameter and pressure tap distances are stamped. This information shall be so located that it can be read without removing the orifice plate from pipe line.
3. The standard primary element shall be thin plate, square-edge concentric orifice plate mounted between a pair of weld-neck type orifice flanges with flange taps. The minimum pressure rating of flanges shall be 300 pounds ANSI. The material of the orifice plates shall be SS 316 in general. Orifice plates shall be not less than 3 mm thick for nominal pipe diameters up to and including 300 mm, and not less than 6 mm thick above 300 mm NB pipe.
4. Quadrant edge or quarter circle orifice plates shall be used for highly viscous liquids and for pipe Reynolds Number below 10,000. Conical entrance type of orifice plates shall preferably be used for very highly viscous liquids up to Reynolds Number below 250. Vent and drain holes shall be provided wherever necessary.
5. Orifice diameter shall be selected, so that d/D ratio is between 0.20 to 0.70 for gas and steam and up to 0.75 for liquids.
6. Metering orifices shall not be installed in lines less than 1 ½" (40 mm) the lines shall be blown to the 1 ½ " (40 mm) size for the meter run, keeping the d/D ratio within limits.
7. Restriction orifices and integral orifice transmitters do not require upstream or downstream straight pipe runs.

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8. The orifice plate shall be supplied and fitted in conformity with ISO. When the pipe diameter is larger than the value specified in ISO, the restriction ratio shall be decided by extending the specific curve externally.

9. The length of straight pipe run required for metering accuracy shall be in conformity with ISO. When it is extremely difficult to comply with the standard, a minimum straight length of 10D (D = pipe inner diameter) on the upper stream and a minimum length of 5D on the downstream shall be considered.

10. All orifice plates shall be supplied with matching flanges of material and pressure rating not less than the rating of the associated pipe system.

11. For pipeline sizes of 500 mm and less, the orifice plates shall be an integral unit comprising of carrier ring assembly, tapping arrangement on both upstream as well down stream side. For line sizes more than 500 mm, the orifice plate shall be disc type. For disc type orifice plate, suitable corner tapping arrangement on both upstream as well as down stream side shall be provided. All tapping arrangements shall be complete with a piece of impulse pipe line and a shut – off valve suitable for specified line pressure.

12. For steam applications, orifice plate shall be supplied with a pair of steam condensation chambers suitable for specified line pressure.

13. Data sheets, sizing calculation, fabrication & sheets for the elements shall be submitted for approval and finalization.

b) Flow Nozzle

Table 9.21 B

Specification for Flow Nozzle

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

1. Contractor to provide Beta ratio calculation, Assembly drawings & flow vs DP curves.

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2. The branch pipes for holding the flow nozzle shall also be furnished along with the flow nozzle. All nipples, welding adaptors and root valves shall also be in the scope of supply.

3. Flow nozzles in high pressure pipes shall be subject to a test according to DIN 50049, 3.1C, considering the technical guideline. The test of flow nozzles shall contain:

   - Check of drawings
   - X-ray testing of the circular bead or colour soaking or ultra-sonic testing
   - Test of sizes.

4. Flow nozzle shall be provided with a permanent mark indicating:

   - Measuring point number
   - Direction of flow
   - Plus and minus tapping
   - Material

   Moreover, the actual inside pipe diameter "D" and the diameter of the flow nozzle shall be stated on the identification plate.

5. The Contractor shall provide the following documents:

   - Design drawings of the flow nozzle
   - Calculation documents
   - Fabrication, assembly and installation drawings
   - Test reports.

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

c) Aerofoil

Table 9.21C

Specification for Aerofoil

S.N	Feature	Minimum Requirement
1	Type	Flanged
2	Material	SS 316
3	Tapping's	3 nos. tappings of ½" NPT
4	Material of Branch Pipe	SS 316
5	Root Valve type	Ball
6	Root Valve material	SS 316

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S.N	Feature	Minimum Requirement
7	Root Valve size	1/2″
8	Accessories	All required mounting accessories

d) Venturi

Table 9.21D

Specification for Venturi

S.N	Feature	Minimum Requirement
1	Design standard	BS 1042/ISO5167
2	Material	SS 316
3	Type	Fabricated Machine Cast
4	Mounting	Flanged
5	Root Valve type	Ball
6	Root Valve material	SS 316
7	Root Valve size	1/2″
8	Accessories	All required mounting accessories & piezometric ring with 4 nos. tapping's for choke removal & screwed cap/plug on the ring

9.23 Oxygen Analyzer

Table 9.22

Specification for Oxygen Analyzer

S.N	Feature	Minimum Requirement
1	Type	In-situ Heated type
2	Principle	Partial pressure using Zirconium oxide cell
3	Sensor Type	Zirconium Oxide cell
4	Measurement Range	0.01 to 10 % O2
5	Accuracy	+/- 0.2 % of full scale
6	Linearity	+/- 1% of full scale
7	Response time	3 seconds or less (Up to 90% of full scale)
8	Drift	+/- 0.005% per 2 Deg. Centigrade temp. change
9	Operating Temperature Range	0-1600 *C
10	Temperature compensation	Automatic
11	Sample filter	Ceramic 3.5 micron
12	Zero & Span Adjustment	Required
13	Ambient Temperature	60*C
14	Indication	Digital
15	Enclosure Type/Material	Weather & Dust proof IP-65/ SS 316

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S.N	Feature	Minimum Requirement
16	Type of Electronics	Microprocessor based with self diagnostic facility
17	Calibration	Auto & manual
18	Output signals	Analog: 4-20 mA DC Binary: 2 NO + 2 NC for Alarms
19	Digital Signal transmission	RS-232 or RS-485 OR as per requirement to suit connection protocol of Plant DCS
20	Other requirement	HART Communication protocol compatibility & suitable for connection to Smart Transmitter Maintenance system. Purging System

9.24 Carbon Monoxide Analyzer

Table 9.23

Specification for Carbon Monoxide Analyzer

S.N	Feature	Minimum Requirement
1	Type	In-situ type
2	Principle	IR Double beam absorption
3	Sensor Type	IR
4	Measurement Range	0-999 ppm selectable
5	Accuracy	+/- 0.2 % of full scale
6	Linearity	+/- 1% of full scale
7	Response time	3 seconds or less (Up to 90% of full scale)
8	Drift	+/- 0.005% per 2 Deg. Centigrade temp. change
9	Operating Temperature Range	0-1600 *C
10	Temperature Compensation	Automatic
11	Sample filter	Ceramic 3.5 micron
12	Zero & Span Adjustment	Required
13	Ambient Temperature	60*C
14	Indication	Digital
15	Enclosure Type/Material	Weather & Dust proof IP-65/ SS 316
16	Type of Electronics	Microprocessor based with self diagnostic facility
17	Calibration	Auto & manual
18	Output signals	Analog: 4-20 mA DC Binary: 2 NO + 2 NC for Alarms
19	Digital Signal transmission	RS-232 or RS-485 OR as per requirement to suit connection protocol of Plant DCS
20	Other requirement	HART Communication protocol compatibility & suitable for connection to Smart Transmitter Maintenance system. Purging System.

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9.25 Control Valves

A. Introduction

The control valves and accessories equipment furnished by the Contractor shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & Pressure Vessel code, Indian Boiler Regulation (IBR) & ISA or acceptable equal standards.

B. Control Valve Design & Sizing

1. The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI for dimensions, material thickness and material specification for their respective pressure classes.
2. The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA Handbook on control valves. While deciding the size of valves, Contractor shall ensure that valves outlet velocity does not exceed 8 m / sec. for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Contractor shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which shall be subject to Consultant's / Owner's approval during detailed engineering.
3. Control valves for steam and water applications shall be designed to prevent cavitations, wire drawing, flashing on the downstream side of valve and downstream piping. Thus for cavitations / flashing service, only valve with anti-cavitations trim shall be provided. Detailed calculations to establish whether cavitations shall occur or not for any given application shall be furnished.
4. Trim shall be multistage type having sufficient number of discrete pressure drop turns (stages) to ensure elimination of vibration, erosive – action, cavitations. Contractor shall identity the number of pressure drop turns in proposed equipment and shall also provide calculation demonstrating compliance to the trim exit velocity.
5. To prevent flow induced vibration and to protect the valve internals from foreign particles such as weld slag flow, direction shall be a flow to close (over the plug) configuration for liquid applications. To maximize noise attenuating benefits and to allow for constant fluid expansion, flow direction shall be under the plug for steam and gas applications.

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6. Control valves for application such as SH spray control, RH spray control, Heavy oil pressuring & control system shall have permissible leakage rate as per leakage class V. All other control valves such as low and high range feed control valves etc shall have leakage rate as per leakage class IV.
7. The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.
8. The characteristic of the control valves shall be determined based on the application / service.
9. On supply air or electrical failure for pneumatic / electrical drive, the valve shall remain full closed, open or stay – put position as per process safety requirement.

C. Valve Construction

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

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12. The valve body shall be marked to show direction of flow.

D. **Valve Materials**

1. The control valve body material shall be

- Carbon steel as per ASTM – A216 GR WCB for non – corrosive, non – flashing and non – cavitations services below 275 deg c temperature like Auxiliary Steam flow to Deaerator, CRH flow to Deaerator, Condensate flow to Deaerator etc.
- Alloy steel as per ASTM – A217 GR WC 9 for severe flashing / cavitations services like low load and full load feed water control, HP and LP heaters emergency drains, Deaerator overflow drain to Hotwell etc.
- Alloy steel as per ASTM A – 217 GR WC 6 for low flashing / cavitations services like HP heaters & LP heaters normal drain control, drain cooler normal level control, gland steam cooler minimum flow etc.
- 316 SS for condensate service below 300 deg C like condensate normal and emergency make – up controls etc.

2. The control valve trim material shall be

- 17 – 4 PH SS for severe services listed under item D.1, 2nd point & 3rd point above
- 316 SS for services listed at D.1, 4th point above and
- 316 SS with stellite faced guide parts and bushings for remaining applications.

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

E. **End Preparation**

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

F. **Valve Actuator**

1. The regulating control valves shall be furnished with pneumatic actuators. The Contractor shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut

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off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 *C continuously.

2. Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 kg / cm^2 per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.
3. The travel time of the pneumatic actuators shall not exceed 10 seconds.
4. For quick opening / closing services (such as fuel oil shut – off valve), the actuator shall be pilot solenoid operated pneumatic drive; the rating of solenoid shall be 24 V DC.
5. Selection of actuator shall be such that it meets the requirements of thrust / torque, stroke length, angular movement, full scale travel time, repeatability & accurate positioning for successful operation of final control element.
6. All the actuators shall have also provision for manual operation during emergency / maintenance along with graduated local position indicator.

G. Control Valve Accessory Devices

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

Table 9.24(i)

Specification for E-to-P converter

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

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Table 9.24(ii)

Specification for Smart Positioners

S.N	Feature	Minimum Requirement	
1	Input	4-20 mA DC	
2	Power Supply	24 V DC Loop powered	
3	Type of Electronics	Microprocessor based with self diagnostic facility & digital communication by means of HART Protocol	
4	Valve position sensing	Non-Contact type with 4-20 mA DC Output	
5	Enclosure Type/Material	Weather & Dust proof to IP-65/ Die cast Aluminium	
6	Ambient conditions	Suitable for - 30 to +80 *C temperature & 0-95% Humidity	
7	Operating Range	Suitable for Full range & Split Range operation	
8	Modes of operation	Suitable for Direct & reverse valve action	
9	Flow characteristics	Suitable for Linear & Equal percentage Characteristics	
10	Fail safe/Freeze feature	Required	
11	Air Capacity	Sufficient to handle the Valves Selected/Boosters to be supplied if required.	
12	Air supply pressure	To suite the Air Supply Pressure / Quality available	
13	Process Connection	1/4" NPT	
14	Characteristic Deviation	< =0.5% of span	
15	Ambient Temperature effect	< =0.01%/Deg C or better	
16	Configuration	Remote Calibration, Auto & Manual Calibration shall be possible	
17	Cable Entry	½" NPT, Side or Bottom Entry to avoid water ingress	
18	Accessories	a)	Display with push buttons for configuration and Display on the positioner itself (Password Protected / Hardware Lock).
		b)	For Supply & Output Pressure, Filter Regulator and other accessories shall be provided as on required basis for making system complete
		c)	Valves Mounting Assembly For Sliding Stem / Rotary / Single Acting / Double Acting on required basis

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

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

Table 9.24(iii)

Specification for Air Filter Regulator (AFR)

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

Table 9.24(iv)

Specification for Position Transmitter

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

Table 9.24(v)

Specification for Limit Switch (Non Contact Type)

S.N	Feature	Minimum Requirement
1	Type	Non-contact type inductive Proximity
2	Sensing distance	10 mm minimum
3	Hysteresis	Maximum 10% of sensing distance
4	Indicator	LED indication

S.N	Feature	Minimum Requirement
5	Protection class	IP 67
6	Integral Cable	1 mtr.
7	Power supply	24 V DC/ 8 V DC
8	Mounting	Flush mounting with check nut
9	Other Feature	Explosion proof enclosures shall be provided wherever required by the application. Shock & Vibration proof.

G. **Test & Examination**

1. All valves shall be tested in accordance with the quality assurance programme agreed between the Owner / consultant and the Contractor which shall meet the requirement of IBR and other applicable codes.

2. The tests shall include but not but limited to the following:

   - Non-destructive test as per ANSI B – 16.34.
   - Hydrostatic shell test in accordance with ANSI B16.34 prior to seal leakage test.
   - Valve closure test and seal leakage test in accordance with ANSI B16.34 and as per the leakage class indicated under clause no. B.6.
   - Functional test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.
   - All control valves shall be tested with the positioners for accuracy of positioning and reproducibility over the full range of travel.
   - CV Test : CV test shall be carried out as type test on each size, type and design of the valves as per AISA 75.02 standard and test report shall be furnished for Owner's / consultant's approval.
   - Magnetic particle inspection shall be performed on all machined surfaces of valves having ASA rating of 1500 lbs ASA or greater. All carbon steel valves with 1500 lbs ASA or greater shall receive 100% radio graphic examination in accordance with ASTM – E71.

3. Contractor shall submit test certificates for the tests mentioned in above paragraphs in accordance with ASME and ASTM requirements. In addition Contractor shall also submit for the above equipment, certificate of manufacture and test as required by the Indian Boiler Regulations. The certificate shall be in the prescribed forms III A & III C and shall be endorsed by an Inspection Authority recognized by the Indian Boiler Regulations.

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H. **General Requirements**

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

9.26 Pneumatic Power Cylinder

Table 9.25

Specification for Pneumatic Power Cylinder

S.N	Feature		Minimum Requirement
1	Applicable standard		ISO 6431
2	Mounting Type		Fixed Position mounting/ Trunion mounting
3	Material	Cylinder	Seamless Steel Tube
		Piston rod	Hard Chrome Plated Steel
		Tie rod	Stainless steel
		End Cover	Cast Iron
		Sealing	Polyurathane
4	Control Signal		4-20 mA DC signal to Smart positioner with HART protocol for modulating purpose. Solenoid valve operating on pneumatic line for open & closing purpose of ON-OFF Damper.
5	Supply Air		0-7 Kg/cm2
6	Accuracy		Better than +/- 1%
7	Repeatability		Better than 0.5 % of full travel
8	Hysteresis		Less than +/- 0.2% of full travel
9	Dead Band		+/- 0.1%
10	Selection		Based upon thrust/torque, stroke length, angular movement, full scale travel time, repeatability, space factor etc. Provision for air-to-open or air-to-close operation

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S.N	Feature	Minimum Requirement
11	Accessories	Air lock relay, hand wheel, AFR, Volume booster, Limit switch, Positioner, Solenoid valve, position transmitter & all required mounting accessories etc.
12	Fail safe operation	Stay put for regulating duty

9.27 Lignite Feeder Instruments

Table 9.26

Specification for Speed Switch

S.N	Feature	Minimum Requirement
1	Type	Microprocessor based
2	Power supply	230 VAC/110 VAC/ 24 VDC
3	Input	Pulses from Sensor Probe
4	Sensor Probe	Inductive/Capacitive type proximity sensor
5	Speed Range	Programmable
6	Output	Potential free contact output
7	Contact Rating	5A, 240 V AC, 0.5A, 220 VDC
8	Time Delay	Selectable for start up & Trip
9	Enclosure	SS 316, IP-67(for outdoor mounting)/IP-55 (for mounting inside JB/panel)
10	Accessories	All required mounting accessories

Table 9.27

Specification for Speed Probe

S.N	Feature	Minimum Requirement
1	Type	Proximity type (inductive / NAMUR)
2	Frequency Response	0-10 KHz
3	Housing	SS 316/ Polyurethane tip
4	Sensing distance	10 mm minimum (2mm for embedded type)
5	Enclosure class	IP67
6	Power supply	24 V DC/8 V DC (for NAMUR)
7	Cable	Integral Cable 6 mtr.
8	Mounting	Flush with check nut
9	Accessories	Flexible conduit, Non-conductive mounting plates etc.

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Table 9.28

Specification for Speed Transmitter

S.N	Feature	Minimum Requirement
1	Type	Microprocessor based Programmable
2	Enclosure Protection	IP-67
3	Accuracy	+/- 1 RPM
4	Power Supply	24 V DC
5	Range	Programmable
6	Resolution	0.1 RPM
7	Output	4-20 mA
8	Input signal	Pulse Input from Proximity Probe
9	Display	LCD display

Table 9.29

Specification for Flow/No Flow detector switch

S.N	Feature	Minimum Requirement
1	Operating Principle	Microwave
2	Detection Range	Adjustable
3	Power Supply	230 V AC, 50 Hz
4	Housing	SS 316
5	Protection Class	IP 67
6	Output	Potential free contact output
7	Contact Rating	5A, 240 V AC; 0.5A, 220 VDC
8	Time delay for contact Changeover	Adjustable
9	Accessories	All required mounting accessories

9.28 Solenoid Valves

Table 9.30

Specification for Solenoid Valves

S.N	Feature	Minimum Requirement
1	Operating Principle	Electromagnetic (noiseless), Pilot operated
2	Coil Voltage Rating	24 V DC (in general)/220 V DC/230 V AC/ 110 V AC as required
3	Ways	3 ways in general others as required
4	Port size	¼ " NPT all ports
5	Body	SS Bar stock/Brass

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S.N	Feature	Minimum Requirement
6	Trim	AISI 316 SS
7	Manual Operation	In built
8	Duty	Suitable for continuous Energisation
9	Sealing	Airtight & leak proof
10	Coil Enclosure	SS 316/Moulded type
11	Insulation class	Class H
12	Coil Casing	IP-67
13	Mounting	Suitable for mounting On pipe or in panel
14	Cable connection	½" NPT Cable gland
15	Accessories	Mounting Bracket, nuts, bolts etc.
16	Other Features	LED Indication

9.29 Dew Point Meter

Table 9.31

Specification for Dew Point Meter

S.N	Feature	Minimum Requirement
1	Type	Sensor- Hyper Thin Film high capacitance Al2O3, Transmitter- Microprocessor based 2-wire loop powered
2	Accuracy	±5.5°F (±3°C)
3	Repeatability	±0.9°F(±0.5°C
4	Storage temperature	-40°F to +176°F (-40°C to +80°C)
5	Local Indication	To be provided
6	Input Resolution	0.1°C dew point
7	Power Supply	24 VDC
8	Output	4 - 20mA
9	Enclosure material	Die – cast Aluminium
10	Enclosure protection	Weatherproof IP 65
11	Electrical connections	½ " NPT
12	Process connection	As per requirement
13	Accessories	All required mounting accessories.

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5. DESIGN CRITERIA

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

5.1 General Requirements

5.1.1 Ambient Conditions

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

Table 5.1

Protection Class Requirement

Ambient Temperature (outside temperature)	Pressure	Relative Humidity	Atmosphere	Required Protection class of panels /cabinets /desks to be provided by Contractor
Outdoor Location				
55 *C max	Atmosphere	100%Max	Air (dirty)	IP 65
4 *C min	Atmosphere	5% Min	Air (dirty)	IP 65
Indoor Location				
55 *C max	Atmosphere	95% Max	Air	IP 54^^
4 *C min.	Atmosphere	5% Min	Air	IP 54^^
Air-conditioned Area				
24 +/- 2 *C normal	Atmosphere	95% Max	Air	IP 42
50 *C Max. ^	Atmosphere	5 % Min	Air	IP 42

^ During Air Conditioning failure
^^ For non-ventilated enclosures. For Ventilated enclosures, protection class shall be IP 42.
1. For hazardous areas the protection class shall be in accordance with the requirements of the relevant NEC code for the location.
2. For PCs, OWS, EWS, Servers, Printers and other peripherals, maximum temperature limit shall be 35 *C. For LVS the same shall be 25 *C & for UPS the same shall be 40 *C

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12. SYSTEM CABINETS, PANELS & JUNCTION BOX

12.1 General Requirements

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

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11. All panels, cabinets shall be properly grounded. The grounding scheme shall be as approved by the Owner.

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

13. The colour of the panel's interior shall be brilliant white. External colour of the panels shall be as RAL 7032 for LIE/ LIR and RAL 7035 for control room system cabinets.

14. All panels, enclosures, system cabinets, marshalling cabinets shall be provided with a minimum of 20% spare terminations and system cabinets shall be provided with spare space for 20% additional modules fully wired with connectors etc. in excess of the total requirement of the system design when the cabinets are delivered. The spare space capacity shall be distributed evenly throughout the cabinets.

12.2 System Cabinets

Table 12.1

Specifications for System Cabinets

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

1. The racks in system cabinets shall have provision along with plug in sockets/back plane to house accommodate the spare slots/modules as specified elsewhere.

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2. The system cabinets, racks in system cabinets, slots in the racks & the terminals shall have identification numbers. A stainless steel metal tag (plate) shall be fixed to the inside of the door & the layout of the racks, slots & details of the card type/service shall be inscribed on this metal tag.

3. Each cabinet shall be provided with one each 3 pin receptacles for 230 V, 1P, 50 Hz and receptacles for 24V DC.

4. One of the doors shall be provided with folder to keep the relevant engineering document of the cabinet.

5. All cabinets shall have common key for locks.

6. Door shall have concealed type of hinges with 120 degree swing.

7. Door latches shall be of the three-point type to ensure tight closing.

8. Separate Power & shield earthing bus shall be provided at the front & rear side of the cabinets. The earthing bus shall be isolated from panel body by suitable insulation material.

12.3 Marshalling Cabinets

Table 12.2

Specifications for Marshalling Cabinets

S.N	Features	Minimum Requirements
1	Application	For termination of all cables originating from field.
2	Location	Indoor
3	Type	Free standing Vertical type
4	Protection class	IP-42
5	Material & Thickness	CRCA steel/ min. 2mm for panel sides & 3mm for gland plates
6	Doors	Double door with neoprene gasket, Lockable,
7	Cable entry	Bottom with fire proof compound thickness 50 mm for sealing
8	Terminal Blocks	Rail mounted cage-clamp suitable for conductor size up to 2.5 mm^2 & fused type with LED indication for power supply (24 VDC, 230 V AC, 110 V AC etc.) for instruments & equipments.
9	Anti vibration pad	Required, 15mm
10	Painting	Interior- Brilliant White Exterior- RAL 7035
11	Cabinet Dimension	To be decided during detail engineering
12	Grounding	M6 earthing stud shall be provided
13	Ventilation	Fans & louvers with brass mesh required
14	Lighting	rapid start fluorescent strip fixtures with door actuated switches required
15	Lifting arrangement	Removable lifting eyebolts shall be provided

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

12.4 Local Instrument Enclosure & Racks

1. Transmitters and switches, devices, etc. mounted in the field shall be suitably grouped together and mounted in local instruments enclosures in case of open areas of the plant and in local instrument racks in case of covered areas. These local instrument enclosures and racks shall be furnished as per the actual requirements finalised during detailed engineering stage. The exact grouping of instruments in a particular instrument enclosure/instrument rack shall be as finalised during detailed engineering stage subject to the Owner's approval.
2. The local instrument enclosures shall be constructed of 2 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Vibration dampeners shall be installed for supporting each enclosure. The internal layout shall be such that the impulse piping/ blow down lines are accessible from back doors of the enclosure and the transmitters etc. are accessible from front side for easy maintenance. Gaskets shall be used between all mating sections to achieve protection class of IP-65.

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3. The local instrument racks shall be free standing type constructed of suitable 3 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack. Bulk heads, especially designed to provide isolation from process line vibration shall be provided. Exact fabrication details shall be as finalized during detailed engineering stage. The junction box for racks also shall conform to IP 65 protection class.

4. Provision for continuous purging arrangement is to be made for all air and flue gas applications.

5. Each transmitter enclosure housing instruments i.e. for air and flue gas applications, requiring purge air for continuous air purging shall be provided with common purge air header, air filter regulators of sufficient capacity, required pressure gauges, valves, fittings, SS tubing and individual purge meters for each purge line etc. as required.

6. As soon as the panel's fabrication is over, Owner shall inspect the panels and further work on the panels, namely assembly, wiring and assembly of components shall be carried out only after the inspection.

7. The junction box of Local Instrument Enclosure & Racks shall be provided with hinged type door, latch for locking & gland plates for cable entry. All terminals in junction box shall be of rail mounted cage clamp type suitable for conductor size up to 2.5 Sq. mm.

12.5 Local Junction Box

Table 12.3

Specifications for Junction Box

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

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1. All JB's for outdoor application shall be provided with individual canopies to prevent ingress of water.
2. All JB' shall have provision to add 10% additional TB's.
3. The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams.
4. Separate Terminal blocks shall be used for Analog & Digital Signals & also for signals with different voltage levels.
5. 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.
6. Separate shield bus shall be provided with screw connection for terminating cable shields.
7. All spare cable entries shall be provided with plugs.
8. All wires in JB shall be neatly dressed & ferruled.
9. Double deck type terminal block shall not be used.

Table 12.4

Specifications for Cable Glands

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

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10. PROCESS CONNECTION PIPING

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

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

1. Pressure connections and piping up to the root valves for all pressure indicators, pressure switches, pressure transmitters, etc., shall be as indicated for miscellaneous piping.

2. Temperature indicators, temperature controllers, temperature switches, temperature detectors, and test well connections shall be as follows:

   - Main steam -- 40 mm NPT.
   - Extraction steam -- 40 mm NPT.
   - Boiler feed water -- 32 mm NPT.
   - Reheat steam -- 40 mm NPT.
   - Duct temperatures -- 25 mm NPT.
   - All others -- 19 mm NPT.

3. Draft pressure connections on steam generator walls and ducts shall be 50 mm pipe couplings.

4. Flow transmitter connections and piping up to the root valves shall be 25 mm for all piping except orifice flanges, where 15 mm piping and valves shall be used.

5. Level switch connections and piping up to root valves shall be 25mm.

6. Level controllers and level transmitters of the displacement type shall have connections and piping up to root valves of 50 mm.

7. Level controllers and level transmitters of the differential pressure type shall have connections and piping up to root valves of 25 mm.

8. Instrument columns at tanks and pressure vessels shall generally be 65 mm minimum.

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10.1 Design Pressure and Temperature

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

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

10.2 Sizes of Instrument Primary Piping

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

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

10.3 Materials for Instrument Primary Piping

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

10.4 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.

10.5 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			
1	2	25NB	> =62 bar or 425degree C
F. Level measurement			
1	1	25NB	<62 bar and 425 degree C

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S. N.	Quantity of root valves (Nos.)	Size of stub and root valves	Service condition
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
H. Air and Flue gas Tapping points			
The Air and Flue Gas Tapping points shall be 40 NB. These tappings shall be of "Y" type to have access for removing the choke. One arm of the "Y" piece shall be closed with leak proof threaded cap with chain. The other arm shall be with reduced diameter suitable to connect to 25 NB impulse pipes.			

10.6 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 tube material	Impulse line fitting material	valves material
		Pipe	Tube			ANSI rating	ANSI Rating
1	Main steam / Saturated steam	SCH.XXS 21.34mm OD	1.7 mm ODX 1.65HK	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 21.34mm OD	12.7 mm ODX 1.65mm THK	SS 316	ASTM-A-335-Gr-P-22 (alloy steel)	ASTM-A-182-Gr-F-22	ASTM-A-182-Gr-F-22
						9000 LBS	2500 SPL. Class

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S. N	Service	Size		Impulse tube material	Impulse tube 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 21.34mm OD	12.7 mm ODX 1.65mm 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 21.34mm OD	12.7 mm ODX 1.65mm THK	SS316	ASTM-A-106-Gr-B (carbon steel)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	400LBS
5	LDO system; lube oil system	SCH.80 21.34mm OD	- -	SS316	ASTM-A-106-Gr-B (carbon steel)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	150LBS
6.	Instrument air system	SCH.40 21.34mm OD(pipe through out)	12.7 mm ODX 1.65mm THK	SS316	IS 1239 Heavy Class (Galvanisied)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	150LBS
7.	Service air system	SCH.40 21.34mm OD	12.7 mm ODX 1.65mm THK	SS 316	IS 1239 Heavy Class (Black)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	150LBS
8.	Boiler fuel gas / air system	SCH.8021 .3 mm OD (pipe through out)		SS 316	ASTM-A-106-Gr-B (carbon steel)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	150LBS

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S. N	Service	Size		Impulse tube material	Impulse tube material	Impulse line fitting material	valves material
		Pipe	Tube			ANSI rating	ANSI Rating
9.	Vacuum	SCH.40 21.34mm OD	7 mm ODX1.6 5mm THK	SS 316	ASTM-A-106-Gr-B (carbon steel)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	150LBS
10.	Make up water system	SCH.40 21.34mm OD	12.7 mm ODX1.6 5 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 shall 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 9.1 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 then ½ inch and the nipple size shall be same as the root valve size. Reducer / adepter shall be provided to suit instrument connection, where nipple, root valve size is more then 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.

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c. Drain

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

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 62 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

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 otherwise 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.

10.6.1 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 9.1) the

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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.

10.6.2 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.

10.6.3 The source shut-off (primary process root valve) and blow down valve shall be as per Table 10.2. 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.

10.6.4 The valve manifolds shall be of 316 s Furnishing Recommended protection interlock logics stainless steel 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.

10.6.5 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
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

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S.N	Property	Requirement
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.

Table 10.8

Specification for Condensate Pot

S.N	Property	Requirement
1	Reference	ASTM A 182 F22/ ASTM A105
2	Material	Alloy Steel/Carbon Steel as per application
3	Construction	Drilled Bar stock
4	End Connection	3 nos. ½" SW

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S.N	Property	Requirement
5	Accessories	Vent Valve

10.7 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 shall 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. For air supply to various devices mentioned above, the Contractor shall provide 2 nos., 2 inch size GI pipe header with isolation valve, one for boiler area and one for turbine area. In the boiler area the 2 inch head shall be provided up to top most elevation of boiler floor and from this 2 inch header, 1 inch sub-header shall be branched off at each floor with isolation valve. From this 1 inch sub-header, branch line of 1/2 inch, with isolation valve shall be provided up to various devices. Similar air supply piping shall be done in the turbine area also. Similar system is to be followed for service air required for intermittent purging in the Local Instrument Enclosures (LIEs) etc.

5. 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.

6. 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.

7. **Purge Air Connection for Air and Flue Gas Applications**

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a) The continuous purging with instrument air shall be done, for all air and flue gas measurements excepting instrument air and service air instruments, at the process source connection end. Necessary arrangements required for continuous purging shall be provided inside all the air and flue gas local instrument enclosures.

b) For intermittent purging with service air, necessary arrangements inside all the air and flue gas Local Instrument enclosures/racks shall be provided. The SS three way valve provided in the SS tubing shall be used for isolating the transmitter and connecting the service air quick disconnect line.

c) One air filter regulator, purge Rotameter and blow down device per instrument shall be provided in the transmitter rack/enclosure.

