2X800 MW LARA TPP STAGE II

TECHNICAL SPECIFICATION
FOR
AIR CONDITIONING SYSTEM

SPECIFICATION No. **PE-TS-508-553-A001**

REV NO. 0

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA

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PROJECT INFORMATION

SL. NO	DESCRIPTION	UOM	DETAILS
1	**CUSTOMER**	-	**NTPC LTD.**
2	**CUSTOMER CONSULTANT**	-	**NTPC LTD.**
3	**METEOROLOGICAL DATA**	-	
3.1	SUMMER OUTSIDE DBT	°C	44
3.2	SUMMER OUTSIDE WBT	°C	25.5
3.3	MONSOON OUTSIDE DBT	°C	31
3.4	MONSOON OUTSIDE WBT	°C	27.7
3.5	WINTER OUTSIDE DBT	°C	12.2
3.6	WINTER OUTSIDE WBT	°C	6.6
3.7	SEISMIC ZONE (AS PER IS 1893)	-	III
3.8	HEIGHT ABOVE MSL	m	220
4	**ELECTRICAL DATA**		
4.1	AMBIENT TEMPERATURE FOR DESIGN OF ELECTRICAL EQUIPMENT	°C	50
4.2	RATED FREQUENCY	Hz	50
4.3	FREQUENCY VARIATION	%	(+) 3 to (-) 5
4.4	AC VOLTAGE	V	415
4.5	AC VOLTAGE VARIATION	%	+/-10;
5	**RAW WATER ANALYSIS**		
5.1	PH	-	8.0

5.2	Turbidity	NTU	84
5.3	P-Alkalinity	mg/l as CaCO3	NIL
5.4	M-Alkalinity	mg/l as CaCO3	108
5.5	Total Hardness	mg/l as CaCO3	164
5.6	Calcium	mg/l as CaCO3	100
5.7	Magnesium	mg/l as CaCO3	64
5.8	Chloride	mg/l as Cl	28
5.9	Sulphate	mg/l as SO4	80
5.10	Total Silica	mg/l as SiO2	14.4
5.11	Colloidal Silica	mg/l as SiO2	6.3
5.12	Reactive Silica	mg/l as SiO2	8.4
5.13	Sodium + Potassium	mg/l as Na	52
5.14	Total Organic Carbon (TOC)	mg/l	7.2
5.15	Chemical Oxygen Demand (COD)	mg/l	12
5.16	Biological Oxygen Demand (BOD)	mg/l	3.8
5.17	Equivalent Mineral Acid (EMA)	mg/l	98
5.18	Total Suspended Solids (TSS)	mg/l	78
5.19	Total Iron	mg/l as Fe	0.56
5.20	KMnO4 No.	mg/l	1.6
5.21	Dissolved Oxygen (DO)	mg/l	7
5.22	Temperature	°C	29
5.23	TDS	ppm	
5.24	Total cations	mg/l as CaCO3	216
5.25	Total anions	mg/l as CaCO3	216

SCOPE

SCOPE OF THIS PACKAGE COVERS THE FOLLOWING:

SL.NO	**PARAMETERS**	**REQUIREMENT**
1	Supply Including Design, Engineering, Manufacturing Of	
a)	Main Supply	YES
b)	Commissioning Spares	YES
2	Painting	YES
3	Inspection & Testing	YES
4	Packing	YES
5	Transportation & Delivery To Site	YES
6	Erection & Commissioning	YES
7	Supervision of Erection & Commissioning	NO
8	Performance Guarantee (PG) Test	YES
9	Mandatory Spares	YES
10	O & M Service	YES
11	O & M Spares	YES
12	Storage	YES
13	Consumables	YES

	GENERAL TECHNICAL REQUIREMENT
1	It is not the intent to specify herein all the details of design and manufacturing. Bidder shall ensure that the offered equipment(s) conforms in all respects to high standards of design, engineering and workmanship.
2	Bidder shall also ensure that the offered equipment shall comply with all applicable statutory and regulatory requirements.
3	In the event of any conflict between the requirements of two clauses of this specification, documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply.
4	Drawing/document submission shall be through web based Document Management System (DMS) of BHEL. Bidder would be provided access to the DMS for drawing/document submission. Bidder to ensure internet connectivity of min speed of 2Mbps at their end.
5	Drawings/ documents submitted by supplier at any stage shall be complete in all respects. Any incomplete drawing submitted shall be treated as non- submission with delays attributable to vendor. For any clarification/ discussion required to complete the drawings, the bidder shall depute his personnel to BHEL / Customer's Office as per the requirement for across the table submission/ finalizations of drawings.
6	Wherever references are made in the Contract to codes and standards in accordance with which the Contract shall be executed, the edition or the revised version of such codes and standards current at the date twenty eight (28) days prior to date of bid submission shall apply unless otherwise specified. During Contract execution, any changes in such codes and standards shall be applied after approval by the BHEL / customer.
7	Bidder shall submit Quality Plan on compliance route in the event of order Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.
8	In case, the bidder is sourcing the item/any component from outside India, the third party inspection shall be arranged by bidder at their cost and shall be deemed to be considered by the bidder in their offer.
9	Nameplates shall be manufactured from stainless steel or aluminium with a matte or satin finish, and engraved with black lettering of a minimum 6 mm height or as per equipment standard whichever is higher
10	All sub - vendors shall be subject to BHEL/ Customer approval in the event of order.
11	Mandatory Spares : Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the mandatory spare list
12	Foundations for equipment's i.e. Chillers, Package AC, AHU, Condensing unit, cooling Tower, Pumps is excluded from vendor's scope. Grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of vendor
13	False ceiling, Underdeck Insulation work are excluded from vendor's scope
14	Construction of AC plant room, air handling unit room are excluded from vendor's scope
15	Slab cutout / Wall Openings for ducts, pipes, fans, cables are excluded from vendor's scope. Sealing of duct opening, pipe opening, fan opening in wall and floor is in scope of vendor
16	Fixing frame works for diffusers and grilles in the scope of Vendor.
17	Drain piping within room up to the drain point to be provided by the Vendor.
18	Instruments required for performance testing of various equipment / system of the package shall be arranged by Vendor at site. Instrument for testing shall be calibrated by Air-conditioning plant supplier before taking up testing.
19	Instruments to be used for PG test shall be additionally supplied over and above the instruments shown in tender P&IDs. PG test Instruments being supplied, installed and commissioned for each unit,shall be retained by employer after completion of PG test
20	Chilled water pipe and condenser water pipe from AC plant to AHU room and cooling Tower shall not be routed from inside building. These pipe shall be routed outside the building and all support shall be in scope of vendor
27	In addition to one number TH and RH sensor in each AHU room, 15 nos. additional TH and RH sensor is required over and above TH and RH sensor in each AHU room
	TRAINING TO CUSTOMER PERSONEL
1	The scope of service under training of Employer's engineers shall include a training module covering the areas of Operation & Maintenance
2	Training module shall enable these personnel to individually take the responsibility of operating and maintaining the system in a manner acceptable to the Employer

3	Training on Erection methodologies of system and Equipment's associated with the Package, including a visit to power plant construction site
4	The exact details, extent and schedule for training shall be as finalized during detailed engineering and shall be subject to Employer's approval
5	The scope of services under training shall also necessarily include training of Employer's Engineering personnel covering entire scope for the package
6	This shall cover all disciplines viz, Mechanical, Electrical, C&I , QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing erection, welding etc.
7	In all the above cases, the lodging and boarding of the Employer's personnel shall be at the cost of Bidder
8	The Bidder shall make all necessary arrangements towards the same
9	For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.
10	Location of classroom training for engineering shall be at Design/Engineering office. Classroom training for erection/O&M shall be at location of Manufacturers' works.
	E-LEARNING PACKAGE REQUIREMENT
1	e-learning package shall be provided for the system. e-learning package shall be installed on the Learning Management Server (LMS) of Power Management Institute (PMI), NTPC located at Noida. The Engineer- In-Charge (EIC) for the e-learning modules shall be from PMI.
2	The objective of the e-Learning package consisting of courses for erection, commissioning, operation and maintenance of equipment / system as specified and to facilitate the employees to have first hand information / requirement with respect to above activities for the supplied equipment / system
3	The bidder shall submit e-learning courses each for erection, commissioning, operation and maintenance of each of the equipment / system supplied
3.1	The erection course(s) should include instructions on pre-checks, prerequisites, erection strategy, erection procedure
3.2	The commissioning course(s) should include instructions on pre-commissioning, commissioning initial operation
3.3	The operation course(s) should include instructions on the permissive, interlocks, physical check-ups, start-up, shutdown and protections
3.4	The maintenance course(s) should include instructions on predictive, preventive, breakdown and overhauling
4	Depth of coverage of above courses shall be as specified for "Instruction Manuals" in above clauses. A literature on caution / safety while handling equipment / system for the above modules shall follow the description of the said equipment /system
5	The e-Learning packages on equipment / system shall be installed by the vendor and shall be successfully test run in the presence of EIC or representative before acceptance by NTPC. The vendor will also give the master copy in form of Flash Drive/CD/DVD. The respective module for erection & commissioning shall be delivered and successfully test run at least three months before the scheduled start of the corresponding activity at site
6	e-Learning course broad requirements:
6.1	The courses shall be web based and mobile based Application type. It shall run on all possible versions of web browser like Internet Explorer, Google Chrome, Firefox etc. on Laptop/Desktop and shall be Smartphone/Tablet/Mobile responsive. The Mobile responsive courses shall run on Android, Windows Mobile, Blackberry, iOS etc.
6.2	The courses shall support liquid/fluid page layout so that the entire screen gets adjusted to PC, Laptop, Smartphone/Mobile, Tablet and any other display devices.
6.3	Course content text shall be in English language and be associated with a voiceover in English language with Indian accent
6.4	Courses shall be SCORM (Sharable Content Object Reference Model) compliant, version 1.2 which is compatible with LMS at PMI.
6.5	Each course shall have every physical and functional detail of the equipment / system supplied.
6.6	Each of the e-Learning course shall be based on multiple web pages and mobile pages with multiple modules.
6.7	There shall be option for self-assessment test after every course. In case the user doesn't opt for self-assessment test the user shall be able to go to the next course. There shall be no restriction in no. of times for repeating the assessments. All correct answers along with the answers marked by the users shall be displayed at the end of test/quiz.
6.8	If Java and Flash, as applicable are not available in the system to run the package, then there shall be a prompt message for updation of the same.
6.9	Each course shall have a self-running interactive content with navigation buttons containing forward, backward, pause, bookmark and menu options in the course window.
6.10	The course shall contain chapter titled 'Introduction/overview' that explains the purpose of the course
6.11	The course content shall contain descriptive text shall be factual, specific, terse, clearly worded, and simply illustrative, so that the user can understand it.
6.12	The system shall provide the user with the ability to select the information with a Cursor

6.13	The course menu should contain table of content linked to concerned pages. The user shall be given the capability to access all of the functions available on the system through a menu system. This shall consist of active buttons, which shall control a hierarchy of pull down/pop-up menus. Menu shall appear quickly and exist only while a selection is being made. The user shall be given the capability to position the cursor or pointer on the menu item and use pointer device such as mouse to activate the function
6.14	Every course shall contain the 3D design/drawing/exploded view/360 deg. Turn around view of the equipment/system, textual description of the equipment/system and its functionality with video (as applicable), animation and audio
6.15	The users shall be able to control audio sound level associated with the courses.
6.16	Drawings / text in the courses shall be scalable (Zoom In/ Out).
6.17	The user shall have the capability to record a bookmark to mark displayed information for later recall, whenever he accesses the same course next time.
7	e-learning Package of an equipment / system shall include e-learning courses for each of erection, commissioning, operation and maintenance of that equipment / system.
8	e-learning courses on erection, commissioning, operation and maintenance of an equipment / system shall include e-learning lessons/chapters/modules (as required) for erection, commissioning, operation and maintenance respectively of that equipment / system.
9	**MINIMUM MANPOWER AND T&P REQUIREMENT FOR OVERALL DURATION OF CONTRACT E&C CONTRACT PERIOD**
9.1	Site engineer at least Diploma holder.
9.2	Mechanical work: Equipment/Piping gang comprising- Piping Gang -01 number for 15 months, Equipment Gang – 01 number for 10 months. Ducting Gang - 2 numbers for 15 months
9.3	T&P: Welding machine, cutting machine, chain pulley block,----min. 2 nos each for 15 months
9.4	Manpower and T&P mentioned is minimum requirement and agency to deploy any additional requirement as per mutual agreement with concerned site dealing engineer.
9.5	In case agency fail to deploy above, BHEL shall engage such manpower/T&P and cost of the same +30% penalty shall be levied on this

C&I	
1	Control of Air conditioning plant shall be through DCS located in Control Room.
2	Complete Field Intrumentation for monitoring and operation of Air conditioning plant shall be provided by Vendor.
3	The design of the control systems and related equipment shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved. 'Fail Safe' operation signifies that the loss of signal, loss of excitation or failure of any component shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided / minimized.
4	The quantity of instruments for the system shall be as per tender P &ID wherever provided of the respective system as a minimum, for bidding purpose.
5	Instruments to be used for PG test shall be additionally supplied by bidder over and above the instruments shown in tender P&IDs. PG test equipment being supplied, installed and commissioned for each unit,shall be retained by employer after completion of PG test. All PG test process parameters shall be made available in DDCMIS.
6	Microprocessor based controls of Chiller units , Air cooled condensing unit (D-X type), PAC (if applicable) etc. shall be provided with local display along with facilities to Soft link & Hardwired interface with DDCMIS and to meet the requirement of all system operations and controls. Soft link communication between Microprocessor (MP) based control panels & DDCMIS shall be redundant Bi-directional via TCP/IP on OPC or MODBUS with RS485 link. Bidder shall include required hardware at MP end.
7	Time synchronization of Microprocessor (MP) with DCS is to be carried out. Necessary hardware/software for same at MP end to be provided by Bidder
8	Each Screw Chiller units and condensing unit shall be provided with local start / stop & indication in addition to DDCMIS based Control system of A/C plant for Main plant area, ESP Control Room, FGD Control Room & AHP Control Room, Office area at 34.0m in power house, CEP VFD unit 1 and CEP VFD unit 2
9	AHU shall be started locally as well as from the main control room of AC system by means of Remote / Manual selection facility. Selector Switches for AHU shall be provided in the DCS. LCP shall have the provision of command (start/stop) & feedback interface with DDCMIS along with lamp indication.
10	The PROFIBUS protocol design shall be further validated by BHEL and approved by NTPC during detailed engineering and any variation/ changes required based on DDCMIS system requirements and actual field installation, operational philosophy etc. shall be considered by bidder without any implications.
11	Temperature transmitter shall be provided for all temperature measurement applications. All temperature transmitters shall be suitably grouped together and mounted inside racks in case of covered areas etc. on as required basis. In case grouping is not possible and temperature transmitter is to be installed individually, canopy with suitable mounting arrangement shall be provided.
12	Bidder to provide temperature transmitter along with compensating cable, JB/Rack & other erection hardware.
13	Diaphragm seal shall be provided with Instruments having contact with corrosive media.
14	Redundancy of sensors shall be provided by bidder (i) Triple redundancy for all analog and binary inputs required for protection of system/drives. (ii) For all other control functions dual redundancy of the sensors shall be provided by the bidder.
15	415V AC/ 230V UPS Power supply shall be provided by BHEL at a single point, All necessary hardware for deriving other power supply from given feeder shall be in Vendor's scope. Bidder to furnish electrical load/UPS load data during detailed engineering.

16	Root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold, junction boxes and all other accessories required for erection of local / remote instruments shall be provided by Vendor. Double root valve to be provided where the design pressure is or more than 40kg/cm2.
17	The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes.
18	All instruments other than profibus type shall be terminated on JB/LCP in field. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable.
19	All the outdoor field instruments such as transmitters/meters etc. shall be provided with suitable Free standing cabinet(s)/panel/rack so that the equipment are protected against rain/ sunlight etc.
20	All electric actuators, pneumatic control valves, Junction Boxes, Solenoid boxes and Local control panels which are not installed inside building, suitable canopy shall be provided and design of canopy shall be approved by Employer during detailed engineering.
21	Bidder to provide Comprehensive Annual Maintenance Services (AMS) for three (03) years after warranty period for profibus instruments.
22	For all Profibus devices GSD and DTM files are to be provided for configuration/ testing in the DCS for proper interfacing and diagnostics.
23	Bidder's presence is required for at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic in DCS. Bidder's presence is required in multiple visits at site during commissioning of DDCMIS for assistance related to process correctness. All the expenses like boarding, lodging and travel, air fare etc. shall be in bidder's scope.
24	Every panel-mounted instrument requiring power supply shall be provided with easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
25	The design of the control systems and related equipment shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved. 'Fail Safe' operation signifies that the loss of signal, loss of excitation or failure of any component shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided / minimized.
26	**TYPE TEST**
26.1	Submission of type test results and certificate shall be acceptable provided:
26.2	The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment.
26.3	There has been no change in the components from the offered equipment & tested equipment.
26.4	The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening.
26.5	In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.
26.6	The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.
26.7	For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording, precautions to be taken etc. for the tests to be carried out.

27	**ANNUAL MAINTAINENCE SERVICE (AMS) FOR PROFIBUS INSTRUMENTS**
27.1	The requirements specified below are applicable for warranty (defect liability period) and 3 years AMS period.
27.2	The Contractor's scope shall also include providing Post Warranty Maintenance for 3 years after completion of warranty period of the offered wireless systems and all associated components as per specification. The AMS shall include tools and tackle as required; travel, boarding & lodging of service engineer. In the event of any malfunction of the system hardware/system software, experienced service engineer shall be made available at site within 48 hours on the receipt of such information from Employer.
27.3	Employer personnel will work on system day-to-day basis and wherever possible, Employer shall inform the type of failure of hardware/ software to Contractor based on diagnostic available with the system. However Contractor shall be fully responsible to attend and rectify the root cause and the failure within 48 hrs. Contractor may utilize the spares available with Employer, if necessary and available with Employer at site, which are part of mandatory spares supplied with system as per this specification. However, the consumed spares shall be replenished to Employer within 2 months' time.
27.4	**The services under Post Warranty Maintenance Agreement, shall broadly comprise of the following:**
27.4.1	Periodic Maintenance Site visits, minimum four (4) times in a year (total days expected 16 in a year), schedule of visits to be discussed and finalized jointly between Contractor and client after placement of order/ delivery. It shall include inspection of general healthiness of the system, study and advice on daily maintenance, inspection of Hardware & Software, if any problem is reported, running of test programs, on-line servicing and solving reported problems. System shall be checked online.
27.4.2	Software Maintenance/ Support Contractor shall maintain the existing operating & application software for any debugging requirements to have consistent performance of the system.
27.4.3	Emergency Service In the event of any malfunction of the wireless system hardware/system software during this period, Service Engineer must report at site within 48 hrs. of report of failure. The system must be brought back within 48 hours after reporting at site.
27.4.4	Contractor shall note that while carrying out the Annual Maintenance Contract activities, Employer's engineers shall associate with the Contractor. On-job training of these associated engineers shall be covered under this scope. This shall include all items being supplied by Contractor, including any bought out items but not limited to the following: Labour, at no additional cost, to repair any system devices , to provide tests, and adjustment to system devices.
28	**PLANT CONTROL OF AC SYSTEM**
28.0.1	Brief scheme of controlling the operation is described below. Detailed description of the control system for safe and efficient operation of the plant shall be elaborated, got approved from employer.
28.1	**Control Scheme for Air-Conditioning System**
28.1.1	The basic function of the system shall be to closely control and monitor temperature and humidity conditions inside the air-conditioned spaces, to optimize / minimize energy consumption by automated operation, to provide remote centralized monitoring & control for various mechanical facilities including sequential start/stop of the whole Air conditioning System, automatically calculate record and cooling load for each hour /day/season, to generate maintenance data & alarms, to maintain records of plant operation & energy consumption for varying loads, duty cycling to operate all the equipment including standby equipment for equal duration, automatic startup of standby equipment in case of failure of operating unit and displaying fault alarm status of the tripped unit, activating /deactivating water valves to startup/stop water flow through chiller/condenser circuit.

28.1.2	For sequential operation /duty cycling, Programmed startup/stop of individual AHU as per operating requirements and inside room temperature and humidity of "CCR, CER, SWAS control room, UPS and Battery Charger room, static excitation room (as applicable)", "ESP control rooms, AHP control room, FGD control room" shall be maintained by controlling the chilled water flow by means of motor operated three way modulating valve at chilled water line, humidified system and duct heater.
28.1.3	The operation of each Air Conditioning system shall be possible through Microprocessor based dedicated controllers to be provided by Contractor for each Screw /centrifugal Chiller units with local start / stop & indication for main plant A/C system in addition to Main DDCMIS based Control system of A/C plant for "Main plant area", "ESP control rooms, FGD control room & AHP control room". Further these microprocessor-based control panels of Chiller units shall be suitably interfaced with DDCMIS based Control panels.
28.1.4	Air-Conditioning system for "Water system control room" shall be controlled through microprocessor based Distributed Digital Control Monitoring and Information System (DDCMIS).
28.1.5	Air-Conditioning system for "Switchyard control room building" shall be controlled through microprocessor based Distributed Digital Control Monitoring and Information System (DDCMIS) / control system as per Manufacturer's standard & proven practice.
28.1.6	For Air Conditioning System of "office area in control tower" Contractor shall provide Microprocessor /PLC/ controller integrated GIU based Control System as per Manufacturer's standard & proven practice
28.2	**Water Chilling Plant Control**
28.2.1	Microprocessor based controls shall be provided as per manufacturer's standard practice along with facilities to interface with control system and to meet the requirement of all system operations and controls
28.2.2	Water chilling unit control system shall be designed to have a constant chilled water outlet temperature from evaporator at all load condition by means of controlling ON-OFF thermostat (one for each compressor). The closure of liquid line solenoid valve and tripping of compressor at lower water temperature and opening of solenoid valve and starting of compressor at high water temperature set point shall be automatic through the thermostat. Between the above set points the compressor capacity shall be controlled automatically through cylinder "load-unload" mechanism activated through the suction pressure or return chilled water temperature.
28.2.3	Water chilling unit shall be equipped with superheat control of water chilling unit through thermostatic expansion valve which gets its impulse from temperature element connected with suction line after chiller outlet.
28.2.4	High discharge pressure cut-out and oil pressure (OP) differential cut-out shall be of manual reset type and low pressure cut-out shall be automatic reset type. The OP cut-out shall trip the compressor in case of low oil pressure.
28.2.5	Facility toggle switch to close the liquid refrigerant line solenoid valve shall be provided to shut the compressor by the operation of low pressure cut-out (after the refrigerant has been pumped to the condenser).
28.2.6	Switching of Crank case heaters shall be interlocked with starting and stopping/tripping of compressor motor. Further, the safety thermostat shall switch off the crank-case heater in the event temperature rises above safe limit.
28.2.7	Provision shall also be made for the manual restarting of the compressor.
28.2.8	On-off type anti-freeze thermostats, one for each chiller shall be provided in addition to the controlling on-off thermostat for safety purpose and shall act in the event of failure of on-off thermostat to close the liquid line solenoid valve and also to simultaneously trip the compressor.

28.2.9	Compressor starting/running shall be interlocked with the low / adequate flow at the outlet of each chiller and each condenser and as well as with pressure in the inlet of the condensers. In addition, closure or open status of various valves shall be used for interlock, alarm and control of Air Conditioning System.
28.2.10	Condenser water pumps shall be interlocked with the low - level switch in each cooling tower sump and operation of cooling tower fans. High level in the cooling tower shall be annunciated in the panel by means of a separate level switch.
28.2.11	Closure of fire dampers shall raise an alarm in the system.
28.2.12	There shall be provision for temperature and flow measurement in chilled water inlet and outlet line across AHUs to monitor the air conditioning load of each area.
28.2.13	Operation of air conditioning system shall be interlocked with the required minimum pressure and temperature of cooling tower at inlet to the condenser. Status indication of condenser water pumps and associated cooling towers shall be provided in the control panel of air conditioning plant.
28.3	**Air Handling Unit**
28.3.1	Inside room temperature and humidity shall be maintained by controlling the chilled water flow by means of motor operated three way modulating valve and by varying the flow by means of signal from TH and RH sensor which shall get its signal from the Control system for main plant A/C system and ESP/FGD/AHP control rooms A/C system.
28.3.2	Humidity sensor and gyserstat located in the return air duct shall actuate the PAN humidifier to obtain the desired degree of humidification.
28.3.3	Humidity and temp. sensor shall be provided and interlocked in steps with winter heater/ re-heater / strip heaters for monsoon and winter re-heating or heating as the case maybe.
28.3.4	Heater banks shall be interlocked with the running of AHU, temperature of return air, humidity of return air and safety thermostat (airstat - located in front of the each heater in the supply air duct)
28.3.5	AHU shall be started locally as well as from the main control room of AC system by means of Remote / Manual selection facility. Local control panel for AHU is in vendor's scope.
28.3.6	The closure of fire dampers, automatic tripping of AHU fans and fresh air fans shall be interlocked with fire detection system.
28.3.7	Each AHU shall be provided with temperature indicators and pressure transmitter in the chilled water piping inlet and outlet to monitor the air-conditioning load of each area.
28.4	**D-X Air-Conditioning System**
28.4.1	The control and interlocks described above for water chilling plants are applicable for this system also.
28.4.2	Further the compressor starting/running shall be interlocked with the flow switches in condenser water (if applicable) circuit as well as with AHU motors.
28.4.3	The standby condenser water pumps (if applicable) & standby AHU shall be started automatically when the working equipments are stopped / tripped. Auto/ Manual selector Switches and working / standby selector switches for the pumps, fresh air fans and AHU shall be provided in the panel.
28.5	**Cassette /Hi-wall Split Air Conditioners**
28.5.1	Control and interlocks for these type of units shall be as per manufacturer’s standard practice.
28.6	**Miscellaneous Control Requirements**
28.6.1	Separate emergency local stop push button shall be provided for each pump,compressor, fans etc. of A/C system.
28.6.2	Status shall be provided of each pump, compressor, fans etc. of A/C system and Ventilation system on HMI system at control room.

28.6.3	All the annunciations related to failure of equipments, tripping of equipments, source of failure / reason due to which the equipment is stopped/tripped, low & high limits of parameters such as level, temperature, pressure drop, pressure etc. shall be provided for each pump, fan, compressor, AHU, PAC, etc. of centralized A/C system.
28.6.4	The fans (both supply and exhaust fans) associated with mechanical ventilation system shall be operated locally.
28.6.5	Relative humidity and temperature measurement of all control rooms, CERs and all major air-conditioned areas shall be available in DDCMIS. Relative humidity and temp. measurement for main plant control room and CERs to be available in multiple numbers.

SPECIFIC TECHNICAL REQUIREMENT		
1	**TYPE**	
1.1	**AC PLANT 1 :Main Plant Areas [control room, control equipment room, UPS room, battery charger, SWAS room & water analysis lab**	
i)	Vapor compression type water chilling units	3X50%
ii)	Chilled water pump	3X50%
iii)	Condenser water pumps	3X50%
iv)	Cooling Towers	3X50%
v)	AHUs	At least one (1) no. unit, capacity same as each working unit as common standby.
vi)	fresh Air fan	1 x 100 % capacity for each AHU room
1.2	**AC PLANT 2: ESP control rooms, FGD control room, AHP MCC control rooms**	
i)	Vapor compression type water chilling units	3X50%
ii)	Chilled water pump	3X50%
iii)	Condenser water pumps	3X50%
iv)	Cooling Towers	3X50%
v)	AHUs:	2x100% AHUs for each control room of ESP/FGD/AHP Building.
vi)	fresh Air fan	1 x 100 % capacity for each AHU room
1.3	**AC PLANT 3: office area in control tower**	
i)	Air cooled (D-X Type) condensing units	2X100%
ii)	AHUs	2x100%
iii)	fresh Air fan	1 x 100 % capacity for AHU room
1.4	**AC PLANT 4: Water System Control Room Building**	
i)	Air cooled (D-X Type) condensing units	2X100%
ii)	AHUs	2x100%
iii)	fresh Air fan	1 x 100 % capacity for AHU room
1.5	**AC PLANT 5: CEP VFD UNIT 1**	
i)	Air cooled (D-X Type) condensing units	2X100%
ii)	AHUs	2x100%
iii)	fresh Air fan	1 x 100 % capacity for AHU room
1.6	**AC PLANT 6: CEP VFD UNIT 2**	
i)	Air cooled (D-X Type) condensing units	2X100%
ii)	AHUs	2x100%
iii)	fresh Air fan	1 x 100 % capacity for AHU room
1.7	**Other Auxiliar building/Control room**	
i)	Cooling load upto 5 TR	Hi-wall Split/Cassette air conditioner units
ii)	Cooling load 5 TR to 25 TR -	ductable split/packaged A/C

iii)	Redundency :	a) 100% standby for control rooms/RIO room/etc. served by ductable split/package type air conditioners. b) At least one (1) no. unit, capacity same as each working unit as a common standby shall be provided for control rooms/RIO room/etc. served by non-ductable split (cassette / Hiwall) type air conditioners. c) No stand-by for office areas of offsite buildings
2	**DESIGN CRITERIA**	
2.1	Inside Design Temprature For all AC areas	24°C± 1°C
2.2	Inside Humidity for all AC areas (except served with Split/cassette AC)	50% ± 5%.
2.3	Fresh air for air-conditioned areas of ESP Control Room / AHP Control Room /FGD control room, Control Room / Control Equipment Room / UPS, Water System Control Room Building	Maximum of 0.45 M3/minutes/person or 1.0 ACPH
2.4	Fresh air for areas like office area in control tower	minimum 1.5 air changes per hour
2.5	Light Load	1W/sqft or actual whichever is higher
2.6	Occupancy	
2.6.1	General area	1 person per 10 Sq. M (min.)
2.6.2	Conference room/meeting room	1 person per 3 Sq. M
2.6.3	Control rooms, control equipment rooms	1 person per 25 Sq. M (min.)
2.7	Design Margin	
2.7.1	Sensible Heat	10%
2.7.2	Latent Heat	12.50%
2.7.3	Overall heat load	10%
2.7.4	Cooling tower	20%
2.7.5	Pump head	10 % on friction head
2.7.6	Pump motor rating (at 50 deg. C)	10 % over max. load demant in entire operating range
2.8	Chilled water flow rate	0.7 Cu.M/hr per TR (min.)
2.9	Chilled water flow rate	1 Cu.M/hr per TR (min.)
2.10	Velocity through AC duct	7.6 m/s (max.)
2.11	All Refrigerant and Insulation	CFC/HCFC free

	MINIMUM MANPOWER AND T&P REQUIREMENT FOR OVERALL DURATION OF CONTRACT E&C CONTRACT PERIOD
1	Site engineer at least Diploma holder.
2	Mechanical work: Equipment/Piping gang comprising- Piping Gang -01 number for 15 months,
3	T&P: Welding machine, cutting machine, chain pulley block,----min. 2 nos each for 15 months
4	Manpower and T&P mentioned is minimum requirement and agency to deploy any additional requirement as per mutual agreement with concerned site dealing engineer.
5	In case agency fail to deploy above, BHEL shall engage such manpower/T&P and cost of the same +30% penalty shall be levied on this

TECHNICAL DATA - PART - A (MECHANICAL)

Chiller			
S. No	**DESCRIPTION**	**UOM**	**DETAIL**
1	General		
1.1	Type	-	Water-cooled type (Chillers for main plant shall preferably be with multiple compressors)
1.2	Configuartion	-	As per specific Technical requirement
1.3	Vibration Isolators	-	Steel spring/ Neoprene rubber cushy foot/ neoprene serrated rubber pad type with isolation efficiency not less than 85%.
1.4	COP (min.) as per AHRI condition	-	For capacity <260 TR : 4.7
		-	For capacity ≥ 260 & < 530 TR : 4.9
2	Compressor	-	
2.1	Type	-	Screw type (open/semi hermetic/ multiple hermetic)
2.2	Type of drive	-	Motor driven, along with Star delta/Double delta Starter.
3	Condenser	-	
3.1	Type	-	Water cooled shell and tube type.
3.2	Fluid	-	Shell side- Refrigerant
		-	Tube side - Water
3.3	Capacity	-	To match with respective compressor and to provide at least 2 deg. C sub-cooling. To store full charge of refrigerant
3.4	Design fouling Factor	MKS	Not less than 0.0002
3.5	Shell material	-	Mild steel (IS: 2062) / SA 106 Gr. B
3.6	Tube material	-	Replaceable seamless copper
3.7	Fin material	-	Copper
3.8	Accessories	-	•Purge and drain connections
		-	•Relief valves,
		-	•Liquid line shut-off valves
		-	•Refrigerant filling charging
		-	•Flow switches
		-	•Isolating valves
		-	•Pressure & temperature indicators at inlet and outlet
3.9	Refrigerant	-	R-134a/R-410A/R-407C or any other environment friendly refrigerant.
3.1	Steel structure	-	Mounted steel structure with necessary vibration isolators
3.11	Inlet temperature	deg. C	33-36
3.12	Leaving temperature differential	deg. C	5 (max.)
4	Evaporator	-	
4.1	Type	-	Shell and tube type
4.2	Superheating	deg. C	At least 2
4.3	Design Fouling Factor	MKS	0.0001 (min.)
4.4	Fluid	-	Shell side - Refrigerant
		-	Tube side - Water
4.5	Shell material	-	Mild steel (IS : 2062) / SA 106 Gr. B
4.6	Tube material	-	Plain tube internally /externally finned copper
4.7	Fin material	-	Integral
4.8	Accessories	-	•Purge and drain connections.
		-	• Isolating valves.
		-	• flow switches.
		-	• Pressure & temperature indicators at inlet and outlet.
		-	• Anti-freeze thermostats.
		-	• Electronic expansion valve or float assembly as applicable.
		-	• Pilot solenoid valve.
		-	• Relief valves.
		-	• Operating thermostats for capacity control.
		-	• Supporting frame
4.9	Steel Structure	-	Mounted on steel structure and shall be provided with necessary vibration isolators.
4.10	Special requirement for Electrical and control	-	1. Single power source shall be provided by BHEL for chiller having multiple compressor
		-	2. Chiller of main power house shall be feed from DG source also without neutral (3 phase, 3 wire system. Sutable control transformer shall be in scope of OEM for deriving neutral
		-	3.Chiller shall have inbuilt selector switch and provision for operating through DDCMIS with on command, off comand command, on status, off status and MCC disturb feedback.Neccessary communication module for signal exchange between DDCMIS and chiller to be considered.

Condensing Unit -Air-Cooled (D-X type)			
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Type	-	Air cooled scroll type
2	Configuration	-	As per specific Technical requirement
3	Vibration Isolators	-	Steel spring / Neoprene rubber cushy foot type with isolation efficiency not < 85%.
4	Compressor Type	-	Scroll, serviceable, either hermetic type or semi-hermetic type with automatic capacity control (minimum 3 steps).

5	Refrigerant	-	R-134a/ R-410A/R-407C or any other environment friendly refrigerant.
6	Accessories	-	•High/Low pressure cutouts.
		-	• Oil pressure switches.
		-	• Relief valves.
		-	• Pressure gauges at each stage.
		-	• Lube oil and control oil pressure gauges.
		-	• Suction & discharge stop valves.
		-	• Muffler.
		-	• Crank case heaters.
		-	• Oil filters.
		-	• Magnetic oil separators.
		-	• Temperature indicators for lube oil/heaters.
		-	• Oil level indicators.
		-	• Safety thermostat for crank case heater.
		-	• Vibration isolators
		-	• Temperature sensor with cable length suitable for site condition of distance between DX AHU and condensing unit
7	Special requirement for control	-	Condensing unit shall have inbuilt selector switch and provision for operating through DDCMIS with on command, off comand command, on status, off status and MCC disturb feedback.Neccessary communication module for signal exchange between DDCMIS and condensing unit to be considered.
	Package AC		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Type	-	Floor mounted Top/ side discharge incased in cabinet
2	Casing	-	Heavy gauge sheet steel suitable for floor mounting thermally insulated with 25 mm thick insulation of totally flame proof type (T.F. type).
3	Accessories	-	• Pre and fine filter
		-	• NRD and VCD
		-	• Flexible connection of fire retarding, at least 150 mm width closely woven, rubber impregnated double layer canvas or neoprene coated fibre glass
		-	• Machine mounted microprocessor panl
		-	• HP and LP cutout for compressor protection.
		-	• A thermostat with adjustable setting in the return air circuit to control the room temperature by ON-OFF mode
		-	• Provision for manual start stop of compressor
		-	• Compressor interlock with condenser fan and evaporator fan
		-	• Humidstat for humidity control and interlock with humidifier and heater
		-	• Inbuilt selector switch and provision for operating through DDCMIS with on command, off comand command, on status, off status and MCC disturb feedback.Neccessary communication module for signal exchange between DDCMIS and Package AC.
	Gate Valve		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Size Range	-	50 MM & above, suitable for horizontal and vertical installation
2	Design Code	-	IS: 14846 or BS : 5150
3	Pressure Rating	-	a) PN 1.0 (as per IS:14846) b) PN 10 (as per BS:5150)
4	Construction Features	-	
4.1	Stem	-	Outside screw and yoke type, rising stem
4.2	Ends	-	Flanged, ANSI B16.5 Cl 150 (minimum)
4.3	Bonnet	-	Bolted
4.4	Wedge	-	Solid Wedge
5	Operation	-	by handwheel (Gear reduction unit for valve size 200 NB and above wherever applicable)
6	Seat	-	
	a) Body	-	Renewable
	b) Disc.	-	Renewable
7	Material of Construction	-	
7.1	Body/Bonnet/Handwheel	-	Cast Iron to IS:210 FG-200
7.2	Wedge Gland	-	Cast Iron to IS:210 FG-200
7.3	Stem	-	S.S. 410
7.4	Body Seat	-	GM to IS:318 Gr.-2
7.5	Wedge Seat	-	GM to IS:318 Gr.-2
7.6	Packing	-	Non-Asbestos
7.7	Back Seat Bushing	-	GM to IS:318 Gr.-2
7.8	Bolts, Nuts, & Studs	-	Carbon Steel to IS:1367, CL – 4.6/4.0
8	Accessories	-	• Position Indicator
		-	• Draining arrangement for Valve Seat
		-	•Locking Facility with lock
		-	•Gear reduction unit for valve size 200 NB and above.
		-	• Companion flanges, nut, bolts, washers
		-	• Limit switch for open and close status of valve at DDCMIS

S. No.	DESCRIPTION	UOM	DETAIL
	Globe Valve		
1	Size Range	-	50 MM & above, suitable for horizontal and vertical installation
2	Design Code	-	BS : 5152 / Equiv.
3	Pressure Rating	-	PN 10 (as per BS:5152)
4	Construction Features	-	
4.1	Stem	-	Outside screwed & rising spindle
4.2	Ends	-	Flanged, ANSI B16.5 Cl 125 / Cl. 150
4.3	Bonnet	-	Bolted
4.4	Wedge	-	Solid Wedge
5	Operation	-	by handwheel (Gear reduction unit for valve size 200 NB and above wherever applicable)
6	Seat	-	
	a) Body	-	Renewable
	b) Disc.	-	Renewable
7	Material of Construction	-	
7.1	Body/Bonnet/Handwheel	-	Cast Iron to IS:210 FG-200
7.2	Wedge Gland	-	Cast Iron to IS:210 FG-200
7.3	Stem	-	S.S. 410
7.4	Body Seat	-	GM to IS:318 Gr.-2
7.5	Wedge Seat	-	GM to IS:318 Gr.-2
7.6	Packing	-	Non-Asbestos
7.7	Back Seat Bushing	-	GM to IS:318 Gr.-2
7.8	Bolts, Nuts, & Studs	-	Carbon Steel to IS:1367, CL – 4.6/4.0
8	Accessories	-	• Position Indicator
		-	• Draining arrangement for Valve Seat
		-	•Locking Facility with lock
		-	•Gear reduction unit for valve size 200 NB and above.
		-	• Companion flanges, nut, bolts, washers
		-	• Limit switch for open and close status of valve at DDCMIS
	Check Valve (below 50 NB)		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Size range	-	Below 50 NB
2	Design Code/rating	-	IS : 778
3	Type	-	Swing check type
4	Pressure Rating	-	a) PN 1.0 (as per IS:5312) b) PN 10 (as per BS:5153)
5	End connection	-	Screwed ends ANSI B16.5
6	Material Specifications	-	
	a) Body, cover, flap, hinges	-	GM to IS:318 Gr.2
	b) Hinge pin, door pin	-	HT Brass
	c) Body seat ring, Disc. facing ring	-	As per OEM
	d) Gaskets	-	As per OEM
	Check Valve (50 NB and above)		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Size range	-	50 NB and above
2	Design Code/rating	-	IS : 5312/ BS:5153
3	Type	-	Swing check type
4	Pressure Rating	-	a) PN 1.0 (as per IS:5312) b) PN 10 (as per BS:5153)
5	End connection	-	Flanged to CIass 150 min
6	Material Specifications	-	
	a) Body, cover, flap, hinges	-	Cast Iron IS:210 Gr. FG.200
	b) Hinge pin, door pin	-	SS
	c) Body seat ring, Disc. facing ring	-	GM to IS:318, LTB 2
	d) Gaskets	-	Non-Asbestos
	Butterfly Valve		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Size Range	-	50 MM & above, suitable for horizontal and vertical installation
2	Design Code	-	Double flanged or lugged wafer type of low leakage rate confirming to AWWA C-504/BS:EN:593/API 609/equivalent
3	Pressure Rating	-	PN 10
4	End Connection	-	Flanged as per ANSI B.16.5 Class 125 / BS-EN 1092
5	Material of Construction	-	
5.1	Body & Disc	-	Cast Iron
5.2	Shaft	-	SS 410 / SS 420
5.3	Seat Rings	-	EPDM
6	Accessories	-	• Position Indicator
		-	•Locking Facility with lock
		-	•Gear reduction unit for valve size 200 NB and above.
		-	• Nut, bolts, washers
		-	• Limit switch for open and close status of valve at DDCMIS
	Balancing/Controller valve (32 mm to 50 mm dia)		

S. No.	DESCRIPTION	UOM	DETAIL
1	Material of Construction	-	gun metal / cast iron construction with screwed ends.
	Balancing/Controller valve (65 mm and above)		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Material of Construction	-	cast iron construction with internal parts of SS 410 and EPDM / nitrile seat with flanged ends
	Air Handling Unit		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	General	-	
1.1	Vibration Isolators	-	Anti-vibration mountings (AVMs), vibration dampening efficiency >85%
1.2	Configuration	-	As per specific Technical requirement
1.3	Duct Connection	-	Flame retardant, water proof neoprene impregnated flexible connection on fan discharge
1.4	Filter	-	Pre-filter at the suction and fine (micro-vee type) at the discharge of each individual AHU. HEPA filter at each discharge of individual AHU of Power house
1.5	Dampers	-	•Isolation dampers and NRD at the discharge of each AHU.
1.6	Casing	-	•Double skin sandwich panels (inside and outside), fabricated using minimum 0.63 mm (24g) galvanized steel sheet
		-	•25 mm thick polyurethane foam insulation of minimum 38 Kg/Cum density in between
		-	• Flexible connection of fire retarding, at least 150 mm width closely woven, rubber impregnated double layer canvas or neoprene coated fibre glass
1.7	Drain Pan	-	• Sloping type with min. 1.2 mm thick Stainless-Steel sheet extending beyond coil.
		-	•25mm thick heavy duty treated for Fire (TF) quality expanded polystyrene or polyurethane foam at bottom of pan.
1.8	Cooling coil	-	•Min. 4 row deep, made of seamless copper tubes with aluminium fins firmly bonded to copper tubes.
		-	• With suitable drains and vents.
1.9	Filter plenum	-	walking platform inside the plenum chamber for filter cleaning purpose with inspection door with removable ladder
1.10	Local control panel	-	**For each AHU having provision of local start/stop with integration from DDCMIS for remote operation also**
2	Centrifugal Fan	-	
2.1	Type	-	Double Width Double Inlet (DWDI) Centrifugal Type
2.2	Impeller	-	Backward curved blades
2.3	Casing material	-	GI /Mild steel with minimum thickness of 3 mm
2.4	Impeller material	-	Carbon steel
2.5	Shaft	-	EN 8 Steel
2.6	Fan bearings	-	Self-aligning type, permanently lubricated, heavy duty with a design life of 10,000 operating hours
2.7	Critical speed	-	First critical speed of rotating assembly shall be at least 25% above the operating speed.
2.8	Drive	-	•Motor driven with removable belt guard.
		-	•Motor rating (at 50 deg.C ambient) shall be at least fifteen percent (15%) above the maximum load demand of drives at the design duty point
	Non Ductable Split (Hi-Wall/Cassette), Ductable Split, Package ACs		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Type	-	Invertor Type
2	Compressor Type	-	Hermetically sealed rotary/scroll Compressor
3	Condenser	-	Air Cooled Condenser
4	Components	-	• Casing
5	Indoor unit of Ceiling Mounted Cassette Type Unit	-	• Powder coated galvanized steel Housing.
		-	• All the indoor units even with difference in capacity should have same decorative panel size.
		-	•Four-way supply air grills on sides and return air grill in center.
		-	•Units shall have lift drain pump and low operating sound.
6	Package AC	-	• Heavy gauge steel sheet •Casing to be thermally insulated with 25mm thick totally flame proof insulation
7	Star Rating	-	Highest as per latest BEE Rating.
	Cooling Tower		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Type	-	Induced draft, cross or counter flow., vertical discharge (fan shall be mounted on Top of unit)
2	Configuration	-	As per specific Technical requirement
3	Casing & Sump tank	-	F.R.P/G.R.P
4	Fan	-	Cast Aluminum / FRP Propeller type and multiblade aerofoil construction with adjustable pitch.
5	Fill	-	Non-combustible PVC or equivalent
6	Louvers	-	F.R.P. /PVC/ Aluminum