Table 10.9

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 10.10

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 10.11

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

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S.N	Property	Requirement
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 10.12

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 Stellited
7	Size	½" to 2 " as required
8	Packing	Teflon/Grafoil as required
9	Hand wheel	CS
10	Yoke	ASTM A105
11	Design Standard	As per ANSI B16.34

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S.N	Test Requirement	Standard
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 JB	Plug-in connector	Posts mount cage clamp type	G
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	Marshalling Cubicle /	Cage clamp (Rail mount)	Screwed, Cage clamp (Rail	A, C*. These

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S.N	Application		Type of Termination		Type of Cables
	From (A)	To (B)	End A	End B	
	Thermocouples for interlock and protection	Marshalling cum Termination Cabinet	type	mount) type	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

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

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5.8 Flow Element Selection

Table 5.5

Flow Element Selection

S. N	Type of Flow meter	Fluid medium	Process Parameter	Pipe sizes suitable for FE	Application	Type of connection
1	Orifice Plate	Water (DM Water)	As per process requirement	For all sizes Except very large diameter pipe	DM Water Flow To CST	Flange
2	Orifice Plate	Steam	For any condition	< 3″	Soot blowing steam flow	BW
3	Flow nozzle(AISI Type316L)	Water	As per process requirement	For all pipe sizes except very large diameter Pipe	(i) FW Flow to boiler drum (ii) SH/RH Spray water flow	BW
4	Flow nozzle(AISI Type316L)	Steam	As per process requirement		AUX. Steam flow	BW
5	Air foil	Air		All duct sizes	(i) Primary air flow (ii)secondary air flow	BW BW
6	Any Other Services required.	Subject to Owner / Consultant's approval during Detail Engineering.				

5.9 Drive Control Philosophy

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

5.9.1 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

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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 hardwired 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 hardwired 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

7. All Numerical relays/Intelligent controllers shall be interfaced to Control System through IEC 61850 protocol

The block diagram of the bidirectional drive (On-Off type & Inching type) controls is shown in drawing no. **LII-GEOE11019-G-00172-727 & LII-GEOE11019-G-00172-728**.

5.9.2 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 hardwired 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-00172-729.**

5.9.3 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 hardwired 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-00172-731**

5.9.4 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.

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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 hardwired 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

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-00172-730**

5.9.5 Variable Frequency Drives (VFD)

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.

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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 hardwired 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

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-00172-733**

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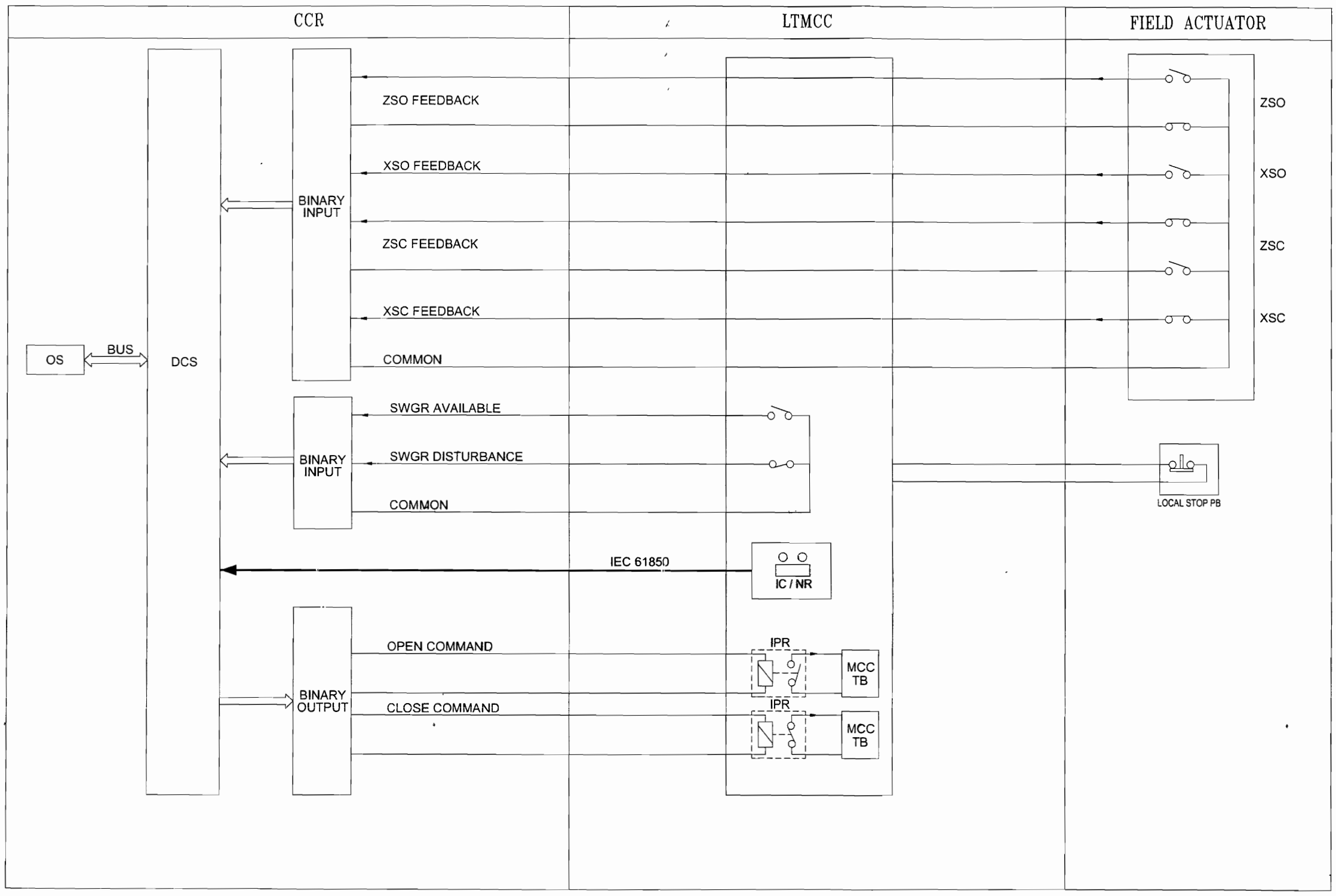

NOTE:-

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

ABBREVIATIONS

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

Bharat Heavy Electricals Limited * Power Sector * New Delhi - 110049

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FOR CONTRACT PURPOSE ONLY

REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
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00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

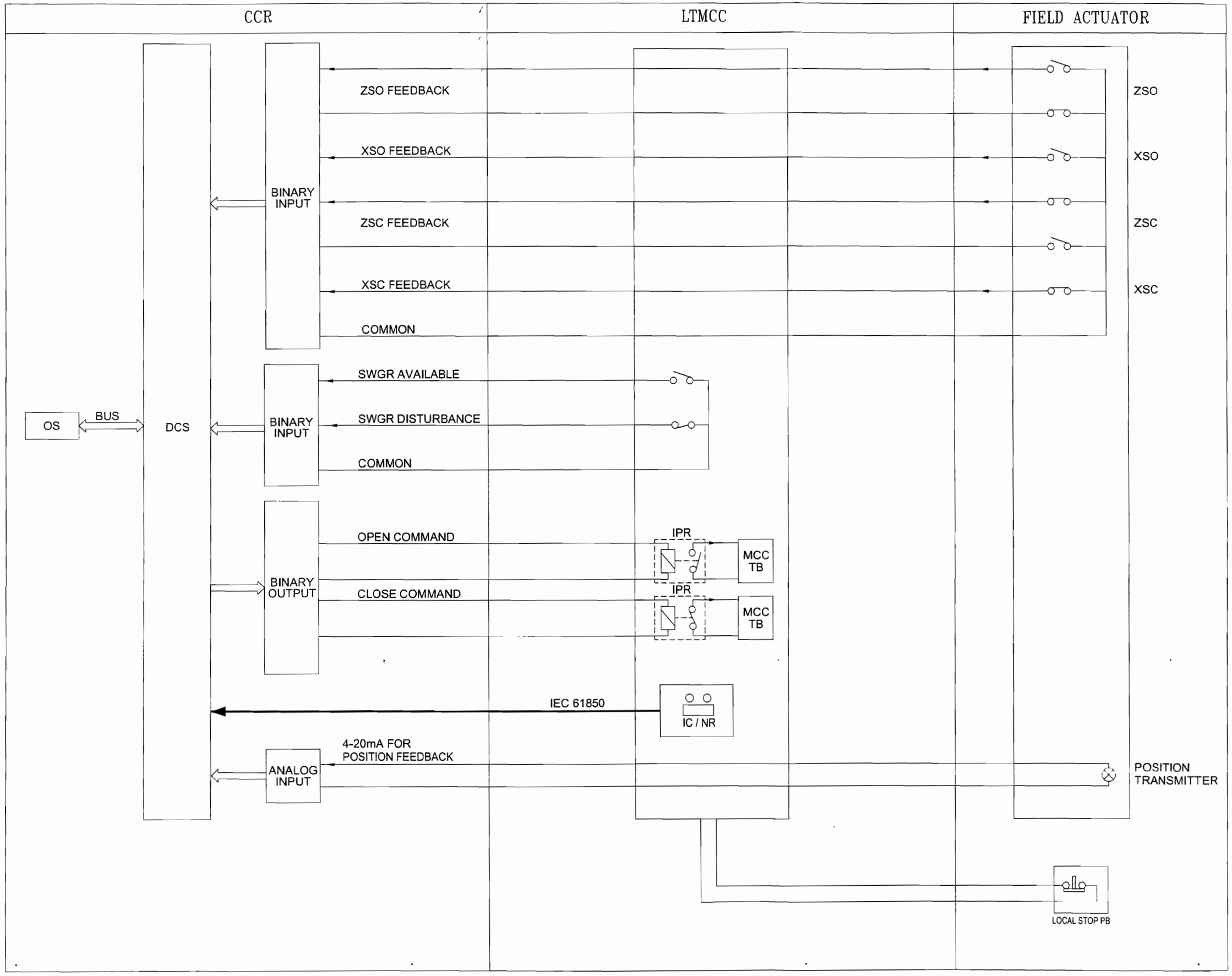
CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

DRAWING TITLE : DRIVE CONTROL PHILOSOPHY BI-DIRECTIONAL DRIVES (MOV-ON/OFF TYPE)

DRAWING NO : LII-GEOE11019-G-00172-727 | REV. 00 | SHEET 1 OF 1

Varun Jain
S A Khan
Praveen Kishore



NOTE:-

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

ABBREVIATIONS

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

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FOR CONTRACT PURPOSE ONLY

REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
		CHECKED				
00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

CONTRACT NO.		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

DRAWING TITLE : DRIVE CONTROL PHILOSOPHY BI-DIRECTIONAL DRIVES (MOV-INCHING TYPE)

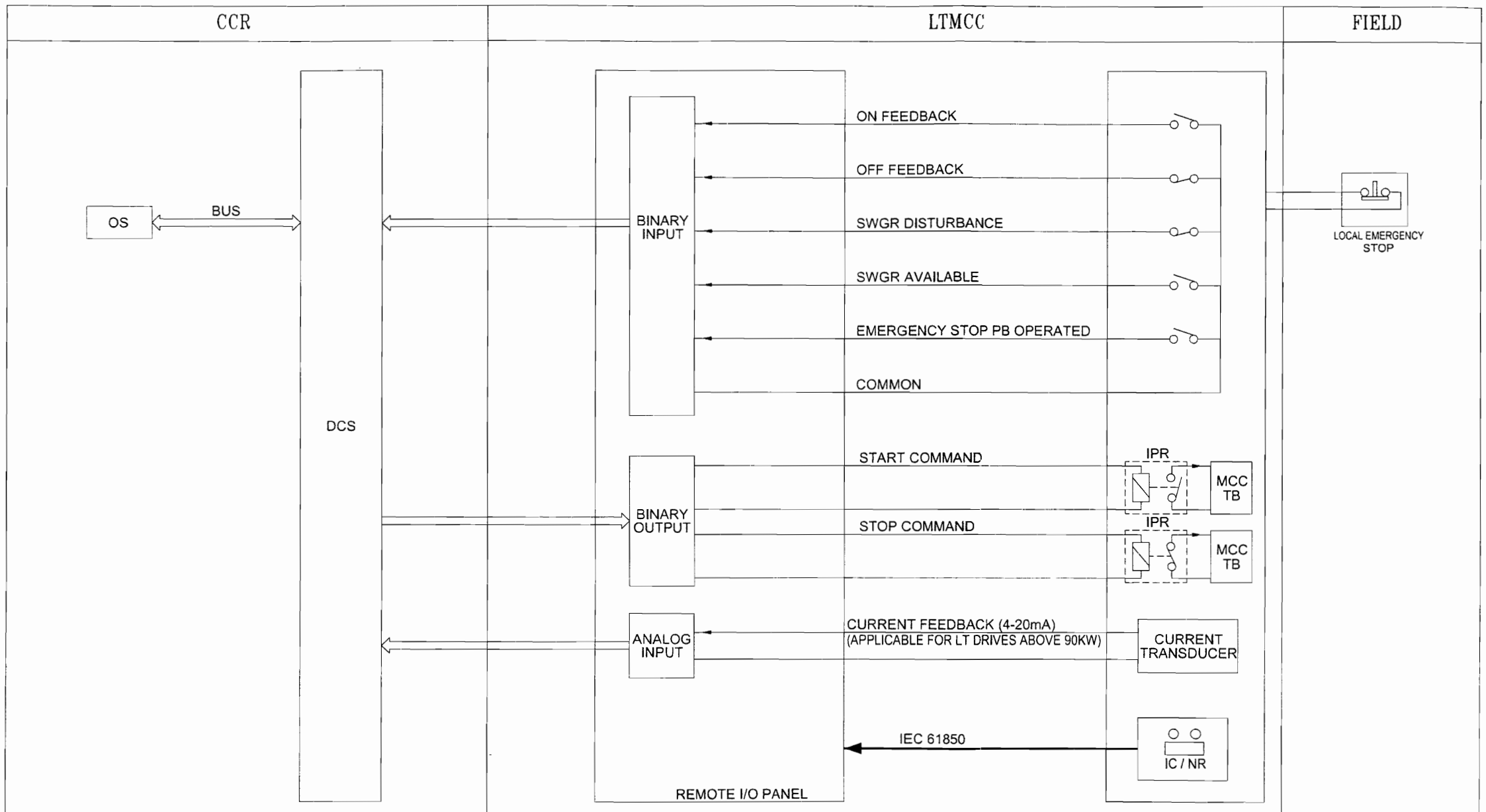
DRAWING NO : LII-GEOE11019-G-00172-728

REV.	SHEET
00	1 OF 1

Varun Jain

S A Khan

Praveen Kishore



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
IC	-	INTELLIGENT CONTROLLER
NR	-	NUMERICAL RELAY

Bharat Heavy Electricals Ltd. Power Sector, Noida

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REV No	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
		CHECKED				
00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

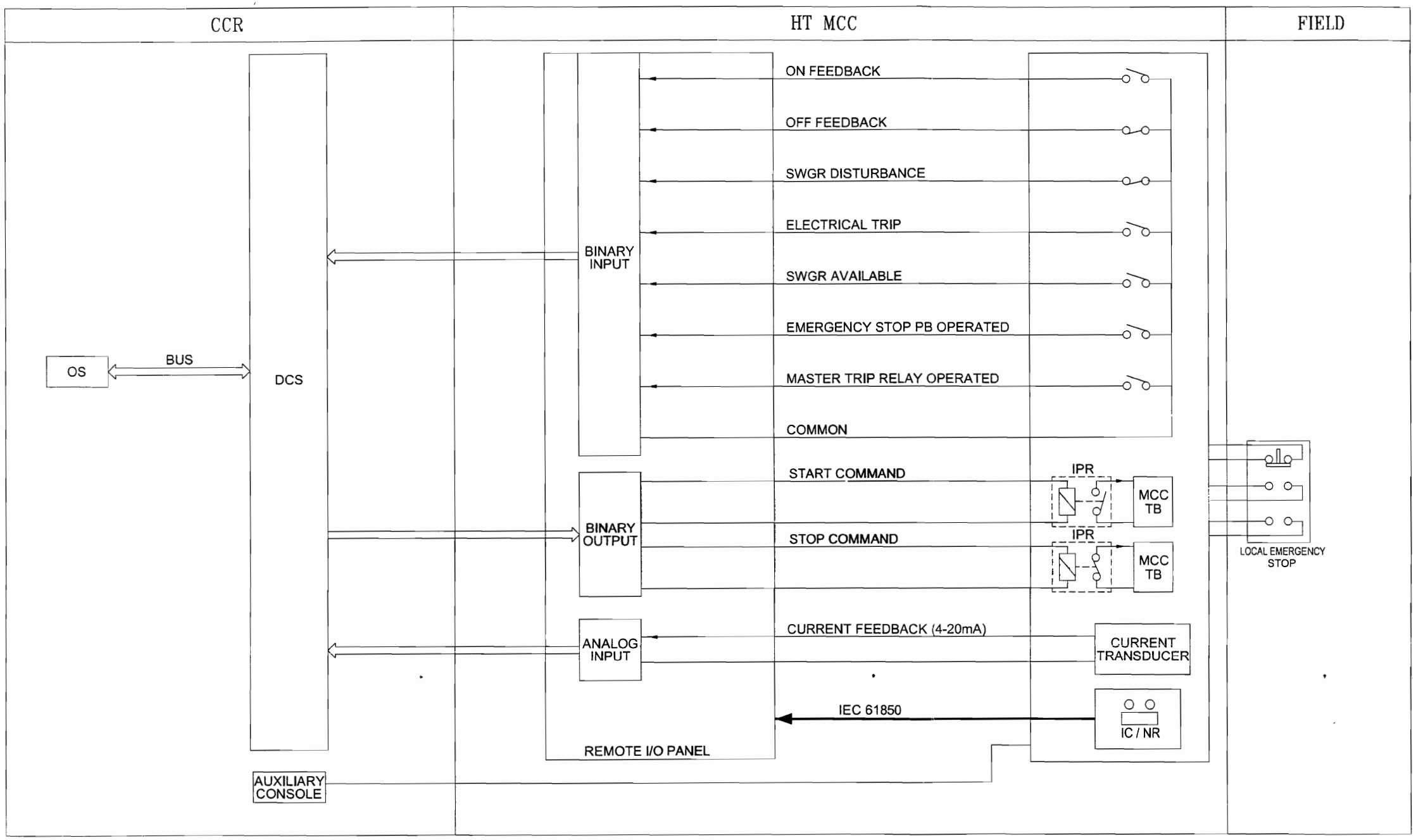
CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT: 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

DRAWING TITLE: DRIVE CONTROL PHILOSOPHY UNI-DIRECTIONAL LT DRIVE

DRAWING NO: LII-GEOE11019-G-00172-729 | REV. 00 | SHEET 1 OF 1

Varun Jain | S A Khan | Praveen Kishore



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
IC	-	INTELLIGENT CONTROLLER
NR	-	NUMERICAL RELAY

NLC LTD NEYVELI

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FOR CONTRACT PURPOSE ONLY

REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
		CHECKED				
00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

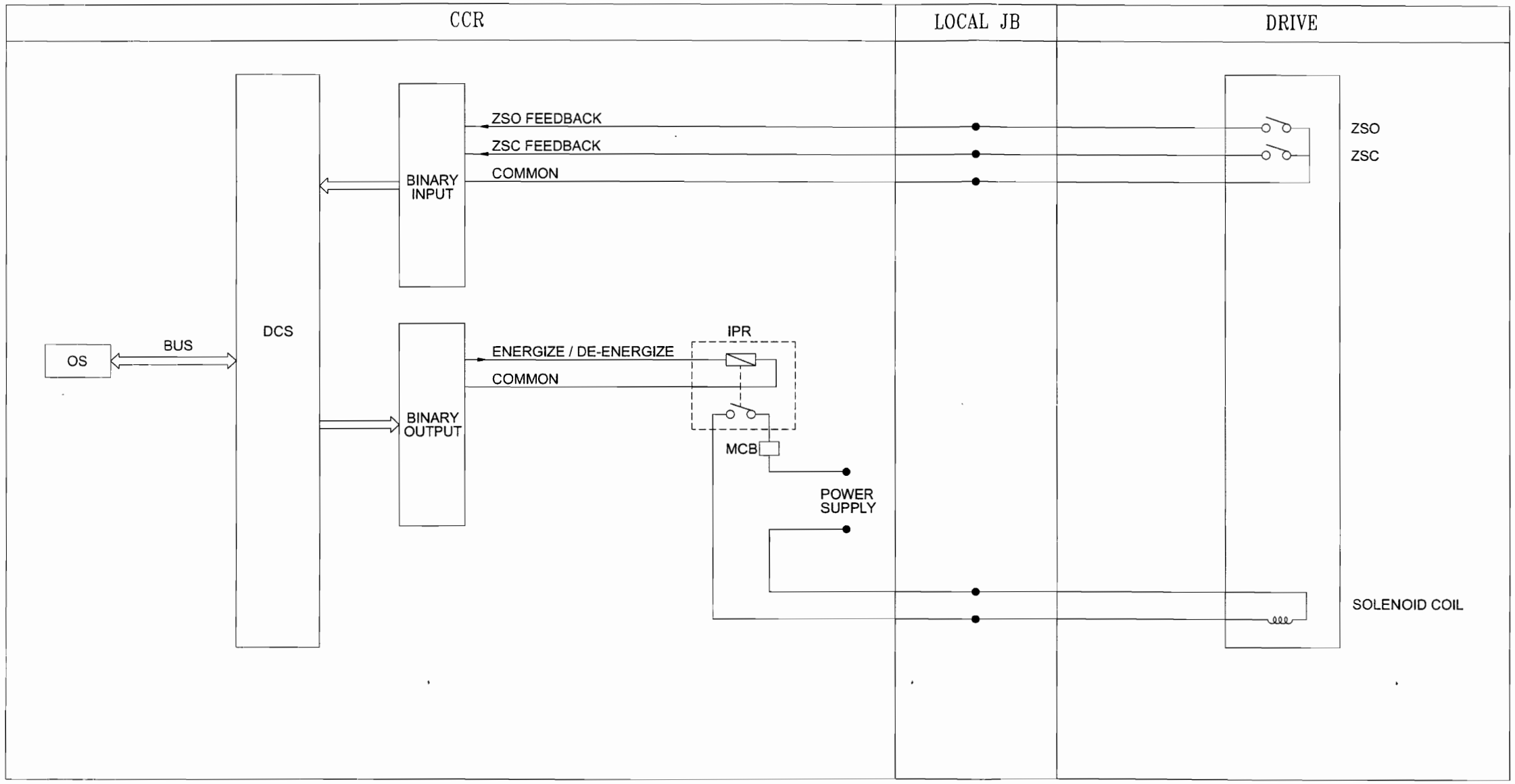
CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

DRAWING TITLE : DRIVE CONTROL PHILOSOPHY UNI-DIRECTIONAL HT DRIVE

DRAWING NO : LII-GEOE11019-G-00172-730 | REV. 00 | SHEET 1 OF 1

Varun Jain | S A Khan | Praveen Kishore



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

Bharat Heavy Electricals Limited Power Sector Noida 201301

NLC LTD

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FOR CONTRACT PURPOSE ONLY

REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
		CHECKED				
00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

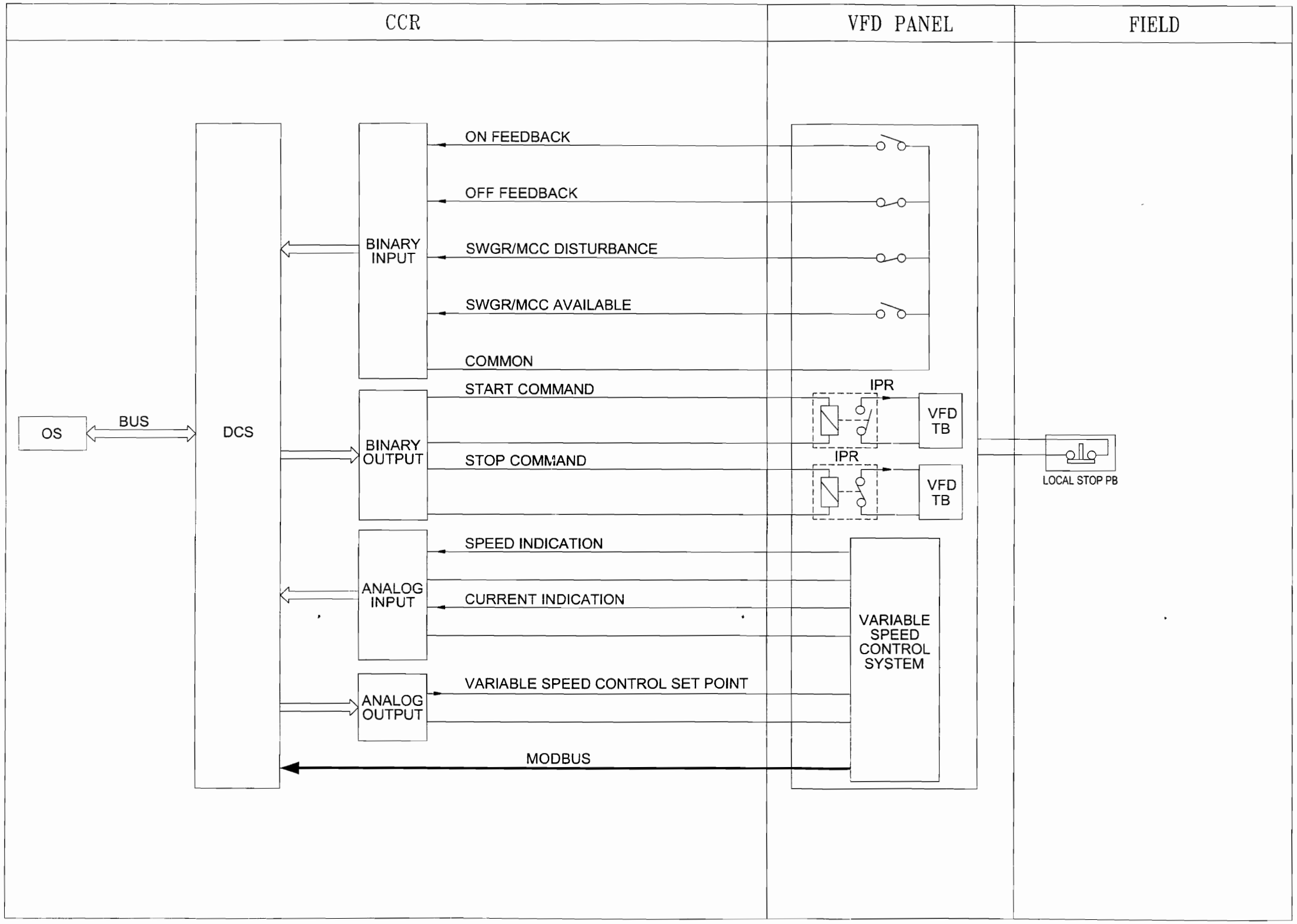
CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

DRAWING TITLE : DRIVE CONTROL PHILOSOPHY SOLENOID VALVE-SINGLE COIL

DRAWING NO : LII-GEOE11019-G-00172-731 | REV. 00 | SHEET 1 OF 1

Varun Jain S A Khan Praveen Kishore



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

Varun Jain S A Khan Praveen Kishore

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FOR CONTRACT PURPOSE ONLY

REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
		CHECKED				
01	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

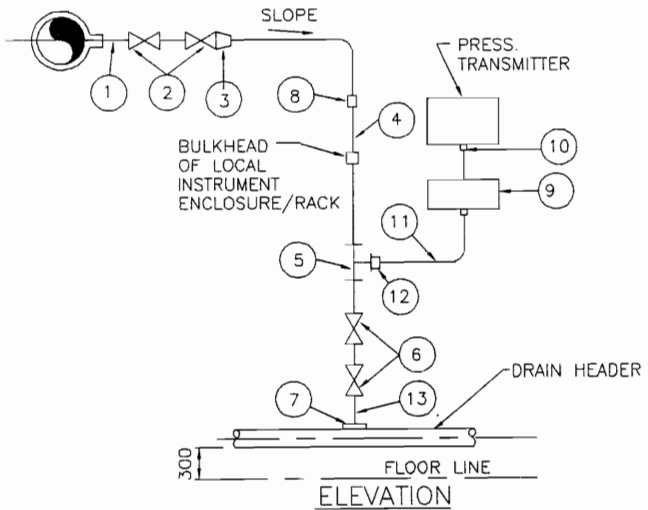
LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO .		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT . 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

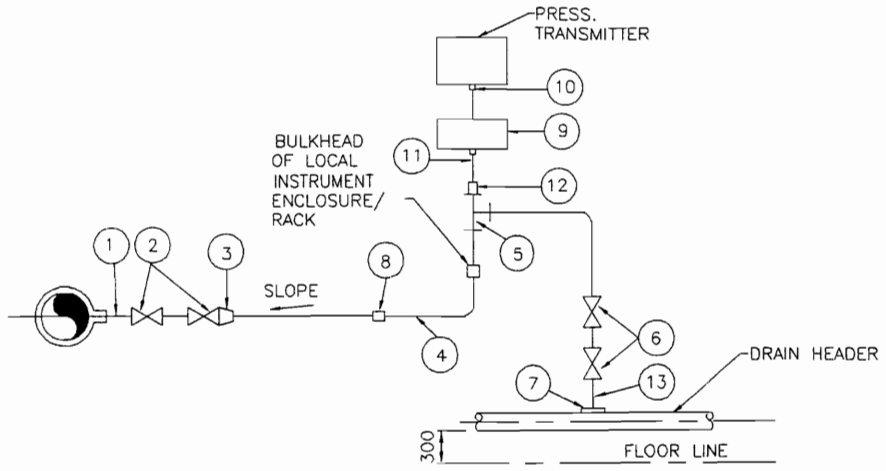
DRAWING TITLE : DRIVE CONTROL PHILOSOPHY VFD CONTROL

DRAWING NO : LII-GEOE11019-G-00172-733 | REV. 00 | SHEET 1 OF 1



ELEVATION

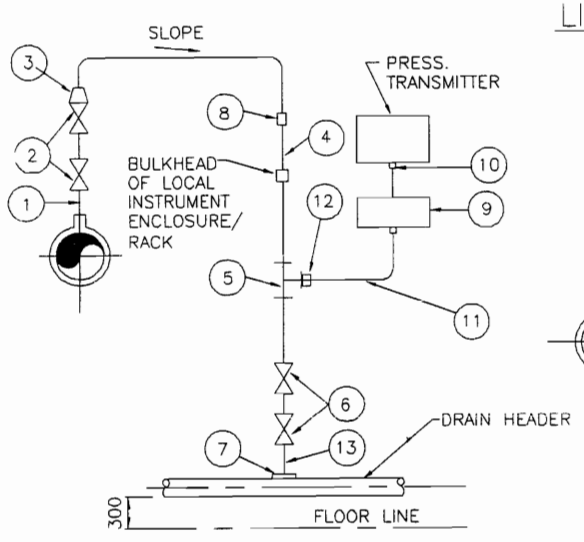
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION

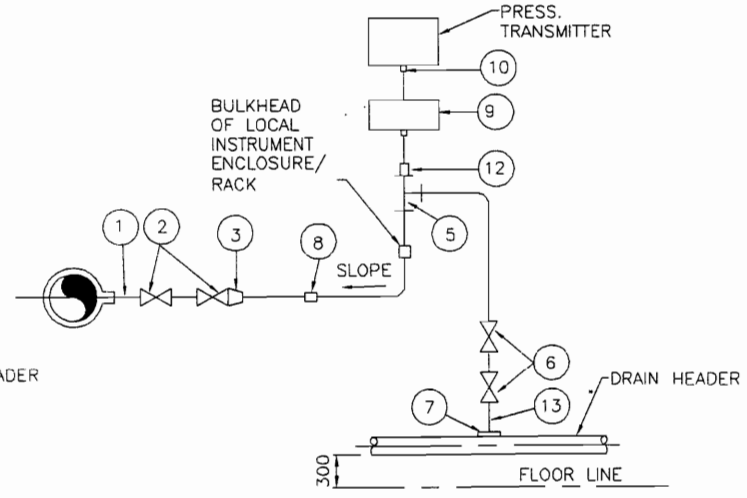
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

LIQUID PRESSURE MEASUREMENT



ELEVATION

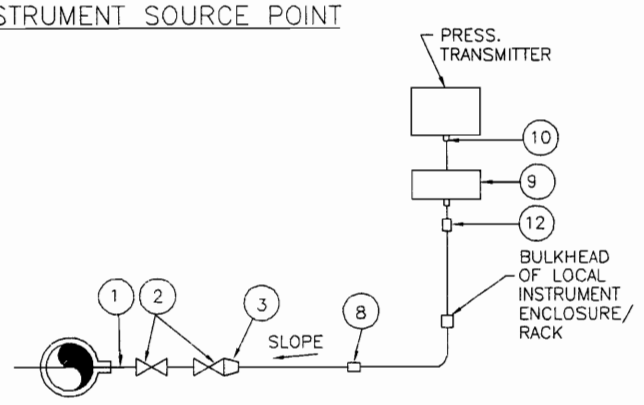
TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

STEAM PRESSURE MEASUREMENT



ELEVATION

VACCUM PRESSURE MEASUREMENT

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:-

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

Bharat Heavy Electricals Limited * Power Sector Noida * BHEL

NLC LTD. NEYVELI

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REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
		CHECKED				
00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

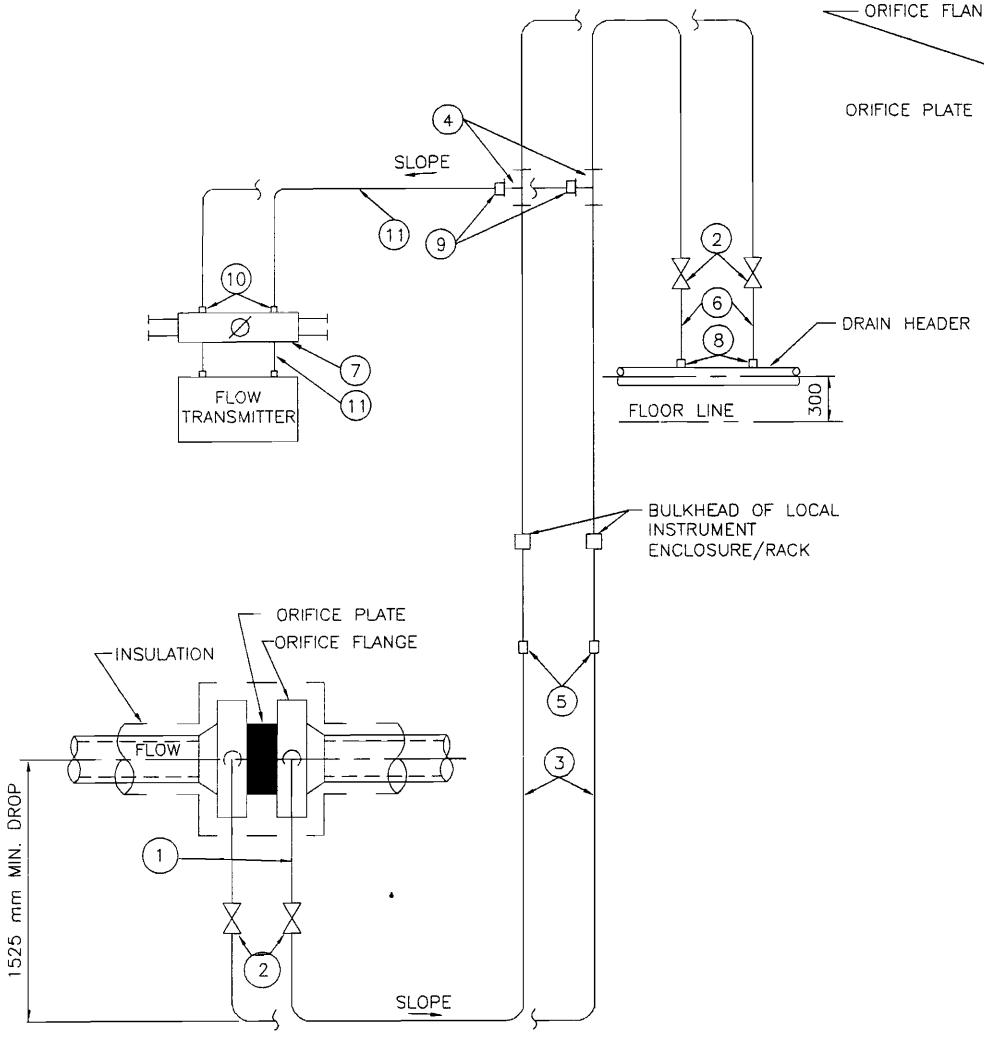
DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM (PRESSURE MEASUREMENT USING PRESS./DP TRANSMITTER STEAM/LIQUID VACCUM)

DRAWING NO : LII-GE0E11019-G-00172-703 | REV. 00 | SHEET 1 OF 1

Varun Jain

S A Khan

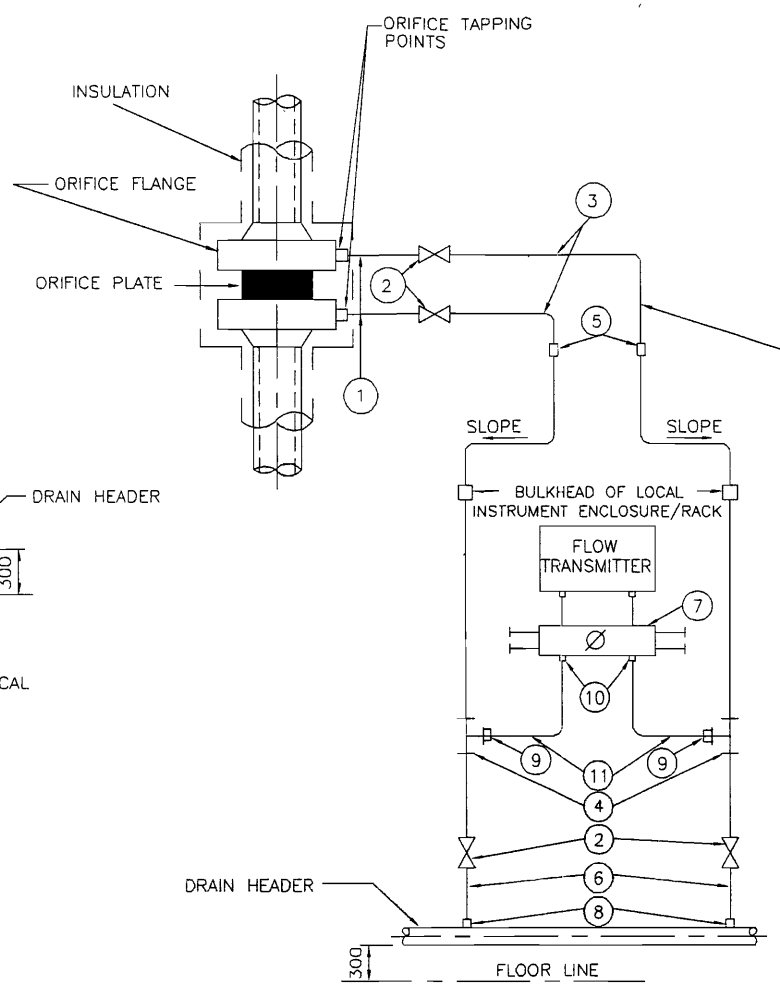
Praveen Kishore



ELEVATION

HORIZONTAL PIPE RUN

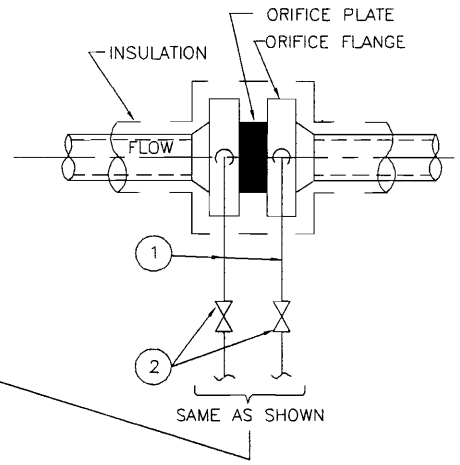
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT



ELEVATION

VERTICAL PIPE RUN

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION

HORIZONTAL PIPE RUN

LIST OF MATRERIALS

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 COUPLET CS
9	1/2" PIPE x 1/2" TUBE UNION
10	SUITABLE ADAPTER
11	SS TUBE

Varun Jain

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Praveen Kishore

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REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
		CHECKED				
00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

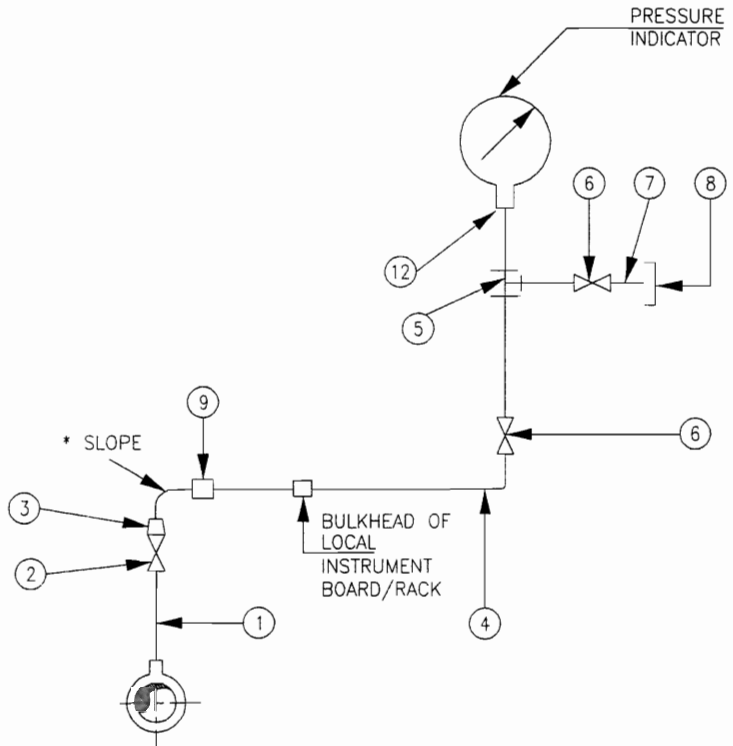
LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

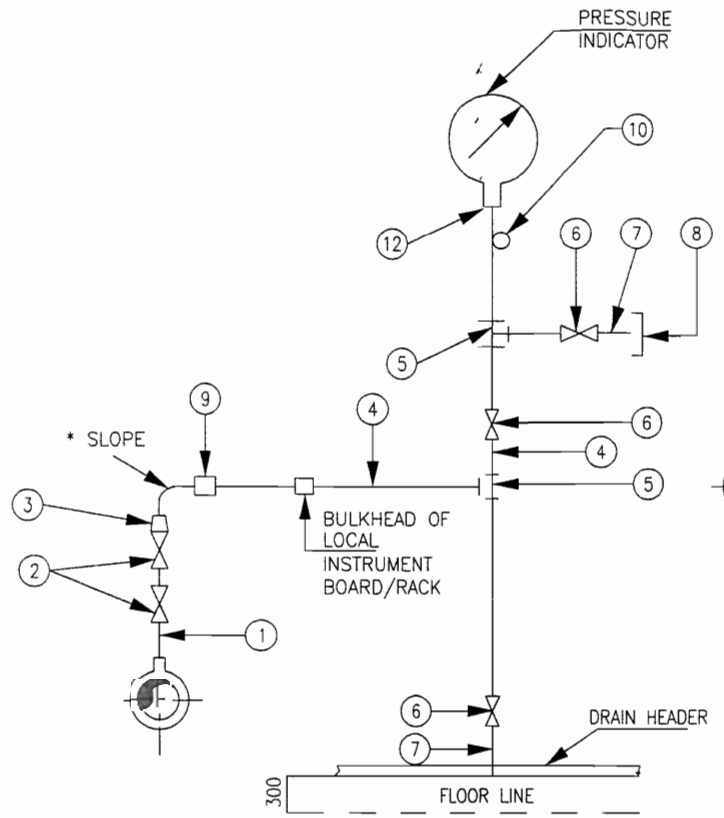
DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM FLOW MEASUREMENT (USING ORIFICE PLATES) CONDENSATE & SERVICE WATER

DRAWING NO : LII-GE0E11019-G-00172-704 | REV. 00 | SHEET 1 OF 1



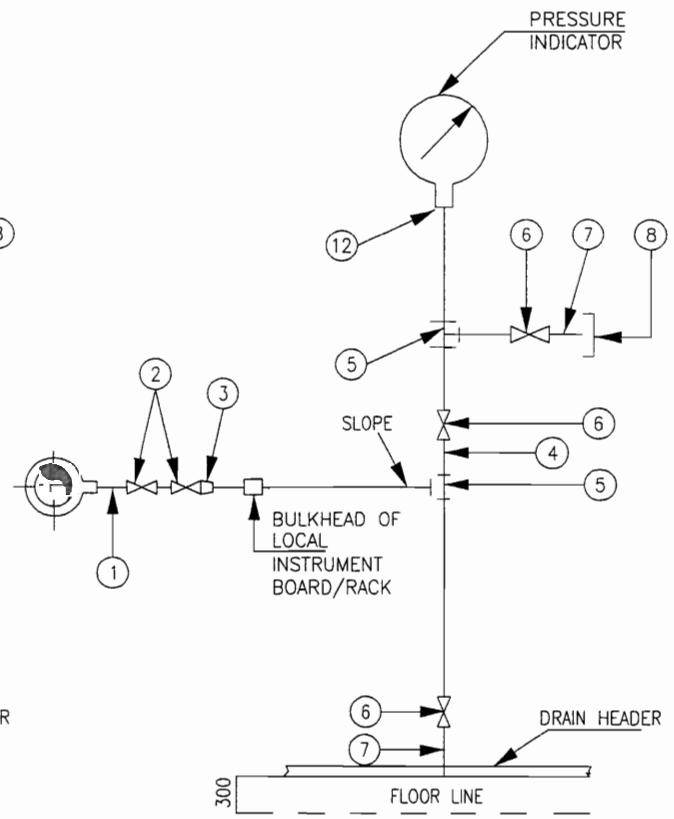
ELEVATION INST./SERVICE AIR

(PRESSURE INDICATORS MOUNTED REMOTE FROM INSTRUMENT SOURCE POINT)



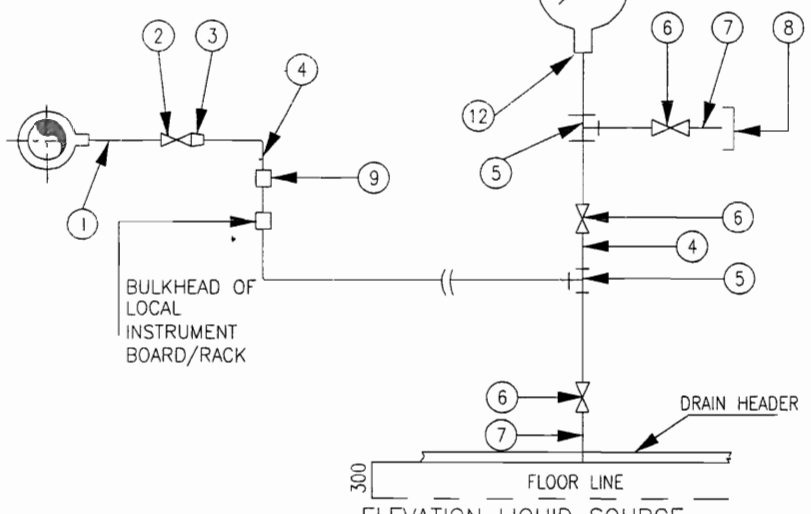
ELEVATION STEAM SERVICE

(PRESSURE INDICATORS MOUNTED REMOTE FROM INSTRUMENT SOURCE POINT)



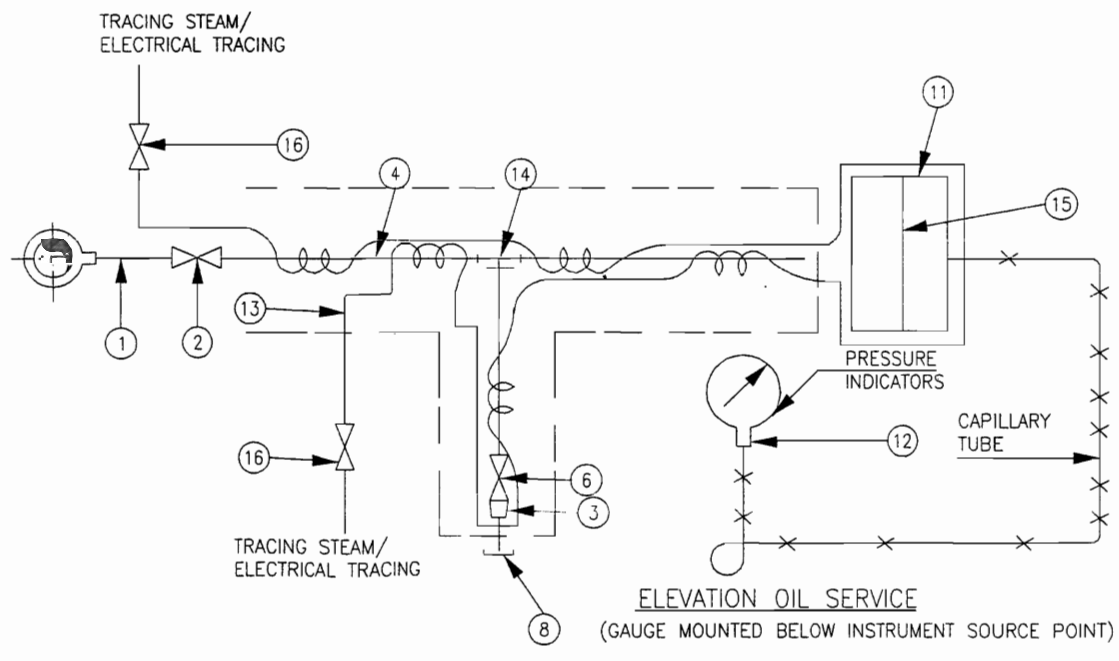
ELEVATION LIQUID SOURCE

(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 /THREDED 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 MATRERIALS

ITEM NO	DESCRIPTION
1	1/2",3/4", 1"NPS SCH 40/80/160/XXS/P91(AS PER PROCESS REQUIREMENT) NIPPLE OF MATRIAL 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

Bharat Heavy Electricals Limited Power Sector Manufacturing Unit New Delhi

NLC LTD NEYVELI 082

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REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
		CHECKED				
00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

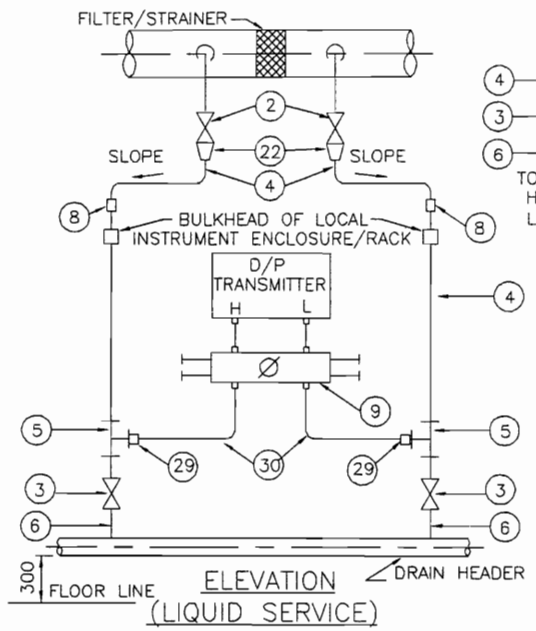
DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM (FOR PRESSURE GAUGE)

DRAWING NO : LII-GE0E11019-G-00172-705 | REV. 00 | SHEET 1 OF 1

Varun Jain

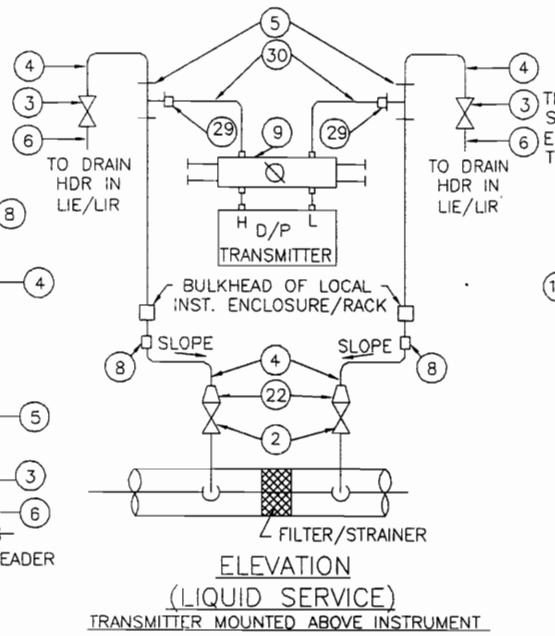
S A Khan

Praveen Kishore



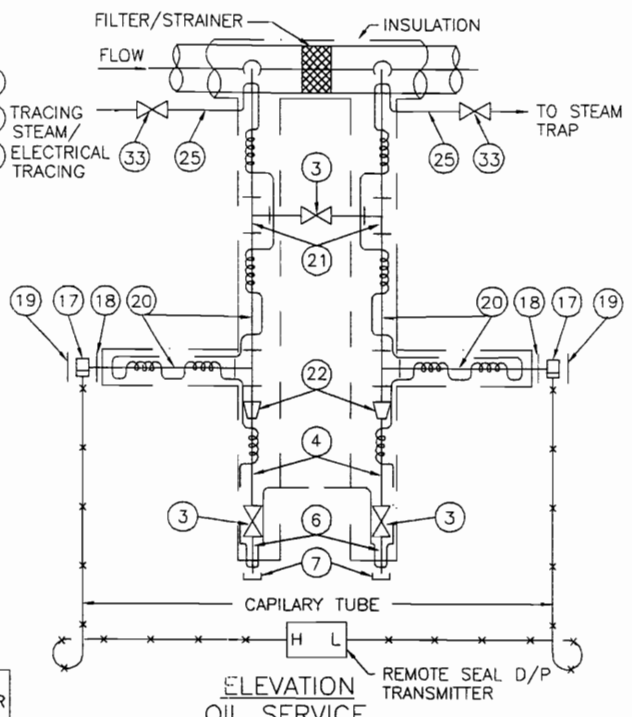
ELEVATION
(LIQUID SERVICE)

TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

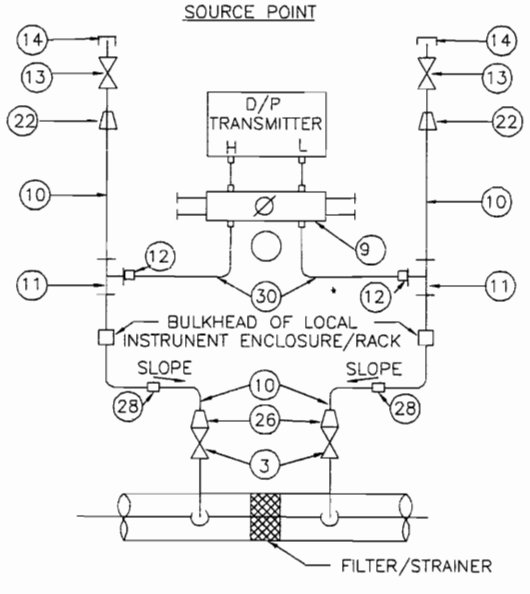


ELEVATION
(LIQUID SERVICE)

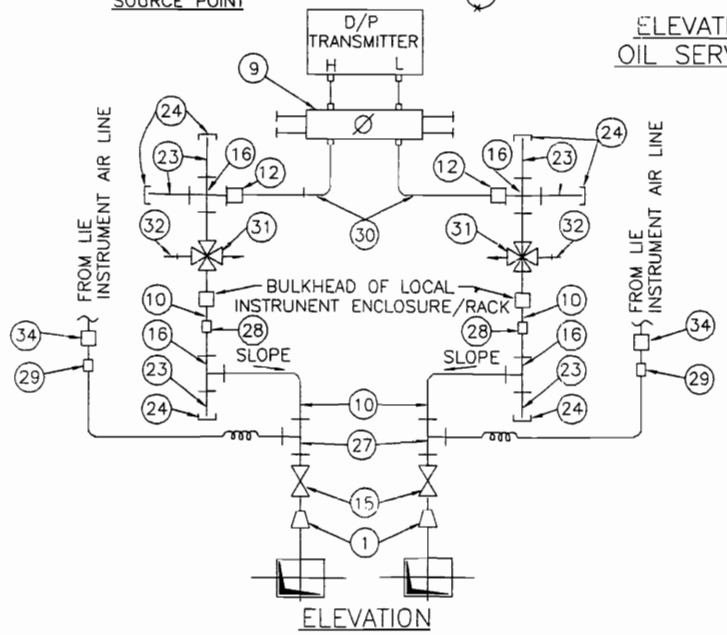
TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT



ELEVATION
OIL SERVICE



ELEVATION
CLEAN GAS/AIR SERVICE



ELEVATION
FLUE GAS SERVICE/DIRTY AIR SERVICE

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
DIFFERENTIAL PRESSURE MEASUREMENT

Varun Jain

S A Khan

Praveen Kishore

LIST OF MATRERIALS

ITEM NO	DESCRIPTION
1	42x2 TO 3/4" SW REDUCING AGENT
2	3/4" SW GLOBE VALVE
3	1/2" SW GLOBE VALVE FOR LIQUID APPLICATION & 3/4" / 1" IN GAS / AIR APPLICATION
4	1/2" NPS 40/80/160 (AS PER PROCESS REQUIREMENT) CARBON / ALLOY STEEL PIPE
5	1/2" SW EQUAL TEE
6	1/2" NPS SW x 1/2" NPT(M) CS NIPPLE
7	1/2" NPT (F) CS CAP
8	1/2" PIPE x 1/2" PIPE UNION
9	5 VALVE MANIFOLD
10	3/4" SCH 80 CARBON / ALLOY STEEL PIPE
11	3/4" / 1/2" SW EQUAL TEE
12	3/4" x 1/2" TUBE UNION
13	1/2" SCREWED GLOBE VALVE
14	1/2" NPT (M) PLUG
15	3/4" SW GATE VALVE
16	3/4" SW EQUAL CROSS
17	WAFER ELEMENT FOR USE WITH 3" ANSI R.F VALVE
18	3" BLIND 300lbs R.F. WELD NECK FLANGE DRILLED FOR 1" SCH. 40/80 PIPE
19	3/4" BLIND FLANGE
20	1" NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) CS PIPE
21	1" SW EQUAL TEE
22	3/4" X 1/2" SW REDUCING INSERT
23	3/4" SW x 3/4" NPT (M) CS/AS NIPPLE
24	3/4" NPT (F) CS/AS CAP
25	1/4" NPS ALLOY STEEL PIPE
26	1" x 3/4" REDUCING AGENT
27	3/4" SW x 1/2" PSW BRANCH TEE
28	3/4" PIPE UNION
29	1/2" CLAMP UNION (THREADED) SUITABLE FOR FLEXIBLE CONNECTION OF NYLON REINFORCED PVC TUBE
30	SS TUBE
31	3/4" SW 4 WAY VALVE
32	QUICK DISCONNECT FITTINGS
33	1/4" SW ISOLATION VALVE 316SS
34	1/2" x 1/2" SS PIPE UNION

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FOR CONTRACT PURPOSE ONLY

REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
		CHECKED				
00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

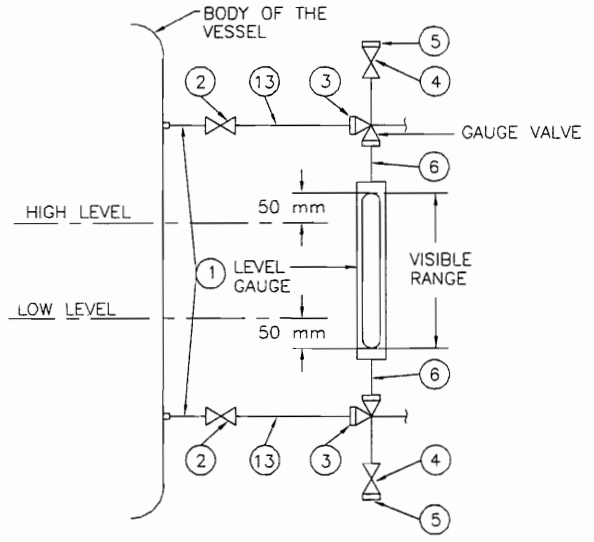
LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

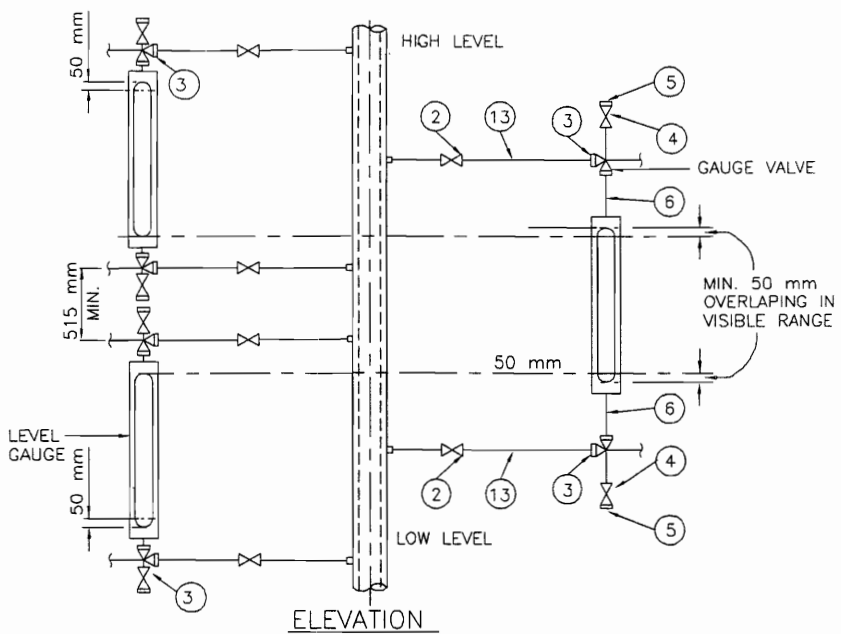
DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM
DIFF. PRESS. MEASUREMENT (LIQUID,OIL,AIR/GAS SERVICE)

DRAWING NO : LII-GE0E11019-G-00172-706 | REV. 00 | SHEET 1 OF 1



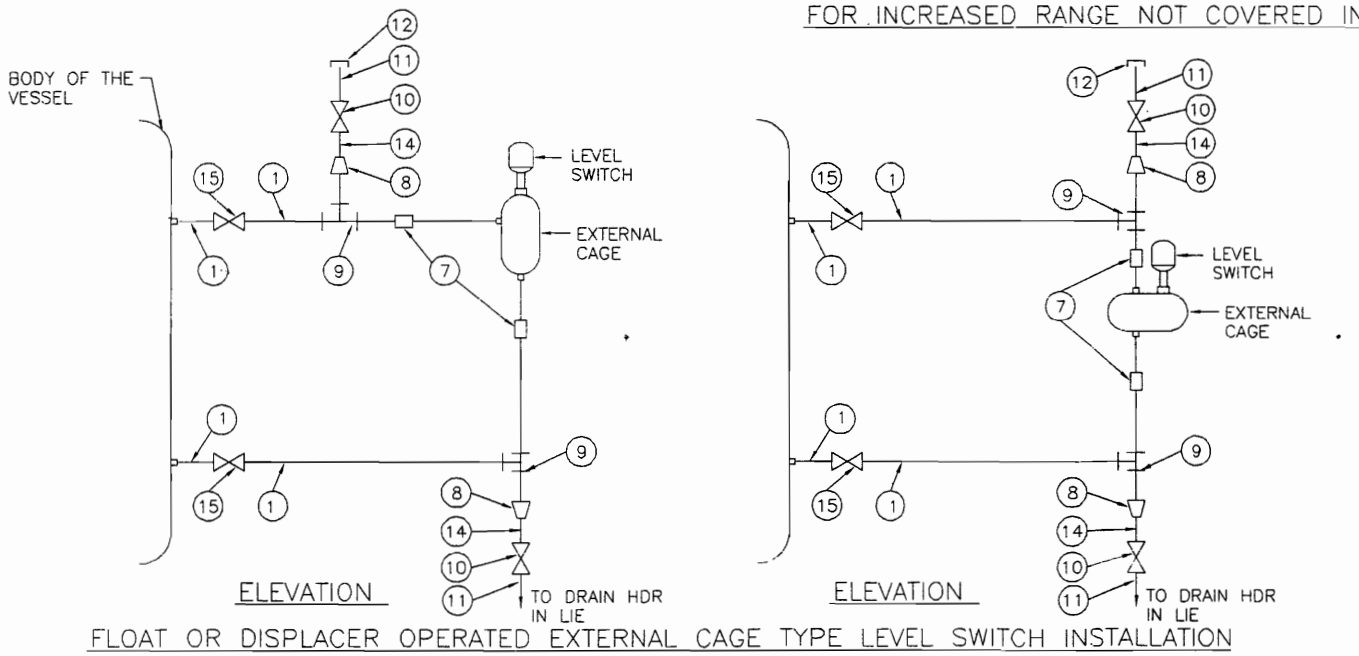
ELEVATION

LOCAL LEVEL INDICATION USING GAUGE GLASS



ELEVATION

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



FLOAT OR DISPLACER OPERATED EXTERNAL CAGE TYPE LEVEL SWITCH INSTALLATION

LIST OF MATRERIALS

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:-

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

Bharat Heavy Electricals Limited Power Sector Market New Delhi - 110049

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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

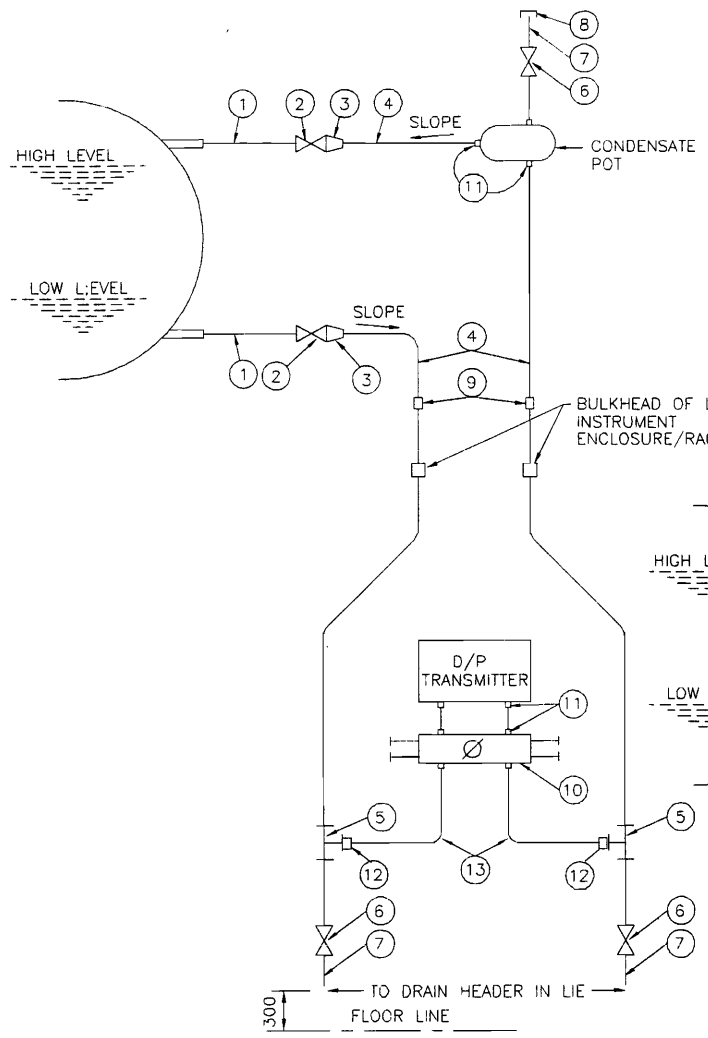
CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM (LEVEL GAUGE AND SWITCHES)

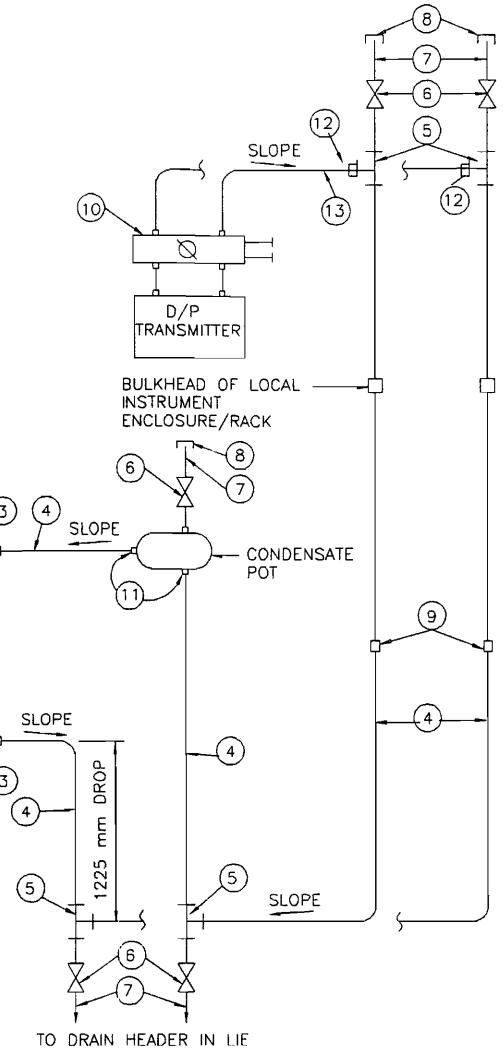
DRAWING NO : LII-GE0E11019-G-00172-707 | REV. 00 | SHEET 1 OF 1

Varun Jain S A Khan Praveen Kishore



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

Heavy Electricals Limited * Boiler Auxiliary * New Delhi - 110049

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REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
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00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

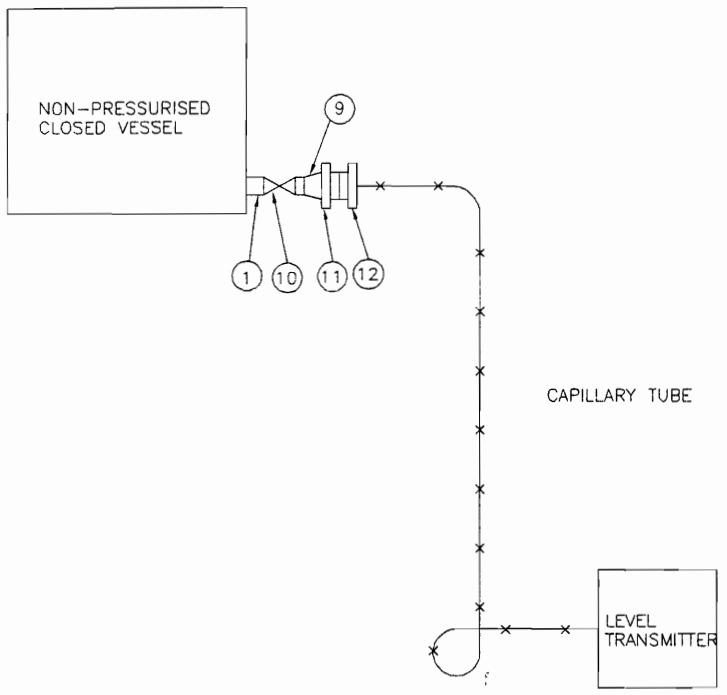
DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM (LEVEL MEASUREMENT USING D/P TRANSMITTER)

DRAWING NO : LII-GE0E11019-G-00172-708 | REV 00 | SHEET 1 OF 2

Varun Jain

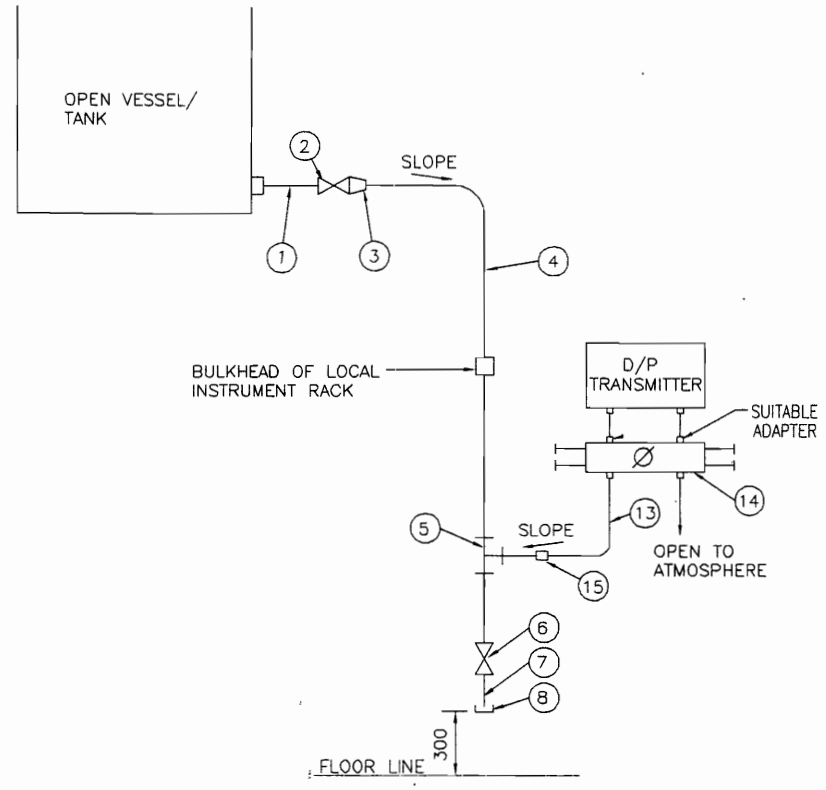
S A Khan

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:-

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

Bharat Heavy Electricals Limited Power Sector Marketing New Delhi

NLC LTD. NEYVELI

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REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
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00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM (LEVEL MEASUREMENT- CLOSED/OPEN VESSEL)

DRAWING NO : LII-GE0E11019-G-00172-709 | REV. 00 | SHEET 1 OF 1

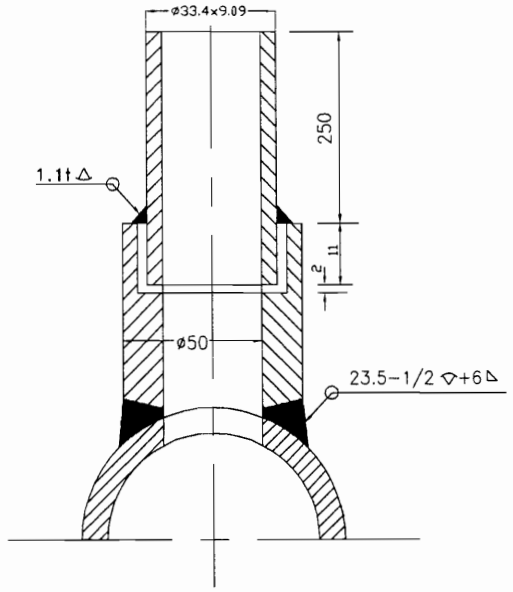
Varun Jain

S A Khan

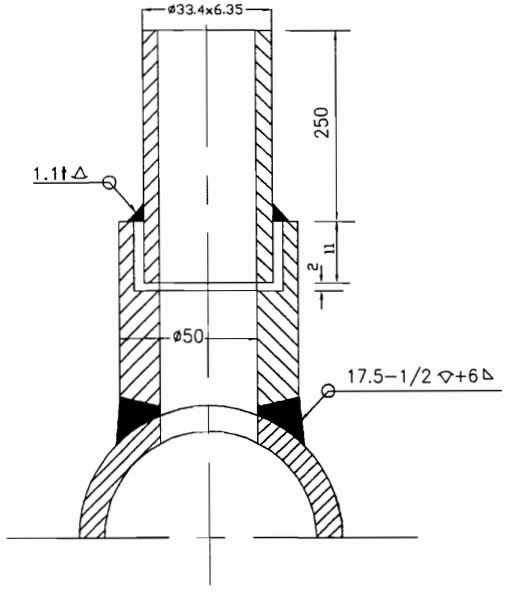
Praveen Kishore

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=>62Kg/MCm2 & 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.

Bharat Heavy Electricals Limited ★ Power Sector ★ New Delhi - 110049

NLC LTD. NEYVELI

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REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
			CHECKED			
00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

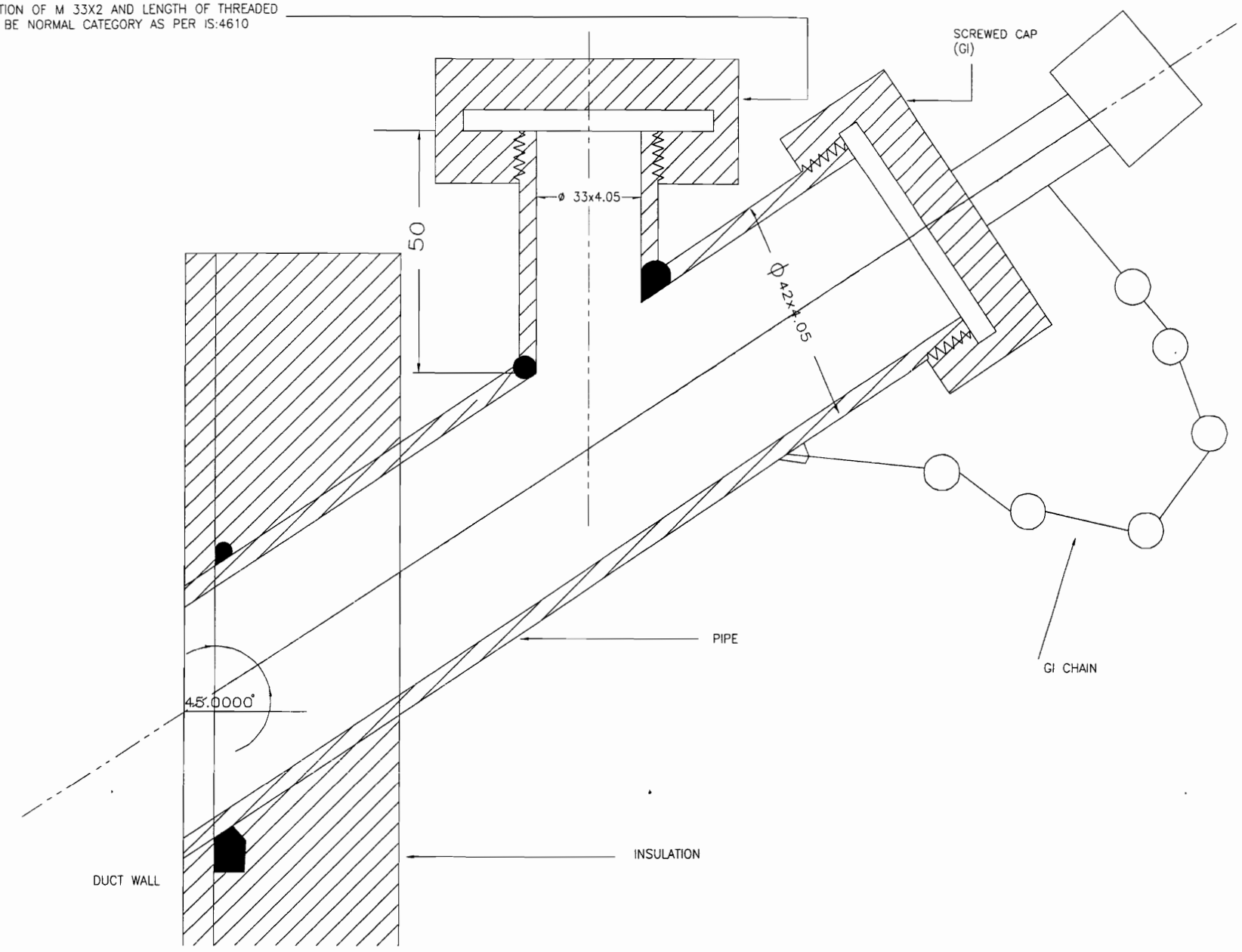
PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - PRESSURE MEASUREMENT

DRAWING NO : LII-GE0E11019-G-00172-710 | REV. 00 | SHEET 1 OF 1

Varun Jain | S A Khan | Praveen Kishore

PRESSURE MEASUREMENT



NOTES:-

1 THIS TYPE OF PRESSURE CONNECTION SHALL BE PROVIDED FOR PRESSURE MEASUREMENTS IN AIR AND FLUE GAS DUCT/FURNACE

2. DIMENSION ARE INDICATIVE ONLY.

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REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
		CHECKED				
00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - PRESSURE MESUREMENT

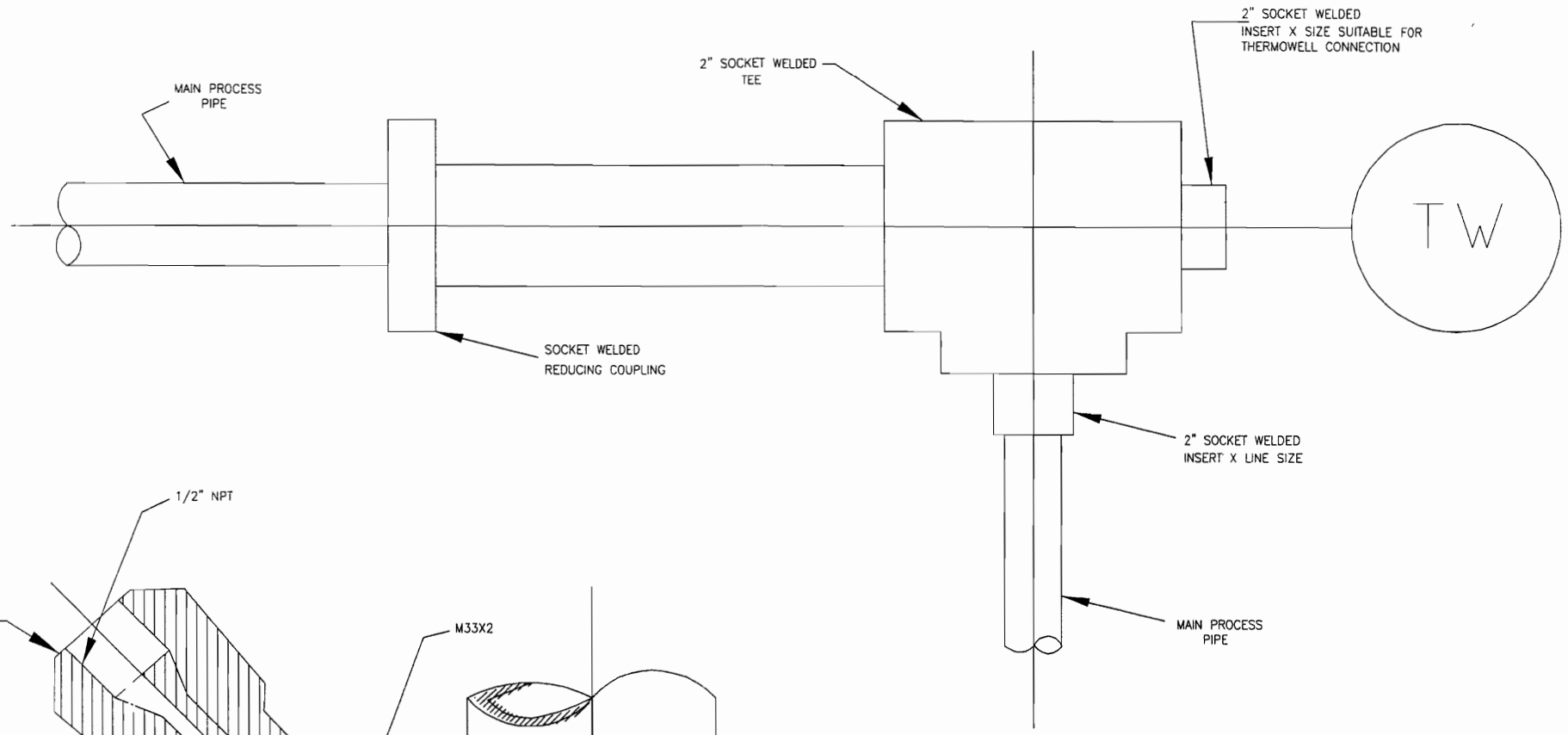
DRAWING NO : LII-GEOE11019-G-00172-711 | REV. : 00 | SHEET : 1 OF 1

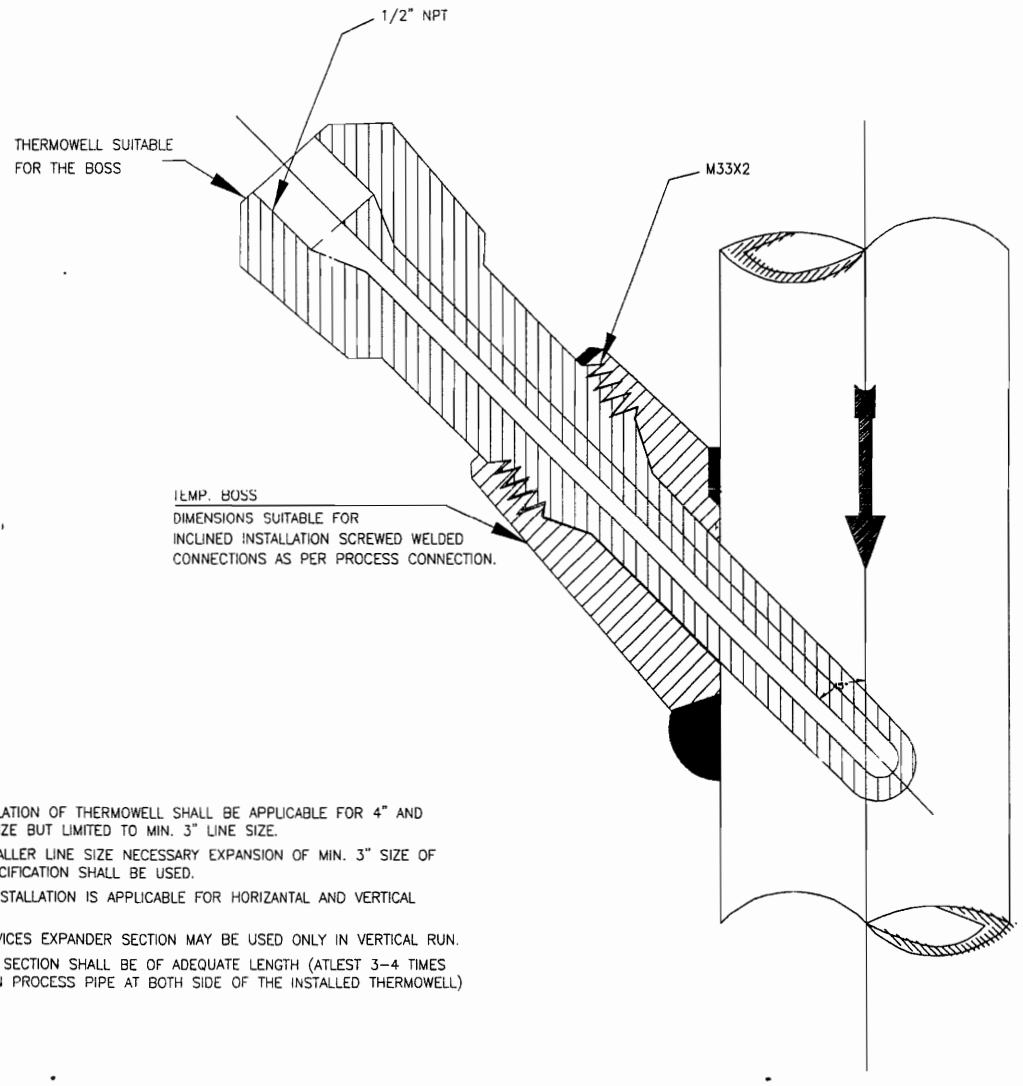
Varun Jain

S A Khan

Praveen Kishore

TEMP. MEASUREMENT





ELEVATION LIQUID SOURCE

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 MAN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZANTAL 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)

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)

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REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
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00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

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APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : - 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

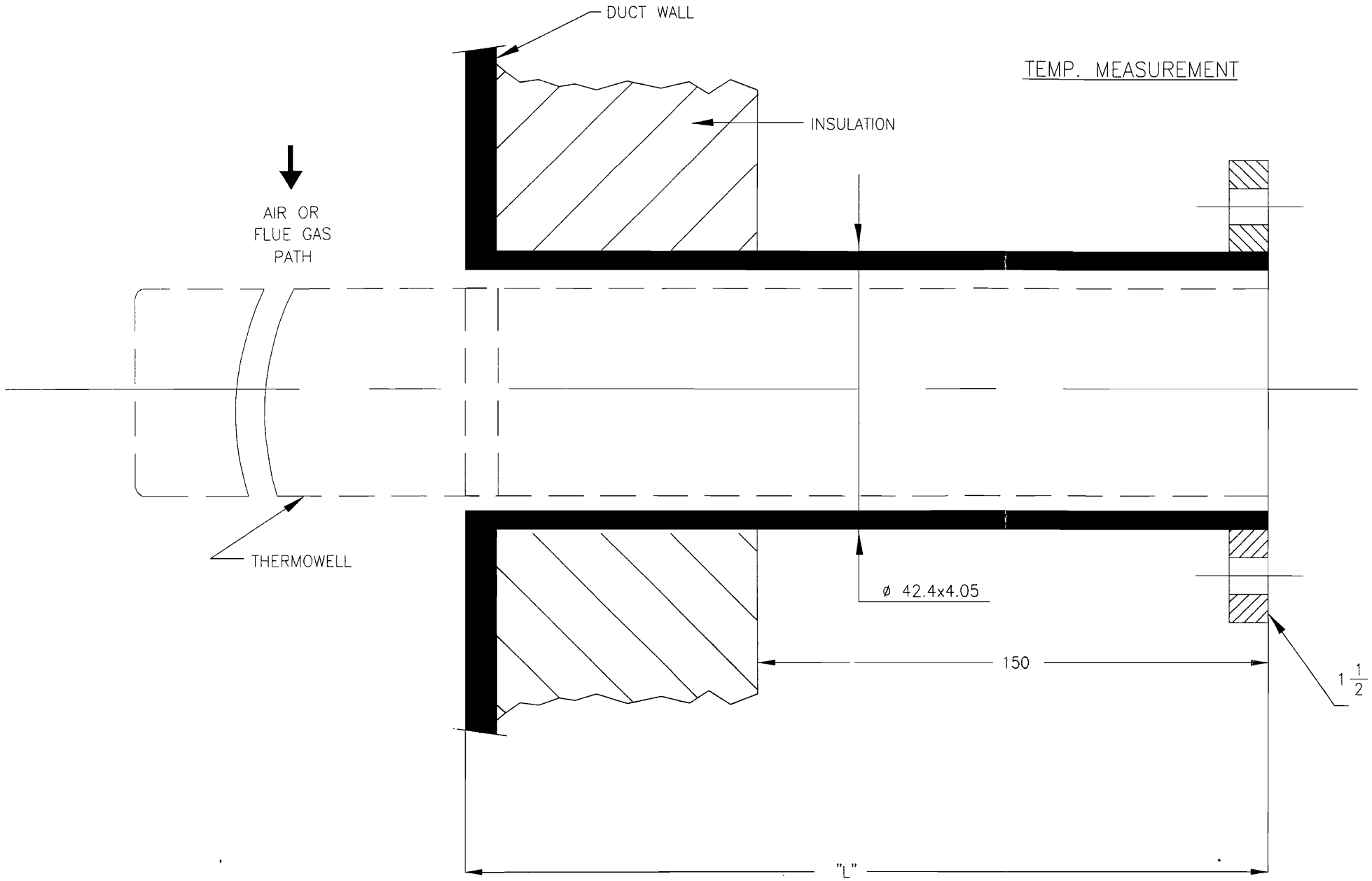
DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - TEMP. MESUREMENT

DRAWING NO : LII-GE0E11019-G-00172-712 | REV. 00 | SHEET 1 OF 1

Varun Jain

S A Khan

Praveen Kishore



TEMP. MEASUREMENT

NOTES:–

1. THIS TYPE OF THERMOWELL CONNECTION SHALL BE PROVIDED FOR TEMPERATURE MEASUREMENT IN AIR AND FLUE GAS DUCT
2. MATERIAL OF THERMOWELL SHALL BE OF 316SS.
3. EXTERNAL CONNECTION SHALL BE OF SLIP ON FLANGED TYPE AND THERMOWELL DESIGN SHALL BE AS PER ASME. PTC--19.3
4. CONTRACTOR TO SUPPLY AND INSTALL THE COUNTER FLANGED AND THERMOWELL (ALONG WITH TEMP. ELEMENT)
5. ALL DIMENSIONS ARE INDICATIVE ONLY

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FOR CONTRACT PURPOSE ONLY

REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
		CHECKED				
00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

CONTRACT NO :		
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CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