7	Nozzles	-	Brass with chrome plating / Polypropylene
8	Eliminators	-	In removable sections to reduce the drift loss to 0.2% of water flow.
9	Supporting structure	-	Mild steel with spray galvanization or epoxy painting.
10	Strainer at water outlet	-	Plate strainer made of GI/SS wire mesh of 16 gauge.
11	Bird screen on top of tower	-	25 mm square made of GI/SS wire mesh of 16 gauge.
12	Distribution Pipe (if any)	-	Galvanised MS pipe.
13	Accessories	-	•Drain connection with isolation valve.
		-	• Make up connection with ball float valve, back up gate valve and a bypass with a gate valve for manual operation.
		-	• Overflow connection.
		-	• Equalizing connection to connect sump of all the towers wherever applicable.
		-	• Access door in louvers/fan deck.
14	VFD	-	NA
15	Margin	%	Twenty (20) over the selected A/C capacity provided.
	Centrifugal Pumps		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Type	-	Horizontal split casing type
2	Configuration	-	As per specific Technical requirement
3	Impeller	-	Closed type
4	Casing MOC	-	2% Ni Cast Iron: IS:210 Gr. FG-260
5	Impeller MOC	-	Bronze IS:318 Gr-2
6	Wearing rings	-	Bronze
7	Shaft	-	SS 316
8	Shaft sleeve	-	SS 316
9	Lantern ring	-	Brass / Bronze
10	Packing	-	Asbestos free
11	Base Plate	-	Carbon steel as per IS:2062
12	Speed	-	Maximum 1500 rpm
13	Operating Range	%	40 - 120 of the duty point
14	Efficiency	-	Max. efficiency at ± 10% of the rated design
15	Head	-	Minimum shut-off head of about 15% more than the design head.
16	Margin	-	Head of the pumps shall consider min. ten (10) % margin on friction head
17	Motor	-	Continuous Motor rating (at 50 deg.C ambient) shall be at least ten percent (10%) above the maximum load demand of the pump in the entire operating range.
18	Critical Speed	-	Not less than 130% of the rated speed
19	VFD	-	NA
20	Noise level	-	not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment surface
21	Vibration level (peak to peak) at 1500 rpm and below with Antifriction Bearing	micron	75
22	Vibration level (peak to peak) at 1500 - 3000 rpm with Antifriction Bearing	micron	50
23	Vibration level (peak to peak) at 1500 rpm and below with Sleeve Bearing	micron	75
24	Vibration level (peak to peak) at 1500 - 3000 rpm with Sleeve Bearing	micron	65
	Pan Humidifier		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Tank	-	22 gauge SS 304 tank
2	Insulation	-	25 mm thick resin bonded fiber glass insulation (min. 24 Kg/m3 density) with 0.5 mm GSS cladding
3	Heaters	-	Stainless steel immersion heaters
4	Accessories	-	• Safety thermostat.
		-	• Float valve with stainless steel ball.
		-	• Sight glass.
		-	• Overflow and drain connections.
		-	• Steam outlet nozzle and float switch
5	Step Control	-	Step controller for switching on / off heater banks as per system requirement
	Piping		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Chilled and Condenser water lines	-	•Heavy grade-IS:1239 or Equivalent upto150 NB
		-	•Grade 410 of IS:3589 or Equivalent for pipes beyond 200 NB
2	Refrigerant piping	-	• Seamless steel tubes conforming heavy grade IS:1239 or
		-	• Copper tubes as per IS:2501 (copper material as per IS:191 hard copper grade)
3	Drain piping	-	Heavy grade-IS:1239 or Equivalent & galvanized as per IS:4736

4	Fittings	-	• Steel fitting conforming to ASTM A234 Gr. WPB and dimensional standard to ANSI B 16.9/ANSI B16.11 / equivalent for sizes 65 NB and above.
		-	• For sizes 50 NB and below, the material shall conform to ASTM A-105.
		-	• All steel flanges shall be of slip on type and shall conform to ANSI B 16.5.
		-	• For pipe sizes above 350 NB, dimensions shall be as per BS:2633/BS:534.
		-	• Fittings, flanges and pipe joints of refrigerant piping shall conform to ANSI B31.5
Filter			
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Pre Filter		
1.1	Type	-	Flange / Cassette
1.2	Media	-	**a) Fabric Filter**:Washable non-woven synthetic fiber or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or G.I. wire mesh on both sides.
		-	**b) Metallic Filter**: Filter medium, aluminium alloy shall be supported on galvanized expanded metal casing. Frame shall be fabricated from aluminium alloy of minimum 16G thickness conforming to IS: 737 or 18 gauge.
1.3	Efficiency	-	Average arrestance of 65 - 80 % when tested in accordance with BS:6540/ASHRAE 52 76 / EN-779
1.4	Minimum thickness	-	50 mm
1.5	Face Velocity	-	Not more than 2.5 m/sec.
1.6	Pressure drop	-	Initial pressure drop - Not to exceed 5.0 mm WC at rated flow.
		-	Final pressure drop - Upto 7.5 mm WC.
1.7	Location	-	• At the suction of each AHUs
		-	• At the discharge of each Fresh air fan
		-	• At discharge of each Supply air fan
1.8	General	-	• Suitable aluminium spacers be provided for uniform air flow
		-	• Casing shall be provided with neoprene sponge rubber sealing.
		-	• Capable of being cleaned by water flushing.
		-	• Density of filter medium shall increase in the direction of air flow in case of metallic filter.
		-	• Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.
2	**Fine Filters (Microvee type)**		
2.1	Type	-	Flange / Cassette
2.2	Media	-	•Washable non-woven synthetic fibre or High density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame.
		-	•The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or G.I. wire mesh on both sides.
2.3	Efficiency	-	Average arrestance > 90% when tested in accordance with BS:6540/ASHRAE 52-76 / EN-779.
2.4	Minimum thickness	-	150 mm or 300 mm.
2.5	Face Velocity	-	Not more than 1.2 m/sec for 150 mm and not more than 2.4 m/sec. for 300 mm
2.6	Pressure drop	-	Initial pressure drop - Not to exceed 10 mm WC at rated flow ; Final pressure drop-Up to 25 mm WC.
2.7	Location	-	•At the discharge of each individual AHU.
		-	• At the discharge of each Fresh air fan.
		-	• At the discharge of each supply air fan having static pressure 30mm wc or more.
2.8	General	-	• A neoprene sponge rubber sealing shall be provided on either face of the filter frame.
		-	• Capable of being cleaned by air or water flushing.
		-	• Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.
3	**Absolute/HEPA Filters**		
3.1	Media	-	100% sub-microscopic glass fibers.
3.2	Frame	-	Aluminium alloy (minimum 16 gauge conforming to IS: 737) with handles.
3.3	Efficiency	-	99.97 % down to 0.3 micron when tested in accordance with BS: 3928 (Sodium flame test)/FED 209B.
3.4	Minimum thickness	mm	300
3.5	Face Velocity	m/sec.	<1.2 .
3.6	Pressure drop	-	* Initial pressure drop - Not to exceed 25 mm WC at rated flow * Final pressure drop - Up to 75 mm WC
3.7	Location	-	At the discharge of each individual AHUs for Control Equipment Room / Control room /UPS & battery Charger Rooms.
3.8	Other requirements	-	A neoprene sponge rubber sealing shall be provided on either face of the filter frame
GI Sheet			

S. No.	DESCRIPTION	UOM	DETAIL
1	Material	-	Galvanized Steel sheet (GSS)
2	Indian Standard "IS"	-	IS : 277
3	Zinc Coating	GSM	275
4	Thickness	-	As per IS : 655, depending on size of the longer side of duct
		-	•Upto to 750: 24 G (0.63 mm)
		-	•751-1500: 22 G (0.8 mm)
		-	•1501-2250: 20 G (1.0 mm)
		-	• 2251 & above: 18 G (1.25 mm)
5	Fabrication	-	Manually fabricated and/ or formed into L Shaped factory fabricated ducts, SMACNA standard to be followed.
6	Support Material	-	* For larger side > 2250 mm - 16mm MS rods and 50x50x3 mm MS double Angles * For larger side < 2250 mm - 10mm MS Rods and 40x40x3 MS angles
7	Support distance	-	at a distance of not more than 2000 mm
	Axial Fans		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Axial Fans		
1.1	Blades	-	Fixed / variable pitch cast aluminum blades of aerofoil design.
1.2	Casing	-	Heavy gauge sheet steel construction.
1.3	Accessories	-	•Necessary rain protection cowl.
		-	• Inlet and outlet cones.
		-	• Bird protection screen.
		-	• Adjustable damper.
		-	• Vibration isolators.
		-	• Back draft dampers
		-	• supporting frame and structure
1.4	Motor Type	-	Battery room exhaust fans shall be spark proof (with flame proof motor) fans.
1.5	Fan Speed with Static Pressure (mm WC) <30 and Impeller	RPM	<1000
1.6	Fan Speed with Static Pressure (mm WC) <30 and Impeller	RPM	<1500
1.7	Fan Speed with Static Pressure (mm WC) >=30 and Impeller	RPM	<1500
1.8	Fan Speed with Static Pressure (mm WC) >=30 and Impeller	RPM	<3000
	Fire Dampers		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Type	-	Motorized
2	Fire rating	minutes	Minimum 90
3	Reference Code/Standard	-	As per UL-555, 1995 (certified by CBRI)
4	Actuator	-	Spring return actuator with emergency function
	Diffusers, Grills, Dampers & Louvres		
S. No.	**DESCRIPTION**	**UOM**	**DETAIL**
1	Grilles/Diffuser	-	• Supply air diffusers/grills to have factory fitted volume control dampers • Extruded Aluminum of minimum 1.2 mm thick with powder coating for AC system •Mild steel powder coated for Ventilation System
2	Dampers for Grills/diffusers	-	• 20 gauge minimum thickness • All VCDs shall have key based operations
3	Splitters and dampers (for equipment/area isolation and for proportionalbvolume control of system	-	minimum 16 gauge GS sheet of quadrant type with suitable locking device, mounted outside of duct in accessible position
4	Louvres	-	• 22 gauge minimum thickness

TECHNICAL DATA - PART - A (ELECTRICAL)

SL.NO	DESCRIPTION	UOM	DETAIL
1.0	**DESIGN CODES & STANDARDS**		
1.1	Three phase induction motors :	-	IS15999, IEC:60034, IS: 12615, IS: 325
1.2	Single phase AC motors	-	IS:996, IEC:60034
1.3	Energy Efficient motors	-	IS 12615, IEC:60034-30
1.4	Crane duty motors	-	IS:3177, IS/IEC:60034
1.5	Mechanical Vibration of Rotating Electrical Machines with Shaft Heights 56 mm and Higher - Measurement, Evaluation and Limits of Vibration Severity	-	IS 12075/IEC 60034-14
1.6	Designation of Methods of Cooling of Rotating Electrical Machines	-	IS 6362
1.7	Designation for types of construction and mounting arrangement of rotating electrical machines	-	IS 2253
2.0	**DESIGN /SYSTEM PARAMETERS**		
2.1	Rated voltage	V	415
2.2	Frequency	Hz	50
2.3	Permissible variations for		
a)	Voltage	%	+/-10
b)	Frequency	%	(+)3 to (-)5
c)	Combined	%	10 (absolute sum)
2.40	System fault level at rated voltage for 1 sec	kA	50
2.4	Short time rating for terminal boxes for 0.25 sec	kA	50
2.5	Type of motors	-	a) Squirrel cage induction motor suitable for direct-on-line starting (for non- VFD motors). b) Motor operating through VFD shall be suitable for inverter duty with VPI insulation.
2.6	Efficiency class	-	*Continuous duty LT motors upto 50 KW Output rating (at 50 deg.C ambient temperature), shall be super Premium Efficiency class-IE4, 50-200 KW shall be of Premium Efficiency class – IE3,conforming toIS 12615, or IEC:60034-30.*
2.8	Rating	-	
a)	Motor duty	-	Continously rated-S1
b)	Design margin over continous max. demand of the driven equipment (min)	%	10
3.0	**CONSTRUCTION FEATURES**		

3.1	Winding	-	Electrolytic grade Copper conductor
3.2	Enclosure Details	-	
a)	Degree of protection	-	
	i) Indoor motors	-	IP 55
	ii) Outdoor motors	-	IP 55
b)	Method of ventilation	-	Totally enclosed fan cooled (TEFC) or totally enclosed tube or ventilated (TETV) or Closed air circuit air cooled (CACA) type.
3.3	Insulation	-	Class 'F' with temperature rise limited to class 'B'. Non-hygroscopic, oil resistant, flame resistant Insulation.
3.4	Bearings	-	Grease lubricated ball or roller bearings for Horizontal motors Grease lubricated ball or roller bearings or combined thrust and guide beaing for Vertical motors.
3.5	Main terminal box	-	
a)	Type	-	-Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation. -Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame. - The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
b)	DOP	-	Same as motor
c)	Position when veiwed from the non driving end	-	Left hand side
d)	Rotation	-	90 Deg.
e)	Space heater	-	Motors rated 30KW and above shall have space heater suitable for 240V, 50 Hz single phase AC supply. Separate terminal box for space heaters & RTDs shall be provided.

f)	Cable glands and lugs	-	-Motor terminal box shall be furnished with Solder less crimping type heavy duty Lugs (aluminium lugs for aluminium cables and copper lugs for copper cables) and double compression Ni-Cr plated brass glands to match with cable used. -Gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.
3.6	Earthing points suitable for conenction	-	Motor body shall be grounded at two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.
3.7	Paint shade (Corrosion proof paints of colour shade)	-	RAL 5012 (Blue) The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However, in case electrostatic process of painting is offered. minimum paint thickness of 50 microns shall be acceptable for finish coat.Epoxy based paint with suitable additives shall be used.
3.8	The spacing between gland plate & centre of bottom terminal stud	-	UP to 3 KW As per manufacturer's practice. Above 3 KW - upto 7 KW 85 Above 7 KW - upto 13 KW 115 Above 13 KW - upto 24 KW 167 Above 24 KW - upto 37 KW 196 Above 37 KW - upto 55 KW 249 Above 55 KW - upto 90 KW 277 Above 90 KW - upto 125 KW 331 Above 125 KW-upto 200 KW 385/203 (For Single core cables only)
3.9	Minimum inter-phase and phase-earth air clearances with lugs installed	-	UP to 110 KW 10mm Above 110 KW and upto 150 KW 12.5mm Above 150 KW 19mm
4.0	**PERFORMANCE PARAMETERS**		
4.1	Starting requirement	-	

a)	Minimum permissible voltage as a percentage of rated voltage, at start to bring the driven equipment upto the driven equipment upto rated speed	-	a) Up to 85% of rated voltage for ratings below 110 KW b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW
b)	Maximum locked rotor current	-	as per IS 12615
c)	Starting duty	-	Two hot starts in succession, with motor initially at normal running temperature.
d)	The locked rotor withstand time under hot condition at highest voltage limit	-	a) atleast 2.5 secs. more than starting time(for motors with starting time upto 20 secs. at minimum permissible voltage during starting) b)atleast 5 secs. more than starting time(for motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting) c) more than starting time by at least 10% of the starting time(For motors with starting time more than 45 secs.at minimum permissible voltage during starting) Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
e)	The ratio of locked rotor KVA at rated voltage to rated KW	-	(a) Below 110KW : 10.0 (b) From 110 KW & upto 200 KW : 9.0
4.2	Torque (percent of full load torque)	-	1] Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. 2]Pull out torque at rated voltage shall not be less than 205% of full load torque.
4.3	Noise level (max.)	-	85 dB(A)
4.4	Vibration shall be limited within the limits	-	as per IS:12075
5.0	**INSPECTION/TESTING**		
5.1	All type & Routine tests shall be as per IS 12615.		
5.2	The Contractor shall submit the type tests reports for the tests conducted on the equipment similar to those to be supplied under this contract and the test(s) should have been conducted at an independent laboratory not earlier than ten (10) years prior to supply under this contract.		
5.3	In case the contractor is not able to submit valid report of the type test(s) or in case type test report(s) are not found to be meeting the specification requirements, or not including all specified tests the contractor shall conduct all such tests under this contract. The cost of such test shall be deemed to be included in the price. The owner shall have right to witness the type tests.		
5.4	All routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.		

TECHNICAL DATA - PART - A (C&I)

SL.NO	DESCRIPTION	UOM	DETAIL
1.0	**DESIGN CODES & STANDARDS**		
1.1	Impulse pipes, tubes (material, rating)		ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70
1.2	Valves (material, pr. Class, size)		ASTM A182/ASTM A105 as per ASME 16.34
1.3	Fittings (size, rating, material)		ANSI B31.1, ANSI B31.1a, ASME B16.11
1.4	Installation schemes		BS 6739-2009, ANSI/ISA 77.70
1.5	Actuator		EN15714-2
1.6	Fieldbus concepts		IEC 61158
1.7	Instruments and apparatus for pressure measurement		ASME PTC19.2
1.8	Electonic transmitters		BS-6447, IEC-60770
1.9	Bourdon tube pressure and vacuum gauges		IS-3624
1.13	Colors for ready mixed paints and enamels.		IS-5
1.18	Annunciator Sequences and Specification		ISA-18.1
1.21	Instrument and apparatus for temperature measurement		ASME PTC 19.3(1974)
1.22	Temperature measurement by electrical Resistance thermometers		IS:2806
1.23	RTD Sensor		IEC-751/ DIN-43760
1.24	Type of Enclosures		NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13)
1.25	Racks, panels and associated equipment		EIA : RS - 310 C- 1983 (ANSI C83.9 - 1972)
1.26	Protection class for enclosures, cabinets, control panels & desks		IS:2147 -1962
1.28	**Codes for Orifice plate Design**		
	Orifice plate		ISO 5167
	Flange Standard for Orifice plate		ASME B16.36
1.29	**Codes for Control Valve Design**		
	Control Valve Sizing		ISA S-75
	Pressure / Temperature Rating		ANSI-B16.34
	Seat Leakage		ANSI/FCI 70.2
	Noise		IEC 60534-4
	Face to face dimensions of control valves		ANSI B 16.00
	End Connection: Butt Weld		ANSI B16.25
	End Connection: Socket Weld		ANSI B16.11
	End Connection: Flanged End		ANSI B16.5
	End To End Tolerance		ANSI B16.10
	ISA Hand Book of Control Valves		(ISBN : B: 1047-087664-234-2)
	Codes for pressure piping		ANSI B 31.1
	Control Valve leak class		ISA RP 39.6
2.0	**DESIGN /SYSTEM PARAMETERS**		

2.1	**DATASHEET - PRESSURE TRANSMITTER, DIFFERENTIAL PRESSURE TRANSMITTER, DP BASED FLOW AND LEVEL TRANSMITTER**		
	Output		Profibus PA complying to IEC 61158, digital output
	Turndown ratio		50:1
	Accuracy	%	0.06%
	Stability (% of calibrated range)	%	+/-0.25% for 10 year
	Diaphragm seal material		Suitable for process fluid
	Diagram fill fluid		Inert liquid
	Wetted parts		All wetted parts upto diaphragm seal shall be suitable for process application.
	Housing		Metallic housing with durable corrosion resistant coating
	Protection		Weather proof IP-67
	Display		Integral digital display
	Diagonstic feature		Required
	Electrical connection		1/2" NPT (f)
	Manifold		2/3 valve non integral manifold for PT and 5 valve non integral manifold for DPT
2.2	**DATASHEET - PRESSURE GAUGE, DIFFERENTIAL PRESSURE GAUGE**		
	Sensing element		Bourdon for high pressure, diaphragm/bellow for low pressure
	Sensing element material		SS316
	Movement material		SS316
	Body material		SS316
	Dial size	mm	150mm
	End connection	inch	1/2 inch NPT (m)
	Accuracy		±1% of span
	Scale		Linear, 270° arc graduated in metric units
	Range selection	%	Cover 125% of max. of scale
	Over range test		Test pr. for the assembly shall be 1.5 to the max. Design pr. At 38°C.
	Diaphragm seal material		Suitable for process fluid
	Diaphragm fill fluid		Inert liquid
	Wetted parts		All wetted parts upto diaphragm seal shall be suitable for process application
	Housing		IP-55
	Zero/span adjustment		External
	Accessories		Blow out disc, siphon, snubber, pulsation, dampener, chemical seal, gauge isolation valve
2.3	**DATASHEET - ULTRASONIC LEVEL TRANSMITTER**		
	Transmitter type		Non contact microprocessor based 2 wire type loop powered, HART protocol compatible
	Output signal	mA	4-20 mA DC (analog signal) alongwith superimposed digital signal based on HART protocol
	Accuracy	%	±0.5% of calibrated span or minimum 5mm
	Power supply	V	24V DC +/- 10%
	Temperature compensation		To be provided within transducer

	Housing material		Metallic housing with durable corrosion resistance coating
	Protection		Weather proof as per IP-65
	Sensor material		Corrosion resistant material to suit individual application requirement
	False signal tolerance		Transmitter shall be capable of ignoring false echoes from internal tank/sumped obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry.
	Display		Integral digital display
	Diagnostics		Loss of echo alarm etc.
	Electrical connection		Plug and socket
	Acessories		All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.
			All mounting accessories required for erection and commissioning shall be provided.
2.3	**SPECIFICATIONS - LEVEL SWITCH**		
	Repeatability	%	+/-0.5% of full range
	No. of contacts		2 No.+2NC. SPDT snap action dry contact
	Rating of contacts	V, VA	60 V DC, 6 VA
	Elect. Connection		Plug in socket.
	Set point adjustment		Provided over full range.
	Dead band adjustment		Adjustable/ fixed as per requirement of application.
	Enclosure		IP-55
	Power Supply	V	24V DC
	Sensing Element		Float type, conductivity type, Ultrasonic type as per suitability to the application
	Material		316 SS
	End connection		Manufacturer standard
	Over range/ proof pressure	%	150% of maximum operating pr.
	Accessories		All mounting accessories
2.4	**DATASHEET - LEVEL GAUGE**		
	Sensing element and material		Tempered toughened borosilicate gauge glass steel armoured reflex or transparent type, bicolour type
	Body material		304 SS
	End connection		Process connection as per ASME ptc , 3/4" and drain/vent 15 NB
	Accuracy	%	± 2%
	Scale		Liner vertical
	Housing		304 SS leak proof
	Over range test		Test pr. for the assembly shall be 1.5 to the max. Design pr. At 38°C.
	Wetted parts		All wetted parts upto diaphragm seal shall be suitable for chemical application
	Accessories		Gasket for all KEL-F shield for transparent type vent and drain valves of steel/SS as per CS /Alloy process requirement.