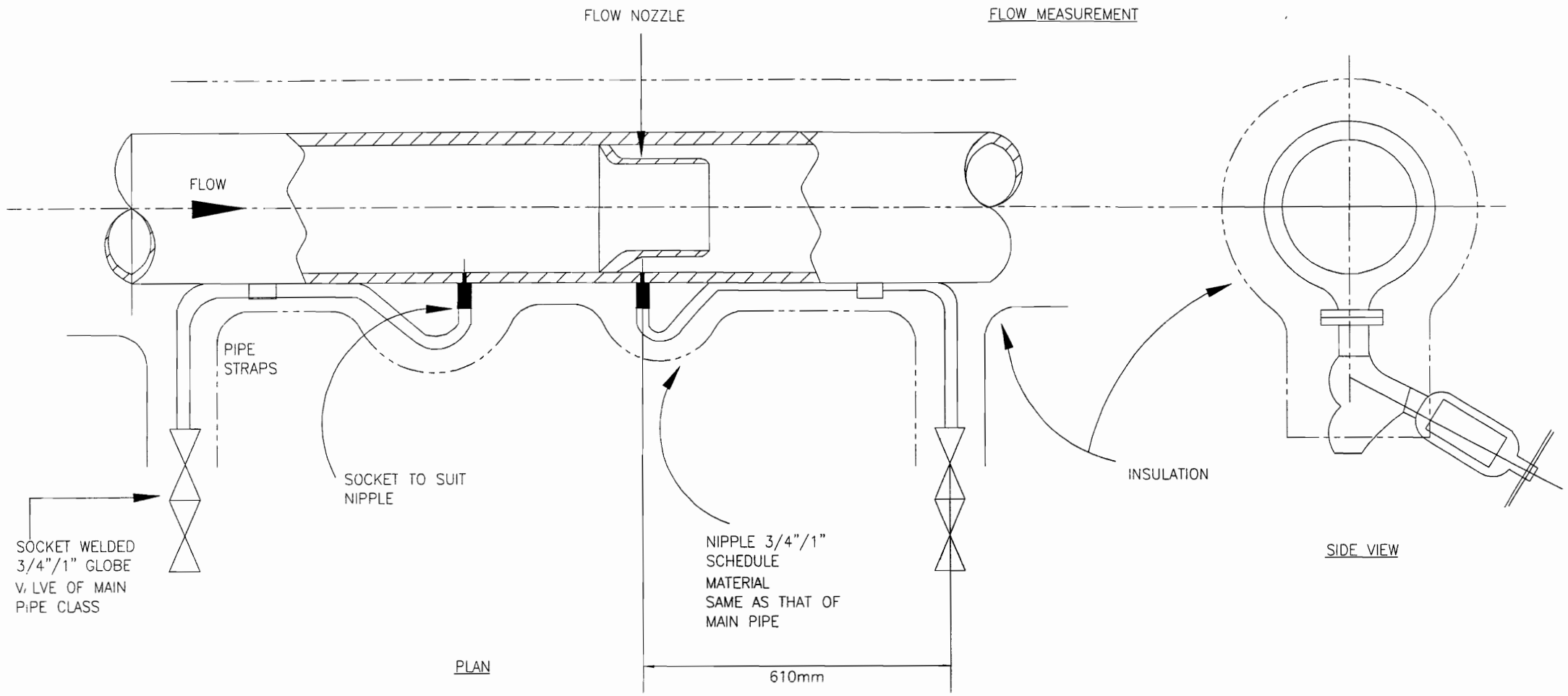
DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - TEMP. MESUREMENT

DRAWING NO : LII-GE0E11019-G-00172-713 | REV. 00 | SHEET 1 OF 1

Varun Jain

S A Khan

Praveen Kishore



PLAN

FLOW MEASUREMENT

SIDE VIEW

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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REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
00	16.12.13				SKM	

CHECKED

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

CONTRACT NO :		
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CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

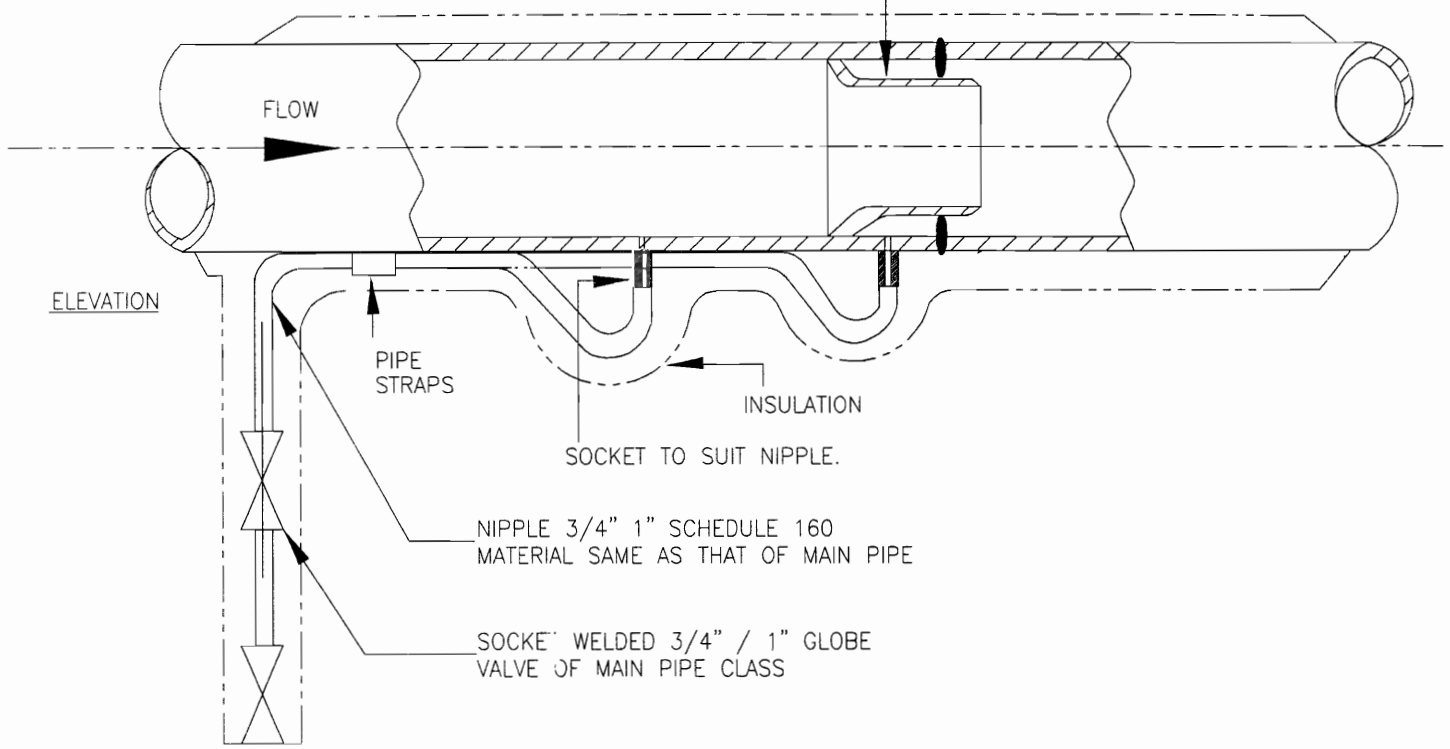
DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - FLOW MEASUREMENT

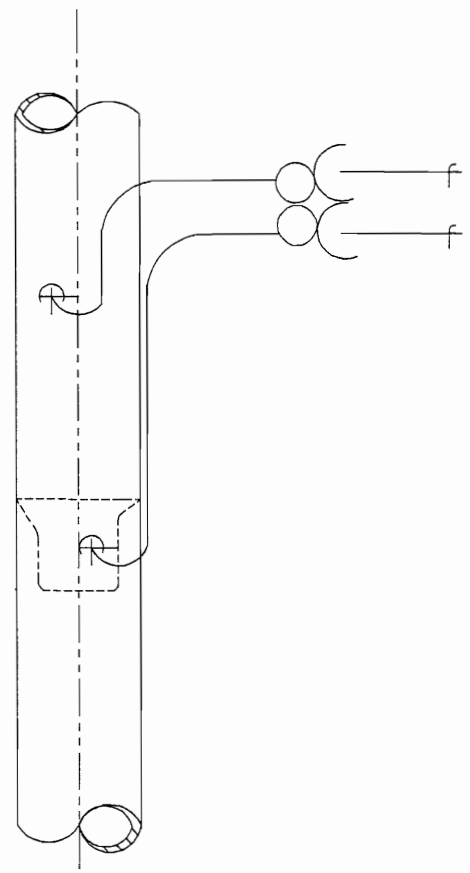
DRAWING NO : LII-GEOE11019-G-00172-714 | REV. 00 | SHEET 1 OF 1

Varun Jain | S A Khan | Praveen Kishore

FLOW NOZZLE

FLOW MEASUREMENT





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.

Varun Jain

S A Khan

Praveen Kishore

092

FOR CONTRACT PURPOSE ONLY

REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
		CHECKED				
00	16.12.13				SKM	

NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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

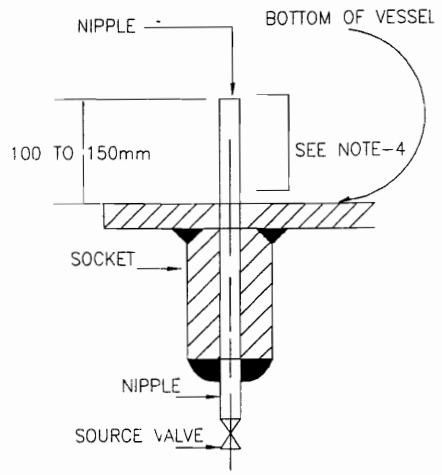
CONTRACT NO :		
PREPARED	NAME	DATE
DRAWN BY	PS	16-DEC-13
DESIGNED BY	NHR	16-DEC-13
CHECKED BY	SKM	16-DEC-13
APPROVED BY	AJV	16-DEC-13
SHEET SIZE	A3	
SCALE	NTS	

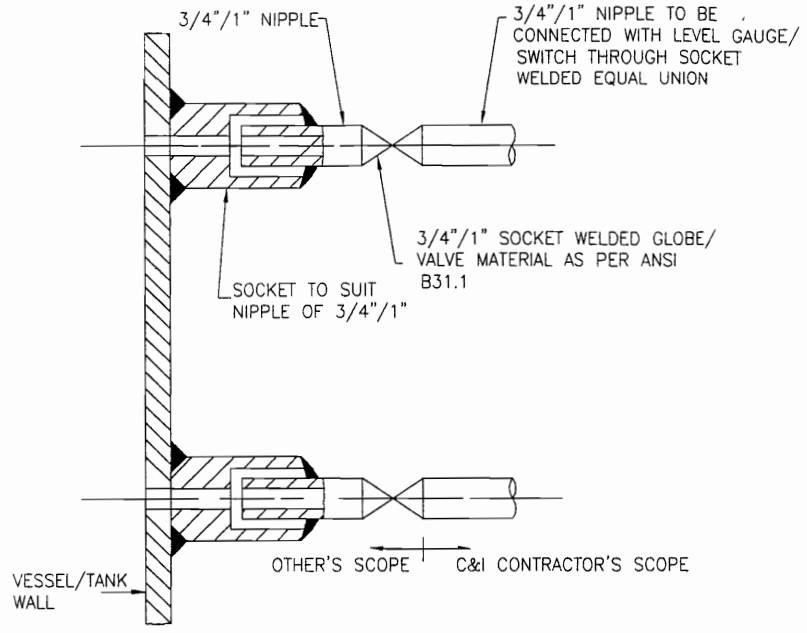
PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - FLOW MEASUREMENT

DRAWING NO : LII-GE0E11019-G-00172-715 | REV. 00 | SHEET 1 OF 1

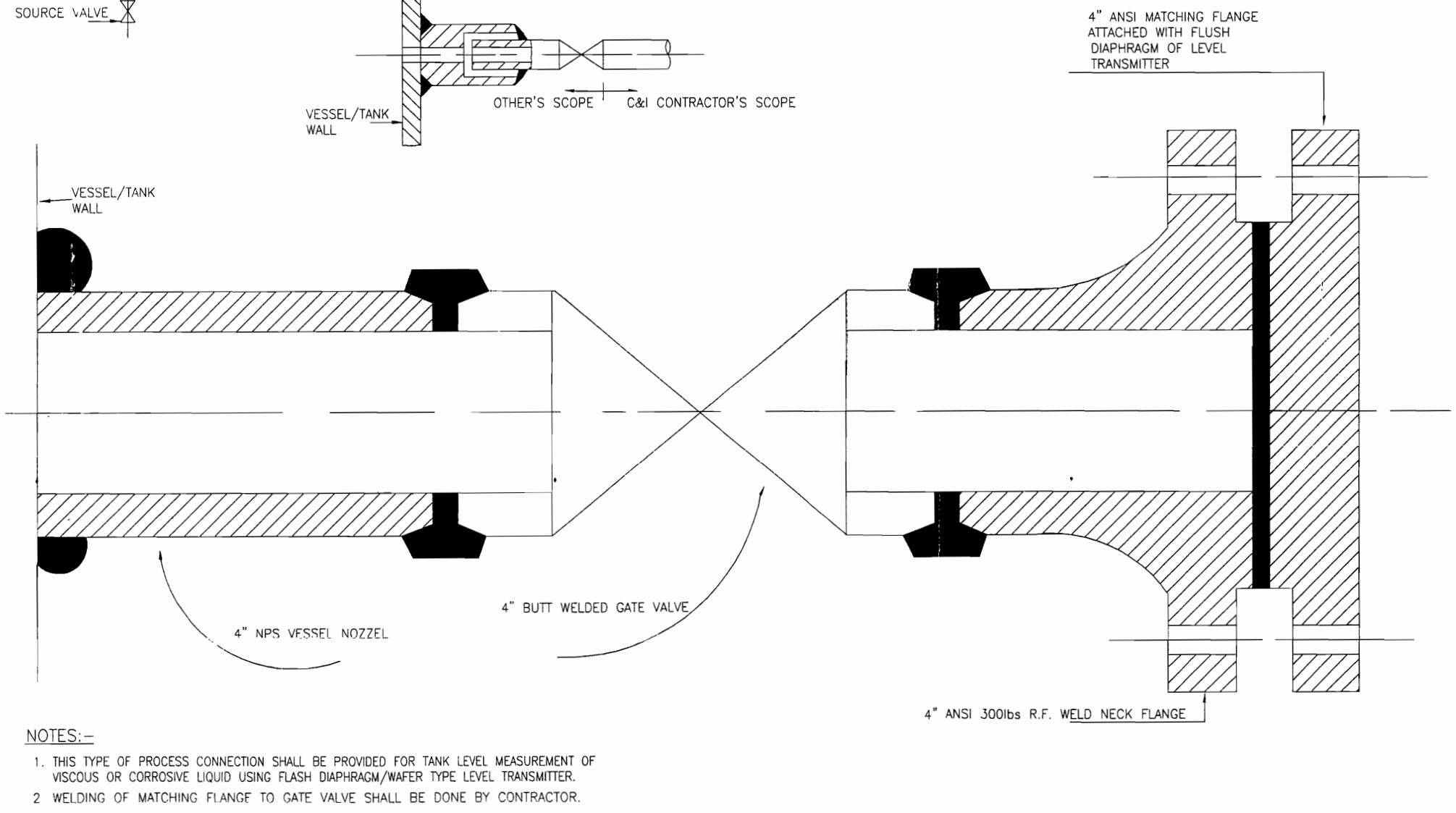
LEVEL MEASUREMENT





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.

Varun Jain

S A Khan

Praveen Kishore

Bharat Heavy Electricals Limited Power Sector Marketing New Delhi

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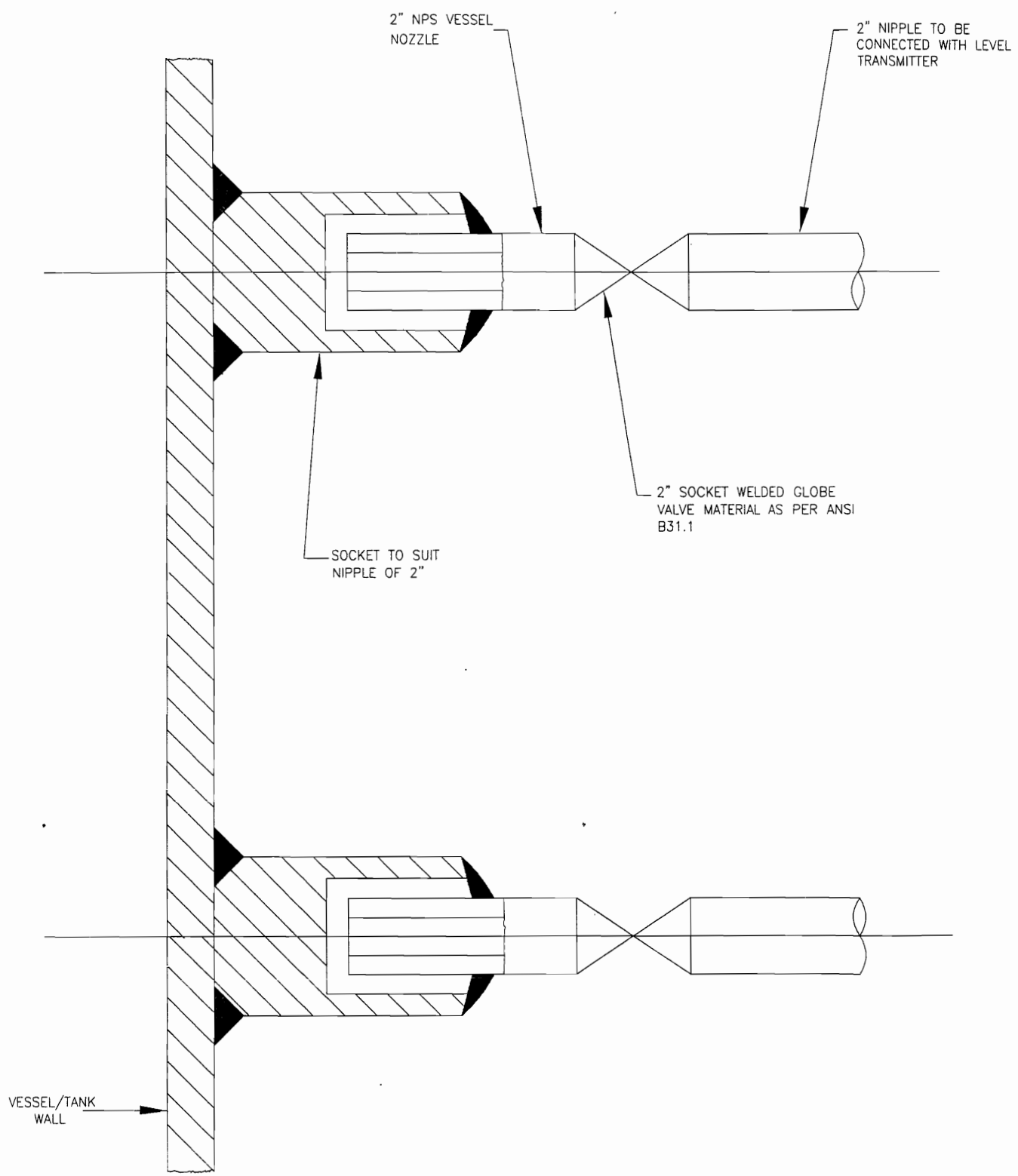
SHEET SIZE	A3	
SCALE	NTS	

PROJECT: 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

DRAWING TITLE: INSTRUMENT SOURCE CONNECTION DETAILS - LEVEL MEASUREMENT

DRAWING NO: LII-GE0E11019-G-00172-716 | REV. 00 | SHEET 1 OF 1

LEVEL MEASUREMENT



NOTES:-

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

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FOR CONTRACT PURPOSE ONLY

REV. No.	DATE	DEM	DEC	DEE	DEI	DESCRIPTION
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NEYVELI LIGNITE CORPORATION LTD, NEYVELI, TAMILNADU

LAHMEYER INTERNATIONAL INDIA

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CONSULTING ENGINEERS, GURGAON, INDIA

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PROJECT : 2 X 500 MW NEYVELI NEW THERMAL POWER PROJECT

DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - LEVEL MEASUREMENT

DRAWING NO : LII-GE0E11019-G-00172-717 | REV. 00 | SHEET 1 OF 1

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SECTION: D
STANDARD TECHNICAL SPECIFICATIONS

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STANDARD TECHNICAL SPECIFICATION FOR AIR WASHER

1. GENERAL

1.1.1 This specification covers the design, manufacture, construction features, installation, commissioning and conducting performance test at site.

2. CODES AND STANDARDS

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

2.1.1 IS:277: Galvanised steel sheets

2.1.2 IS:1239: Mild steel tubes

2.1.3 IS: 2062:

3. DESIGN/CONSTRUCTION FEATURES

3.1 GENERAL

3.1.1 The air washer shall be designed for max. air velocity of 2.8M/sec. Circulating water quantity shall be 1.0 CMH for every 1000 CMH of air flow, unless otherwise stated in data sheet A. The minimum saturating efficiency of air washer shall not be less than 90% Minimum length of air washer shall be 2500 mm.

3.2 TANK (SUMP)

3.2.1 The air washer tank shall either be masonry or metallic construction as specified in data sheet A. Masonry tank shall be provided by purchaser whereas metallic tank shall be of welded construction, fabricated from not less than 6mm thick MS plates, and inside, outside surfaces shall be provided with anti corrosive paint (Zinc sprayed to coating thickness of 75 micron min.).

3.2.2 The air washer tank shall have a minimum depth of 600mm and tank construction shall be such that the suction screen can be replaced while the air washer is under operation. The inlet and outlet ends of tank shall be suitably constructed to accommodate distribution plates and eliminator plates.

3.3 DISTRIBUTION PLATE

3.3.1 The distribution plate shall be fabricated from minimum 18 gauge thick GSS and shall have minimum 50% free area. The angles used for supports shall be galvanised.

3.3.2 The distribution plate shall be built up of number of sections for easy handling.

3.4 HEADERS AND STAND PIPE

3.4.1 The air washer shall be of two bank construction (one cross flow and other unit flow). The piping up to and including 100mm dia meter shall be of galvanised steel and above 100mm dia shall be black steel (subsequently spray galvanized to coating thickness as per approved TDS). All piping shall be adequately supported.

3.5 SPRAY NOZZLES

3.5.1 Spray nozzles shall be made of HDP (High density polyethylene) and shall be self cleaning type. The nozzles shall be designed to produce fine atomised spray and shall be spaced to give, uniform coverage of the air washer section. The pressure drop through the nozzle shall be in the range of 1.4 kg/cm2 g to 2.4 Kg/cm2g

3.6 ELIMINATOR PLATE

3.6.1 Eliminator plate shall be fabricated from 22 gauge thick GSS (Zinc coating thickness as per approved TDS).The eliminator section shall have minimum 6 bends. Spacer bars, tie rods and supports shall be of galvanised steel construction. Eliminator box shall be complete with suitable drop tray and drain pipe.

3.7 SUCTION SCREENS

3.7.1 Suitable no. of suction screens shall be provided by vendor and one set of spare screens shall be furnished along with each air washer.

3.8 INSPECTION DOOR AND MARINE LIGHT

3.8.1 Air tight inspection door of 600x700mm, metallic construction shall be provided. The air washer shall be equipped with marine light as required.

3.9 MAKE UP, DRAIN AND QUICK FILL CONNECTION

3.9.1 The air washer shall be provided with quick fill and make up connection. The quick fill valve shall be a globe valve. Float valve for making connection shall be backed up by a gate valve. Drain connections complete with isolating valves shall be provided for both suction and main tank. Over-flow pipe shall be provided for main tank and shall be connected to drain pipe, before the isolating valve or drain. In case of masonry tanks suitable pipe pieces with stiffener plates shall be provided by Vendor for use during casting of masonry tank.

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

4.1.1 Performance curve for air washer

4.1.2 GA drg.

4.1.3 Foundation drag. weight, dynamic loading etc.

4.1.4 O&M manual

S.No.	DESCRIPTION	DETAILS
	GENERAL	
1.	Designation	Air washers for power house building.
2.	Nos. required	Refer Section-C of Specific Technical Requirement
3.	Service	Evaporative Cooling of TG Hall & electrical bay
4.	Location	As per section-C/ Tender Layout Drg.
DESIGN DATA		
5.	Type	Sheet metal type, as per schedule of Ventilation system.
6.	Capacity M3/hr	Refer Section-C of Specific Technical Requirement
7.	Inlet air temperature	(Refer design data.)
8. (min).	Saturation Efficiency	To achieve saturation efficiency of 90%
9.	Allowable Pressure drop through Spray nozzle	2.4 Kg/cm2 (g) max.
9.	Pressure drop across Spray chamber	15 to 20 mm WG.
MATERIALS		
11.	Moisture Eliminators plates	24 SWG Galvanized Sheet (Vertical and brake type)./ 100% Virgin PVC of minimum finished thickness of 2 mm.
12.	Moisture Eliminators Frame	22 SWG G.I. Sheets.
13.	Distribution plates	18 G GSS to have 50% free area.
14.	Tank	MS
15.	Casing	Black M.S. (10 SWG min.)
16.	Louvers	20 G GSS sheet & frame of 18 G galvanized steel angle. Louvers with Bird screen of galvanized wire mesh of 10 mm square.
17.	Piping	MS Heavy Class Galvanized to IS: 1239 Part I, OR IS –3589 depending upon size.

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18.	Suction Screen Water	Brass (40 mesh size 2 nos for each air washer)
19.	Spray nozzles	Brass/Bronze with chrome plating or suitable plastic material (Nylon/Polymer) and shall be self cleaning type.
20.	Flooding Nozzles	Nylon/Polymer.
21.	Banks	Two spray banks each connected to individual header

EQUIPMENT SELECTION CRITERIA

22.	Face Velocity through louver.	Not to exceed 2.5 m/s
23.	Max. Pressure drop	Not to exceed 6.5 mm Wg when clean
24.	Saturation efficiency	Not less than 90%.
25.	Face velocity of air through spray chamber.	Not to exceed 2.5 m/s.
26.	Allowable pressure drop for washing chamber.	15 to 20 mm Wg.

NOTE:

1) All parts coming in contact with moisture for air washer shall be spray galvanized/epoxy painted
(2 coat of rust preventing epoxy primer & 2 coat of finished paint from both sides.)

2) Moisture eliminator shall have bends at 30 Degree with the direction of air flow & shall have
effectively hooked edges for traping the water.

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STANDARD TECHNICAL SPECIFICATION FOR VENTILATION FANS

1. GENERAL

This specification covers the design, manufacture, testing of performance at manufacturer's/sub-contractors works, delivery at site, handling at site, erection and commissioning of ventilation fans.

2. CODE AND STANDARDS

The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where it is to be installed. The equipment shall conform to latest edition of applicable Indian Standards or their equivalent standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall conform to the latest editions of the Following standards.

2.1.1 IS:4894 -Centrifugal fans

2.1.2 IS:3588 -Electric Axial Flow fans

2.1.3 IS:2312 -Propeller type A.C. ventilation fans

2.1.4 IS-3963 -Roof extractor units

2.1.5 BS:848 -Method of performance test for fans.

2.1.6 AMCA publication 99 standards handbook

2.1.7 AMCA standard 210, Test code for air moving devices.

3. DESIGN AND CONSTRUCTION

3.1 THE ENCLOSED DATA SHEET A GIVES THE NECESSARY DETAILS FOR CENTRIFUGAL/AXIAL/ROOF EXTRACTOR UNITS ETC.

3.2 WELDING PROCESS AND WELDERS EMPLOYED FOR FABRICATION SHALL BE QUALIFIED AS PER ASME SEC. IX

3.3 CASING

3.3.1 The centrifugal fans casing shall be of welded construction fabricated with heavy gauge material (min 3 mm) with flanges (min. 5 mm) on inlet and out let side for direct connection and shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed airtight. Horizontal Split casings shall be provided on large size fans. Casing drain (at bottom) with threaded plug/ with valve shall be provided, as required. All mounting/ connecting holes shall be drilled off centre.

3.3.2 The axial flow casing for supply fans/roof extractors shall be of heavy gauge construction (min 3 mm) properly reinforced for rigidity and shall be complete with suitable supports. Access doors with suitable locking arrangement shall be provided in the casing for easy access to the motor and impeller. External junction box/ Terminal box on casing with IP-55 protection shall be provided, if required. Wiring for motor from external junction box/ Terminal box shall be through flexible conduit.

3.3.3 Suitable motor brackets designed for rigid mounting of motors, shall be provided for roof extractors and wall mounted exhaust/ supply fans.

3.4 IMPELLER

3.4.1 Centrifugal fan impeller shall have die formed, aerofoil or laminar blades welded to the rim and back plate and shall have non-overloading, self cleaning characteristics. Rim shall be spun to have smooth contour. If required, intermediate stiffening rings shall be provided. Shaft sleeves shall be furnished, if specified. The impeller, pulley and shaft sleeve shall be secured to the shaft by key and/or nuts (threaded opposite to direction of rotation of impeller). The impeller shall be statically and dynamically balanced.

~~3.4.2~~ The axial fan impeller shall be of high efficiency aerofoil design. The blades shall be mounted on a streamlined hub and the impeller shall be mounted directly on the motor shaft. Impeller shall be in one piece however; fabricated blades will be acceptable up to 450 mm impeller diameter.

3.4.3 Roof ventilator impeller may either be centrifugal or axial type. Backward inclined blades shall be provided for centrifugal impellers. Blades may be die-formed or cast. Axial flow impeller shall be directly mounted to motor shaft whereas centrifugal impeller may either be direct-driven or belt-driven. The shaft of belt-driven centrifugal fan shall be solid cold rolled carbon steel, ground and polished. However, direct mounted impellers are preferred.

3.5 BEARINGS:

3.5.1 The centrifugal fan bearing may be ball, roller or sleeve bearings of self-aligning heavy duty type with adequate capacity and life. Make of Bearings to be specified. Bearings shall be oil/grease lubricated and provided with fittings for lubrication from outside and shall be located in easily accessible position to facilitate maintenance.

3.6 INLET CONES AND GUARDS

3.6.1 Centrifugal fans inlet shall be spun to have a smooth contour. Inlet screen, if provided, shall be galvanised wire mesh of 25 mm square with wire thickness of min. 1.5 mm.

3.6.2 Inlet cone, outlet bell and suitably designed guards shall be provided.

3.7 GUIDE VANES:

3.7.1 In case of vane axial fans guide vanes shall be provided on discharge side.

3.8 BASE PLATE AND VIBRATION ISOLATORS

3.8.1 Base plate and vibration isolators, which may be double deflection rubber in shear or rubber in compression type or spring type shall be provided. With each fan rubber bushes, washers wherever needed for vibration isolator in sufficient nos. shall be included, as required, to ensure isolation of foundation from vibration of equipment. For roof ventilators suitable mounting arrangement shall be provided such that there is no ingress of rain water into the building.

3.9 HOOD AND COWL

3.9.1 Roof exhaustors shall be provided with hinge type hood providing easy access to motor and impeller. Weather proof lockable type disconnect switch shall be provided such that hood can open only when the disconnect switch is in'off'

position. On larger size of roof ventilators hoods may be of split construction. 15 mm mesh galvanised bird screen shall be provided.

3.9.2 Rain protection cowls shall be designed to suit wall exhausters/supply fans for protecting fans from rain. The cowls shall be provided with bird screen of heavy gauge expanded metal netting.

3.10 SPEED

3.10.1 The speed of axial flow fans/roof ventilators shall not exceed 960 RPM for impeller dia exceeding 450 mm and shall not be greater than 1440 with impeller dia less than 450 mm.

4. MOTORS

Drive motors shall be of totally enclosed type, suitable for horizontal/vertical mounting as applicable and shall comply with the requirments of the specifications furnished elsewhere for motors.

5. ACCESSORIES

Accessories as specified in Data sheet-A and as required for satisfactory trouble free & safe operation of fans shall be provided.