	Length of Gauge glass		Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.
2.5	**DATASHEET - TEMPERATURE TRANSMITTER**		
	Transmitter Type		Profibus PA complying to IEC 61158 with EMC compatibility as per EN 61326, Dual input (Trip/Protection), Single Input (other application)
	Compatibility		fully compatible with RTDs
	Protection Class		IP-67
	Display		Integral digital display
	Diagonstic feature		self-indicating diagnostics
	Operating ambient temperature (with display)	DegC	70 deg C
	Operating ambient temperature (without display)	DegC	85 deg C
	Electrical Connection	inch	1/2" NPT(F)
	Composite Accuracy	%	RTD =<0.25% of 0-250 deg C span
	Changeover facility		Bump less changeover to second sensor in case first sensor fails with alarm facility.
	Composite accuracy Calculation		Accuracies of temperature transmitter for converting sensor input to output + temperature effect on these accuracies at ambient temperature of 50 deg C (based on the figure/ formula given in the standard product catalogue for span as specified for RTD).
	Emergency/failure Measures		In case of failure (open or burn-out) of RTD, transmitter shall provide low temperature output.
2.6	**DATASHEET - RESISTANCE TEMPERATURE DETECTOR (RTD)**		
	Type		Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
	No. of element		Duplex
	Housing		Diecast Aluminium
	Protection Class		IP-65
	Head		Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter
	Plug in connectors		Required
	Terminal head		Spring loaded for positive contacts with the thermo well
	Insulation and sheathing		Mineral (magnesium oxide) insulation and SS316 sheath
	Calibration and accuracy		As per IEC-751/ DIN-43760 Class-A for RTD
	Accessories		Thermo well and associated fittings
2.7	**DATASHEET - THERMOWELL**		
	Design		One piece solid bored type of step-less tapered design
	Material		SS316
2.4	**SPECIFICATIONS - TEMPERATURE GAUGE**		

	Body Material		Die-cast aluminium
	Material of bourdon/movement		316SS / 304SS
	End connection		3/4" NPT (M)
	Accuracy	%	± 1% of span
	Dial Size	mm	150 mm
	Scale		Linear, 270° arc graduated in °C
	Range selection	%	Cover 125% of max. of scale
	Over range test		Test pr. for the assembly shall be 1.5 to the max. Design pr. At 38°C.
	Housing		IP-55
	Zero/span adjustment		Required
	Accessories		SS Thermowell
2.14	**DATASHEET - TEMPERATURE/ HUMIDITY INDICATOR**		
	Sensor		RTD for(Pt 100) for temperature
			Capacitance Type for Humidity (specs for humidity and temperature shall be as mentioned above)
	Display		Combined enclosure with two three digit seven segments LED display with decimal point after two digits. LED height shall be 4 inches, clearly legible from a distance of at least 10 meters.
	Range		0-60 Deg C for temperature.
			0-95.0 % for Relative Humidity.
	Accuracy		Better than +/_0.5 % for Temperature
			Better than +/_2.5 % for Relative Humidity
	Mounting		Table Top/ wall mounting.
	Power supply		240 V AC, 50 Hz.
	Output		4-20 mA signal each for temperature.
	Qty.		15 nos. each of temperature & Humidity indicators (combined indicators for Humidity and temperature is also applicable).
2.15	**DATASHEET - HUMIDITY SENSOR**		
	Sensor		Capacitance type
	Accuracy		+/-3% R.H
	Range		0-100% R.H
	Output		4-20 ma
	Time constant		2 mins.
2.16	**DATASHEET - SOLENOID VALVE**		
	Type		2/3/4 way SS 316/Forged Brass (depending on the application subject to Employer's approval during detailed Engg.)
	Power supply		24 V DC + 10%.
	Electrical connection		Plug and socket
	Insulation		Class 'H'
	IP Class		IP65
	Limit switches (for open/close feedback)		Required
2.17	**DATASHEET - LIMIT SWITCH**		
	Type		Inductive proximity type
	Mounting arrangement		Inside the enclosure

	Operating voltage Range	V	10-40 V DC
	Sensing system		Inductive Proximity type , 2 Wire
	Sensor Contact Type		NO
	Reverse polarity and short circuit protection		Yes
	IP Class-Sensor		IP67
	IP Class-Enclosure(Switch box)		IP67
	Cable entry-Enclosure(Switch box)		2 no-1/2" NPT
	Casing material-Sensor		Brass /SS
	Enclosure(Switch box) Housing material		FRP or SS
	Operating Ambient temp(sensors)	DegC	-5 to 70 deg C
	Max allowed Voltage Drop across sensor	V	5 V
	Standard applicable		EN 60947-5-2 or equivalent.
	Applicable for		Manual valves and solenoid operated on-off valves
	Corrosion resistance		Silver plated with high conductivity and non corrosive
	Protection class		IP 55
	Contact rating		shall be sufficient to meet the requirement of DCS subject to a minimum of 60 V, 6 VA rating
2.12	**DATASHEET - ORIFICE PLATE**		
	Material		SS316
	Thickness	mm	3 mm for main pipe diameter up to 300 mm and 6 mm for main pipe dia above 300 mm.
	Tappings		Minimum 2 Pairs of Tappings, Flanged weld neck or D & D/2
	Number of tappings	pair	minimum 2 pairs
	Beta Ratio		0.34 to 0.7
	Root Valves		To be provided in all the tappings
2.22	**DATASHEET - MOTORISED VALVE ACTUATOR**		
2.22.1	**General**		
	Duty		£ On / Off £ Inching
	Valve type		£ Globe £ Gate £ Reg. Globe £ Butterfly
	Ambient condition		Shall be suitable for continuous operation under an ambient temp. Of 0-60 deg c and relative humidity of 0-95%
2.22.2	**Construction and sizing**		
	Construction		Totally enclosed weather proof, minimum IP:68
	Mechanical position indicator		To be provided for 0-100% travel
	Bearings		Double shielded, grease lubricated anti-friction.
	Gear train for limit switch/torque switch operation		Metal (not fibre gears). Self-locking to prevent drift under torque switch spring pressure when motor is de-energized.
	Sizing		Open/close at rated speed against designed differential pressure at 90% of rated voltage. For isolating service three successive open-close operations or 15 mins. Whichever is higher. **For inching service - 150 starts/hr or required cycles whichever is higher.**
2.22.3	**Handwheel**		

	Required		¢ Yes £ No
	Orientation		£ Top Mounted £ Side Mounted
	Additional requirement		To disengage automatically during motor operation.
2.22.4	**Electric actuator**		
	Motor type		Squirrel cage induction motor suitable for Direct On-Line (DOL) Starting
	Power supply to motor / starter		415V +/- 10%, 3 Ph, 3W & 50Hz +/- 5%
	Control voltage requirement		To be derived from the Power Supply to the Starter £ 230 V ¢ 110 V AC / 24 V DC
	Enclosure class of motor		IP 68
	Insulation class		Class F. Temperature Rise 70 Deg C. Over 50 Deg C Ambient
	Winding temp protection		Thermostat (3 Nos.,1 In Each Phase)
	Single phasing protection & wrong phase sequence protection		Required, suitable means shall be provided to diagnose the type of fault locally.
2.22.5	**Integral starter**		
	Integral starter		Required with built in SPP (Single Phasing Preventer)
	Type of switching device		¢ Contactors £ Thyristors
	Type		Non-Intrusive Profibus Actuator
	Feature		All actuator settings including torque, limit shall be possible without opening the actuator cover.
	If smart		
	A) Serial link protocol		£ Foundation Field-Bus ¢ Profibus DP
	B) Redunadant profibus DP port		Required
	C) Hand held programmer		Required
	D) Profibus DP cable connection		Suitable connector integral to the actuator, or external devices/ accessories (mounted inside minimum IP65 protection class enclosure) shall be provided so that the actuator can be isolated online from the profibus network without disturbing the profibus communication of other actuators of the segment.
	E) Open/Close command termination logic		Shall be suitably built inside actuator
	F) GSD and DTM files		To be provided which shall be configured/ tested with DCS for proper interfacing and diagnostics
	G) Available signals to DCS (through profibus network)		Open/ close commands, open/ close feedback status, disturbance signal etc. along with diagnostics. The detailed diagnostics including the actuator operating data shall be available to the DCS
	Step down cont. Transformer		Required
	Open / close PB		Required
	Stop PB		Required
	Indicating lamps		Required
	Local remote s/s		Required (Lockable)
	Status contacts for monitoring		Required
2.22.6	**Position/ torque transmitter**		
	Position/torque transmitter		i. Position/limit measurement shall be done using absolute encoders which will give information of position/limit in both the directions.
			ii. Electronic measurement of torque shall be provided.
	Supply		24V DC
	Accuracy		+ 1% FS

2.22.7	**Space heater**		
	Space heater		Required
	Power supply (non integral)		230V AC,1 Ph.,50 Hz
	Power supply (integral)		Power supply derived from main power supply available at actuator end
2.22.8	**Terminal block**		
	Actuator/motor terminal block		Required. For power cables, the grade of TBs shall be minimum 650V
	Terminals / connectors		Suitable terminals/ connectors, integral to actuator, for terminating fieldbus cables and power cables shall be provided
	Earthing terminal		Required (2nos.)
2.22.9	**Cable glands**		
	Type		Double Compression
	Material		Brass Material
	Armored fieldbus cable glands		Required
	Power cable glands		Required
2.22.10	**Wiring**		Suitable voltage grade copper wire
2.22.11	**LCD Display**		
	LCD Indication		Integral to actuator body
	Local display information		Regarding actuator alarms, status and valve position indications as a minimum.
2.22.12	**Motor considerations**		
	Power Supply		shall operate satisfactorily under the +/- 10% supply voltage variation at rated frequency, -6% to +4% variation in frequency at rated supply voltage, simultaneous variation in voltage & frequency the sum of absolute percentage not exceeding 10%.
2.22.13	**SIL certification**		SIL2
2.22.14	**Accessories**		
	Accessories for calibration / settings / configuration of various parameters of actuator		Required
2.23	**LOCAL INSTRUMENT ENCLOSURE AND LOCAL INSTRUMENT RACK**		
	Scope		LIE and LIR complete with all fittings, mountings & accessories, drains and utility lighting, cable & grounding cable etc.
	Construction		
	Rack	mm	1.6mm sheet plate
	Frame	mm	3mm thick channel frame of steel
	Free standing type		Yes
	Canopy		Yes, >=3mm thick steel, extended beyond the ends of the rack.
	Degree of Protection		IP-55 for LIE & JB of LIE/LIR
	Junction Box		Applicable
2.24	**JUNCTION BOX**		
	No. of ways		12/24/36/48/64/72/96/128
	Material and Thickness		4mm thick Fiberglass Reinforced Polyester(FRP)
	Type of terminal blocks		Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm2. A M6 earthing stud shall be provided.

	Protection Class		IP- 55 min. for indoor & IP-65 min for outdoor applications.
	Grounding		To be provided
	Color		RAL 7035
	Spare Terminals		At least 20% unused terminals
2.4	**DATASHEET - LOCAL CONTROL PANEL**		
2.4.1	**Construction**		
	Type		Skid mounted
	Construction		Folded
	Devices & equipments		Panel enclosure, secondary instruments, annuniciation system, selector switch, push buttons, indicating lamps/ led cluster, relays, MCBs, clamp on terminals, plug socket, panel light, space heater, nameplate, earth bus
	Enclosure sheet material		Cold rolled sheet steel
	Enclosure sheet thickness		Minimum 3.0 mm for load bearing sections (mounted with instruments)
			2.0 mm for doors
			Minimum 2.0 mm for other sections
	Height		Minimum 1100 mm
	Frame thickness		Minimum 3.0 mm
	Internal plate thickness		2.5 mm
	Gland plate thickness		3.0 mm
	Cable gland		Double compression
	Base channel		ISMC 100 with anti-vibration mounting & foundation bolts
	Class of protection		IP-55
2.4.2	**Doors**		
	Rear doors		Required with integral lockable handle
	Door locking		Door when locked shall be held at minimum three places.
	Type		Removable type with concealed hinges to facilitate maintenance work
	Suitable pocket inside the door		Required for keeping the drawings / documents
	Double door		Required with suitable glass windows as per the requirement.
2.4.3	**Power & control supply**		
	Input power supply		415V 3 phase AC
	No. Of feeders		Two
	Control supply		230V AC
	Additonal requirement for control supply		MCBs
			Supervisory relay along with a pilot lamp to indicate control supply 'on'
			Auto changeover unit mounted on panel

2.4.4	**Internal wiring**		
	Voltage	V	1100 V
	Material & size		PVC insulated copper multi strand wire /flexible of 1.5mm2, power cable 2.5sqmm
	Routing and runs		Through PVC troughs, AC & DC wires shall be kept separately
	Colour		Separate colours for AC & DC wires
	Ferruling		Cross ferruling
2.4.5	**Painting details***		
	Painting shade & thickness - exterior / interior (these details shall be finalised during detailed engineering)		RAL 5012 & minimum 85 microns / glossy white & minimum 70 microns
2.4.6	**Gasket**		
	At door & removable cover		Neoprene
2.4.7	**Ventilation system along with louvers**		
	Cooling fan		2 x 100%, covered with removable wire mesh
2.4.8	**Terminal block**		
	Type		Clip on, separate for AC & DC circuits
	Voltage		1100 V
	Tb points		Cage clamp
	Mounting height from finished floor	mm	>=250 mm
	Spare	%	20%
	Identification strip		To be provided
2.4.9	**Illumination**		
	Light		Led tubelight
	Shrouded cover	W	15W minimum
	Operating power supply		240V 50 Hz AC
	Operable through		Panel door switch
	Power receptacle		15 Amp, 3-pin
2.4.10	**Earthing studs**		
	Termination to main station earth		Internally with 10 mm bolts at extreme ends for connection
2.4.11	**Alarm annunciator system**		
	No. Of windows	Nos.	Minimum 20
	Facia		Solid state discrete
	Hooter		10W
	Annunciator spare (with electronics)		10% spare window or minimum 2nos. Whichever is more
	Lamp test provision		Required
2.4.12	**Mounting devices on panel**		
	On front side		All operable and indicating devices
	Inside panel		Aux. Relays, terminal, PVC trough, MCBs etc.
	Easy access for operation / maintenance.		Required

2.13	**Impulse piping for water area/equipment**		
	Painting color scheme		Grey RAL 9002
	Identification Tag/band color scheme		Sea green, ISC no. 217
3.0	**INSPECTION/TESTING**		
3.1	Type Test requirement		Yes
	Item-1		Electronic Transmitters
	Test & Standard -1		As per Standard, BS-6447 / IEC-60770
	Item-2		Orifice Plate
	Test & Standard -2		Calibration, ISO 5167
	Test to be specifically conducted		No
	NTPC's approval required. on Test certificate		Yes

TECHNICAL DATA - PART - B (SUPPLIER DATA TO BE FURNISHED AFTER AWARD OF CONTRACT) - MECHANICAL

Chiller

S. No.	Description	Specification	UOM	DETAIL
1	Nominal Capacity (TR)			
2	Actual Capacity at site conditions (TR)			
3	Weight(kgs)			
4	Overall Dimensions (LxWxH)			
5	Tube Cleaning Space (m)			
6	Equiment rating (kW)			

Condensing Unit -Air-Cooled (D-X type)

S. No.	Description	Specification	UOM	DETAIL
1	Nominal Capacity (TR)			
2	Actual Capacity at site conditions (TR)			
3	Weight(kgs)			
4	Overall Dimensions (LxWxH)			
5	Equiment rating (kW)			

Air Handling Unit

S. No.	Description	Specification	UOM	DETAIL
1	Capacity (TR)			
2	Air Flow (cfm)			
3	Weight(kgs)			
4	Overall Dimensions (LxWxH)			
5	Equiment rating (kW)			

Non Ductable Split (Hi-Wall/Cassette), Ductable Split, Package ACs

S. No.	Description	Specification	UOM	DETAIL
1	Capacity (TR)			
2	Air Flow (cfm)			
3	Weight ODU(kgs)			
4	Weight IDU(kgs)			
5	Overall Dimensions ODU (LxWxH)			
6	Overall Dimensions IDU (LxWxH)			
7	Equiment rating (kW)			

Cooling Tower

S. No.	Description	Specification	UOM	DETAIL
1	Condenser Water Flow (CMH)			
2	Air Flow through fans (cfm)			
3	Weight(kgs)			
4	Overall Dimensions (LxWxH)			
5	Equiment rating (kW)			

Centrifugal Pumps

S. No.	Description	Specification	UOM	DETAIL
1	Type			
2	Flow rate (CMH)			
3	Head (m)			
4	Weight(kgs)			
5	Overall Dimensions (LxWxH)			
6	Equiment rating (kW)			

TECHNICAL DATA - PART - B (SUPPLIER DATA TO BE FURNISHED AFTER AWARD OF CONTRACT) - ELECTRICAL

SL.NO		UOM	DETAIL
1.0	**GENERAL**		
i)	Manufacturer & Country of origin.		
ii)	Equipment driven by motor)		
iii)	Motor type		
iv)	Country of origin		
v)	Quantity	nos.	
2.0	**DESIGN AND PERFORMANCE DATA**		
i)	Frame size		
ii)	Type of duty		
iii)	Type of enclosure and method of cooling		
vi)	Type of mounting		
vii)	Direction of rotation as viewed from DE END		
viii)	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard	(KW)	
ix)	(A) Derated rating for specified normal condition i.e. 50 deg. C ambient temperature	(KW)	
	(B) Rating as specified in load list	(KW)	
xi)	Rated speed at rated voltage and frequency	rpm	
xii)	At rated Voltage and frequency		
	a) Full load current	A	
	b) No load current	A	
xiii)	Power Factor at		
	a) 100% load		
	b) At duty point		
	c) 75% load		
	d) 50% load		
	e) NO load		
	f) Starting.		
xiv)	Efficiency at rated voltage and frequrecy		
	a) 100% load		
	b) At duty point		
	c) 75% load		
	d) 50% load		
xv)	Starting current*(inclusive of IS tolerance)* at		
	a. 100 % voltage	A	
	b. Minimum starting voltage	A	
xvi)	Starting time with minimum permissible voltage		

	a. Without driven equipment coupled	sec	
	b. With driven equipment coupled	sec	
xvii)	Safe stall time with 110% of rated voltage		
	a. From hot condition	sec	
	b. From cold condition	sec	
xviii)	**Torques :**		
	a. Starting torque at min. permissible voltage	(kg-mtr.)	
	b. Pull up torque at rated voltage.	(kg-mtr.)	
	c. Pull out torque	(kg-mtr.)	
	d. Min accelerating torque available	(kg-mtr.)	
	e. Rated torque	(kg-mtr.)	
xix)	Stator winding resistance per phase (at 20 Deg.C.)	Ohm	
xx)	GD^2 value of motors		
xxi)	Locked rotor KVA input (at rated voltage)		
xxii)	Locked rotor KVA/KW.		
xxiii)	**Bearings**		
	a. Type		
	b. Manufacturer		
	c. Self Lubricated or forced Lubricated		
	d. Recommended Lubricants		
	e. Guaranteed Life in Hours		
	f. Whether Dial Type thermometer provided		
	g. Oil pressure Gauge/switch		
	i. Range		
	ii. Contact Nos. & ratings		
	iii. Accuracy		
xxiv)	**Vibration**		
	a) Velocity	mm/s	
	b) Displacement	microns	
xxv)	Noise level	db	
3	**CONSTRUCTIONAL FEATURES**		
i	Stator winding insulation		
	a. Class & Type		
	b. Tropicalised (Yes/No)		
	c. Temperature rise over specified max.		
	i. Cold water temperature of 38 DEG. C.		
	ii. Ambient Air 50 DEG. C.		
	d. Method of temperature measurement		
	e. Stator winding connection		
	f. Number of terminals brought out		
ii	Type of terminal box for		
	a. stator leads		

	b. space heater		
	c. Temperature detectors		
	d. Instrument switch etc.		
iii)	For main terminal box		
	a. Location		
	b. Entry of cables		
	c. Recommended cable size		
	d. Fault level	MVA	
iv)	Temperature detector for stator winding		
	a Type		
	b. Nos. provided		
	c . Location		
	d. Make		
	e. Resistance value at 0 deg. C	ohms	
vi)	Paint shade		
vii).	Weight of(approx)		
	a. Motor stator (KG)		
	b. Motor Rotor (KG)		
	c. Total weight (KG)		
4	Relevant motor curves		

TECHNICAL DATA - PART - B (SUPPLIER DATA TO BE FURNISHED AFTER AWARD OF CONTRACT) - C&I

SL.NO	DESCRIPTION	UOM	DETAIL
	FOLLOWING DATA SHALL BE FILLED UP BY VENDOR FOR EACH INSTRUMENT		
1.0	MAKE		
1.1	MODEL		
1.2	TAG NO. / KKS NO.		
1.3	SERVICE		
1.4	QUANTITY		
1.5	OPERATING PRESSURE		
1.6	OPERATING TEMPERATURE		
1.7	DESIGN PRESSURE		
1.8	DESIGN TEMPERATURE		
1.9	RANGE		

INDUCED DRAFT COOLING TOWER
(2 WORKING & 1 STANDBY)

CT – 1 | CT – 2 | CT – 3

CDS INLET PIPE

90SAC31AN001 | 90SAC32AN001 | 90SAC33AN001

INLET

SUCTION SCREEN

OUTLET

MAKE UP WATER

OVERFLOW WATER LINE

90SAC11LL001

90SAC11AA001A | 90SAC12AA001A | 90SAC13AA001A

C.TOWER EQUALIZING LINE

CT EQUALIZING HEADER

DRAIN LINE

CDS PIPE

SOFT WATER SUPPLY FROM TANK TO FAN HUMIDIFIER

MAKE-UP WATER

BHEL

AC VENDOR

90SAC39AA001

MAKE UP TANK(MU) 8 CUM

INSULATION

DRAIN & OVERFLOW

DRAIN PIPE

PUMPS FOR SOFTENING PLANT
2 NOS.(1W + 1S).

90SAC34CP201 | 90SAC34CP501 | 90SAC34AP001 | 90SAC34CP502

BY PASS LINE

BY PASS VALVE

WATER SOFTENING PLANT 2X100%

SOFT WATER STORAGE TANKS (MAKEUP TANK)
(2 NOS., 8 CUM CAP. EACH)

90SAC36CL202 | 90SAC37CL202 | 90SAC36CL201 | 90SAC37CL201

MAKE UP & QUICK FILL

SOFT WATER SUPPLY FROM MAKE UP TANK TO COOLING TOWER BASIN

EXPANSION TANK(EX) 8 CUM

90SAC38CL201 | 90SAC38CL501

SOFT WATER SUPPLY FROM EXPANSION TANK TO CHILLED WATER RETURN HEADER

DRAIN TO NEAREST DRAIN POINT

COLD WATER SUPPLY FROM COOLING TOWER TO CONDENSER

HOT WATER RETURNED FROM CONDENSER TO COOLING TOWER

CHILLER | CONDENSER

90SAC01AH001 | 90SAC02AH001 | 90SAC03AH001

SCREW CHILLER PACKAGE-3x50%(2W+1S)

CONDENSER WATER PUMP
(2 WORKING & 1 STANDBY)

CHILLED WATER SUPPLY FROM CHILLER TO AHU

CHILLED WATER RETURN FROM AHU TO CHILLER

CHILLED WATER PUMP
(2 WORKING & 1 STANDBY)

AIR HANDLING UNIT
(3 WORKING & 1 STANDBY)
AHU ROOM AT 25.5 M LEVEL

90SAC40AA101 | 90SAC40AA102 | 90SAC40AA103 | 90SAC40AA104

SUPPLY AIR DUCT | NON RETURN DAMPER | FINE FILTER HEPA FILTER | VCD | SUCTION AIR

90SAC40AA001 | 90SAC40AA002 | 90SAC40AA003 | 90SAC40AA004

90SAC40AN001 | 90SAC40AN002 | 90SAC40AN003 | 90SAC40AN004

TO AHU ROOM FLOOR DRAIN

25 NB MAKE UP WATER LINE FOR PAN HUMIDIFIER

90SAC40AH001 | 90SAC40AH002 | PAN HUMIDIFIER

HIGH CLOSE STRIP HEATER ADEQUATE AIRFLOW START PERMISSION

90SAC40CP201 | 90SAC40CT201 | 90SAC40CM001 | 90SAC40CT013

SUPPLY AIR FIRE DAMPER | RETURN AIR FIRE DAMPER

TO A/C AREA OF 17.00 MTR
(CCR, CER, AUX. CONTROL ROOM & MISC AREA)

AIR HANDLING UNIT
(2 WORKING & 1 STANDBY)
AHU ROOM AT 8.5 M LEVEL IN CONTROL TOWER

90SAC45AA101 | 90SAC45AA102 | 90SAC45AA103

90SAC45AA001 | 90SAC45AA002 | 90SAC45AA003

90SAC45AN001 | 90SAC45AN002 | 90SAC45AN003

90SAC45AH001 | 90SAC45AH002 | 90SAC45CM001 | 90SAC45CT013

TO A/C AREA of 0 MTR (SWAS ROOM, WATER ANALYSIS LAB),
8.5 MTR (UPS, BATTERY CHARGER ROOM AND CER)

LEGEND

SYMBOL	DESCRIPTION	TAG	SYMBOL	DESCRIPTION	TAG
	TEMPERATURE GAUGE	TI		NON RETURN VALVE	NRV
	PRESSURE GAUGE	PI		Y-STRAINER	YSTR
	BALANCING VALVE	BV		GATE VALVE	GV
	MOTORISED BUTTERFLY VALVE	MBF		NON RETURN DAMPER	NRD
	BUTTERFLY VALVE	3MV		FIRE DAMPER (MOTOR OPERATED)	FD
	3-WAY MOTORISED MIXING VALVE	P		VOLUME CONTROL DAMPER.	VCD
	PUMP	–		GLOBE VALVE	
	VENT VALVE	–		DESCALING TEE	–
WFS	PURGE VALVE.	WFS	AT	AIRSTAT	AT
WFS	WATER FLOW SWITCH	–		FIRE DAMPER (MOTOR OPERATED)	FD
	PRE FILTER	–		FINNED TYPE STRIP HEATER	–
	HEPA FLTER	–	GT	GEYSER THERMOSTAT	GT
	FINE FILTER	E	HLS	HIGH LEVEL SWITCH	HLS
PH	PAN HUMIDIFIER	PH	PX	PRESSURE TEST POINT	PX
LLS	LOW LEVEL SWITCH	LLS	TE	TEMP. ELEMENT WITH TRANSMITTER	TE
TX	TEMP. TEST POINT	TX	RHS	HUMIDITY SENSOR	RHS
DPS	DIFFERENTIAL PRESSURE SWITCH	DPS	PS	AIR LINE PRESSURE SWITCH	PS
	ELECTRICAL LINE	–	HLS	HIGH LEVEL SWITCH	HLS
TE	TEMPERATURE ELEMENT	TE		SIGNAL TO DCS	D
	ORIFICE PLATE	–			–
LS	LEVEL SWITCH (LOW/HIGH)	LS		2-WAY MOTORISED	
			OC-LS	OPEN CLOSE LIMIT SWITCH	
FT	FLOW TRANSMITTER		LT	LEVEL TRANSMITTER	