TESTING AND INSPECTION

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

- Visual inspection of sheets/plates, angles, channels etc. – Pitting, lamination in sheets/ plates, angles and channels shall be avoided.- visual inspection by main contractor of BHEL.
- Sheets/ Plates - Test certificate shall be furnished for physical and chemical properties for sheets / plates- for review by BHEL
- Shaft: Mechanical and chemical-– review by BHEL
- Motors (of approved make): Routine TC ,FLP TC if applicable
- Workmanship and dimensional check as per manufacturing drg. and approved Drgs.- by main contractor of BHEL.- Shall be checked by BHEL/ Customer during final inspection.
- Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked/ welded to avoid loosening. - witness by manufacturer - TC to be furnished for review by BHEL(consisting of weight of impeller, radius of correction and balancing rpm). For spare impellers Dynamic Balancing shall be witnessed by BHEL.
- Performance test of one Centrifugal fan or Axial Fan /per type/per size as per applicable standard – by BHEL.

Centrifugal/ Axial fans 100% run tested by main contractor of BHEL. Run test by BHEL/Customer may be at random or 100%- Vibration shall be within satisfactory zone of VDI 2056 (group- G) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient

No.	Particulars	Data
1	**General Information**	
1.1	Fan Designation/application. system/	Refer schedule of Ventilation Air washers & UAF Units.
1.2	Nos. required/capacity Technical	Refer Section-C of Specific Requirement
1.3	Location	Refer layout drg. Attached.
2.0	**Design Data**	
2.1	Type	DIDW for Air Washer and SISW for UAF
2.2	Type of blades	backward curved
2.3	Arrangement	To suit application as per layout.
2.4	Discharge direction	To suit application as per layout.
2.5	Duty	Continuous
2.6	Capacity at site (Cubic Meter/hr) & static pressure. Technical	Refer Section-C of Specific Requirement
2.7	Suction pressure (mm Wg)	As per system requirement.
2.8	Fluid	Atmospheric Air.
2.9	Suction Temperature	Refer weather data attached.
2.10	Suction humidity	Refer weather data attached.
3.0	**Materials**	
3.1	Fan Scroll	Heavy Gauge Mild Steet to IS: 2062 with galvanised
3.2	Fan Casing (side plates & stiffeners)	Heavy Gauge Mild Steet to IS: 2062 / IS: 1079 / Eq. Minimum 3 mm thick casing.
3.3	Impeller	Mild Steel/plate to IS: 2062
3.4	Impeller hub	Mild Steet/plate to IS: 2062
3.5	Impeller back plate blade & shroud	Mild Steet to IS: 2062 / IS: 1079 / Eq.

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3.6	a) Shaft b) Shaft sleeve	EN-8 or eqv. -do-
3.7	Support frame and structure.	Mild Steet to IS: 2062
3.8	Flexible connection at outlet	Fire resistant type plastic impregnated canvas with MS Flanges and cleats (3mm thick).
3.9	V Belt	ISI marked (Reinforced rubber section to IS: 4776)
3.10	V Pulley per	Cast Iron multi groove to grade FG 20 as IS: 210. Having taper lock type
3.11	Slide rails	M.S./C.I.
3.12	Connection pieces	G.I. according to supplier's design
3.13	Bolts & nuts	M.S. Galvanized / Epoxy painted.
3.14	Vibration isolating pads, washers and spring if any.	Hard synthetic rubber

4.0 **ACCESSORIES**

4.1	Common base plate	Required.
4.2	Anchor bolts	-do-
4.3	Vibration Isolators	Hard synthetic rubber
4.4	V-belt pulleys	-do-
4.5	V-belts	Reinforced rubber of appropriate section
4.6	Belt guard	Required.
4.7	Outlet damper	Required(M.S. Heavy Gauge)
4.8	Inlet guard	Required.
4.9	Inlet Vane (variable)	Not required.
4.10	Drain valve	Required.
4.11	Acoustic silencers	Not required.

5.0 **Motor**

5.1	Motor by	Bidder

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5.2	Starter by	BHEL
6.0	Painting of fans including base frame	Galvanized / epoxy painting (as per Section-C & painting specifications)

NOTE:

1) Motors shall have 15 % margin on duty power point.

2) Fan shall be designed to operate with in 9% and 25% of system throttling line.

3) Opposed Multiple louvers damper shall be provided at fan outlet.Louvres shall be of 2 mm thick
MS (galvanized). Casing shall be of 3.15 mm thick MS (galvanized).

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General Information

1)	Designation	Roof extractor Units for areas as per schedule of ventilation system.
2)	Nos. required	As per schedule.
3)	Service	Continuous
4)	Location	Roof of respective areas.
5)	Area	As per schedule

Design Data

6)	Type	axial flow type.
7)	Air delivery capacity	as per schedule of ventilation system.
8)	Fluid	Atmospheric Air.
9)	Temperature	50 Deg. C
10)	Static Pressure required	As per Section'C' schedule of ventilation system.
11)	Outlet air velocity	Not more than 12 m/sec.

Materials

12)	Casing/cowl/hood	M.S. Sheet to IS: 2062 /IS: 1079/Eq.
13)	Impeller	Cast A1uminium alloy to A-6M IS-617 Grade LM6
14)	Support frame and structure.	M.S. of adequate thickness (IS-2062).

ACCESSORIES

15)	Vibration isolating pads	Yes.
16)	Base frame for mounting	Yes.
17)	Wire Guard at inlet.	Yes.
18)	Disconnect switch	Yes.

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19)	Gravity damper at outlet	Yes
	Motor	
20)	Motor by	Bidder
21)	Starter by	Bidder
22)	Type of motor	Conforming to IS: 325 latest/as per specification.
23)	Free delivery test	Yes.
24)	Performance test at specified duty point.	Yes
25)	Speed	Not more than 1500 RPM

NOTE:

1. Motors shall have 15% on duty power Point.

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No.	Particulars	Data
	General Information	
1)	Designation	Supply/Exhaust Fans.
2)	Nos. required in	Refer schedule of Ventilation system section-C under specific technical requirement.
3)	Service air.	To exhaust warm air/to supply fresh
4)	Location	Wall mounted.
5)	Area	Same as above in 2.
	Design Data	
6)	Type supply	Axial fans suitable for 415V/3 phase for Motor.
7)	Air delivery capacity system.	As per schedule of ventilation
8)	Fluid	Atmospheric Air.
9)	Temperature	Refer Section of specific technical requirement
10)	Static Pressure required	As per Section'C' schedule of ventilation system.
11)	Outlet Air Velocity	Not more than 12 m/sec.
	Materials	
12)	Casing	M.S. (IS-2062)
13)	Impeller 617)	Cast A1uminium. (Alloy A-6M, IS-
14)	Hub	Al Alloy.
15)	Support frame and structure. (Galvanized/	M.S. of adequate thickness Painted) IS-2062.
16)	Neoprene rubber pads	As required.

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17)	Coned inlet for wall exhausters/supply fans	MS (IS-2062)
18)	Supporting frame for mounting.	Required.
19)	Protective screen at inlet.	Yes (Min 14 SWG Galvanized wire knitted in 1" square mesh.
20)	Rain Protection Cowl	Aluminum or hot dip Galvanized after fabrication from M.S.

Motor

21)	Motor by	Bidder
22)	Starter by	BHEL

NOTE:

1) For Battery Room, motor for fan shall be of flame proof type & fan of spark proof construction with
Epoxy painting.

2) Gravity type damper shall be provided at the outlet of axial fan for exhaust application.

3) Motor shall have 15% margin over Duty Point.

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STANDARD TECHNICAL SPECIFICATION FOR LOW PRESSURE AIR DISTRIBUTION SYSTEM

1. GENERAL

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 airconditioning system and ventilation system not involving localised exhaust.

2. CODES AND STANDARDS

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

2.1.2 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

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

3.1.2 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 IS 277 Gr. 275 / as specified in Data Sheet A.

3.1.3 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

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.

4.1 RECTANGULAR DUCTS

4.1.1

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
b)	601 to 750	0.63	0.80	S-drive, 25mm pocket or	25x25x3 mm MS

		(24G)		25mm bar slips or flanged joints on 2.5m centres	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				

4.1.2 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.

4.1.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.

4.1.4 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:

a) Upto 1000mm - 6 mm dia GI bolts
b) 1001 to 1500 - 8 mm dia GI bolts
c) 1501 and above - 10mm dia GI bolts

4.1.5 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.

4.1.6 MS angles used for bracings shall be tack welded to the ducts or rivetted at 125mm centres, as applicable.

4.2 ROUND DUCTS

4.2.1

S.No.	Duct dia-mm	Sheet Thickness		Reinforcing
		(mm) GI	(mm) Al	
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 to1250	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

4.2.2 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.

4.2.3 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.

4.3 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.

4.4 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 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.

4.5 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.

4.6 CAULKING

Wherever duct passes through wall, the opening between masonary 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.

4.7 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.

4.8 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.

4.9 DAMPERS AND SPLITTERS

4.9.1 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.

4.9.2 Fire Dampers

Fire dampers/fire doors 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.

4.9.3 Gravity operated back draft dampers shall be provided to ensure pressurisation of rooms as specified. These dampers shall be designed such as not to allow infiltration of outside air while forced exit of air shall be achieved through this damper. The louvres shall be freely mounted on spindles to allow the dampers to open with the pressure developed by the fan. The dampers shall be provided with flange at inlet.

4.9.4 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.

4.9.5 Flashing

For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.

4.10 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 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.

4.11 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 appox. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonary 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.

4.12 ACCOUSTIC LINING

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

4.13 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.

4.14 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–BY MAIN VENDOR

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.- visual inspection by Main Vendor.

5.1.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating –review of TC by BHEL/Customer

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.

6. BALANCING

6.1.1 The entire air distribution system shall be balanced by vendor to supply the air quantities as required in various rooms so as to maintain the requisite temperature and air flow in the conditioned spaces. The final balance of air quantities through each grill/diffuser etc. shall be recorded and submitted to purchaser for approval. Proper steps shall be taken to have a uniform temperature in all enclosures, with utmost care for noise level to be within tolerance limit

6.1.2 All instruments required for testing/balancing etc. of the air distribution system shall be provided by vendor.

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

7.1 Fabrication drawings of ducts and grilles, louvers, dampers, etc, including typical details of grilles dampers etc.

7.2 Test certificates in line with scope of inspection.

7.3 Other dimensional drawings & documents as may be required by purchaser for better understanding of the system & for preparation of operation, maintenance & instruction manual.

1)	General (List of areas)	As per schedule/tender drgs of Ventilation system.
2)	i) GSS Duct Work	
	a) Type	Zinc coating (Refer Section-C of Specific Technical Requirement)
	b) 1.25 mm thk ducting	Bidder to estimate as per Drawings/sketch
	c) 1.0 mm thk ducting	Separately for Ventilation system.
	d) Any other size	(area wise)
	e) Battery Room ducting.	MS with epoxy painting on both sides.
3)	Special painting epoxy	MS Ducts in Battery Room to be painted. Both interior & exterior)
4)	Thermal Insulation	Required in duct for vent. System exposed to Sun only (furnished by Cement sand plaster)
5)	SA grilles (for each size) (SQ.M) schedule/tender	To suit airflow as per drgs.
6)	Exhaust Gravity/Manual relief dampers (for each size & to maintain a slight positive pressure inside.)	-do-
	a) Frame	1.6mm M.S.
	b) Louver	0.8mm Al.

NOTE:

1) Ducting shall be as per IS-655 standard.

2) Opposed blade type volume control damper (gang operated) shall be provided at each supply air grilles.

3) Bidder to provide suitable gasketing at each duct flange.(Asbestos shall not be used).

4) Supply Air Grills shall have 2 (two) set of adjustable louvres.

5) Bidder to indicate unit rates for variable items like ducting, grilles with & without volume control damper, gravity damper, thermal insulation, etc.

6) Grilles, frames & louvres shall be of at least 18 SWG sheet and 20 SWG MS respectively.

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6) Fire damper shall be solenoid operated in accordance with NFPA. The solenoid shall be charged during open condition and shall be de-energising to close.

7) Access door in ducting system shall be provided as required.

8) MS Angle (painted) shall be used only as duct supports.

9) Velocity thru duct shall not exceed 12 M/sec for Ventilation system.

10) All exhaust/return air grilles shall have one set of louvres in the front or thick rat-proof wire net guards.

STANDARD TECHNICAL SPECIFICATION FOR CENTRIFUGAL PUMPS

1.0 **GENERAL**

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

2.0 **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):

a) IS-1520 :Horizontal centrifugal pumps for clear, cold and fresh water
b) IS-5120 :Technical requirements - Rotodynamic special purpose pump
c) IS-1710 :Vertical turbine pumps for clear, cold and fresh water
d) Hydraulic Institute Standards of USA
e) BS - 599 :Method of testing Pumps
f) PTC - '6' :Centrifugal Pumps Power test code
g) API - 610

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 engineer shall be final and binding.

3.0 **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

4.0 **CONSTRUCTIONAL 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 the maximum pressure developed by the pump at the pumping temperature.

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.

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**

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 statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity.

4.3 **Wearing Ring**

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**

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 runway speed.

4.5 **Bearings**

Bearings and hydraulic devices (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 Boxes**

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.

4.7 **Shaft Couplings**

The pumps shall be directly coupled to their drives through heavy duty flexible coupling. Suitable coupling guards 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**

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.

If required in the data specification sheet, steel sole plates shall be provided, below the base plate.

4.9 **Prime Mover**

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

4.10 **Lifting arrangement**

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

5.0 **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.

6.0 **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.

7.0 SCOPE OF INSPECTION AND TESTING

7.1 Castings

7.1.1 Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers.

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 neat treatment charts (as applicable)

Note: Casting effects shall not be filled by any method until an unless approved by BHEL/their customer

7.2 Forgings and

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 neat treatment charts (time temperature) (as applicable).

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.

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 Hydro test as per para 7.5.1 below.

Note: For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating test certificates are not available, material shall be identified by BHEL and physical tests conducted by the supplier in the presence of BHEL

7.4 **In process Inspection and Testing**

7.4.1 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. No defect shall be permitted on moving parts. 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.

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.

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:

Capacity V/s Head

Capacity V/s Power absorbed by pump

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 and noise level measurement. Acceptance norms shall be as per manufacturers standards.

7.5.4 Overall dimensions as per GA drawings

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**

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**

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.

8.0 **CLEANING, PROTECTION & PAINTING**

Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard shall be done to remove all dirts, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as necessary. Flanges, inlet and outlet pipe, etc shall be protected.

9.0 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:-

i) Foundation base plate and sole plate details as applicable

ii) Civil foundation and anchor bolts details and loading data

iii) 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 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.

10.0 DRAWINGS AND DATA AFTER AWARD OF CONTRACT

The vendor shall furnish the drawings and other technical documents as required in Data Sheet-C enclosed with this specification

10.1 MANUFACTURERS NAME AND TAG. PLATES

Each pump shall have a permanently attached brass/metal 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.

11.0 DRAWINGS/DOCUMENTS TO BE FURNISHED BY VENDOR AFTER THE 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.

S.No.	DESCRIPTION	DETAILS
1)	Designation	Air washer Pumps.
2)	Type	Horizontal Centrifugal Type.
3)	Quantity	As per section-C
4)	Installation	On floating type foundation inside Air Washer Room
5)	Fluid to be handled	Filtered Water.
6)	Temperature of Fluid	To suit.
7)	Capacity Cum/Hr TDH at	To suit system requirements however head shall Not be less than 35 MWC.
8)	Duty	————Continuous (24Hr./day)————-
9)	Suction condition	————Flooded————-
10)	Type of drive	Direct (flexible coupling)
11)	Type of prime mover	LV Ac Motor.
12)	Maximum speed	Not more than 1500 RPM
13)	Type of lubrication	Grease Lubrication

MATERIALS OF CONSTRUCTION

S.No.	DESCRIPTION	DETAILS
a)	Impeller	Bronze
b)	Pump Shaft	Carbon Steel C-45, IS-1570 or class-IV, IS-1875
c)	Casing	Cast Iron, grade-20, IS- 210
d)	Wearing ring	Bronze
e)	Shaft Sleeve	Bronze
f)	Base Plate/frame	Cast Iron to Grade FG-200 IS-210/fabricated Mild steel

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g)	Counter Flanges	Mild Steel
h)	Stuffing box bush	Deep Bronze packing to be renewable with Case.
i)	Stuffing box gland	Flexible graphite or PTFE (Asbestos shall not be used)
j)	Pump Motor Coupling	Pin & Bush type (Flexible)
k)	Bolt and Nuts	MS

15) **ACCESSORIES REQUIRED**

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

a)	Priming funnel	Yes
b)	Drain piping upto Common drain point.	Yes
c)	Vent	Yes
d)	Suction & Discharge Pressure gauges	Yes
e)	Companion flanges	Yes
f)	Common base plate	Yes
g)	Suction strainer.	Yes
h)	Isolating valve.	Yes
i)	NRV at pump outlet at inlet/outlet	Yes
j)	Any special requirements	Yes
k)	Inspection & Testing	Yes

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STANDARD TECHNICAL SPECIFICATION FOR AIR FILTER

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 ABSOLUTE FILTERS (HEPA)

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 dioctyphalate 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.

3.5 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:

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

4.1.1 Dimensional inspection of frame & filter media – TC from Manufacturer- review by BHEL/Customer.

4.1.2 Witnessing by BHEL/Customer 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.

4.1.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet) - by BHEL/Customer

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

5.1.1 GA Drawing

5.1.2 Drawing showing material/construction detail

5.1.3 Installation and\service manual

5.1.4 Rating curves/charts

5.1.5 Test certificates

Elect. diagrams (when automatic cleaning type)

Description		Data
1)	**General**	
1.1	Service	Ventilation system .
1.2	Location	Main power house bldg. & Blower room of both the unit.
1.3	Nos.	Refer Section 'C' of Specification.
1.4	Total air flow/type	Refer Section 'C' of Specification.
1.5	Temperature	As per project information.
1.6	Relative Humidity	100%
1.7	Gas Composition	Atmospheric Air (Dusty) as prevalent in power station.
1.8	Filter Media	Synthetic non woven
1.9	Efficiency	Average arrestance efficiency of 65-80 % for Dry panel filter (pre-filters) and average arrestance efficiency of 80-90 % for fine filters.
1.10	Allowable pressure drop	2.5 mm & 6.5 mm in clean and dirty condition respectively for **dry panel filters** (pre filters). 12 mm in clean condition for fine filters.
1.11	Frame Work	18 G, GSS.
1.12	Mounting	Ladder Type M.S Angles (galvanised)
1.13	Size	600 x 600 mm

Note:-

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

Varun Jain S A Khan Praveen Kishore

STANDARD TECHNICAL SPECIFICATION FOR THERMAL INSULATION FOR COLD SURFACES

1. SCOPE

This specification covers design, manufacture, testing at manufacturers works, supply, application & finishing of insulation for cold piping, air conditioning ducting & equipment for low temperature service.

2. CODES & STANDARDS

The design, manufacture and performance of materials covered under this specification shall comply with all currently applicable statues, regulations & safety codes in the locality where the equipment/material are to be installed. The material shall also conform to the latest applicable Indian/British/American codes & standards. Nothing in this specification shall be construed to relieve the vendor of his responsibility. In particular, the material shall conform to the latest editions of the following standards :-

2.1.1 IS:3069 : Glossary of terms & symbols & units relating to thermal insulation materials.

2.1.2 IS:4671 : Expanded polystyrene for thermal insulation purposes.

2.1.3 IS:3677 : Mineral wool for thermal insulation

2.1.4 IS:8183 : Resin bonded mineral wool

2.1.5 IS:702

3. DESIGN REQUIREMENTS

3.1.1 The insulating material as well as protective covering shall be new & unused, non-corrosive, vermin/rodent proof and shall be guaranteed to withstand continuously & without deterioration the maximum/minimum temperatures to which they may be subjected to, under specified site conditions.

3.1.2 The insulation material must be light weight, strong, free from shots & coarse fibre & shall provide high insulation efficiency at low weight & coat. It should be non-hygroscopic & should not rot. It shall not settle or shake down even when subjected to prolonged vibrations.

3.1.3 The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.

4. APPLICATION DETAILS

4.1.1 The surface to be insulated shall be thoroughly cleaned and allowed to dry. Pressure/hydrostatic tests, if any, shall be carried out before application of insulation.

4.1.2 A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.

4.1.3 Hot industrial bitumen of grade 85/40 or 85/25 conforming to latest IS:702 shall be uniformly applied @ 1.5 kg/sq.m on the surface to be insulated. A similar layer shall also be applied on the inside surface & edges of the insulation. A suitable cold adhesive compound may also be used in place of bitumen.

4.1.4 Insulation in the form of pipe sections/rolls slabs of specified density & thickness shall be stuck to the coated surface with joints staggered & well butted & secured. The adjoining sections shall be tightly pressed together. All the joints shall be sealed with bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.

4.1.5 In case of double layer application both circumferential & longitudinal joints shall be suitably staggered.

5. VAPOR SEALING & INSULATION FINISH

The insulation shall be treated for vapor sealing & weather proofing & finished as specified in DATA SHEET A The acceptable types of finishes are outlined below:-

5.1 FINISHING SYSTEM I: EXTERNAL INSULATION WITH PLASTER FINISH

5.1.1 A thick vapor seal of hot bitumen @ 2.5 kg/Sqm shall be applied on the outer surface of insulation & allowed to dry.

5.1.2 The surface shall then be wrapped with 20mm (3/4"_ hexagonal mesh of 24 SWG GI wire, butting all the joints & laced down with 22 SWG GI lacing wire.

5.1.3 12.5mm (1/2 inch) thick sand cement plaster in the ratio of (1:1) shall be applied in two layers, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.

5.2 FINISH SYSTEM II: EXTERNAL INSULATION WITH PLASTER FINISH OVER POLYTHENE.

5.2.1 The insulation shall be covered with 500 g polythene/polythene bonded Hessians (PBH) with 50mm overlap on longitudinal & circumferential joints. Overlaps shall be sealed with synthetic adhesive in case o-f polythene & liberal coat of bitumen in case of PBH:

5.2.2 The surface shall then be wrapped with 20mm (3/4") mesh of 24 SWG GI wire butting all the joints & laced down with 22 SWG GI lacing wire.

5.2.3 12.5mm thick (1/2 inch) sand cement plaster in ratio of(4:1) shall be applied in two layers, the second layer being brought to a smooth & even finish similarly as described above.

5.3 FINISH III:EXTERNAL INSULATION WITH SHEET METAL FINISH

5.3.1 The insulation shall be covered with 500g polythene with 50mm overlaps at joints which shall be sealed with synthetic adhesive or equivalent compound.

5.3.2 The polythene shall be covered with 24 gauge GI/aluminum sheet

5.3.3 25mm wide x 22 SWG GI/aluminum peripheral straps shall be fixed over the GI/aluminum sheet at 300mm centres to secure.

5.4 FINISH IV: EXTERNAL INSULATION WITH PLASTER & WATER PROOFING COMPOUND

For ducts & piping exposed to atmosphere, the finish shall be as follows:

5.4.1 A thick vapor seal of hot bitumen at 2.05 kg/sq.m shall be applied on the outer surface of insulation & allowed to dry.

5.4.2 The surface shall then be wrapped with 20mm (32/4") hexagonal mesh of 24 SWG GI Wire butting all the joints & laced down with 223 SWG GI lacing wire.

5.4.3 12.5mm thick (1/*2 inch) sand cement plaster in ratio of (4:1) shall be applied in two layers, the second layer being brought to a smooth finish with water proofing compound added to the cement.

5.4.4 3mm (1/8") thick coat of water proofing compound shall be applied & wrapped with fibre glass RP tissue. A final coat of 3mm thick water proofing compound shall then be applied over the fiberglass RP tissue & allowed to dry. Alternatively, in place of water proofing as desired above, tar felt type 3 grade 1 of IS 1322 with joints overlapped by 75mm shall be fixed & sealed with bitumen & over this 24 SWG. 25mm hexagonal GI mesh shall be fixed with 22 swig. GI lacing wire & finally bitumen paint shall be applied over wire netting.

6. INSULATION OF PUMPS & VALVES

For all inspection covers & hatches on equipment, pump casing & valve bodies, flanges etc. the insulation shall be applied such as to facilitate removal with minimum damage to the insulation. This shall be achieved by encasing the insulation in 22 gauge aluminum sheet metal boxes, which shall be bolted together around the equipment to permit easy removal & replacement. Proper care shall be taken to maintain continuity of vapor seal between the static & removable partitions of the insulation.

The tenderer may offer thickness of insulation & finishes other than that specified in DATA SHEET A. However, calculations/reasons in support of alternative proposal shall be furnished for purchaser's approval.

7. INSPECTION & TESTING (REFER SPEC. NO - PES-553.00)

All necessary tests, as required to ensure that the material supplied conform to the requirements of applicable codes & standards, shall be carried out at manufacturer's works & test certificates including these for material/accessories shall be furnished for purchasers approval.

8. PAINTING

8.1.1 Pipe work having insulation & cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.

8.1.2 Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.

8.1.3 All painting for insulated surfaces shall conform to the requirement specified elsewhere.

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1.1 Final version of data sheet 'B' incorporating changes if any along with design data.

9.1.2 Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following :-

i) Thermal conductivity test

ii) Sound absorption coefficient test

iii) Corrosion test

iv) Sulphur content, moisture content, shot content, moisture absorption etc.

v) Compressive strength & cross breaking strength test.

9.1.3 Sketches/technical literature/sectional drgs. indicating insulation materials finish and method of application etc.

9.1.4 Manual dealing with safety aspects & instructions for combating fire arising out of insulation work

9.1.5 Instructions on maintenance of insulation work.

INSULATION MATERIAL :

Insulation	Code	Thermal Conductivity MW/cm ^{0}C	Density Kg/m^3
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 ^{0}C	At least 24 (For Thermal Insulation) 48 for Acoustic insulation
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 ^{0}C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 50^{0}C	At least 15

TYPE OF INSULATION :

S.No.	Surface	Insulation Material	Insulation Form	Thickness (mm)
i)	Supply & Return air duct for air-conditioning system	Resin bonded Glass Wool (IS:8183)	Roll / Slab	50
ii)	Refrigerant Piping	a) Expanded Polystyrene	Pipe Section	75
		or		
		b) Mineral Wool	Pipe Section	75
iii)	AHU drain pipe (Suction & Liquid line)	a) Expanded Polystyrene	Pipe Section	25
		or		
		b) Mineral Wool	Pipe Section	25
iv)	AHU casing and condensate pan	a) Expanded Polystyrene	Slabs	25
		or		
		b) Mineral Wool	Slabs	25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene	Pipe Section	75
		or		
		b) Mineral Wool	Pipe Section	75
vi)	Chiller	a) Expanded Polystyrene	Slabs	100
		or		
		b) Mineral Wool	Slabs	100
vii)	Chilled Water Pumps	a) Expanded Polystyrene	Slabs	50
		or		
		b) Mineral Wool	Slabs	50
viii)	Expansion tank with pipe	a) Expanded Polystyrene	Slabs/Pipe Section	50
		or		
		b) Mineral Wool	Slabs/Pipe Section	50

ix)	Acoustic insulation of Duct	Glass Wool	Slab	25

ANNEXURE-I

LIST OF MAKES OF SUB-VENDOR ITEMS

S.No.	ITEM / EQUIPMENT	SUB SUPPLIER
1.	AIR WASHER & UAF*	HYDERABAD POLUTION CONTROL / SK SYSTEM / ADVANCE VENTILATION / DRAFT AIR / BLUE STAR / VOLTAS / STERLING WILSON & ROOTS COOLING SYSTEM / C.DOCTOR
2.	CENTRIFUGAL FAN (For Air washers and UAF)	FLAKT / KRUGGER / DRAFT AIR / HYDERABAD POLUTION CONTROL / ADVANCE VENTILATION / PATEL AIR / NICOTRA/ SK SYSTEM / MARATHON / CB DOCTOR / SARLA
3.	AXIAL FLOW FANS/RE UNITS	HYDERABAD POLLUTION/ SK SYSTEM / ADVANCE VENTILATION / KRUGER / NICOTRA / MARATHON / FLAKT / CB DOCTOR/ PATEL AIR /SITAL
4.	CENTRIFUGAL 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/ KISHORE PUMP
5.	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP / BHARAT ELECTRIC
6.	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER /SPECTRUM / AIR TECH / PUROMATIC
7.	INSULTATION MATERIAL (Fibreglass / EPS/ PUF / Nitrile /EPDM)	BEARDSHELL / K-FLEX / PARAMONT / ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
8.	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
9.	BUTTERFLY VALVE	ADVANCE / AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE / FLUIDLINE / INSTRUMENTATION LTD / R and D MULTIPLES (METAL CAST) PVT LTD / SURYA VALVES AND INSTRUMENTS MFG CO / PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED / UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED / VENUS PUMPS AND ENGG. WORKS
10.	NON RETURN VALVE(CI)	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA / SURYA VALVES AND INSTRUMENT MANUFACTURING / ATAM VALVES / GM DAULI & SONS / KBL / VENUS PUMPS AND ENGINEERING WORKS
11.	GATE/GLOBE VALVES (CI)	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / LEADER / H.SARKAR / FLUID LINE / HI –TECH / A V VALVES / BANKIM & COMPANY / SHIVADURGA / SURYA VALVES AND INSTRUMENT MANUFACTURING / ATAM VALVES / GM DAULI & SONS / KBL / VENUS PUMPS AND ENGINEERING WORKS.
12.	GUN METAL VALVES	LEADER / A V VALVES / ATAM VALVES / VALTECH INDUSTRY / SANT VALVES

13.	**PIPING - ERW**	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA TUBES / BST / JINDAL / SAIL / PSL / LALIT PROFILE / SAMSHI PIPE INDUSTRIES / MUKUT PIPES / MANN INDUSTRIES/ SURENDRA ENGINEERING / PRATIBHA PIPES AND STRUCTURES PVT LTD / JCO GAS PIPES / NUKAT TANK AND VESSELS / GOODLUCK TUBES / ADVANCE STEEL TUBES / BIHAR TUBES / HITECH PIPES / RATNAMANI / MAHARASHTRA SEAMLESS
14.	**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
15.	**HUMID STAT**	JHONSON CONTROL / HONEYWELL / PENN
16.	**PRESSURE GAUGE / DP GAUGE**	GENERAL INST CONSORTIUM / BELL / H.GURU INST/ H GURU / WAAREE INSTRUMENTS / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES
17.	**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) / BUDENBERG GUAGE CO.LTD./ GOA THERMOSTATIC INSTRUMENTS PVT.LTD./ GAUGE BOURDON INDIA PVT. LTD/ Baumer Technologies India Pvt. Ltd
18.	**LEVEL GAUGE**	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR
19.	**PRESSURE SWITCH / DP SWITCHES**	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT / DELTA CONTROL
20.	**LEVEL SWITCH**	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V ATUOMATE /CHEMTROLS / SIMENS / FLOW STAR / TRAC
21.	LEVEL INDICATOR	SBEM / SIGMA / LEVCON / DK INSTURMENT / V ATUOMATE / FLOW STAR / SCIENTIFIC DEVICES / GAUGES BOURDON / PNE TECHTROL
22.	TRANSMITTERS	EMERSON / LAXONS AUTOMATION / YIL / TAYLOR / ABB/BRISTOL BABCOCK / BIRLA KENT TAYLOR / BLISS ANAND /SBEM/ SMART INST / V AUTOMATION & INST / FISHER-ROSEMOUNT / SIEMENS/ HONEYWELL / YOKOGAWA / FUJI
23.	**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/ OTOKLIN GLOBAL BUSINESS LTD
24.	**CONTROL PANEL**	INDUSTRIAL CONTROL & APPLIANCE/ PYROTECH /POSITRONICS / CONTROL & SWITCHGEAR /SIEMENS / L&T /GE POWER /RITTAL / HOFFMAN

25.	**INSTRUMENT FITTINGS**	AURA INCORPORATED / Astec Valves & Fittings Pvt. Ltd., / Arya Crafts & Engineering Pvt. Ltd./ Comfit & Valve Pvt. Ltd./ FLUIDFIT ENGINEERS PVT. LTD / Fluid Controls Pvt. Ltd./ HP VALVES & FITTINGS INDIA PVT. LTD. / PRECISION ENGINEERING INDUSTRIES / Panam Engineers, / Perfect Instrumentation Control (India) Pvt. Ltd. / VIKAS INDUSTRIAL PRODUCTS

NOTE

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

Above sub-vendor are also subjected to Customer approval during detailed engineering.

ANNEXURE-II

MANDATORY SPARE LIST

LIST OF MANDATORY SPARES:-

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	

ANNEXURE-IV

LIST OF TOOLS & TACKLES

SL NO	ITEM DESCRIPTION	UNIT	QTY
1	MEASURING TAPE	SET	1
2	TECHOMETER	SET	1
3	DOUBLE ENDED SPANNER	SET	1
4	RING SPANNERS	SET	1
5	GASKET PUNCH	NO.	1
6	CENTRE PUNCH	NO.	1
7	HAMMER WITH WOODEN HANDLES	NO.	1
8	SCISSORS FOR SHEET METAL CUTTING	NO.	1
9	TORCH WITH 2 DRY CELLS	NO.	1
10	MULTIMETER	NO.	1
11	ANIMOMETER	NO.	1
12	COMPOUND PRESSURE GAUGE	NO.	1
13	SLIDE WRENCH 8”	NO.	1
14	SLIDE WRENCH 10”	NO.	1
15	SLIDE WRENCH 6”	NO.	1
16	BOX SPANNER SET	NO.	1
17	SCREW DRIVER SET	NO.	1
18	ALIGN KEY SET	NO	1
19	MS TOOL BOX	NO	1

NOTE:-

The above mentioned list is tentative only, same shall be finalized during detailed engineering, as per system / customer requirement.

CLARIFIED WATER ANALYSIS REPORT

S.No.	DESCRIPTION	Unit	Tentative Values
1.0	Total dissolved solids	mg/l	425
2.0	Suspended solids /Turbidity	mg/l	20
3.0	Calcium hardness as $CaCO_3$	mg/l	120
4.0	Magnesium hardness as $CaCO_3$	mg/l	78
5.0	Sodium + Potassium as $CaCO_3$	mg/l	95.35
6.0	Chloride as $CaCO_3$	mg/l	84.6
7.0	Sulphate as $CaCO_3$	mg/l	84.7
8.0	M alkalinity as $CaCO_3$	mg/l	160
9.0	P alkalinity as $CaCO_3$	mg/l	Nil
10.0	Iron as $CaCO_3$	mg/l	1.25
11.0	Silica as SiO_2	mg/l	36.4
12.0	Aluminium as $CaCO_3$	mg/l	2.0
13.0	Conductivity at 30 °C	m-mho/cm	705
14.0	pH at 30 °C		7.0
15.0	Free CO_2		19.36
16.0	Total hardness (as $CaCO_3$)	mg/l	198

ANNEXURE-VI

DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE

DRAWING/DOCUMENT DISTRIBUTION LIST

All documents & drawings shall be in English and in metric units

SI		LII	NLC (HQ)	NLC-SITE	BHEL SITE	PMG BHEL	PEM/ UNITS/ PSSR	REMARKS
1	Master list of drawings / document (duly indicating schedule of submission)	Soft copy	Soft copy	Soft copy		Soft copy	Soft copy (S)	
2	Drawings / document for Approval/Information (First Submission)	Soft copy + 2 prints	Soft copy + 3 prints	Soft copy + 1 print		Soft copy	Soft copy (S)	
3	Return with comments/approval	Soft copy (S)	Soft copy	Soft copy		Soft copy	Soft copy	
4	Drawings / Documents for approval (second & subsequent submissions till approval)	Soft copy	Soft copy	Soft copy		Soft copy	Soft copy (S)	
5	Drawings / documents for distribution (Approved by NLC, in cat. 1 or Received for Information)	Soft copy + 2 print (HQ+ Site)	Soft copy + 3 prints	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
6	Erection Drawings / documents	-	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
7	As built Drawings / documents	Soft copy + 1 print	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
8	Operation & Maintenance Manual	-	Soft copy + 1 print	Soft copy + 10 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	
9	Type Test Certificate	Soft copy	Soft copy + 1 print	Soft copy + 3 prints	Soft copy + 5 prints	Soft copy	Soft copy (S)	

NOTES:

1. The above schedule of submission does not include Docs/Drgs. of quality assurance/inspection and delivery/dispatches. QAP documents to be submitted as per distribution schedule.
2. Date of submitting soft copy is to be taken as date of submission.
3. S – Source for generation of document.

ANNEXURE-VII

INSPECTION AND TESTING

1.01.00 Inspection and Tests during Manufacture.

1.01.01 The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner.

1.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

1.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

1.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The owner's representative shall have at all reasonable times access to bidder's or his sub-vendor's premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.

The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere.

For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.

1.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

1.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.
Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to despatch from place of manufacture.

1.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material. Equipment or parts coming under any statutory

Regulations shall be certified by a Competent Authority under the regulations in the specified format.

1.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

1.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

1.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major but welding joints shall be radiographed unless otherwise stipulated.

Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.

1.02.00 Performance Tests at Site

1.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

1.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

1.02.03 The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.

1.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.

All Statutory testing / clearance is in Bidder's scope including payment of all fees, etc. as required

QAP FORMAT

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT: SYSTEM :

VENDOR : ITEM :

SL NO	COMPONENT /OPERATION OPERATIONS	CHARACTERISTICS CHECKED	CATEGORY	TYPE /METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

Legend: 1. BHEL 2. Vendor 3. Sub-Vendor

QP No	CQS/SQP/31	Signature	Date			
	Rev		Name			
Page No	1 of 1		Party	Customer/Consultant	Bhel	Vendor

Varun Jain S A Khan Praveen Kishore

ANNEXURE-VIII

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

S. NO.	DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
1	PE-V0-402-554-A001	INSPECTION CATEGORISATION PLAN	4
2	PE-V0-402-554-A002	QUALITY PLAN OF UAF	12
3	PE-V0-402-554-A003	QUALITY PLAN OF CENTRIFUGAL PUMPS	12
4	PE-V0-402-554-A004	QUALITY PLAN OF CENTRIFUGAL FANS	13
5	PE-V0-402-554-A005	QUALITY PLAN OF AXIAL FLOW FANS & RE UNITS	14
6	PE-V0-402-554-A006	QUALITY PLAN OF MOTOR	15
7	PE-V0-402-554-A101	VENTILATION FAN SCHEDULE.	22
8	PE-V0-402-554-A202	DATA SHEET & GA FOR UAF ALONGWITH FAN AND PUMP FOUNDATION DETAILS.	10
9	PE-V0-402-554-A203	DATA SHEET & GA FOR ROOF EXTRACTOR, AXIAL EXHAUST AND SUPPLY AIR FANS WITH FIXING ARRANGEMENT.	12
10	PE-V0-402-554-A204	DATA SHEET & GA FOR VALVES AND STRAINER.	8
11	PE-V0-402-554-A205	DATA SHEET FOR INSULATION.	8
12	PE-V0-402-554-A206	DATA SHEET & GA FIRE DAMPER.	8
13	PE-V0-402-554-A207	DATA SHEET FOR INSTRUMENTS (PRESSURE GAUGE, TEMP GAUGE, LEVEL GAUGE, PRESSURE SWITCH, LEVEL SWITCH).	14
14	PE-V0-402-554-A208	DATA SHEET OF PIPE.	5
15	PE-V0-402-554-A209	DATA SHEET OF GI AND MS SHEET.	5
16	PE-V0-402-554-A210	DATA SHEET & GA FOR PRE AND FINE FILTERS.	8
17	PE-V0-402-554-A211	DATA SHEET FOR MOTORS (UAF Fan, UAF Pump, RE units, Supply and Exhaust axial fans)	15
18	PE-V0-402-554-A401	TYPICAL Details DUCT FABRICATION DRAWING / SUPPORT / ERECTION, INSULATION OF DUCTING / PIPING & EQUIPMENTS PIPE ERECTION	7
19	PE-V0-402-554-A	GA OF PROPELLER FAN.	9
20	PE-V0-402-554-A601	SCHEME FOR AIR DISTRIBUTION IN ESP BUILDING.	5
21	PE-V0-402-554-A602	PID FOR UAF UNIT.	8
22	PE-V0-402-554-A605	UAF LAYOUT ALONGWITH FOUNDATION DETAILS - ESP BUILDING (UNIT I & II)..	11
23	PE-V0-402-554-A608	VENTILATION DUCT LAYOUT FOR ESP BUILDINGS (UNIT I & II).	12
24	PE-V0-402-554-A610	VENT. ARRANGEMENT FOR BATTERY ROOM.	13

S. NO.	DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
25	PE-V0-402-554-A611	VENT. ARRANGEMENT FOR VARIOUS AUXILIARY BUILDING.	18
26	PE-V0-402-554-A701	ELECTRICAL FEEDER LIST.	18
27	PE-V0-402-554-A702	VENTILATION CABLE SCHEDULE	18
28	PE-V0-402-554-A901	P.G. TEST PROCEDURE.	12
29	PE-V0-402-554-A902	O & M MANUAL.	25

Note:
The above is not the complete list and may change during detail engineering.

ANNEXURE-IX

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

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

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	**COVER PAGE**				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	**INDEX**				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	**DESCRIPTION OF PLANT/SYSTEM**				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 &				

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
	bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	**COMMISSIONING ACTIVITIES (IF NOT COVERED IN SEPARATE DOCUMENT I.E. ERECTION MANUAL, COMMISSIONING MANUAL)**				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	**OPERATION GUIDELINES FOR PLANT PERSONAL/USER/OPERATOR**				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
6.0	**MAINTENANCE GUIDELINES FOR PLANT PERSONAL**				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	**Statutory and other specific requirements considerations.**				
8.0	**List of reference documents**				
9.0	**Binding as per requirement**				

ANNEXURE-X

SITE STORAGE AND PRESERVATION

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)

PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

Varun Jain S A Khan Praveen Kishore

CONTENT

Varun Jain S A Khan Praveen Kishore

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.

11. Following preservatives/preservation methods can be used depending upon type of equipment

    a. Rust preventive fluid (RPF)

    b. Rust protective paints

    c. Tarpaulin covers, in case of outdoor storage

    d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

    - Ingress of moisture and corrosion damages.
    - Damage to protective coating.
    - Open ends in pipes, vessels and equipment -
        - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.

    - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
    - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere**. (C)

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.

ii **Semi-closed storage**. (S)

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.

iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.

The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

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Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H_2SO_4)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

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Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	**Description of the equipment**	**Type of Storage**	**Check for**	**Remarks**
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

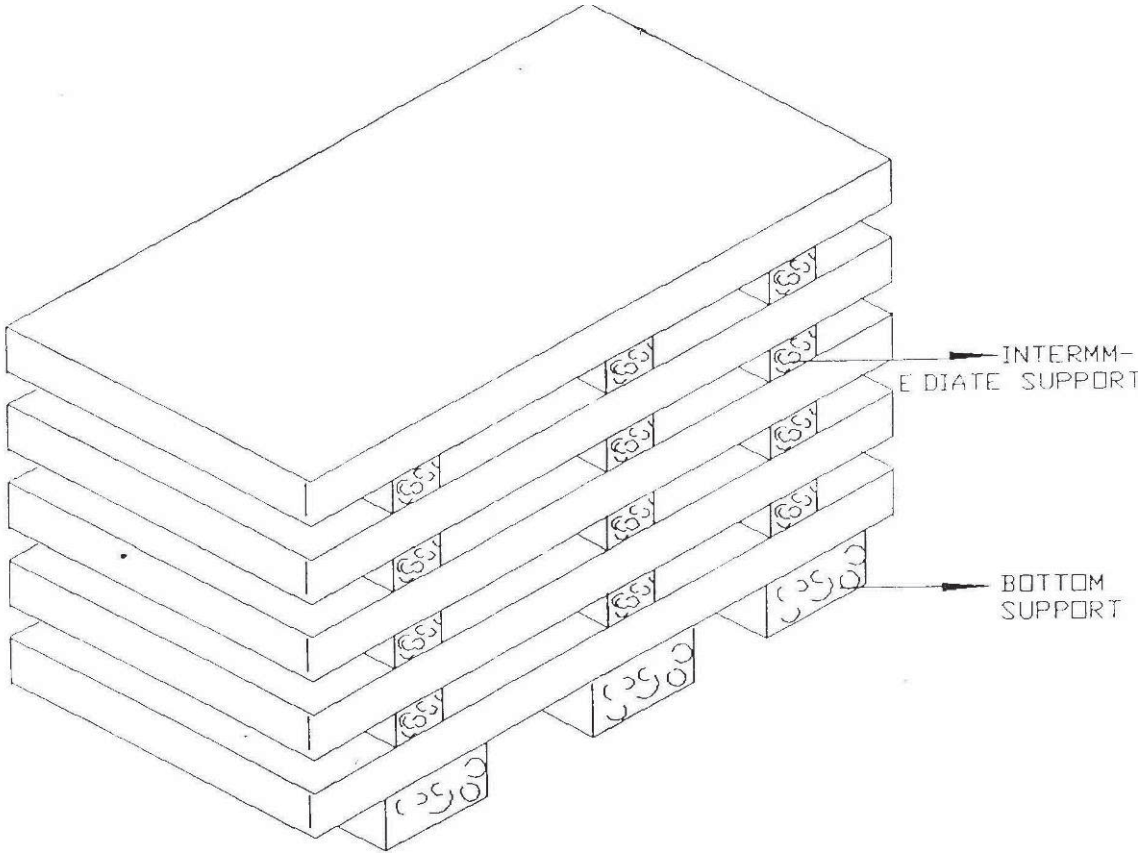

Figure – 1 – PLATE STACKING ARRANGEMENT

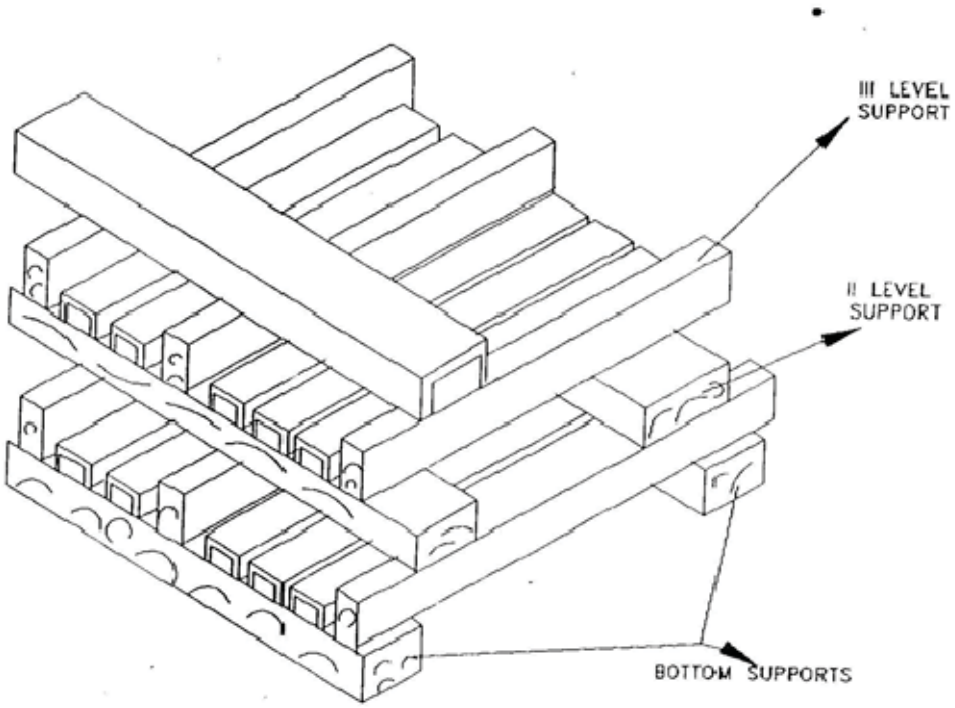

Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

VOLUME III

Varun Jain

S A Khan

Praveen Kishore

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

1. Compliance cum confirmation certificate
2. Guaranteed power consumption
3. Un priced format for main package
4. Un priced format for mandatory spare
5. Complete set of technical specification
6. No deviation certificate
7. Pre bid clarification schedule

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COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.

b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

   For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site

commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

k) As built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

PRE-BID CLARIFICATION SCHEDULE

S. NO.	SECTION/CLAUSE/PAGE NO.	STATEMENT OF THE REFERRED CLAUSE	CLARIFICATION REQUIRED

The bidder hereby clarifies that above mentioned are the only clarifications required on the technical specification for the subject package.

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

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NO DEVIATION CERTIFICATE

SL NO	VOULME / SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF DEVIATION	PORTION OF PRICE SCHEDULE ON WHICH COST OF DEVIATION IS APPLICABLE	NATURE OF COST OF DEVIATION (POSITIVE/ NEGATIVE)	WHETHER COST OF DEVIATION INCLUDED/ EXCLUDED IN PRICE BID	REMARKS
TECHNICAL DEVIATIONS										

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE			
NAME	**DESIGNATIONS**	**SIGN & DATE**	**COMPANY SEAL**

NOTES:

1. Cost of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. All the bidders have to list out all of their Technical Deviations in detail in the above format on cost basis (if any).
3. Any deviation not mentioned above and shown separately will not be taken cognizance of and the offer shall be liable for rejection.
4. Bidder shall indicate "quoted" in cost of deviation column of the schedule above along with their Technical offer.
5. Bidder shall furnish priced schedule of technical deviation along with price bid in sealed envelope.
6. The final decision of acceptance/ rejection of the deviations quoted by the bidder along with its cost shall be at discretion of the Purchaser.
7. Bidders to note that any deviation not listed above and asked after Part I Bid opening shall not be considered.
8. Bidders to note that no Price Impact will be acceptable after Part I Bid opening subject to if there is any change in Technical Specification/NIT terms from BHEL side.
9. Deviation listed above without any cost of deviation, if found acceptable to BHEL, will be considered without any price implication.

Varun Jain S A Khan Praveen Kishore

S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL GUARANTEED POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW)	DUTY FACTOR	TOTAL KW
		WORKING	STAND BY			
		3A	3B	4	5	6=3Ax4x5
1	**VENTILATION SYSTEM FOR ESP CONTROL ROOM BUILDING**					
1.1	Centrifugal Fan of cap. 75,000 CMH at 50 mmwc static pr for UAF.	2	0			
1.2	Pumps for circulation of water in spray chamber of above UAF.	2	2			
				TOTAL (KW)		
NOTES:						
1	Estimated power consumption (EPC) figure at motor input terminals (not shaft power) for the system (for working drives only) shall not be more than 59 KW.					

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SUGGESTIVE PRICE FORMAT

Varun Jain S A Khan Praveen Kishore

VENTILATION SYSTEM FOR 2x500 MW NEW NEYVELLI TPP (SG PACKAGE) --- SUGGESTIVE PRICE FORMAT

SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY						ERECTION AND COMMISIONING				TOTAL
				Unit Price (Rs)	Total ex-works price (Rs)	ED (Inc CESS) (Rs)	CST / VAT (Rs)	Freight (Including service tax, if applicable) (Rs)	TOTAL FOR site price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)	Service Tax (Rs)	TOTAL PRICE (Erection and commissioning including Service tax)	Total Price Supply FOR site and E&C including service tax (Rs)
1.0	Total lumpsum firm prices for equipment & Services as specified, Comprising Engineering, design, manufacture, inspection & Testing at manufacturer's/subvendor's works, Painting at manufactures works, duly packed for transportation, delivery to site, unloading, storage & handling at site, fabrication, erection and commissioning, performance and guarantee testing, submission of as built drawing, O&M Manual, carrying out acceptance tests at site, and final painting of complete Ventilation system on turnkey basis as per specification **PE-TS-400-554-A001** including mandatory spares, special tool & tackels for maintenance, commissioning spares, all taxes, duties etc.													
2.0	Break up prices for items covered in clause 1.0 above.In case, price indicated above does not match with item wise break-up given at 2.0, the highest price so calculated shall be considered for evaluation but in case of order, the same shall be placed at the lowest price.													
2.1	Unitary air filtration unit with centrifugal fan with motor, pumps with motors, dry panel filters (fabric type pre-filter), UAF internals, MS structures, piping as per IS:1239 pt I (heavy class galvanised), valves including motorised valves for auto start of standby equipment, nozzles, level switch, pressure switches, temp indicators, back wash arrangement, galvanised drain piping etc as per spec (fan capacity 75,000 CMH at 50 mmwc static pressure) as specified.The UAF and fan casing shall be spray galvinised on inside and outside.	2	NO											
2.2*	Supply air ducting (finished) for above area complete with dampers, grills , supports (painted) and all accessories as specified.													
2.2.1*	Finished GSS (zinc coating 275 gms/ sqm) Ducting with support structure etc.													
a)*	18 G	1,000	SQM											
b)*	20 G	1,000	SQM											
c)*	22 G	500	SQM											
d)*	24 G	500	SQM											
2.2.2*	MS duct (20 G) with epoxy paint for battery room.	50	SQM											
2.2.3*	Extruded Aluminium grilles with VCD.	50	SQM											
2.2.4*	Extruded Aluminium grilles without VCD.	2	SQM											
2.2.5*	INSULATION													
a*	Thermal insulation 25 mm expanded polystyrene finished with sand cement plaster as specified for supply air duct	400	SQM											
b*	Acoustic insulation for duct	50	SQM											
2.2.6*	Wall mounted dampers (gravity operated) for different areas.	6	SQM											
2.2.7*	Inlet Louvres	1	SQM											
2.2.8*	GI volume control dampers for ducts	3	SQM											
2.3*	FIRE DAMPER													
a)*	Fire dampers (motor operated) with auto resetting, limit switch, indicating lamps etc as specified.	6	SQM											
b)*	Motorized Actuator with single phase power supply for the above Fire damper with auto resetting, limit switches, indication lamps etc	6	NO											
2.4*	Roof extractor units (axial flow type) with hood, disconnect switch and all accessories as specified. **Following fan shall have 15 mmwc static pressure.**													
A)*	Capacity 40,000 CMH with Motor rating 5.5 KW	10	NO											
B)*	Capacity 20,000 CMH with Motor rating 2.2 KW	1	NO											
2.5*	Axial flow supply fans with pre and fine filter (wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories (suitable for 415V/3-phase supply). **Following fan shall have 30 mmwc static pressure.**													
a)*	Capacity 10,000 CMH with Motor rating 2.2 KW	1	NO											
b)*	Capacity 7,500 CMH with Motor rating 1.5 KW	1	NO											
c)*	Capacity 6,000 CMH with Motor rating 1.1 KW	1	NO											
d)*	Capacity 4,000 CMH with Motor rating 0.75 KW	2	NO											

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2.6*	Axial flow supply fans with pre filter (wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories (suitable for 415V/3-phase supply). **Following fan shall have 20 mmwc static pressure.**													
a)*	Capacity 10,000 CMH with Motor rating 1.5 KW	1	NO											
b)*	Capacity 7,500 CMH with Motor rating 1.1 KW	1	NO											
c)*	Capacity 6,000 CMH with Motor rating 1.1 KW	1	NO											
d)*	Capacity 4,000 CMH with Motor rating 0.75 KW	1	NO											
2.7*	Axial flow exhaust fans (Bifurcated type, spark proof construction, wall mounted) complete with casing, flame proof motor & mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted (suitable for 415V/3-phase supply). **Following fan shall have 15 mmwc static pressure.**													
a)*	Capacity 15,000 CMH with Motor rating 2.2 KW	1	NO											
b)*	Capacity 10,000 CMH withMotor rating 1.5 KW	1	NO											
c)*	Capacity 7,500 CMH with Motor rating 1.1 KW	1	NO											
d)*	Capacity 2,000 CMH with Motor rating 0.55 KW	2	NO											
2.8*	Axial flow exhaust fans (Wall mounted) complete with casing,TEFC sq cage induction motor & mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted (suitable for 415V/3-phase supply) as specified.**Following fan shall have 10 mmwc static pressure.**													
a)*	Capacity 15,000 CMH with Motor rating 1.1 KW	1	NO											
b)*	Capacity 10,000 CMH with Motor rating 0.75 KW	10	NO											
c)*	Capacity 7,500 CMH with Motor rating 0.55 KW	3	NO											
d)*	Capacity 6,000 CMH with Motor rating 0.55 KW	1	NO											
e)*	Capacity 2,000 CMH with Motor rating 0.37 KW	1	NO											
2.9*	Exhaust fan (propeller type) completes with induction motor & mounting frame MS rain protection cowl, bird screen and all other accessories as specified (suitable for 240V/ 1 phase). **Following fan shall have 5 mmwc static pressure.**													
a)*	Capacity 1200 CMH with Motor rating 100 watts	20	NO											
2.10*	Manually operated, platform trolley of 1 Ton capacity with base area 2m x 1.5m	2	NO											
2.11	Total lumpsum price for special tools & tackles for maintenance inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).	1	LOT											
2.12	Total lumpsum price for commissioning spares inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).	1	LOT											
2.13	**FIELD INSTRUMENTS** like pressure gauge, temperature gauge, pressure switch, differential pressure switch, flow switch and other instrument required for Ventilation System etc.	1	LOT											
2.14	Any other item not indicated above, but required to make the system complete in all respects.	1	LOT											
2.15	Total lumpsum price for Mandatory Spare inclusive of packing forwarding, transportation up to site, etc. (Bidder to submit item-wise price break-up seperately).	1	LOT											

NOTES

1 The bidder shall furnish unit rates for variable item (marked *) for necessary adjustment (plus or minus) variation during detailed engg. stage. The unit rates quoted above shall be considered and no separate unit rates shall be quoted. Unit rates shall be valid throughout the contract.

2 Bidder must submit prices in the Pro Forma duly filled in signed and stamped on every page without any ambiguity. The price shall be written against each item. Term such as "refer covering letter" etc. are not acceptable. Extra sheet may be attached if the space provided is not sufficient.

3 Price format shall not be changed by the bidder as the bidder may get disqualified by doing so.

4 For limitation on payment, percentages of individual items/equipments, as specified in the **Appendix-A** shall be applicable

Project - 2 x 500 MW NEW NWYVELI (SG PACKAGE)										
PACKAGE : VENTILATION SYSTEM										
MANDATORY SPARE LIST										
SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY	UNIT	SUPPLY						
				Unit Price (Rs)	Total ex-works price (Rs)	ED including CESS (Rs)	CST / VAT (Rs)	FREIGHT including Service Tax, If applicable (Rs)	TOTAL F.O.R. Site Price Supply (Rs)	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							
8.1	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							

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Praveen Kishore

Project :- 2 x 500 MW NEW NWYVELI (SG PACKAGE)		
PACKAGE : VENTILATION SYSTEM		
APPENDIX - A		
SL NO	**DESCRIPTION OF EQUIPMENT/ ITEM**	**Percentage of total price**
1	Total lumpsum firm prices for equipment & Services as specified, Comprising Engineering, design, manufacture, inspection & Testing at manufacturer's/subvendor's works, Painting at manufactures works, duly packed for transportation, delivery to site, unloading, storage & handling at site, fabrication, erection and commissioning, performance and guarantee testing, submission of as built drawing, carrying out acceptance tests at site, and final painting of complete Ventilation system on turnkey basis as per specification PE-TS-400- 554-A001 including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc. (Without mandatory spare - Sr. No. 2.16 of suggestive price format)	**100%**
2.0	**BREAK-UP OF PRICES GIVEN IN 1.0 ABOVE (To be used during contract execution for payment)**	
2.1	Total lump sum firm price for **EQUIPMENT (SUPPLY)** for Engineering, design, manufacture, inspection & Testing at manufacturers works/subvendor's work, Painting at manufactures works, duly packed for transportation, delivery to site, unloading storage & handling at site, for the complete scope of supply of Ventilation system and as defined in the technical specification (PE-TS-400--554-A001).	**80%**
2.2	**Erection & commissioning**, carrying out acceptance tests at site, final painting and handing over to customer the complete ventilation system on turnkey basis as per specification PE-TS-400-554-A001 including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc.	**20%**
3.0	**Break-up (%) of prices given at Sl No-2.1 above (To be used during contract execution for payment)**	**Percentage of total price of SL No 2.1 above**
3.1	UAF - (Item no 2.1 of Suggestive price format)	**23.00%**
3.2	GSS Duct work - (Item no 2.2.1 of Suggestive price format)	**25.00%**
3.3	MS duct and Aluminium grills (Item no 2.2.2, 2.2.3 & 2.2.4 of Suggestive price format)	**5.00%**
3.4	Thermal Insulation (Item no 2.2.5 of Suggestive price format)	**1.90%**
3.5	Gravity damper, Inlet louver, Fire damper, VCD, (Item no 2.2.6 to 2.2.8 & 2.3 of Suggestive price format)	**3.00%**
3.6	RE units (Item no 2.4 of Suggestive price format)	**10.00%**
3.7	Supply air fans (Item no 2.5 and 2.6 of Suggestive price format)	**15.00%**
3.8	Exhaust fans (Item no 2.7 to 2.9 of Suggestive price format)	**15.00%**
3.9	Manually operated, platform trolley (Item no 2.10 of Suggestive price format)	**0.10%**
3.10	Tools and tackles & Commissioning Spares (Item no 2.11 to 2.12 of Suggestive price format)	**1.00%**
3.11	Field Instruments and any other accessories/item (Item no 2.13 to 2.14 of Suggestive price format)	**1.00%**

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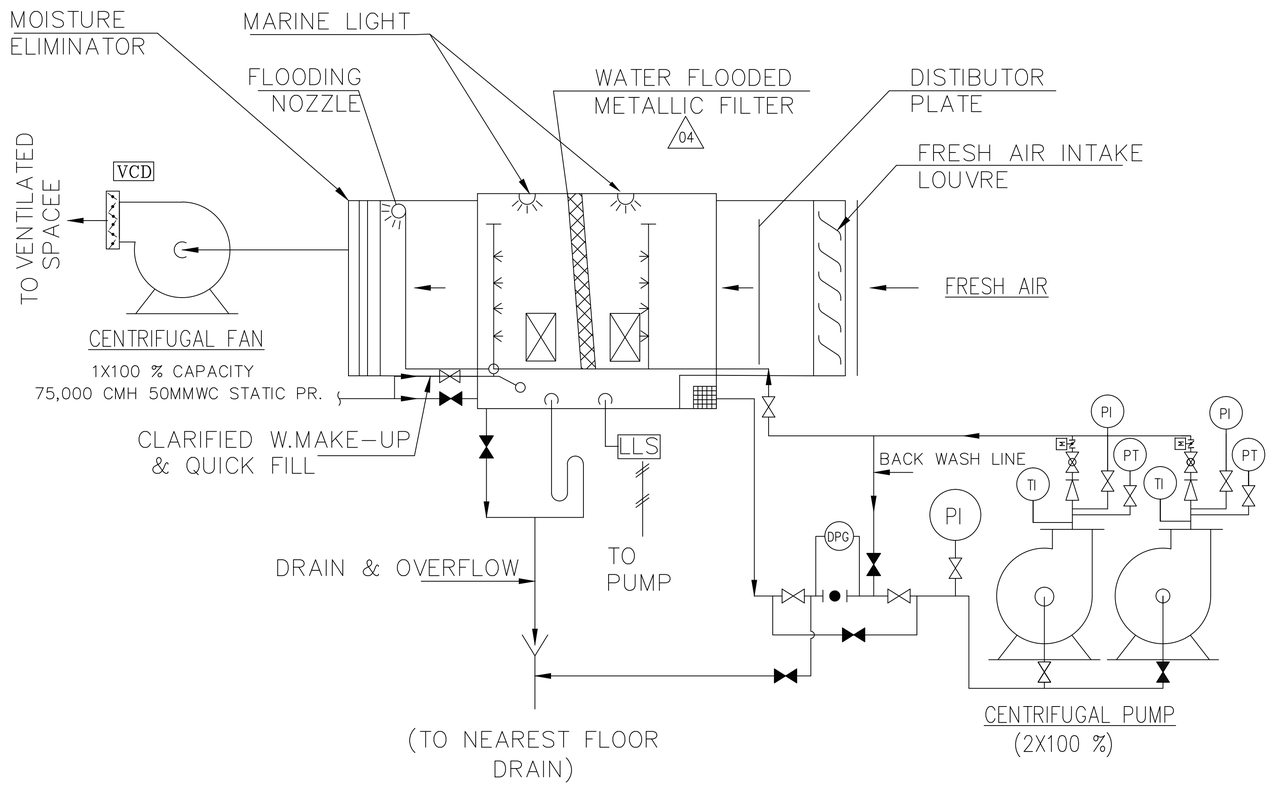
FIRST ANGLE PROJECTION ALL DIMENSIONS ARE IN MM