CONDENSER WATER LINE
CHILLED WATER LINE
SUPPLY AND RETURN AIR DUCT

NOTES:
1. ALL CHILLED WATER PUMPS, PIPING, VALVES, EXPANSION TANK, AHU DRAIN, SUPPLY & RETURN DUCT SHALL BE INSULATED AS PER SPECIFICATION.
2. ALL PIPING AND VALVES OF SIZE 50NB & BELOW SHALL BE PROVIDED AS PER SYSTEM REQUIREMENT
3. ALL PRESSURE GAUGES, PRESSURE SWITCHES, DIFFERENTIAL PRESSURE SWITCHES SHALL BE PROVIDED WITH ISOLATION VALVE AND DRAIN FACILITY.
4. TEMPERATURE SENSOR (TE) & RELATIVE HUMIDITY SENSOR (RHS) ALONG WITH TRANSMITTER SHALL BE PROVIDED IN EACH AHU ROOM.
5. ALL INSTRUMENT AND TEST POINTS SHALL BE PROVIDED WITH ISOLATING ROOT VALVE
6. VENT AND DRAIN SHALL BE PROVIDED AT THE HIGHEST AND LOWESH POINT RESPECTIVELY AS PER SYSTEM REQUIREMENT.
7. ALL EQUIPMENT DRAIN SHALL BE CONNECTED TO NEAREST BUILDING / PLANT ROOM DRAIN.
8. CLARIFIED WATER SHALL BE PROVIDED TO THE AC SUPPLIER AT ONE POINT. FURTHER, DISTRIBUTION OF SAME TO INDIVIDUAL EQUIPMENT SHALL BE IN AC SUPPLIER SCOPE.
9. ALL VALVES SHALL BE LOCATED AT GRADE / MAN APPROACHABLE HEIGHT.
10. ADDITIONAL 15 NOS EACH OF TEMPERATURE AND HUMIDITY INDICATOR SHALL ALSO BE APPLICABLE OVER AND ABOVE QUANTITY REQUIRED FOR EACH AHU ROOM
11. ALL MANUAL VALVES SHALL BE LOCKABLE TYPE AND WITH LIMIT SWITCH
12. LOCAL /REMOTE START STOP SHALL BE PROVIDED FOR AHU (LOCAL CONTROL PANEL BY AC SUPPLIER)
13. THE CLOSURE OF FIRE DAMPERS, AUTOMATIC TRIPPING OF AHU FANS AND FRESH AIR FANS SHALL BE INTERLOCKED WITH FIRE DETECTION SYSTEM.
14. FOR LEGENDS & SYMBOLS, REFER GIVEN LEGEND LIST.
15. PIPE SIZE SHOWN IN P&ID IS INDICATIVE WHICH SHALL BE UPDATED AFTER DETAIL ENGINEERING BY BIDDER
16. INSTRUMENTS AND VALVES SHOWN IN P&ID ARE MINIMUM REQUIREMENT

KKS NOMENCLATURE

90 | SAC | 01 | AA | 001

- EQ / INSTRUMENT NUMBER KEY
- EQUIPMENT/INSTRUMENT KEY
- EQUIPMENT NUMBER
- FUNCTION KEY
- UNIT NUMBER IDENTIFIER
  10 STANDS FOR UNIT#01 AND 20 STANDS FOR UNIT #2
  90 FOR COMMON EQUIPMENTS INSTRUMENTS.

REV.	DATE	CHD	RWD	APPD	REASON

PACKAGE: AIR CONDITIONING SYSTEM

CUSTOMER: एन टी पी सी लिमिटेड N T P C LIMITED

PROJECT: 2X 800 MW LARA TPP STAGE-II

MAIN CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD PROJECT ENGINEERING MANAGEMENT NOIDA (U.P.)

DEPT CODE: M

Designed/Date | Drawn/Date | Checked/Date | Approved/Date

TITLE: P & I DIAGRAM FOR A/C SYSTEM FOR MAIN POWER HOUSE

DRAWING NO.: PE-DG-505-553-A001

SCALE: NTS | SHEET NO.: 01 of 01 | REV: 0

INDUCED DRAFT COOLING TOWER
(2 WORKING & 1 STANDBY, 3x50%(2W+1S)

CT - 1
CT - 2
CT - 3

SOFT WATER STORAGE TANKS (MAKEUP TANK)
(2 NOS., 4 CUM CAP. EACH)

WATER SOFTENING PLANT
2X100%

PUMPS FOR SOFTENING PLANT
2 NOS.(1W + 1S).

DRAIN PIPE

SOFT WATER SUPPLY FROM MAKE UP TANK TO COOLING TOWER BASIN

SOFT WATER SUPPLY FROM EXPANSION TANK TO CHILLED WATER RETURN HEADER

DRAIN TO NEAREST DRAIN POINT

SOFT WATER SUPPLY FROM TANK TO FAN HUMIDIFIER UNIT-1

SOFT WATER SUPPLY FROM EXPANSION TANK TO CHILLED WATER RETURN HEADER

AIR HANDLING UNIT
(1 WORKING & 1 STANDBY)
AHP MCC 1

AIR HANDLING UNIT
(1 WORKING & 1 STANDBY)
AHP MCC 2

TO A/C AREA

UNIT-2
AIR HANDLING UNIT
(2 WORKING & 2 STANDBY)
AHU ROOM AT 13.5 M IN ESP CUM FGD CONTROL ROOM UNIT-2

AIR HANDLING UNIT
(1 WORKING & 1 STANDBY)
AHP MCC 3

UNIT-1
AIR HANDLING UNIT
(2 WORKING & 2 STANDBY)
AHU ROOM AT TERRACE IN ESP CUM FGD CONTROL ROOM

HOT WATER RETURNED FROM CONDENSER TO COOLING TOWER

COLD WATER SUPPLY FROM COOLING TOWER TO CONDENSER

SCREW CHILLER PACKAGE-3x50%(2W+1S)

CONDENSER WATER PUMP
(2 WORKING & 1 STANDBY, 3x50%(2W+1S)

CHILLED WATER PUMP
(2 WORKING & 1 STANDBY, 3x50%(2W+1S)

CHILLED WATER SUPPLY FROM CHILLER TO AHU

CHILLED WATER RETURN FROM AHU TO CHILLER

LEGEND					
SYMBOL	DESCRIPTION	TAG	SYMBOL	DESCRIPTION	TAG
TI	TEMPERATURE GAUGE	TI		NON RETURN VALVE	NRV
PI	PRESSURE GAUGE	PI		Y-STRAINER	YSTR
BV	BALANCING VALVE	BV		GATE VALVE	GV
MBF	MOTORISED BUTTERFLY VALVE	MBF		NON RETURN DAMPER	NRD
JMV	BUTTERFLY VALVE	JMV		FIRE DAMPER (MOTOR OPERATED)	FD
JP	3-WAY MOTORISED MIXING VALVE	JP		VOLUME CONTROL DAMPER.	VCD
–	PUMP	–		GLOBE VALVE	
–	VENT VALVE	–		DESCALING TEE	–
WFS	PURGE VALVE.	WFS	AT	AIRSTAT	AT
WFS	WATER FLOW SWITCH	–		FIRE DAMPER (MOTOR OPERATED)	FD
	PRE FILTER	–		FINNED TYPE STRIP HEATER	–
	FINE FILTER	–	GT	GEYSER THERMOSTAT	GT
	HEPA FLTER	E	HLS	HIGH LEVEL SWITCH	HLS
PH	PAN HUMIDIFIER	PH	PX	PRESSURE TEST POINT	PX
LLS	LOW LEVEL SWITCH	LLS	TE	TEMP ELEMENT WITH TRANSMITTER	TE
TX	TEMP. TEST POINT	TX	RHS	HUMIDITY SENSOR	RHS
DPS	DIFFERENTIAL PRESSURE SWITCH	DPS	PS	AIR LINE PRESSURE SWITCH	PS
– E –	ELECTRICAL LINE	–	HLS	HIGH LEVEL SWITCH	HLS
TE	TEMPERATURE ELEMENT	TE	D	SIGNAL TO DCS	D
	ORIFICE PLATE	–			–
LS	LEVEL SWITCH (LOW/HIGH)	LS		2-WAY MOTORISED	
			OC-LS	OPEN CLOSE LIMIT SWITCH	
FT	FLOW TRANSMITTER		LT	LEVEL TRANSMITTER	

CONDENSER WATER LINE
CHILLED WATER LINE
SUPPLY AND RETURN AIR DUCT

KKS NOMENCLATURE
90 SAE 01 AA 001
90 – EQ / INSTRUMENT NUMBER KEY
SAE – EQUIPMENT/INSTRUMENT KEY
01 – EQUIPMENT NUMBER
AA – FUNCTION KEY
001 – UNIT NUMBER IDENTIFIER
10 STANDS FOR UNIT#1 AND 20 STANDS FOR UNIT #2
90 FOR COMMON EQUIPMENTS INSTRUMENTS

NOTES:
1. ALL CHILLED WATER PUMPS, PIPING, VALVES, EXPANSION TANK, AHU DRAIN, SUPPLY & RETURN DUCT SHALL BE INSULATED AS PER SPECIFICATION.
2. ALL PIPING AND VALVES OF SIZE 50NB & BELOW SHALL BE PROVIDED AS PER SYSTEM REQUIREMENT
3. ALL PRESSURE GAUGES, PRESSURE SWITCHES, DIFFERENTIAL PRESSURE SWITCHES SHALL BE PROVIDED WITH ISOLATION VALVE AND DRAIN FACILITY.
4. TEMPERATURE SENSOR (TE) & RELATIVE HUMIDITY SENSOR (RHS) ALONG WITH TRANSMITTER SHALL BE PROVIDED IN EACH AHU ROOM.
5. ALL INSTRUMENT AND TEST POINTS SHALL BE PROVIDED WITH ISOLATING ROOT VALVE
6. VENT AND DRAIN SHALL BE PROVIDED AT THE HIGHEST AND LOWESH POINT RESPECTIVELY AS PER SYSTEM REQUIREMENT.
7. ALL EQUIPMENT DRAIN SHALL BE CONNECTED TO NEAREST BUILDING / PLANT ROOM DRAIN.
8. CLARIFIED WATER SHALL BE PROVIDED TO THE AC SUPPLIER AT ONE POINT AT THE ROOF OF THE BUILDING. FURTHER, DISTRIBUTION OF SAME TO INDIVIDUAL EQUIPMENT SHALL BE IN AC SUPPLIER SCOPE.
9. ALL VALVES SHALL BE LOCATED AT GRADE / MAN APPROACHABLE HEIGHT.
10. ALL MANUAL VALVES SHALL BE LOCKABLE TYPE AND WITH LIMIT SWITCH
11. FOR LEGENDS & SYMBOLS, REFER GIVEN LEGEND LIST.
12. LOCAL /REMOTE START STOP SHALL BE PROVIDED FOR AHU (LOCAL CONTROL PANEL BY AC SUPPLIER)
13. THE CLOSURE OF FIRE DAMPERS, AUTOMATIC TRIPPING OF AHU FANS AND FRESH AIR FANS SHALL BE INTERLOCKED WITH FIRE DETECTION SYSTEM.
14. PIPE SIZE SHOWN IN P&ID IS INDICATIVE WHICH SHALL BE UPDATED AFTER DETAIL ENGINEERING BY BIDDER
15. INSTRUMENTS AND VALVES SHOWN IN P&ID ARE MINIMUM REQUIREMENT

REV.	DATE	CHD	RWD	APPD

PACKAGE: AIR CONDITIONING SYSTEM
CUSTOMER: एन टी पी सी लिमिटेड N T P C LIMITED
PROJECT: 2X800MW LARA TPP STAGE-II
MAIN CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD PROJECT ENGINEERING MANAGEMENT NOIDA (U.P.)
DEPT CODE: M
checked,cvc
shared,cvc
approved,cvc
TITLE: P & I DIAGRAM FOR A/C SYSTEM COMMON FOR ESP CONTROL ROOM, FGD CONTROL ROOM, ASH HANDLING CONTROL ROOM
DRAWING NO.: PE-DG-508-553-A002
SHEET NO.: 1 of 01
REV: R0

NOTES:

1. FOR LEGENDS & SYMBOLS, REFER BELOW GIVEN LEGEND LIST.
2. INSULATION WILL BE SUPPLIED AS PER SPECIFICATION
3. DRAINS TO BE ROUTED UPTO NEAREST DRAIN POINT.
4. ALL PIPES SHALL BE SUPPLIED AS PER TECHNICAL SPECIFICATION.
5. TEMP. SENSOR IS INTEGRAL PART OF DX UNIT.
6. ALL PRESSURE GAUGES, PRESSURE SWITCHES, DIFFERENTIAL PRESSURE SWITCHES SHALL BE PROVIDED WITH ISOLATION VALVE & DRAIN FACILITY. (FOR WATER LINE)
7. LOCAL /REMOTE START STOP SHALL BE PROVIDED FOR AHU(LOCAL CONTROL PANEL BY AC SUPPLIER)
8. THE CLOSURE OF FIRE DAMPERS, AUTOMATIC TRIPPING OF AHU FANS AND FRESH AIR FANS SHALL BE INTERLOCKED WITH FIRE DETECTION SYSTEM.

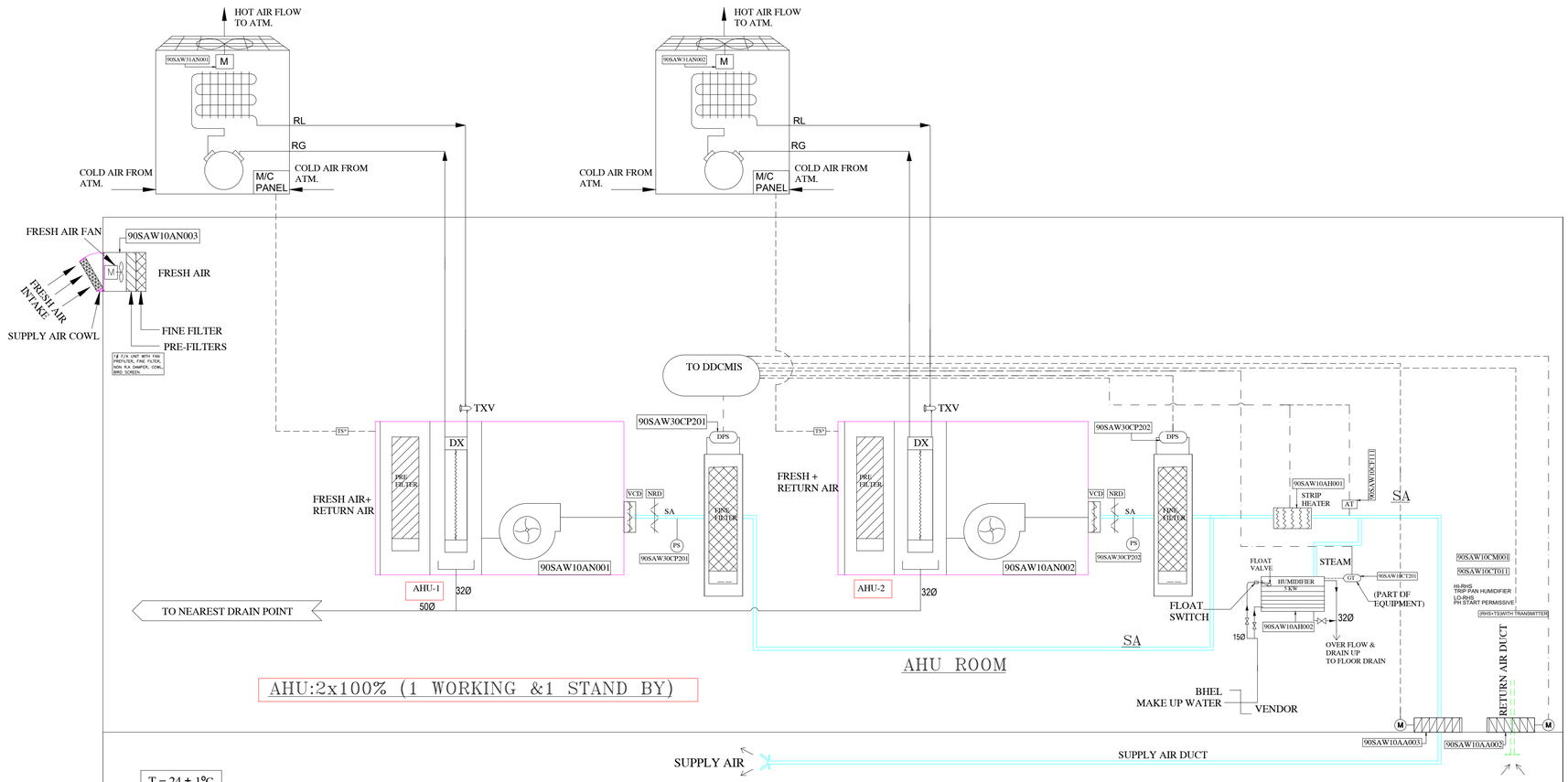
LEGENDS:

- TXV — THERMOSTATIC EXPANSION VALVE
- INSULATION
- CONTROL SIGNAL
- SUPPLY DUCT
- RETURN DUCT
- HUMIDIFIER
- STRIP HEATER
- SA - SUPPLY AIR
- RA - RETURN AIR
- FA - FRESH AIR
- FRESH AIR FAN WITH BIRD SCREEN AND COWL
- (SA) SUPPLY AIR GRILLE/DIFFUSER
- (RA) RETURN AIR GRILLE/DIFFUSER
- PREFILTER
- FINE FILTER
- NRD — NON RETURN DAMPER(NRD)
- MOTORISED FIRE DAMPER
- MANUAL VOLUME CONTROL DAMPER

INSTRUMENTS:

- GT — GYSERSTAT
- AT — AIRSTAT
- DPS — DIFFERENTIAL PRESSSURE SWITCH
- RG — REFRIGERATION GAS
- RL — REFRIGERATION LIQUID
- RHS RTS — RETURN TEMP. & HUMIDITY SENSOR(TRANSMITTER TYPE)
- PS — PRESSURE SWITCH
- TS — TEMP. SENSOR

AIR COOLED CONDENSING UNIT:2x100% (1 WORKING &1 STAND BY)



AHU:2x100% (1 WORKING &1 STAND BY)

T = 24 ± 1°C

RH= 50 ± 5%

P&ID DIAGRAM FOR AIR COOLED CONDENSING UNIT (DX TYPE) FOR WATER SYSTEM

KKS NOMENCLATURE

90	SAW	01	AA	001

- 001 — EQ / INSTRUMENT NUMBER KEY
- AA — EQUIPMENT/INSTRUMENT KEY
- 01 — EQUIPMENT NUMBER
- SAW — FUNCTION KEY
- 90 — UNIT NUMBER IDENTIFIER
  10 STANDS FOR UNIT#01 AND 20 STANDS FOR UNIT #2
  90 FOR COMMON EQUIPMENTS INSTRUMENTS.

DISCRIPTION	REV.	DATE	ALTD	CHD	APPD

PACKAGE: AIR CONDITIONING SYSTEM

ग्राहक CUSTOMER: एन टी पी सी लिमिटेड N T P C LIMITED

परियोजना PROJECT: 2X800MW LARA TPP STAGE-II

MAIN CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD PROJECT ENGINEERING MANAGEMENT NOIDA (U.P.)

DEPT CODE: M

	NAME	SIGN	DATE
prepared/बनाया			
checked/जांचा			
explored/अनु			

शीर्षक/TITLE: P & ID DIAGRAM FOR A/C SYSTEM FOR WATER SYSTEM CONTROL BUILDING, CEP VFD UNIT-7 , CEP VFD UNIT 2 &, OFFICE AREA ON POWER HOUSE

ड्राइंग संख्या / DRAWING NO.: PE-DG-508-553-A003

SHEET 01 of 04 | REV. 0

NOTES:

1. FOR LEGENDS & SYMBOLS, REFER BELOW GIVEN LEGEND LIST.
2. INSULATION WILL BE SUPPLIED AS PER SPECIFICATION
3. DRAINS TO BE ROUTED UPTO NEAREST DRAIN POINT.
4. ALL PIPES SHALL BE SUPPLIED AS PER TECHNICAL SPECIFICATION.
5. TEMP. SENSOR IS INTEGRAL PART OF DX UNIT.
6. ALL PRESSURE GAUGES, PRESSURE SWITCHES, DIFFERENTIAL PRESSURE SWITCHES SHALL BE PROVIDED WITH ISOLATION VALVE & DRAIN FACILITY. (FOR WATER LINE)
7. LOCAL /REMOTE START STOP SHALL BE PROVIDED FOR AHU(LOCAL CONTROL PANEL BY AC SUPPLIER)
8. THE CLOSURE OF FIRE DAMPERS, AUTOMATIC TRIPPING OF AHU FANS AND FRESH AIR FANS SHALL BE INTERLOCKED WITH FIRE DETECTION SYSTEM.