DRAWING NO. PE-DG-400-554-A001



LEGEND:

GATE VALVE	
CHECK VALVE	
GLOBE VALVE	
GATE VALVE (NORMALLY CLOSED)	
POT STRAINER	
SYPHON	
DRAIN	
PRESSURE INDICATOR	PI
PRESSURE TRANSMITTER	PT
TEMPERATURE INDICATOR	TI
LOW LEVEL SWITCH	LLS
COARSE STRAINER	
DIFF. PRESURE GUAGE	DPG
Motorised Butterfly Valve	

FOR REFERENCE PURPOSE ONLY

TYPICAL SCHEME FOR UAF UNIT

FILE NAME : 100_M038R0

Varun Jain | S A Khan | Praveen Kishore

COSTUMER	NEYVELI LIGNITE CORPORATION LTD. (NLC LTD)
CONSULTANT	LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
	BHARAT HEAVY ELECTRICALS LTD POWER GROUP PROJECTS ENGINEERING MANAGEMENT NOIDA , U.P

JOB NO.	400
STATUS	CONTRACT
DISTRIBUTION	

TO									
No.OFF									

REV	DATE	ALTD	CHD	APPD

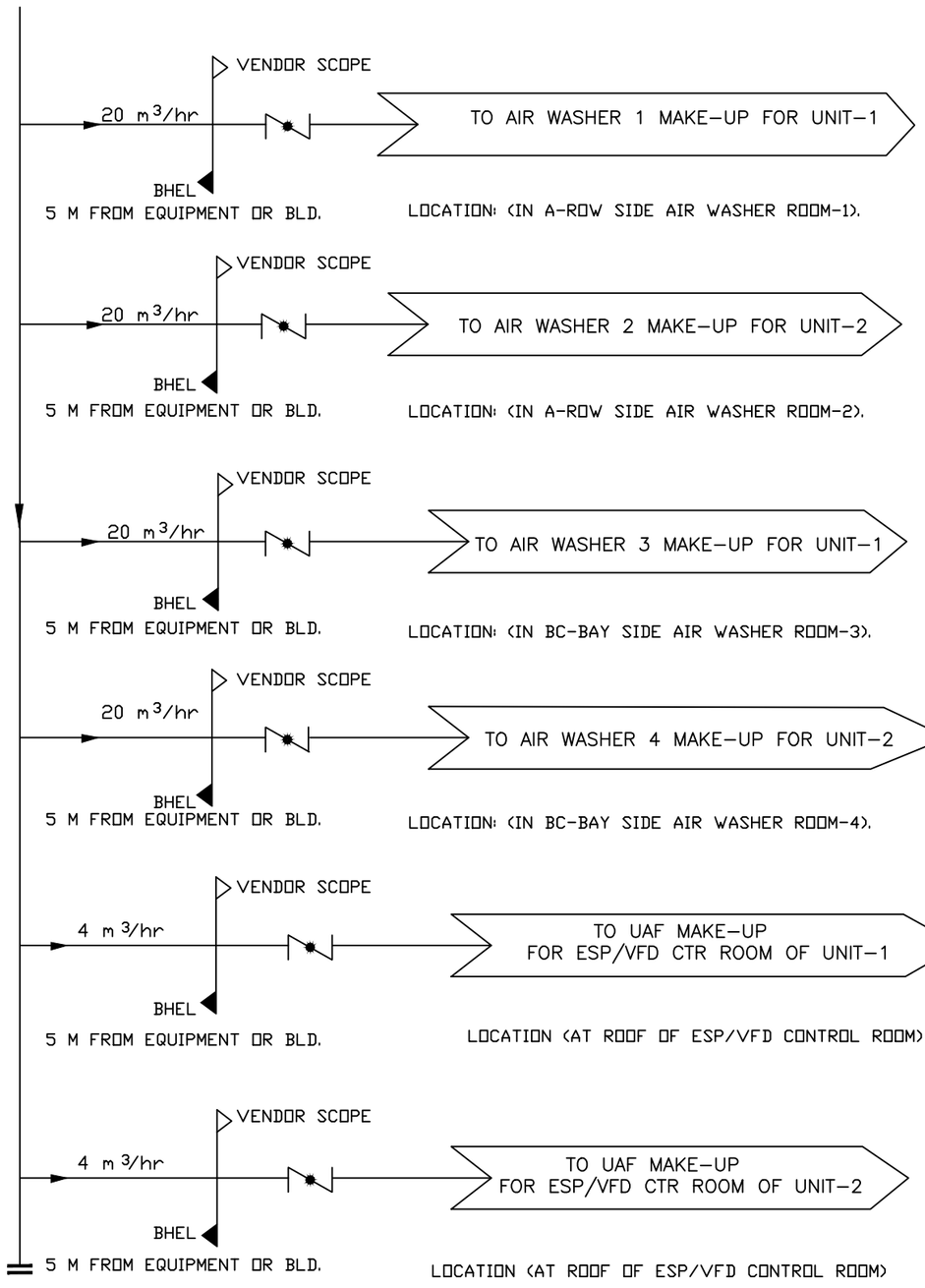
DEPT CODE		NAME	SIGN	DATE
MAX.	DRN	VJ	sd/-	21.08.2014
	DESN	VJ	sd/-	21.08.2014
	CHD	MK	sd/-	21.08.2014
	APPD	SAK	sd/-	21.08.2014

NEYVELI NEW THERMAL POWER PROJECT

TITLE: TYPICAL SCHEME OF UAF

DEPT.	SCALE ~	BHEL DRAWING NO.
SIGN		PE-DG-400-554-A001
DATE		SHEET 1 OF 1 REV 04

FORMAT SIZE A3



Varun Jain

S A Khan

Praveen Kishore

NOTE:-

1. VENTILATION MAKE-UP WATER PIPING INCLUDING FITTINGS SHALL BE TERMINATED WITHIN THE RANGE OF 5 METER DISTANCE FROM THE AIR-WASHER/UAF IF THE EQUIPMENTS ARE IN OPEN AREA OR 5 M FROM THE BLD. IF THE EQUIPMENTS ARE IN HOUSED, BY M/S BHEL FURTHER PIPING SHALL BE DONE BY VENDOR AS MARKED IN THIS DRG.
2. THE HVAC MAKE-UP WATER ISOLATING VALVES SHALL BE ARRANGED BY VENDOR AS PER THE SCHEME.

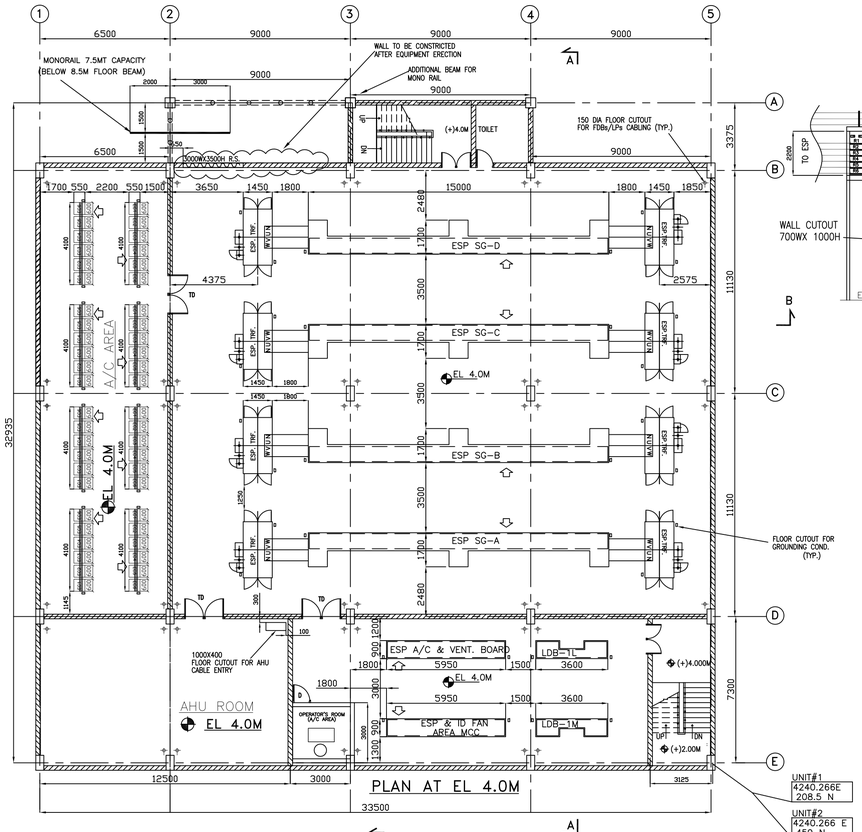
TITLE

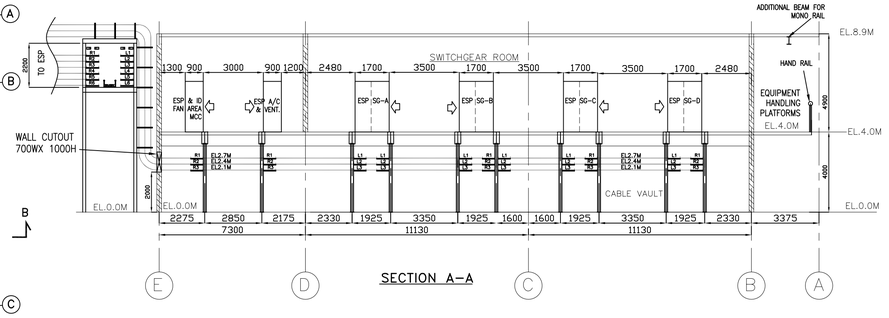
MAKE UP WATER SCHEME

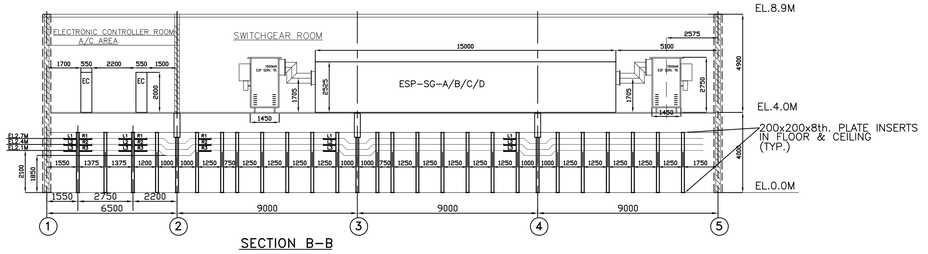
PE-DG-400-554-A003 R00

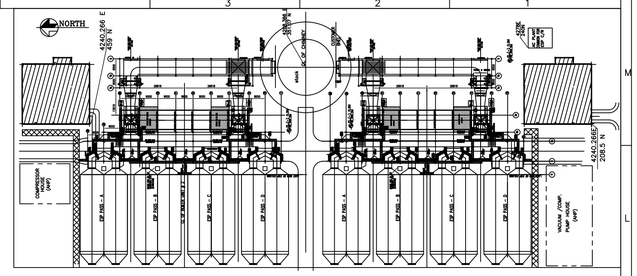
DRAWING NO. PE-DG-400-100-E008

FIRST ANGLE PROJECTION — ALL DIMENSIONS ARE IN MM



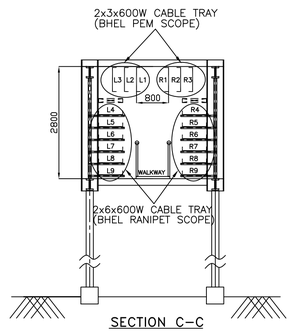


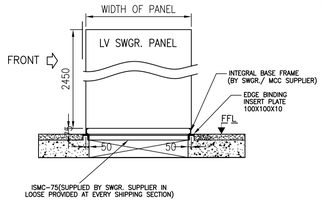


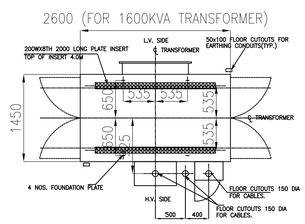


BILL OF QUANTITY

S.NO.	MATERIAL DESCRIPTION	UNIT	QUANTITY
01	CABLE TRAY 600MM WIDE (LADDER TYPE)	METRES	1000
02	CABLE TRAY 600MM WIDE (PERFORATED TYPE)	METRES	500
03	ISMC 100MM	METRES	1000
04	ISA 50x50x6MM	METRES	700
05	TEES 600W (LADDER)	NOS.	16
06	TEES 600W (PERFORATED)	NOS.	8
07	CROSS 600 W (LADDER TYPE)	NOS.	50
08	CROSS 600 W (PERFORATED TYPE)	NOS.	25







REFERENCE DRAWINGS :

S. NO.	TITLE	DRAWING NO.	SOURCE AGENCY
1.	MAIN PLANT EQUIPMENT LAYOUT PLAN	PE-DG-400-100-M002-R4	PEM/ MPL
2.	CROSS SECTION OF MAIN PLANT	PE-DG-402-100-M010	PEM/ MPL
3.	RECOMMENDED CONTROL ROOM LAYOUT FOR ESP	2-00-114-29869	BHEL/ RANIPET
4.	ELECTRICAL SINGLE LINE DIAGRAM	PE-DG-402-565-E001	PEM/ ELECT
5.	CABLE ERECTION PHILOSOPHY	PE-DG-400-507-E004	BHEL/ ELECT
6.	DESIGN PHILOSOPHY FOR ELECTRICAL EQUIPMENTS LAYOUT	PE-DC-400-507-E101	BHEL/ ELECT

NOTES :

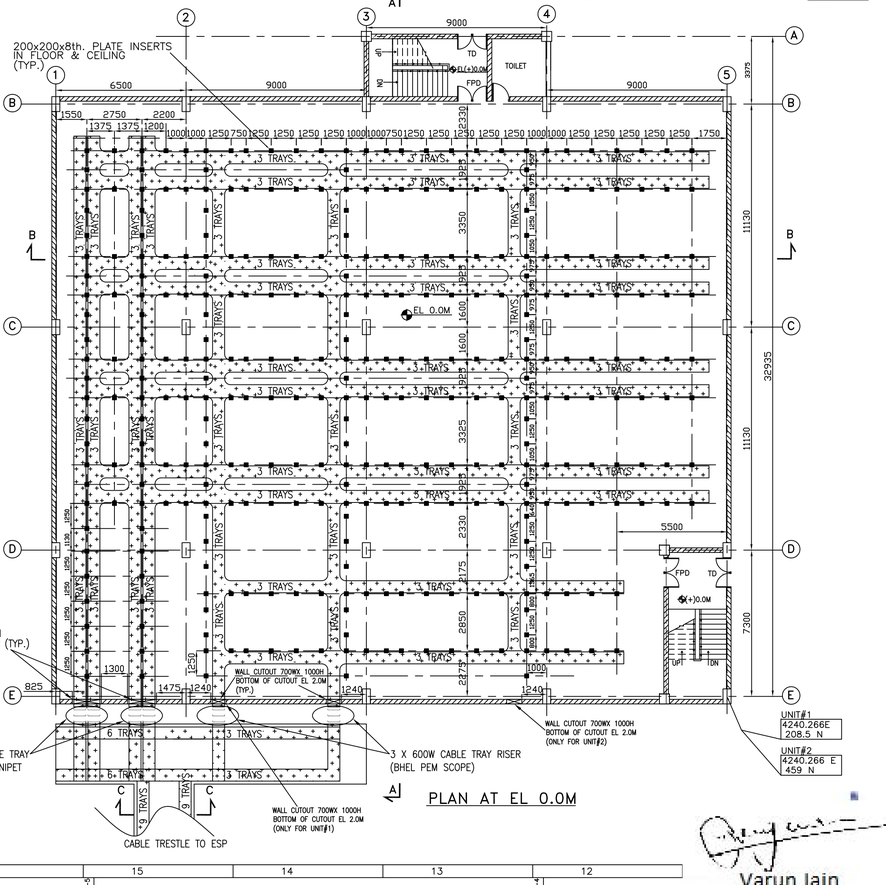
1. ALL ELEVATIONS MARKED ARE W.R.T. T.G. HALL FINISHED FLOOR ELEVATION OF 0.0 M. WHICH CORRESPONDS TO RL +69.50 M.
2. ALL DIMENSIONS ARE IN MM AND ELEVATIONS IN METRES UNLESS STATED OTHERWISE.
3. THE PANEL DIMENSIONS INDICATED IN DRAWING ARE TENTATIVE AND ARE SHOWN FOR DEVELOPING CONCEPTUAL LAYOUT.
4. FOR MOUNTING & FOUNDATION DETAILS AND FLOOR CUTOUTS RESPECTIVE DRAWINGS SHOWN IN 'REFERENCE DRAWINGS' SHALL BE REFERRED.
5. THIS DRAWING IS TO BE REFERRED FOR DETAILS OF ELECTRICAL EQUIPMENT AND CABLING LAYOUT ONLY. LAYOUT SHOWN FOR FACILITIES SUCH AS AC & VENTILATION SYSTEM IS INDICATIVE & FOR INTERFACE PURPOSE. FOR EXACT LAYOUT OF OTHER SYSTEMS, RELEVANT DISCIPLINE DRAWINGS SHALL BE REFERRED.
6. ALL AREAS SHOWN IN THIS DRAWING ARE NON A/C UNLESS STATED OTHERWISE.
7. BOTTOM MOST/OUTERMOST TWO TRAY OF ALL RUNS SHALL BE PERFORATED TYPE.

LEGEND

- OPERATING FRONT OF THE PANEL
- BRICK WALL
- CABLE TRAYS
- CABLE TRAYS
- DOUBLE LEAF DOOR WITH TRANSOM ARRANGEMENT (3M (HT. INCLUSIVE OF TRANSOM ARRANGEMENT) X 2M (WIDTH))
- SINGLE LEAF DOOR (1000Wx2100H)
- FIRE PROOF DOOR
- SPACE FOR FUTURE CABLE TRAYS
- PERFORATED TYPE CABLE TRAY

TABLE-I

S.NO.	EQUIPMENT	SOURCE
1	ESP SG	BHEL/RANIPET
2	EC	BHEL/RANIPET
3	DT TRANSFORMERS	BHEL/JHANSI.
4	NSP BUSDUCT	BHEL/CBU
5	ESP & ID FAN AREA MCCs	BHEL/CBU
6	AC & VENT MCC	BHEL/CBU
7	LDB	PEM/ELECT.



CUSTOMER		नेवेली लिग्नाइट कॉर्पोरेशन लिमिटेड (एनएलसी लिमिटेड) NEYVELI LIGNITE CORPORATION LIMITED (NLC LTD)
CONSULTANT		लहमेयर इंटरनेशनल इंडिया प्राइवेट लिमिटेड M/s LAHMEYER INTERNATIONAL (INDIA) PVT LTD

PACKAGE: STEAM GENERATOR AND AUXILIARIES (NAT1)

NEYVELI NEW THERMAL POWER PROJECT (NNTPP)
2X500 MW LIGNITE FIRED UNITS AT NEYVELI

BHARAT HEAVY ELECTRICALS LTD.
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

JOB NO.	400
STATUS	CONTRACT
DRG./REF. NO. (INTERNAL)	
PRINT SCALE IN METRE	0 5 10 15 20 25 30 40 50

REV	DATE	ALTD	CHD	APPD
02	10.03.15	-SD-	-SD-	-SD-
01	02.09.14	-SD-	-SD-	-SD-

DRG. REVISED DUE TO CHANGE IN ESP CR LOCATION AND CABLE ENTRY.

REVISED AS PER CUSTOMER COMMENTS VIDE LETTER REF.NO. NTA-1/4/0143 DATE 07.08.2014 AND MOM DATE 26 TO 28.08.2014

DEPT CODE		NAME	SIGN	DATE
DRN	E	HB		10/06/2014
DSGN		HB		10/06/2014
CHD		SBH/ SL		10/06/2014
APPD		RG		10/06/2014

TITLE: ELECTRICAL EQUIPMENT & CABLING LAYOUT IN ESP CONTROL BUILDING (UNIT-1)

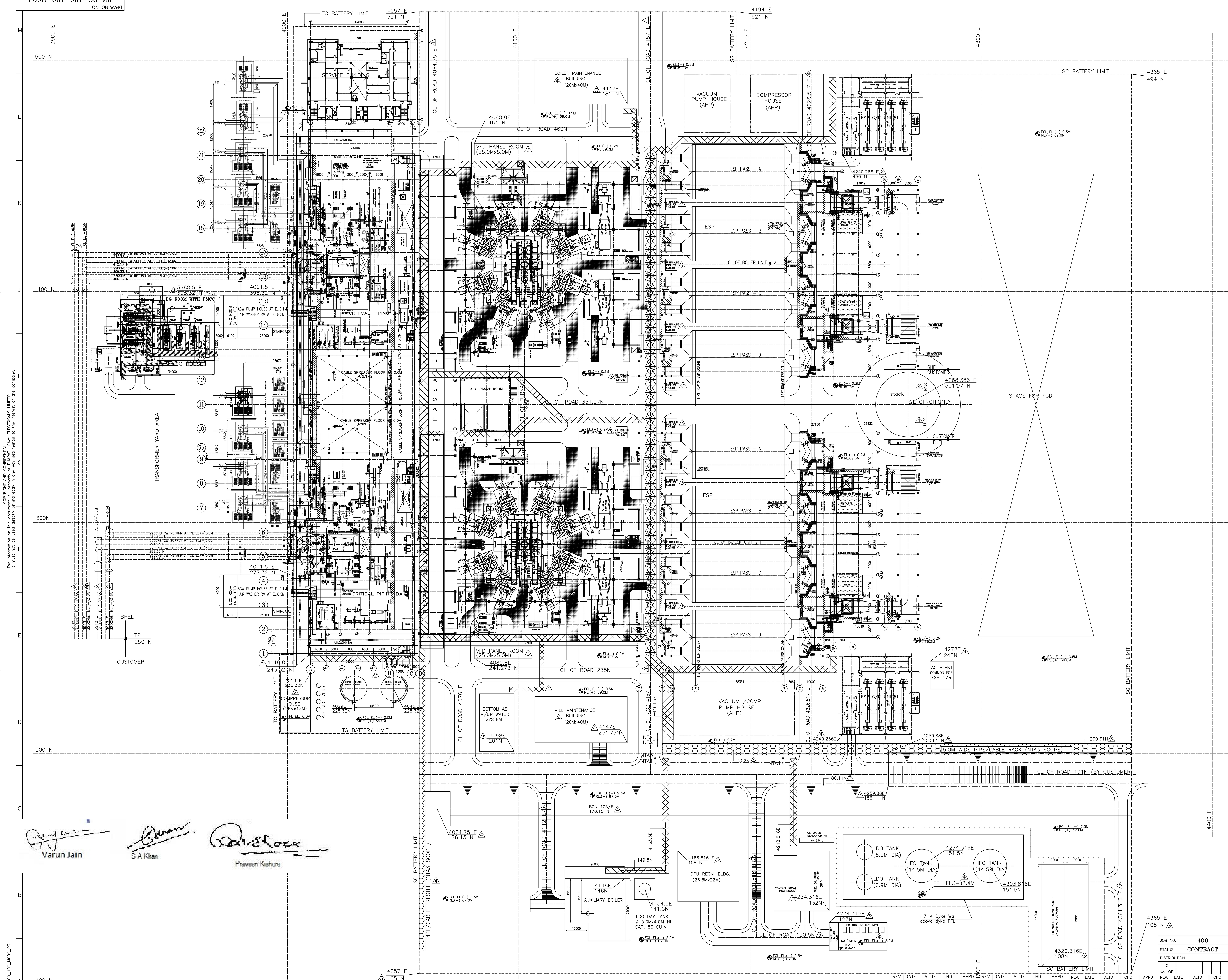
DEPT. | SCALE 1:100 | DRAWING No. PE-DG-400-100-E008
SIGN | SHEET 1 OF 1 | REV 02
DATE

Varun Jain — S A Khan — Praveen Kishore

FORMAT 385-A0

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



NOTES

1. THE EQUIPMENT SHALL BE GENERALLY IN ACCORDANCE WITH THE LAYOUT AND DIMENSIONAL REQUIREMENTS INDICATED IN THESE DRAWINGS. HOWEVER BUILDING SIZES INDICATIVE AND SHALL BE FINALISED DURING CONTRACT ENGINEERING.
2. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
3. ALL ELEVATIONS ARE MARKED w.r.t. T. G. HALL FINISHED FLOOR LEVEL AS ± 0.0M, WHICH CORRESPONDS TO RL(+)69.50M.
4. CHIMNEY COORDINATES HAVE BEEN FIXED AS PER TENDER DRG LII-GEOE11019-G-00110-001; PLOT PLAN (CUSTOMER)
5. SG PACKAGE SCOPE IS WITHIN THE SG BATTERY LIMIT ONLY.
6. (3) BHEL WILL PROVIDE THE PIPE RACK (B/W ESP & BOILER) AT 9.0M ELEVATION WITH CONNECTING BEAMS AT 6.0M INTERVALS WITH WALKWAY. ALL OTHER AUXILIARY STRUCTURES TO BE PROVIDED BY NTA3 AND NTA3 WILL RESTRICT THE PIPE RACK BETWEEN 9.0M & 11.3M.
7. TRANSFORMER AREA IS NOT IN BHEL SCOPE, TRANSFORMER DETAILS SHOWN ARE INDICATIVE ONLY.
8. (3) APPROACH ROADS TO ALL BUILDINGS/FACILITIES/STRUCTURE WITHIN SG BATTERY LIMIT AND IN THE SCOPE OF NTA1 PACKAGE SHALL BE PROVIDED.

REFERENCE DRAWINGS:

1. PLOT PLAN (TENDER STAGE)	:	LII-GEOE11019-G-00110-001 (NLC)
2. EQUIPMENT PLAN AT 0.0M	:	PE-DG-402-100-M003 (PEM)
3. GA - KEY PLAN	:	0-00-020-76587 (TRY)
4. PLAN VIEW (BOILER)	:	0-0-00-021-76590 (TRY)
5. LAYOUT OF ID SYSTEM PLAN	:	0-00-020-76589 (TRY)
6. LAYOUT OF ID SYSTEM ELEVATION	:	0-00-020-76588 (TRY)
7. GA OF ESP	:	0-00-111-27485 (RANIPET)
(3) 8. LAYOUT OF SITE LEVELLING & GRADING	:	LII-GEOE11019-G-00172-550 (NLC)
(3) 9. PIPE & CABLE RACK DRAWING FOR NTA3	:	LII-GEOE11019-G-00110-004 (NLC)
(4) 10. PLOT PLAN (NTA3)	:	3058-C001-MEC-GLT-001 (NLC)
(4) 11. LAYOUT OF TRANSFORMER YARD	:	PE-DG-402-100-E001 (PEM)
(4) 12. LAYOUT OF CW PIPING INSIDE & OUTSIDE TG HALL UP TO TP.	:	PE-DG-402-165-M001 (PEM)

LEGEND:

PIPE/CABLE RACK (BHEL SCOPE)

PIPE/CABLE RACK (NTA3 SCOPE)

SG BATTERY LIMIT

TG BATTERY LIMIT

ROAD (CUSTOMER SCOPE)

REV.	DATE	ALTD	CHD	APPD	DESCRIPTION
4	20.02.2015	AKS/AKV sd/-	AMH sd/-	JJ sd/-	1. DRAWING REVISED IN LINE WITH RESOLUTION IN THE MEETING WITH NLC DATED 19-20.02.15. 2. ORIENTATION OF ESP CONTROL ROOM (UNIT-2) REVISED. 3. DRG. GENERALLY REVISED AS MARKED (4)
3	24.01.2015	AKS/AKV sd/-	AMH sd/-	JJ sd/-	1. DRAWING REVISED AS PER MOM WITH NLC DTD. 21-22.11.14 & 07.01.2015. 2. BOILER MAINTENANCE BUILDING LOCATION RETAINED AS PER TENDER STAGE. 3. VFD PANEL ROOMS ADDED. 4. PIPE/CABLE RACK SCOPE DEMARCATION ADDED. 5. SCOPE OF ROAD ALONG 191N UPDATED AS PER POST. BID RESOLUTION ANNEX. 5.6_DRAWINGS_CIVIL. 6. DRG. GENERALLY REVISED AS MARKED (3)
2	08.09.2014	AKS/AKV sd/-	AMH sd/-	JJ sd/-	1. DRAWING REVISED AS PER RECD. MOM WITH CUSTOMER / CONSULTANT DATED 24-25/07/14 AT TRICHY. 2. COMPRESSOR HOUSE LOCATION REVISED & GENERALLY UPDATED & AS MARKED THUS (2) 3. DG BUILDING LOCATION REVISED AS MARKED.
1	22.07.2014	AKS sd/-	AKS sd/-	AMH sd/-	1. DRAWING REVISED AS PER RECEIVED CUSTOMER COMMENTS VIDE LETTER REF NO. PSE/NNTPS/NTA1/884/2014 DATED 19.04.2014. 2. DRAWING GENERALLY REVISED & AS MARKED (1)

JOB NO.	400
STATUS	CONTRACT
DISTRIBUTION	
TO	
No. OF	

CUSTOMER	नेवेली लिग्नाइट कॉर्पोरेशन लिमिटेड (एनएलसी लिमिटेड) NEYVELI LIGNITE CORPORATION LIMITED (NLC LTD)
CONSULTANT	लहमेयर इंटरनेशनल इंडिया प्राइवेट लिमिटेड M/s LAHMEYER INTERNATIONAL (INDIA) PVT LTD

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2x500 MW LIGNITE FIRED UNITS AT NEYVELI

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE: M

	NAME	SIGN	DATE
DRN	GS	sd/-	03.03.2014
DESN	AKS/AKV	sd/-	03.03.2014
CHD	AMH	sd/-	03.03.2014
APPD	ANIL JOSHI	sd/-	03.03.2014

MAIN PLANT EQUIPMENT LAYOUT

SCALE: 1:550

DRAWING NO. PE-DG-400-100-M002

SHEET 1 OF 1 REV. 4

FORMAT SIZE A0