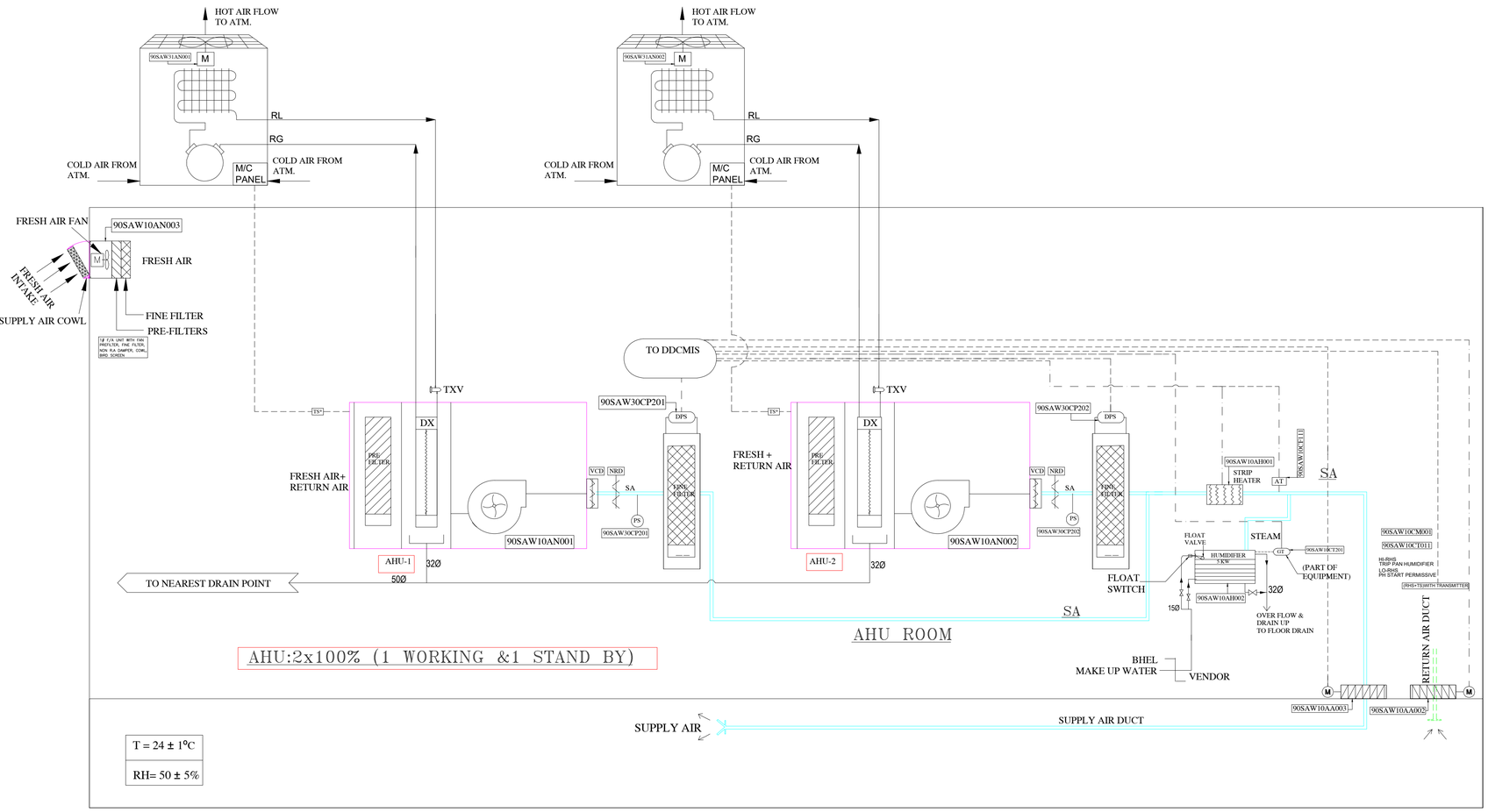
LEGENDS:

TXV — THERMOSTATIC EXPANSION VALVE	(SA) SUPPLY AIR GRILLE/DIFFUSER
INSULATION	(RA) RETURN AIR GRILLE/DIFFUSER
CONTROL SIGNAL	PREFILTER
SUPPLY DUCT	FINE FILTER
RETURN DUCT	NON RETURN DAMPER(NRD)
HUMIDIFIER	STRIP HEATER
SA - SUPPLY AIR RA - RETURN AIR FA - FRESH AIR	MOTORISED FIRE DAMPER
FRESH AIR FAN WITH BIRD SCREEN AND COWL	MANUAL VOLUME CONTROL DAMPER

INSTRUMENTS:

GT	GYSERSTAT	RHS RTS	RETURN TEMP. & HUMIDITY SENSOR(TRANSMITTER TYPE)
AT	AIRSTAT	PS	PRESSURE SWITCH
DPS	DIFFERENTIAL PRESSURE SWITCH	TS	TEMP. SENSOR
RG	REFRIGERATION GAS		
RL	REFRIGERATION LIQUID		

AIR COOLED CONDENSING UNIT:2x100% (1 WORKING &1 STAND BY)



AHU:2x100% (1 WORKING &1 STAND BY)

T = 24 ± 1°C
RH= 50 ± 5%

P&ID DIAGRAM FOR AIR COOLED CONDENSING UNIT (DX TYPE) FOR CEP VFD UNIT 1

KKS NOMENALATURE

90	SAW	01	AA	001

- 90 — UNIT NUMBER IDENTIFIER (10 STANDS FOR UNIT#01 AND 20 STANDS FOR UNIT #2; 90 FOR COMMON EQUIPMENTS INSTRUMENTS.)
- 001 — EQ / INSTRUMENT NUMBER KEY
- AA — EQUIPMENT/INSTRUMENT KEY
- 01 — EQUIPMENT NUMBER
- SAW — FUNCTION KEY

DISCRIPTION	REV.	DATE	ALTD	CHD	APPD

PACKAGE: AIR CONDITIONING SYSTEM

CUSTOMER: एन टी पी सी लिमिटेड N T P C LIMITED

PROJECT: 2X800MW LARA TPP STAGE-II

MAIN CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD PROJECT ENGINEERING MANAGEMENT NOIDA (U.P.)

DEPT CODE: M

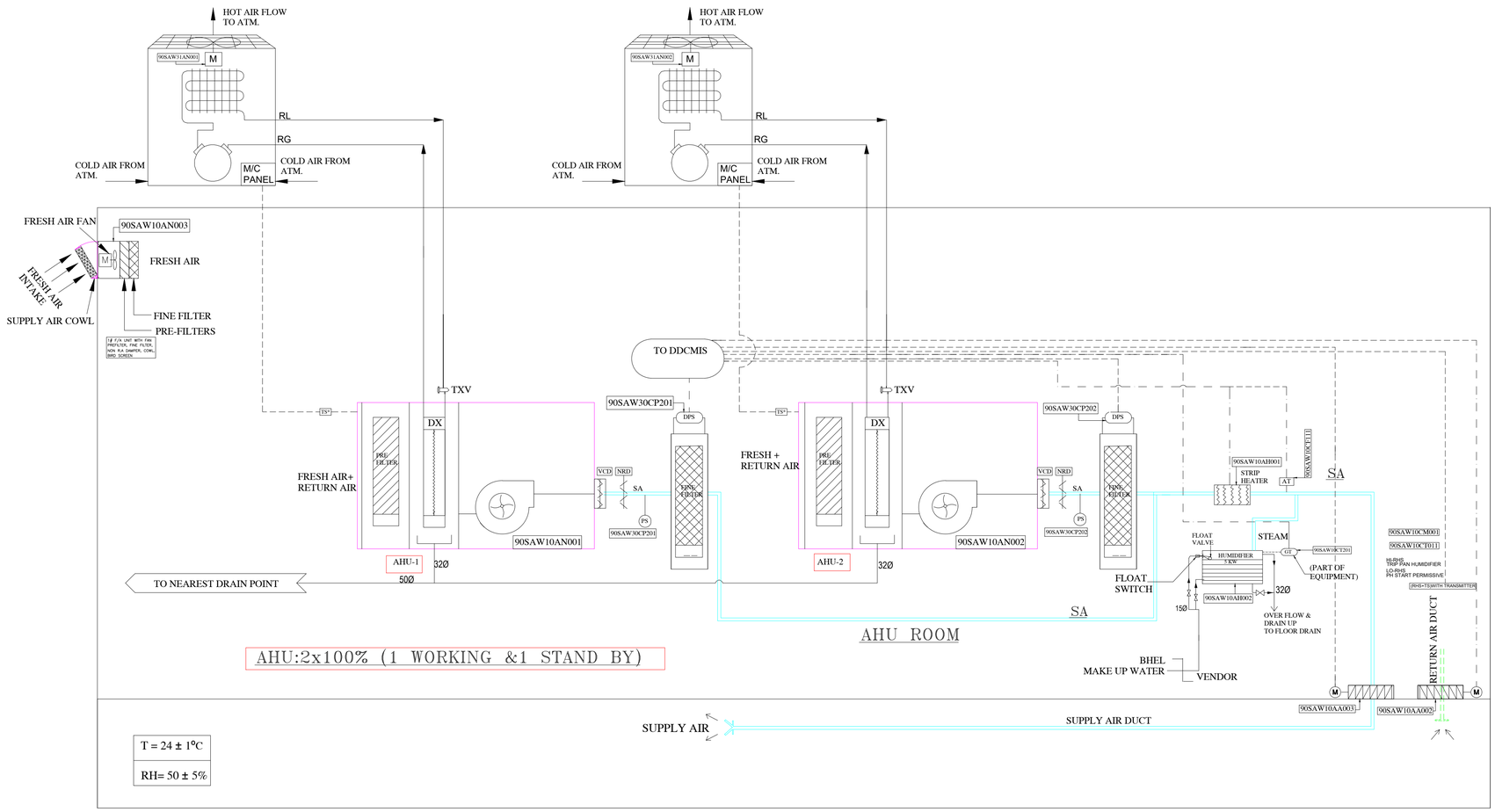
DRAWN/DSN | CHKD/CHK | DCMT CTL

शीर्षक/TITLE: P & ID DIAGRAM FOR A/C SYSTEM FOR WATER SYSTEM CONTROL BUILDING, CEP VFD UNIT-1, CEP VFD UNIT 2 & OFFICE AREA ON POWER HOUSE

ड्राइंग संख्यांक / DRAWING NO.: PE-DG-808-563-A003

SHT. 02 of 04 | REV. R0

AIR COOLED CONDENSING UNIT:2x100% (1 WORKING &1 STAND BY)



AHU:2x100% (1 WORKING &1 STAND BY)

T = 24 ± 1°C
RH= 50 ± 5%

NOTES:

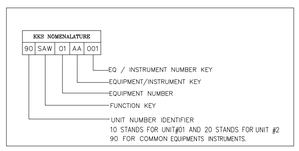
1. FOR LEGENDS & SYMBOLS, REFER BELOW GIVEN LEGEND LIST.
2. INSULATION WILL BE SUPPLIED AS PER SPECIFICATION
3. DRAINS TO BE ROUTED UPTO NEAREST DRAIN POINT.
4. ALL PIPES SHALL BE SUPPLIED AS PER TECHNICAL SPECIFICATION.
5. TEMP. SENSOR IS INTEGRAL PART OF DX UNIT.
6. ALL PRESSURE GAUGES, PRESSURE SWITCHES, DIFFERENTIAL PRESSURE SWITCHES SHALL BE PROVIDED WITH ISOLATION VALVE & DRAIN FACILITY. (FOR WATER LINE)
7. LOCAL /REMOTE START STOP SHALL BE PROVIDED FOR AHU(LOCAL CONTROL PANEL BY AC SUPPLIER)
8. THE CLOSURE OF FIRE DAMPERS, AUTOMATIC TRIPPING OF AHU FANS AND FRESH AIR FANS SHALL BE INTERLOCKED WITH FIRE DETECTION SYSTEM.

LEGENDS:

- TXV — THERMOSTATIC EXPANSION VALVE
- INSULATION
- CONTROL SIGNAL
- SUPPLY DUCT
- RETURN DUCT
- HUMIDIFIER
- STRIP HEATER
- SA - SUPPLY AIR
- RA - RETURN AIR
- FA - FRESH AIR
- FRESH AIR FAN WITH BIRD SCREEN AND COWL
- (SA) SUPPLY AIR GRILLE/DIFFUSER
- (RA) RETURN AIR GRILLE/DIFFUSER
- PREFILTER
- FINE FILTER
- NRD — NON RETURN DAMPER(NRD)
- MOTORISED FIRE DAMPER
- MANUAL VOLUME CONTROL DAMPER

INSTRUMENTS:

- GT — GYSERSTAT
- AT — AIRSTAT
- DPS — DIFFERENTIAL PRESSURE SWITCH
- RG — REFRIGERATION GAS
- RL — REFRIGERATION LIQUID
- RH/S RTS — RETURN TEMP. & HUMIDITY SENSOR(TRANSMITTER TYPE)
- PS — PRESSURE SWITCH
- TS — TEMP. SENSOR



P&ID DIAGRAM FOR AIR COOLED CONDENSING UNIT (DX TYPE) FOR CEP VFD UNIT 2

DISCRIPTION	REV.	DATE	ALTD	CHD	APPD

PACKAGE: AIR CONDITIONING SYSTEM

CUSTOMER: एन टी पी सी लिमिटेड N T P C LIMITED

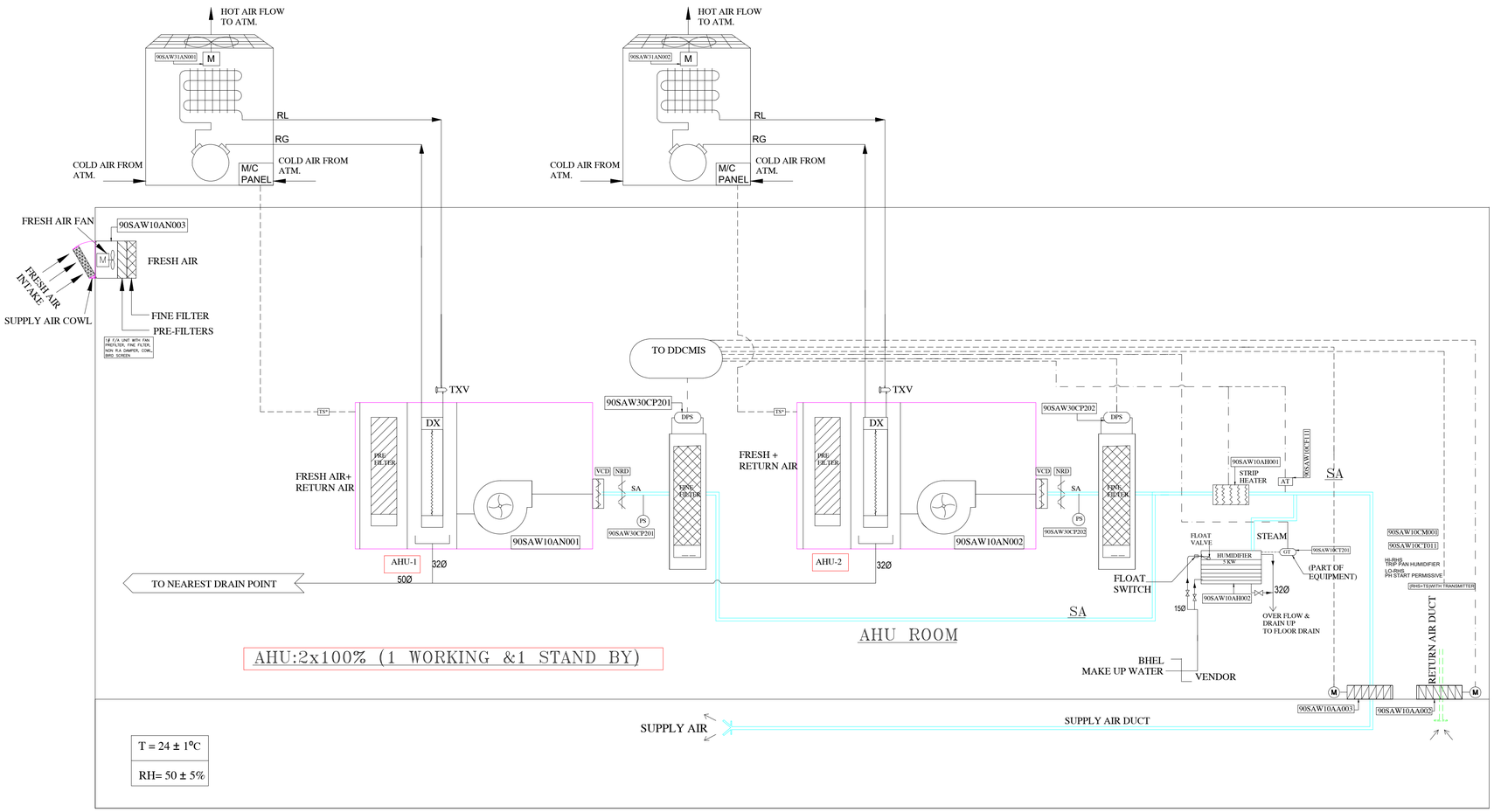
PROJECT: 2X800MW LARA TPP STAGE-II

MAIN CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD PROJECT ENGINEERING MANAGEMENT NOIDA (U.P.) — DEPT CODE M

TITLE: P & ID DIAGRAM FOR A/C SYSTEM FOR WATER SYSTEM CONTROL BUILDING, CEP VFD UNIT # 1, CEP VFD UNIT 2 & OFFICE AREA ON POWER HOUSE

DRAWING NO.: PE-DG-508-553-A003 — SHEET NO. 03 of 04 — REV-0

AIR COOLED CONDENSING UNIT:2x100% (1 WORKING &1 STAND BY)



AHU:2x100% (1 WORKING &1 STAND BY)

T = 24 ± 1°C
RH= 50 ± 5%

P&ID DIAGRAM FOR AIR COOLED CONDENSING UNIT (DX TYPE) FOR OFFICE AREA IN CONTROL TOWER POWER HOUSE

NOTES:

1. FOR LEGENDS & SYMBOLS, REFER BELOW GIVEN LEGEND LIST.
2. INSULATION WILL BE SUPPLIED AS PER SPECIFICATION
3. DRAINS TO BE ROUTED UPTO NEAREST DRAIN POINT.
4. ALL PIPES SHALL BE SUPPLIED AS PER TECHNICAL SPECIFICATION.
5. TEMP. SENSOR IS INTEGRAL PART OF DX UNIT.
6. ALL PRESSURE GAUGES, PRESSURE SWITCHES, DIFFERENTIAL PRESSURE SWITCHES SHALL BE PROVIDED WITH ISOLATION VALVE & DRAIN FACILITY. (FOR WATER LINE)
7. LOCAL /REMOTE START STOP SHALL BE PROVIDED FOR AHU(LOCAL CONTROL PANEL BY AC SUPPLIER)
8. THE CLOSURE OF FIRE DAMPERS, AUTOMATIC TRIPPING OF AHU FANS AND FRESH AIR FANS SHALL BE INTERLOCKED WITH FIRE DETECTION SYSTEM.

LEGENDS:

- TXV — THERMOSTATIC EXPANSION VALVE
- INSULATION
- CONTROL SIGNAL
- SUPPLY DUCT
- RETURN DUCT
- HUMIDIFIER
- STRIP HEATER
- SA - SUPPLY AIR
- RA - RETURN AIR
- FA - FRESH AIR
- FRESH AIR FAN WITH BIRD SCREEN AND COWL
- (SA) SUPPLY AIR GRILLE/DIFFUSER
- (RA) RETURN AIR GRILLE/DIFFUSER
- PREFILTER
- FINE FILTER
- NRD — NON RETURN DAMPER(NRD)
- MOTORISED FIRE DAMPER
- MANUAL VOLUME CONTROL DAMPER

INSTRUMENTS:

- GT — GYSERSTAT
- AT — AIRSTAT
- DPS — DIFFERENTIAL PRESSURE SWITCH
- RG — REFRIGERATION GAS
- RL — REFRIGERATION LIQUID
- RH/S | RTS — RETURN TEMP. & HUMIDITY SENSOR(TRANSMITTER TYPE)
- PS — PRESSURE SWITCH
- TS — TEMP. SENSOR

KKS NOMENALATURE: 90 | SAW | 01 | AA | 001
- 001 — EQ / INSTRUMENT NUMBER KEY
- AA — EQUIPMENT/INSTRUMENT KEY
- 01 — EQUIPMENT NUMBER
- SAW — FUNCTION KEY
- 90 — UNIT NUMBER IDENTIFIER
  10 STANDS FOR UNIT#01 AND 20 STANDS FOR UNIT #2
  90 FOR COMMON EQUIPMENTS INSTRUMENTS.

DISCRIPTION	REV.	DATE	ALTD	CHD	APPD

PACKAGE: AIR CONDITIONING SYSTEM

CUSTOMER: एन टी पी सी लिमिटेड / N T P C LIMITED

PROJECT: 2X800MW LARA TPP STAGE-II

MAIN CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD, PROJECT ENGINEERING MANAGEMENT, NOIDA (U.P.) — DEPT CODE: M

	Designed/Drawn	Checked/Chd	Approved/Apvd
Name			
Sign			
Date			

TITLE: P & ID DIAGRAM FOR AC SYSTEM FOR WATER SYSTEM CONTROL BUILDING, CTP VID UNIT-1, CTP VID UNIT 2 & OFFICE AREA ON POWER HOUSE

DOCUMENT / DRAWING NO.: PE-DG-506-553-A004

REV. NO.: 04 of 04 — SCALE: NTS — REV-0

NOTE:–

1. HVAC MAKE-UP WATER PIPING/VALVE FROM TERMINAL POINT NEAR BUILDING IS IN VENDOR SCOPE.
2. MAKE-UP WATER REQUIREMENT IS CONTINUOUS/INTERMITTENT AS MENTIONED.
3. MATERIAL OF PIPE SHALL BE CARBON STEEL.

HVAC MAKE–UP (Clarified water) FOR HVAC MAKE–UP DISTRIBUTION AT VARIOUS PLACES AND TERMINAL POINT AS SHOWN IN DRG.

150 NB

100 NB

50 NB

50 NB

100 NB

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–1 → TO PACKAGE AIR WASHER-1 MAKE-UP UNIT - 1.
BHEL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–2 → TO PACKAGE AIR WASHER-2 MAKE-UP UNIT - 1.
BHEL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–3 → TO PACKAGE AIR WASHER-3 MAKE-UP UNIT - 1.
BHEL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–4 → TO PACKAGE AIR WASHER-4 MAKE-UP UNIT - 1.
BHEL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–5 → TO PACKAGE AIR WASHER-5 MAKE-UP UNIT - 1.
BHEL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–6 → TO PACKAGE AIR WASHER-6 MAKE-UP UNIT - 2.
BHEL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–7 → TO PACKAGE AIR WASHER-7 MAKE-UP UNIT - 2.
BHEL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–8 → TO PACKAGE AIR WASHER-8 MAKE-UP UNIT - 2
BHEL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–9 → TO PACKAGE AIR WASHER-9 MAKE-UP UNIT - 2
BHEL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–10 → TO PACKAGE AIR WASHER-10 MAKE-UP UNIT - 2.
BHEL
LOCATION: (Along A-Row).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–12 → TO PACKAGE AIR WASHER-11 MAKE-UP UNIT - 1.
BHEL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–13 → TO PACKAGE AIR WASHER-12 MAKE-UP UNIT - 1.
BHEL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–14 → TO PACKAGE AIR WASHER-13 MAKE-UP UNIT - 1.
BHEL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–15 → TO PACKAGE AIR WASHER-14 MAKE-UP UNIT - 1.
BHEL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–16 → TO PACKAGE AIR WASHER-15 MAKE-UP UNIT - 1.
BHEL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–17 → TO PACKAGE AIR WASHER-16 MAKE-UP UNIT - 2.
BHEL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–18 → TO PACKAGE AIR WASHER-17 MAKE-UP UNIT - 2.
BHEL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–19 → TO PACKAGE AIR WASHER-18 MAKE-UP UNIT - 2.
BHEL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–20 → TO PACKAGE AIR WASHER-19 MAKE-UP UNIT - 2.
BHEL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
3.0 m³/hr, 25 NB, HVAC–21 → TO PACKAGE AIR WASHER-20 MAKE-UP UNIT - 2.
BHEL
LOCATION: (Along B-C bay).

VENTILATION SYSTEM VENDOR
1.5 m³/hr, 25 NB, HVAC–22 → TO PACKAGE AIR WASHER-21 MAKE-UP UNIT - 1.
BHEL
LOCATION: (At roof of D-E-F BAY).

VENTILATION SYSTEM VENDOR
1.5 m³/hr, 25 NB, HVAC–23 → TO PACKAGE AIR WASHER-22 MAKE-UP UNIT - 2.
BHEL
LOCATION: (At roof of D-E-F BAY).

AC-VENDOR
10 m³/hr, 50 NB, HVAC–24 → PAN HUMIDIFIER (COMMON FOR UNIT-1 & 2) → For AC SYSTEM, NEAR MAKE-UP WATER TANK NEAR AC SYSTEM COOLING TOWER at roof of D-E-F bay.
BHEL
LOCATION: (At roof of D-E-F BAY).

AC-VENDOR
10 m³/hr, 50 NB, HVAC–24 → PAN HUMIDIFIER (COMMON FOR UNIT-1 & 2) → FOR AC SYSTEM COOLING TOWER at ESP Control Building Unit-1 Terrace.
BHEL
LOCATION: (AT ROOF OF ESP CONTROL ROOM UNIT 1.) common FGD and ESP control room

VENTILATION SYSTEM VENDOR
12 m³/hr, 50 NB, HVAC–25 → Two Nos. UAF of ESP cum FGD building Terrace UNIT - 1.
BHEL
LOCATION: (IN ESP cum FGD BUILDING TERRACE LEVEL)

AC - VENDOR
25 NB, AC - VENDOR → TO HUMIDIFIER OF ESP AHU UNIT - 2.
BHEL

VENTILATION SYSTEM VENDOR
5 m³/hr, 40 NB, HVAC–26 → Two Nos. UAF of ESP cum FGD building Terrace UNIT - 2.
BHEL
LOCATION: (IN ESP cum FGD BUILDING TERRACE LEVEL)

AC-VENDOR
intermittent, 25 NB, HVAC–28 → TO HUMIDIFIER OF AHP-MCC 1
BHEL
LOCATION: (AT AHP MCC 1)

AC-VENDOR
intermittent, 25 NB, HVAC–29 → TO HUMIDIFIER OF AHP-MCC 2
BHEL
LOCATION: (AT AHP MCC 2)

AC-VENDOR
intermittent, 25 NB, HVAC–30 → TO HUMIDIFIER OF AHP-MCC 3
BHEL
LOCATION: (AT AHP MCC 3)

AC-VENDOR
intermittent, 25 NB, HVAC–31 → TO HUMIDIFIER OF CEP VFD UNIT 1
BHEL
LOCATION: (AT CEP VFD UNIT 1)

AC-VENDOR
intermittent, 25 NB, HVAC–32 → TO HUMIDIFIER OF WATER SYSTEM CONTROL ROOM AHU
BHEL
LOCATION: (AT GROUND FLOOR IN AHU ROOM OF WATER SYSTEM CONTROL BUILDING)

AC-VENDOR
intermittent, 25 NB, HVAC–33 → TO HUMIDIFIER OF CEP VFD UNIT 2
BHEL
LOCATION: (AT CEP VFD UNIT 2)

PIPE SIZE - CARBON STEEL
Design pressure - 12 Kg/sq. cm
Design temperature - 60 deg. C

CUSTOMER :	NATIONAL THERMAL POWER CORPORATION (NTPC)
JOB No. : 508	2X800 MW LARA STPP STAGE II
STATUS TENDER	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT PPEI BLDG. PLOT NO. 25, SECTOR-16A, NOIDA
DISTRIBUTION: TO / NoOfI / REV. DATE DRAWN CHD APPD	TITLE: SCHEMATIC DAIAGRAM FOR HVAC MAKE UP
	MPL C MSE I MAX E DEPT. SCALE–N.T.S; SIGN; DATE; SHEET 51 of 219; REV 00 PE–DG–508–553–A004

SIZE–A3

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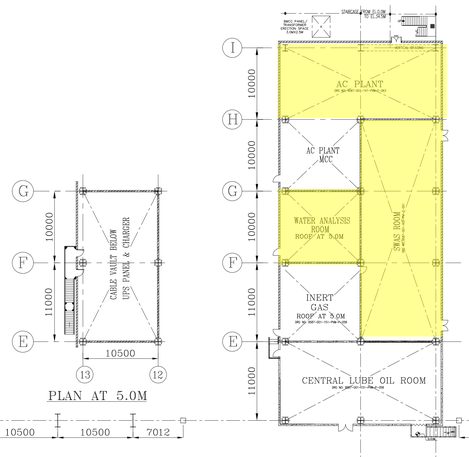
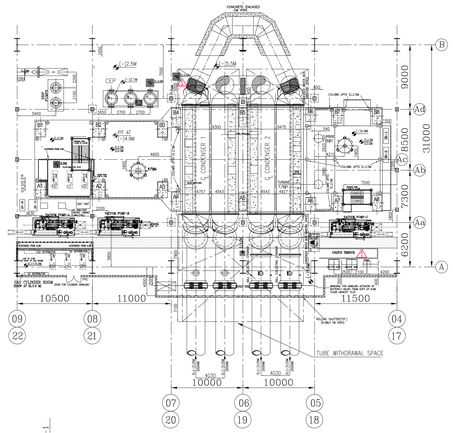
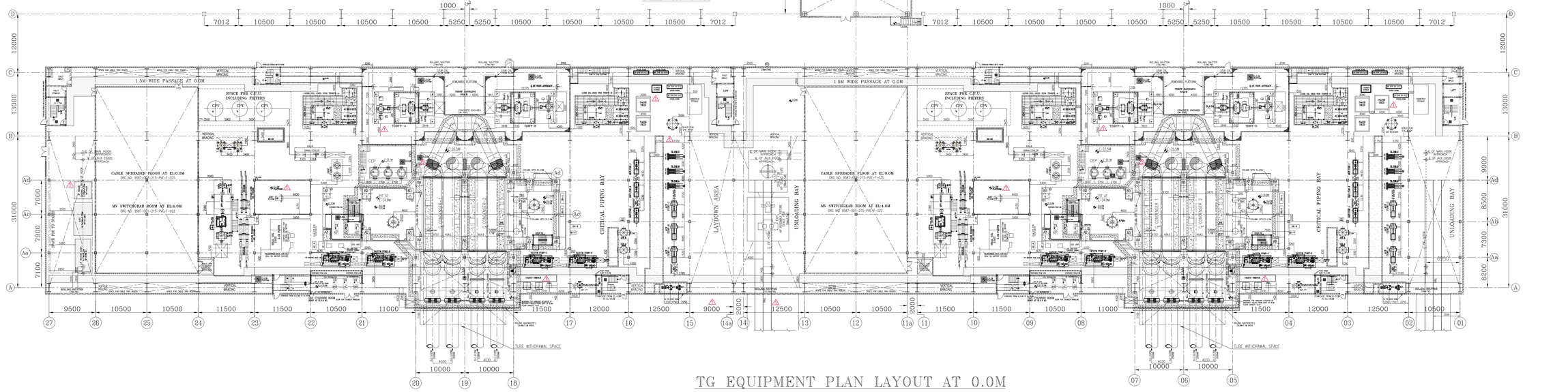
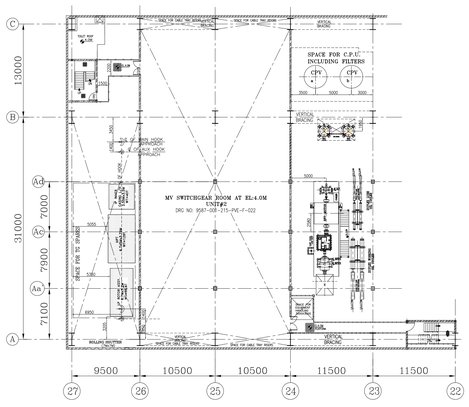
It must not be used directly or indirectly in any way detrimental to the interest of the company./इसका उपयोग प्रत्यक्ष या अप्रत्यक्ष रूप से किसी भी तरीके से कंपनी के हितों के प्रतिकूल नहीं होना चाहिए





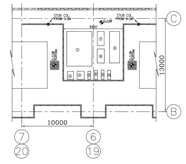




REFERENCE DRGS:				
SL. NO	TITLE	NUMBER	NTPC DRG. NUMBER	UNIT
1	TG EQUIPMENT PLAN AT EL 8.5 M	PE-DG-508-100-M004	9587-001-110-PVM-F-050	PEM
2	TG EQUIPMENT PLAN AT EL18.0 M	PE-DG-508-100-M005	9587-001-110-PVM-F-051	PEM
3	TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS	PE-DG-508-100-M006	9587-001-110-PVM-F-052	PEM
4	T.G. HALL CROSS SECTION	PE-DG-508-100-M007	9587-001-110-PVM-F-053	PEM
5	GA OF UNIT AIR RECEIVER			PEM
6	CONDENSER	0160107007JC238	-	HWR
7	GA OF DRAIN COOLER			HYD
8	GENERAL ARRANGEMENT 1/T/-A			BPL
9	GENERAL ARRANGEMENT 1/T/-B			BPL
10	GENERAL ARRANGEMENT LIFT			BPL
11	FOUNDATION DETAILS OF GENERATOR AUXILIARY EQUIPMENTS			HWR
12	TDBFP AUXILIARY EQUIPMENT FOUNDATIONS			HYD
13	DRIP PUMPS GA			HYD
14	GA OF ACW PUMPS			PEM
15	GA OF TG PHE			PEM
16	GA DMCW PUMP			PEM
17	LEAKAGE OIL TANK AND PUMP			HWR
18	GA WASTE OIL TANK			HWR
19	GA VACUUM PUMPS			HWR
20	EQUIPMENT LAYOUT FOR CPU SV			PEM
21	GA NaOH DOSING SKID			PEM
22	GA AMMONIA DOSING SKID			PEM
23	GA OF OXYGEN DOSING			PEM
24	GA OF GLAND STEAM CONDENSER			HWR
25	GA OF TDBFP			HYD
26	GA OF MDBFP			HYD
27	FOUNDATION ARRG. OF TDBFP			HYD
28	FOUNDATION ARRG. OF MDBFP			HYD

⚠ DETAIL OF LAYDOWN SPACE FOR TDBFP COMPONENTS (HOLD)

S.No.	DESCRIPTION	LENGTH	BREADTH	HEIGHT
(01)	MAXIMUM OF OUTER CASING + EXH. HOOD	3510	4850	4090
(02)	ROTOR	4400	1400	1400
(03)	FRONT BEARING PEDESTAL(UP)	860	1100	370
(04)	REAR BEARING HOUSING(UP)	1000	1120	520
(05)	GUIDE BLADE CARRIER-I (UP)	390	1130	520
(06)	GUIDE BLADE CARRIER-I (LP)	390	1300	620
(07)	GUIDE BLADE CARRIER-II (UP)	960	1970	990
(08)	GUIDE BLADE CARRIER-II (LP)	990	1970	990
(09)	STEAM CHAMBER (UP)	440	1240	620
(10)	STEAM CHAMBER (LP)	440	1240	620



LEGEND

- PIPE HATCH
- VERTICAL BRACING
- FPD — FIRE PROOF DOOR
- GRATING
- CHEQUERED PLATE
- (R) — REMOVABLE
- HAND RAILING
- CABLE TRAY
- FIRE BARRIER WALL
- INDICATES PIPES/CABLE TRESTLE.
- (RS) — ROLLING SHUTTER
- RAIL TRACK
- PIPE TRENCH WITH PCC COVERED SAND FILLED
- BRICK WALL
- BUS DUCT
- WALK WAY
- CONCRETE
- CPB — CHAIN PULLEY BLOCK
- FIRE WALL
- CLADDING

⚠ SPACE FOR FOR MANDATORY SPARES AT 0.0M:-

1. IP INNER CASING LOWER HALF
2. HP TURBINE
3. LP ROTOR ASSEMLY

NOTES:-

1. ALL DIMENSION ARE IN MM AND LEVELS ARE IN METRES.
2. ALL ELEVATION MARKED ARE W.R.T. TG HALL FINISHED FLOOR ELEVATION OF EL 0.0M WHICH CORRESPONDS TO RL 209.50 M.
3. FOR CABLE TRAY/BUS DUCT/TRENCH/SLIT LAYOUT, ELECTRICAL DRAWING TO BE REFERRED.

REV.	DATE	ORIGINATED	CHD	APPD
1.	08.02.24	AA	GSF	SK

1. DRG. REVISED INLINE WITH NTPC COMMENTS RCVD. LETTER NO. CC-ENG-9587-001-110-PVM-F-049 RCVD. DTD. 29/12/2023.
2. REVISION MARKED ⚠

NOTE:- SCAN QR CODE FOR CHECKING THE LATEST REV. STATUS OF DRAWING.

कार्य संख्या-/JOB NO. 508
स्थिति/STATUS CONTRACT
मुद्रण स्केल मीटर में/PRINT SCALE IN METRE

ग्राहक द्वारा संख्या/CUSTOMER DRAWING NO. 9587-001-110-PVM-F-049

ग्राहक/CUSTOMER: एन टी पी सी लिमिटेड N T P C LIMITED

परियोजना/PROJECT: 2x800 मेगावाट लारा सुपर थर्मल पावर परियोजना चरण-II
2x800 MW LARA SUPER THERMAL POWER PROJECT STAGE-II

भारत हेवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD
पावर सेक्टर/POWER SECTOR
परियोजना अभियांत्रिकी प्रबंधन
PROJECT ENGINEERING MANAGEMENT
नोएडा (उ॰प्र॰)/NOIDA (U.P.)

DEPT. CODE: M		नाम NAME	हस्ताक्षर SIGNATURE	दिनांक DATE
	तैयारकर्ता/DRN	ADK/AA	-sd-	12.12.2023
	डिजाइनकर्ता/DESN	GSF	-sd-	12.12.2023
	जांचकर्ता/CHD	PM	-sd-	12.12.2023
	अनुमोदनकर्ता/APPD	BKA	-sd-	12.12.2023

शीर्षक/TITLE: TG EQUIPMENT LAYOUT DRAWING AT 0.0 M

मेकेनिकल MECH.	सिविल CIVIL	इलेक्ट्रिकल ELEC.	एसएमसीई/बीडब्ल्यूएचई S&CE/WSE	पीबंस MAX	विभाग DEPT.	स्केल — SCALE – 1:300
					हस्ताक्षर SIGN	
					दिनांक DATE	

ड्राईंग संख्या/DRAWING NO. PE-DG-508-100-M003

शीट/SHEET 1 OF 1 — पुनरीक्षण/REV. 01

ELECTRONIC FILE NAME : 9587-001-110-PVM-F-049-01

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it must not be used directly or indirectly in any detrimental to the interest of the company/इसका उपयोग प्रत्यक्ष अथवा अप्रत्यक्ष रूप से कंपनी के हितों के प्रतिकूल नहीं होना चाहिये

ELECTRONIC FILE NAME : 9587-001-110-PVM-F-050-01

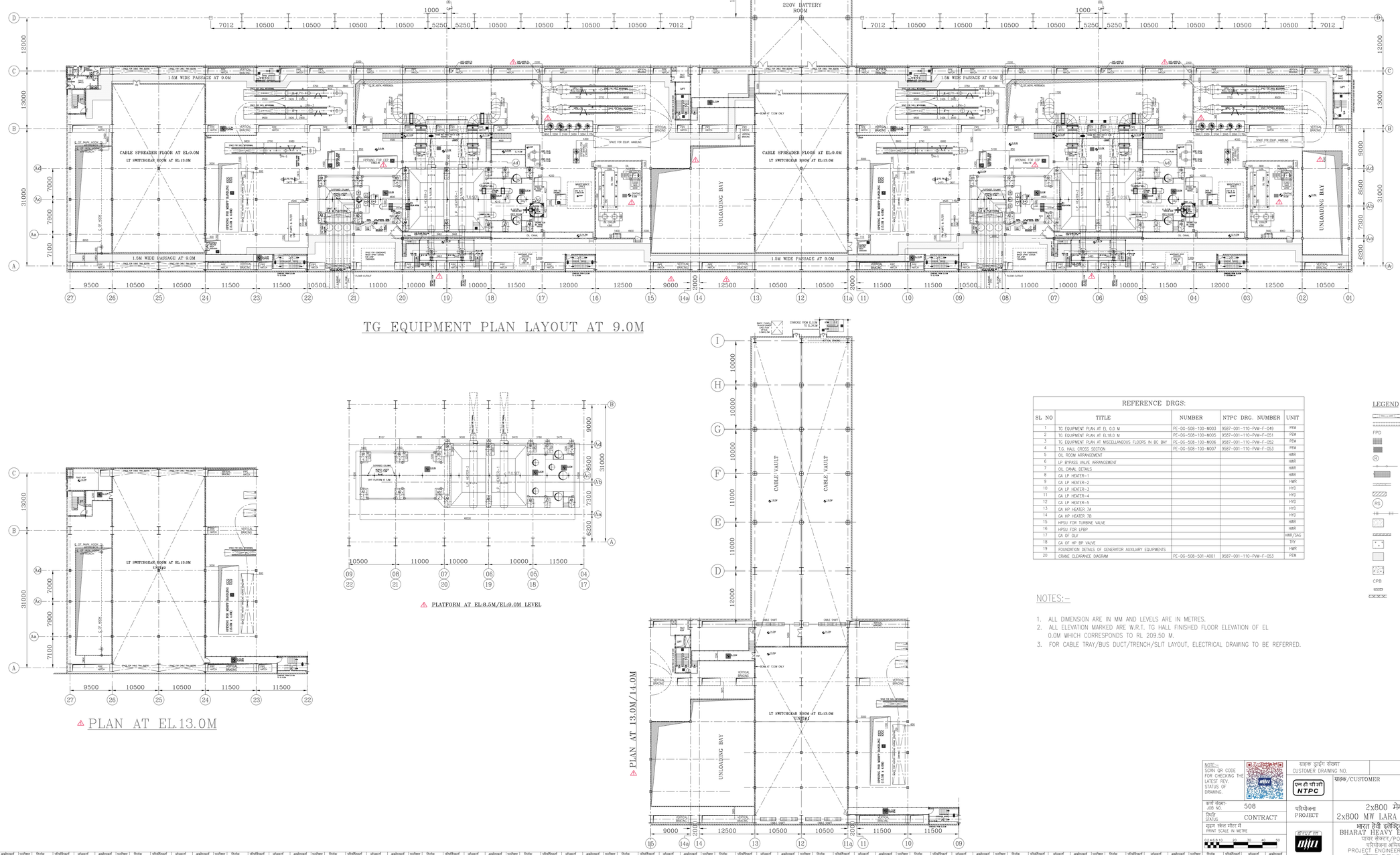
ड्राफ्ट रेफरेंस/DRAWING NO. PE-DG-508-100-M004

फर्स्ट एंगल प्रोजेक्शन/FIRST ANGLE PROJECTION

सभी माप मि॰ मी॰ मे है/ALL DIMENSIONS ARE IN MM

NORTH

TG EQUIPMENT PLAN LAYOUT AT 9.0M



⚠ PLATFORM AT EL:8.5M/EL:9.0M LEVEL

⚠ PLAN AT EL.13.0M

⚠ PLAN AT 13.0M/14.0M

REFERENCE DRGS:				
SL NO	TITLE	NUMBER	NTPC DRG. NUMBER	UNIT
1	TG EQUIPMENT PLAN AT EL 0.0 M	PE-DG-508-100-M003	9587-001-110-PVM-F-049	PEM
2	TG EQUIPMENT PLAN AT EL18.0 M	PE-DG-508-100-M005	9587-001-110-PVM-F-051	PEM
3	TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS IN BC BAY	PE-DG-508-100-M006	9587-001-110-PVM-F-052	PEM
4	T.G. HALL CROSS SECTION	PE-DG-508-100-M007	9587-001-110-PVM-F-053	PEM
5	OIL ROOM ARRANGEMENT			HWR
6	LP BYPASS VALVE ARRANGEMENT			HWR
7	OIL CANAL DETAILS			HWR
8	GA LP HEATER-1			HWR
9	GA LP HEATER-2			HWR
10	GA LP HEATER-3			HYD
11	GA LP HEATER-4			HYD
12	GA LP HEATER-5			HYD
13	GA HP HEATER 7A			HYD
14	GA HP HEATER 7B			HYD
15	HPSU FOR TURBINE VALVE			HWR
16	HPSU FOR LPRP			HWR
17	GA OF OLV			HWR/SAG
18	GA OF HP BP VALVE			TRY
19	FOUNDATION DETAILS OF GENERATOR AUXILIARY EQUIPMENTS			HWR
20	CRANE CLEARANCE DIAGRAM	PE-DG-508-501-A001	9587-001-110-PVM-F-053	PEM

LEGEND

PIPE HATCH
VERTICAL BRACING
FPD FIRE PROOF DOOR
GRATING
CHEQUERED PLATE
(R) REMOVABLE
HAND RAILING
CABLE TRAY
FIRE BARRIER WALL
INDICATES PIPES/CABLE TRESTLE.
(es) ROLLING SHUTTER
RAIL TRACK
PIPE TRENCH WITH PCC COVERED SAND FILLED
BRICK WALL
BUS DUCT
WALK WAY
CONCRETE
CPB CHAIN PULLEY BLOCK
FIRE WALL
CLADDING

NOTES:-

1. ALL DIMENSION ARE IN MM AND LEVELS ARE IN METRES.
2. ALL ELEVATION MARKED ARE W.R.T. TG HALL FINISHED FLOOR ELEVATION OF EL 0.0M WHICH CORRESPONDS TO RL 209.50 M.
3. FOR CABLE TRAY/BUS DUCT/TRENCH/SLIT LAYOUT, ELECTRICAL DRAWING TO BE REFERRED.

NOTE:- SCAN QR CODE FOR CHECKING THE LATEST REV. STATUS OF DRAWING.

कार्य संख्या/JOB NO. 508
स्थिति/STATUS CONTRACT
मुद्रण स्केल मीटर में/PRINT SCALE IN METRE
0 2 4 6 8 10 20 30 40 50

संशोधन/REVISION	दिनांक/DATE	परिवर्तित/ALTD	जांचकर्ता/CHD	अनुमोदनकर्ता/APPD
1.	08.02.24	AK	GSF	SK

1. DRG. REVISED INLINE WITH NTPC COMMENTS RCVD. LETTER NO. CC-ENGG-9587-001-110-PVM-F-049 RCVD. DTD. 29/12/2023.
2. REVISION MARKED ⚠

ग्राहक ड्राइंग संख्या/CUSTOMER DRAWING NO. 9587-001-110-PVM-F-050

ग्राहक/CUSTOMER: एन टी पी सी लिमिटेड / N T P C LIMITED

परियोजना/PROJECT: 2x800 मेगावाट लारा सुपर थर्मल पावर परियोजना चरण-II / 2x800 MW LARA SUPER THERMAL POWER PROJECT STAGE-II

भारत हैवी इलेक्ट्रिकल्स लिमिटेड / BHARAT HEAVY ELECTRICALS LTD
पावर सेक्टर/POWER SECTOR
परियोजना अभियांत्रिकी प्रबंधन / PROJECT ENGINEERING MANAGEMENT
नोएडा (उ॰प्र॰)/NOIDA (U.P.)

	नाम/NAME	हस्ताक्षर/SIGNATURE	दिनांक/DATE
तैयारकर्ता/DSN	ADK/AA	-sd-	12.12.2023
डीजाइनकर्ता/DESN	GSF	-sd-	12.12.2023
जांचकर्ता/CHD	PM	-sd-	12.12.2023
अनुमोदनकर्ता/APPD	BKA	-sd-	12.12.2023

DEPT CODE: M

शीर्षक/TITLE: TG EQUIPMENT LAYOUT DRAWING AT MEZZANINE FLOOR 9.0M

एमपीएल/MPL	सिविल/CIVIL	इलेक्ट्रिकल/ELEC	स्ट्रक्चरल/S&CE	वीएसई/VSE	मैक्स/MAX

डिज़ाइन/DEPT. | स्केल/SCALE – 1:325 | हस्ताक्षर/SIGN | दिनांक/DATE

ड्राइंग संख्या / DRAWING NO. PE-DG-508-100-M004

शीट/SHEET 1 OF 1 | पुनरीक्षण/REV. 01

फॉर्मेट/FORMAT A0

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ELECTRONIC FILE NAME : 9587-001-110-PVM-F-051-01

NORTH

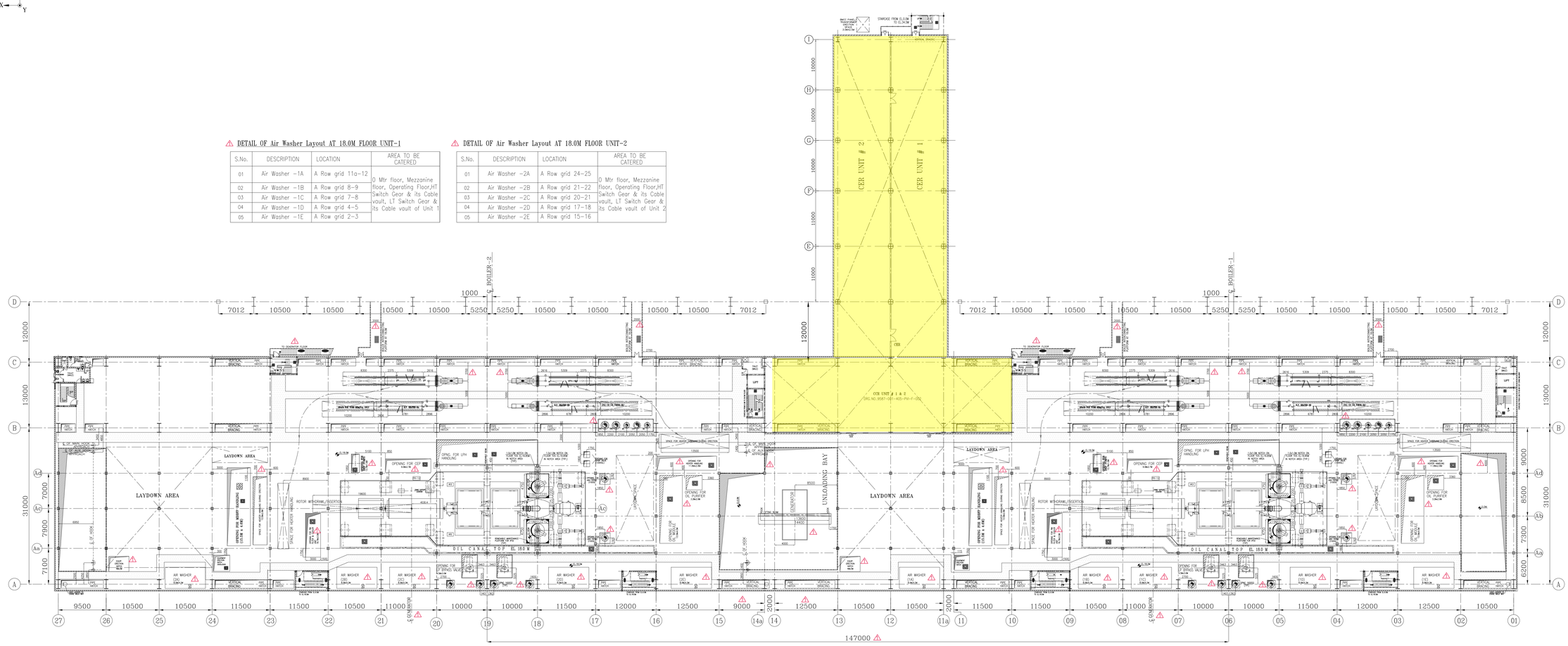
Z
X Y

⚠ DETAIL OF Air Washer Layout AT 18.0M FLOOR UNIT-1

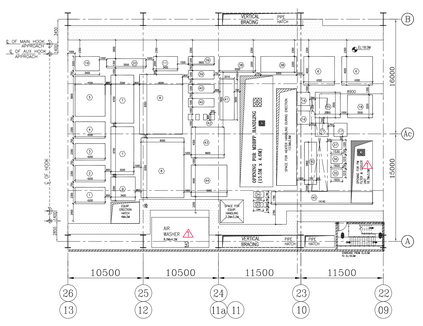
S.No.	DESCRIPTION	LOCATION	AREA TO BE CATERED
01	Air Washer -1A	A Row grid 11a-12	0 Mtr floor, Mezzanine floor, Operating Floor,HT Switch Gear & its Cable vault, LT Switch Gear & its Cable vault of Unit 1
02	Air Washer -1B	A Row grid 8-9	
03	Air Washer -1C	A Row grid 7-8	
04	Air Washer -1D	A Row grid 4-5	
05	Air Washer -1E	A Row grid 2-3	

⚠ DETAIL OF Air Washer Layout AT 18.0M FLOOR UNIT-2

S.No.	DESCRIPTION	LOCATION	AREA TO BE CATERED
01	Air Washer -2A	A Row grid 24-25	0 Mtr floor, Mezzanine floor, Operating Floor,HT Switch Gear & its Cable vault, LT Switch Gear & its Cable vault of Unit 2
02	Air Washer -2B	A Row grid 21-22	
03	Air Washer -2C	A Row grid 20-21	
04	Air Washer -2D	A Row grid 17-18	
05	Air Washer -2E	A Row grid 15-16	



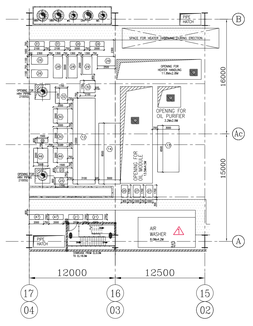
TG EQUIPMENT PLAN LAYOUT AT 18.0M



⚠ LAYDOWN SPACE FOR TURBINE & GENERATOR COMPONENTS

DETAIL OF LAY-DOWN SPACE FOR TG COMPONENTS (HOLD)

S.No	DESCRIPTION	WT IN (T)	AREA M x M
(01)	ASSEMBLY OF GUIDE BLADE CARRIER (UPPER PART LEFT)	4.43	4.2x2.3
(02)	ASSEMBLY OF GUIDE BLADE CARRIER (UPPER PART RIGHT)	4.43	4.2x2.3
(03)	ASSEMBLY OF GUIDE BLADE CARRIER (UPPER PART LEFT)	4.43	4.2x2.3
(04)	ASSEMBLY OF GUIDE BLADE CARRIER (UPPER PART RIGHT)	4.43	4.2x2.3
(05)	IP OUTER CASING (U/H)	42	5.6x4.2
(06)	LP INNER CASING (U/H) 2NOS.	20	4.0x4.3
(07)	LP SHAFT 2NOS.	56.6	6.7x3.2
(08)	LP OUTER CASING 2NOS.	30	6.0x8.35
(09)	HP OUTER CASING - EXHAUST PART	27	3.4x3.3
(10)	IP SHAFT	32	5.9x1.7
(11)	HP INNER CASING (U/H)	18	3.4x2.0
(12)	CROSS OVER PIPE (PART-1)	32	12.0x3.1
(13)	CROSS OVER PIPE (PART-2)	22	6.5x3.0
(14)	LIFTING BEAM	8	8.5x3
(15)	IP INNER CASING (L/H)	40	3.55x3.5
(16)	LPSSC (U/H) (TE) 2 NOS.	0.8	1.85x1.85
(17)	LPSSC (U/H) (GE) 2 NOS.	0.8	1.85x1.85
(18)	IP INNER CASING (U/H)	24	3.5x3.2
(19)	HP INNER CASING (L/H)	18	3.4x2.0
(20)	HP SHAFT	20	5.5x1.3
(21)	LP BYPASS CONTROL VALVE ACTUATOR 2NOS.	0.5	2x0.7
(22)	OVERLOAD CONTROL VALVE	0.8	1.5x0.6
(23)	OVERLOAD CONTROL VALVE ACTUATOR	0.8	1.5x0.6
(24)	IP CONTROL VALVE ACTUATOR 2NOS.	1.6	2.0x0.7
(25)	HP STOP VALVE ACTUATOR 2NOS.	1.5	1.7x0.9
(26)	HP CONTROL VALVE 2NOS.	3	2.3x1.1
(27)	HP CONTROL VALVE ACTUATOR 2NOS.	2	1.7x1
(28)	IP CONTROL VALVE 2NOS.	6.5	3.0x1.3
(29)	HP STOP VALVE 2NOS.	4.5	2.5x1.3
(30)	LP BYPASS CONTROL VALVE 2NOS.	2.5	2.0x2.0
(31)	IP STOP VALVE ACTUATOR 2NOS.	1.4	2.1x0.7
(32)	IP STOP VALVE 2NOS.	7	2.1x1.7
(33)	PEDESTAL COVER - HP FRONT	0.6	1.344x0.62
(34)	PEDESTAL COVER - HP-IP	1	1.45x0.79
(35)	PEDESTAL COVER - IP-LP	1.4	1.6x1.215
(36)	PEDESTAL COVER - LP-GEN	1.4	1.6x1.215
(37)	PEDESTAL COVER - LP-LP	1.4	1.32x1.53
(38)	H2 COOLERS 2NOS.	5	5.0x2.2
(39)	END SHIELD (EE) 2NOS. (U/H) & (L/H)	8/9	3.6x1.2
(40)	END SHIELD (TE) 2NOS. (U/H) & (L/H)	8/9	3.6x1.2
(41)	EXCITER	35	5.65x2.01
(42)	BEARING SHELLS 4NOS.	0.5	0.5x0.8
(43)	EXCITER HOUSING	3.5	4.6x4.3
(44)	H2 COOLER HOUSING	21	5.0x4.4
(45)	GENERATOR ROTOR WITH BASE FRAME	86	14.140x1.79
(46)	LP BYPASS STOP VALVE 2NOS.	2.5	2.0x2.0
(47)	LP BYPASS STOP VALVE ACTUATOR 2NOS.	0.5	2x0.7



⚠ LAYDOWN SPACE FOR TURBINE & GENERATOR COMPONENTS

REFERENCE DRGS:				
SL. NO	TITLE	DRG. NUMBER	NTPC DRG. NUMBER	UNIT
1	TG EQUIPMENT PLAN AT EL 0.0 M	PE-DG-508-100-M003	9587-001-110-PVM-F-049	PEM
2	TG EQUIPMENT PLAN AT EL 8.5 M	PE-DG-508-100-M004	9587-001-110-PVM-F-050	PEM
3	TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS IN BC BAY	PE-DG-508-100-M006	9587-001-110-PVM-F-052	PEM
4	T.G. HALL CROSS SECTION	PE-DG-508-100-M007	9587-001-110-PVM-F-053	PEM
5	GA HP HEATER 8A			HYD
6	GA HP HEATER 8B			HYD
7	GA HP HEATER 9A			HYD
8	GA HP HEATER 9B			HYD
9	TG DECK FOUNDATION PLAN			HWR
10	LAYDOWN SPACE OF STEAM TURBINE COMPONENTS			HWR
11	OIL CANAL DETAILS			HWR
12	LAYDOWN SPACE OF GENERATOR COMPONENTS			HWR

⚠ SPACE FOR MANDATORY SPARES AT 18M:-

1. IP INNER CASING UPPER HALF
2. EXCITER
3. IP ROTOR
4. BFPDT ROTOR
5. GENERATOR ROTOR
6. BFP MOTOR.

LEGEND

- PIPE HATCH
- VERTICAL BRACING
- FPD — FIRE PROOF DOOR
- GRATING
- CHEQUERED PLATE
- (R) — REMOVABLE
- HAND RAILING
- CABLE TRAY
- FIRE BARRIER WALL
- (RS) — ROLLING SHUTTER
- RAIL TRACK
- PIPE TRENCH WITH PCC COVERED SAND FILLED
- BRICK WALL
- BUS DUCT
- WALK WAY
- CONCRETE
- CPB — CHAIN PULLEY BLOCK
- FIRE WALL
- CLADDING

NOTES:-

1. ALL DIMENSION ARE IN MM AND LEVELS ARE IN METRES.
2. ALL ELEVATION MARKED ARE W.R.T. TG HALL FINISHED FLOOR ELEVATION OF EL 0.0M WHICH CORRESPONDS TO RL 209.50 M.
3. FOR CABLE TRAY/BUS DUCT/TRENCH/SLIT LAYOUT, ELECTRICAL DRAWING TO BE REFERRED.

| REVISION HISTORY | | | |

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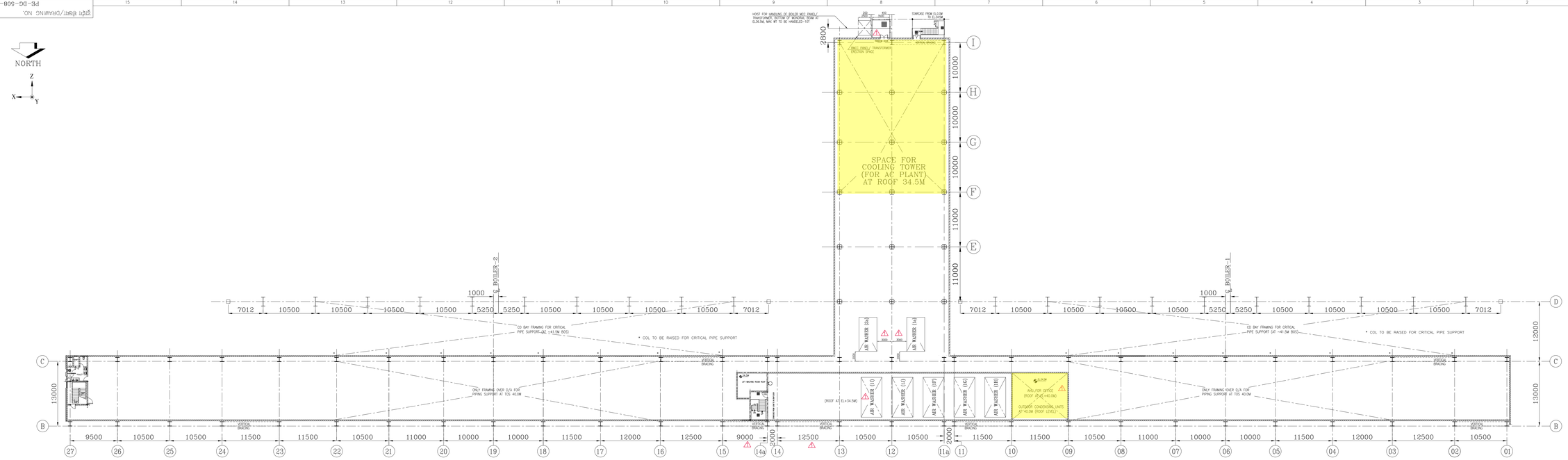
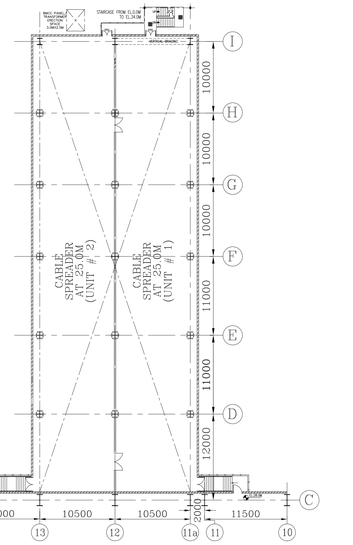
it must not be used directly or indirectly in any way detrimental to the interest of the company/इसका प्रयोग प्रत्यक्ष या अप्रत्यक्ष रूप से कंपनी के हितों के प्रतिकूल नहीं होना चाहिए

ELECTRONIC FILE NAME : 9587-001-110-PVM-F-052-01



TG EQUIPMENT PLAN LAYOUT AT 34.5M/40.0M



⚠ DETAIL OF Air Washer Layout AT 34.5 M FLOOR UNIT-1

S.No.	DESCRIPTION	LOCATION	AREA TO BE CATERED
01	Air Washer -1J	BC Bay grid 11a-12	0 Mtr floor, Mezzanine floor, Operating Floor of Unit 1
02	Air Washer -1F	BC Bay grid 11a-12	
03	Air Washer -1G	BC Bay grid 10-11	
04	Air Washer -1H	BC Bay grid 10-11	
05	Air Washer -1I	BC Bay grid 12-13	

⚠ DETAIL OF Air Washer Layout AT 28.0 M FLOOR UNIT-2

S.No.	DESCRIPTION	LOCATION	AREA TO BE CATERED
01	Air Washer -2J	BC Bay grid 24-25	0 Mtr floor, Mezzanine floor, Operating Floor of Unit 2
02	Air Washer -2F	BC Bay grid 23-24	
03	Air Washer -2G	BC Bay grid 23-24	
04	Air Washer -2H	BC Bay grid 22-23	
05	Air Washer -2I	BC Bay grid 22-23	

⚠ DETAIL OF Air Washer Layout AT 34.5 M FLOOR UNIT-1

S.No.	DESCRIPTION	LOCATION	AREA TO BE CATERED
01	Air Washer -1a	CD Bay grid 11a-12	Boiler MCC & its Cable vault, CCR cable vault, UPS cable vault of Unit 1

⚠ DETAIL OF Air Washer Layout AT 34.5 M FLOOR UNIT-2

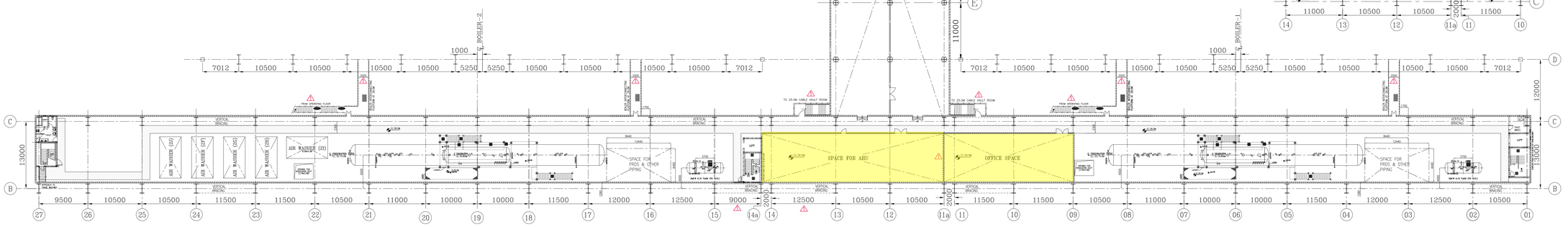
S.No.	DESCRIPTION	LOCATION	AREA TO BE CATERED
01	Air Washer -2a	CD Bay grid 12-13	Boiler MCC & its Cable vault, CCR cable vault, UPS cable vault of Unit 2

LEGEND

PIPE HATCH
VERTICAL BRACING
FPD FIRE PROOF DOOR
GRATING
CHEQUERED PLATE
(R) REMOVABLE
HAND RAILING
CABLE TRAY
FIRE BARRIER WALL
INDICATES PIPES/CABLE TRESTLE.
(RS) ROLLING SHUTTER
RAIL TRACK
PIPE TRENCH WITH PCC COVERED SAND FILLED
BRICK WALL
BUS DUCT
WALK WAY
CONCRETE
CPB CHAIN PULLEY BLOCK
FIRE WALL
CLADDING

REFERENCE DRAWINGS:

SL NO	TITLE	DRG. NUMBER	NTPC DRG. NUMBER	UNIT
1	TG EQUIPMENT PLAN AT EL 0.0 M	PE-DG-508-100-M003	9587-001-110-PVM-F-049	PEM
2	TG EQUIPMENT PLAN AT EL 8.5 M	PE-DG-508-100-M004	9587-001-110-PVM-F-050	PEM
3	TG EQUIPMENT PLAN AT 18.0 M	PE-DG-508-100-M005	9587-001-110-PVM-F-051	PEM
4	T.G. HALL CROSS SECTION	PE-DG-508-100-M007	9587-001-110-PVM-F-053	PEM
5	GA OF DEAERATOR	HY-DG-1-26310-04301	9587-001-110-PVM-B-040	HYD
6	GA OF DMCW TANK			BPL
7	GA D/A PLATFORM			HYD



TG EQUIPMENT PLAN LAYOUT AT 28.0M/28.5M

NOTES:-

1. ALL DIMENSION ARE IN MM AND LEVELS ARE IN METRES.
2. ALL ELEVATION MARKED ARE W.R.T. TG HALL FINISHED FLOOR ELEVATION OF EL 0.0M WHICH CORRESPONDS TO RL 209.50 M.
3. FOR CABLE TRAY/BUS DUCT/TRENCH/SLIT LAYOUT, ELECTRICAL DRAWING TO BE REFERRED.

NOTE:- SCAN QR CODE FOR CHECKING THE LATEST REV. STATUS OF DRAWING.		ग्राहक ड्राईंग संख्या CUSTOMER DRAWING NO.	9587-001-110-PVM-F-052
कार्य संख्या JOB NO.	508	ग्राहक/CUSTOMER	एन टी पी सी लिमिटेड N T P C LIMITED
स्थिति STATUS	CONTRACT	परियोजना PROJECT	2x800 मेगावाट लारा सुपर थर्मल पावर परियोजना चरण-II 2x800 MW LARA SUPER THERMAL POWER PROJECT STAGE-II
मुद्रण स्केल मीटर में PRINT SCALE IN METRE	0 2 4 6 8 10 20 30 40 50	भारत हैवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD पावर सेक्टर/POWER SECTOR परियोजना अभियांत्रिकी प्रबंधन PROJECT ENGINEERING MANAGEMENT नोएडा (उ॰प्र॰)/NOIDA (U.P.)	DEPT. CODE M

	नाम NAME	हस्ताक्षर SIGNATURE	दिनांक DATE
तैयारकर्ता/DRN	ADK/AA	-sd-	12.12.2023
डीज़ाइनकर्ता/DESN	GSF	-sd-	12.12.2023
जांचकर्ता/CHD	PM	-sd-	12.12.2023
अनुमोदनकर्ता/APPD	BKA	-sd-	12.12.2023

REV.	DATE	DESCRIPTION	ALTD	CHD	APPD
1.	08.02.24	AA	GSF		SK
1.	DRG. REVISED INLINE WITH NTPC COMMENTS RCVD. LETTER NO. CC-ENGG-9587-001-110-PVM-F-049 RCVD. DTD. 29/12/2023.				
2.	REVISION MARKED ⚠				

शीर्षक/TITLE

TG EQUIPMENT PLAN AT UPPER FLOORS IN B-C BAY

उपकरीपरा MPL	सिविल CIVIL	इलेक्ट्रिकल ELEC	स्ट्रक्चरल/सीईडब्ल्यूएस S&/CE	वीएसई VSE	मैक्स MAX	डिपार्ट DEPT.	स्केल – SCALE– 1:300
						हस्ताक्षर SIGN दिनांक DATE	

ड्राईंग संख्या / DRAWING NO.
PE-DG-508-100-M006

शीट SHEET 1 OF 1 पुनरीक्षण REV. 01

फॉर्मेट FORMAT A0

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ELECTRONIC FILE NAME : 9587-001-301-POC-F-001-02p.dwg

PLANT NORTH

WIND ROSE

LIST OF BUILDING/EQUIPMENT SHOWN

NO	DESCRIPTION
1	SWITCHYARD
2	TRANSFORMER YARD
3	POWER HOUSE BUILDING
4	BOILER
5	MILL BAY
6	ELECTROSTATIC PRECIPITATOR
7	CHIMNEY
8	COAL STOCK YARD
9	FLY ASH CLASSIFIER HOPPER INCLUDING CLASSIFIER SILO
10	CHP MCC-3
11	PT PLANT
12	D.M. PLANT(RO/CONVENTIONAL)
13	D.M. WATER TANKS & PUMP HOUSE
14	SEWAGE TREATMENT PLANT
15	EFFLUENT TREATMENT PLANT
16	CW TREATMENT
17	F.O.P.H.
18	O&M STORES
19	COOLING TOWER
20	C.W. PUMP HOUSE
21	CLO2 SYSTEM (PT & CW)
22	COMPRESSOR HOUSE
23	FLY ASH SILO / ASH DESPATCH AREA
24	DG SET
25	ESP CUM FGD CONTROL ROOM
26	CONDENSATE STORAGE TANK
27	ASH COMPRESSOR HOUSE
28	CHEMICAL HOUSE-PT PLANT
29	SWITCHYARD CONTROL ROOM
30	ASH WATER TANK/ PUMP HOUSE
31	SAFETY CONTROL ROOM
32	CLARIFIED WATER TANK & PUMP HOUSE
33	SERVICE WATER TANK & PUMP HOUSE
34	ELECTRICAL LAB
35	PIPE CUM CABLE RACK
36	FIRE WATER BOOSTER PUMP HOUSE
37	CPU REGENERATION AREA
38	ASH SLURRY PUMP HOUSE
39	COAL SLURRY SETTLING POND
40	WATER SYSTEM CONTROL ROOM & ANNEX.
41	CHP DS PUMP HOUSE
42	AHP MCC
43	LHP GHP MCC (COMMON FGD)
44	CHP MCC-2 CUM CONTROL ROOM
45	HCSD CUM SILO UTILITY BUILDING
46	FQA LAB
47	DOZER SHED
48	CRUSHER HOUSE
49	GYPSUM DEWATERING BILDING
50	BALL MILL BUILDING
51	CHP MCC-1
52	RAW WATER PUMP HOUSE & MCC
53	NON BIO-DEGRADABLE WASTE
54	CSSP CLASSIFIERS (CHP-WTP)

NOTES:-

1. ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METERS UNLESS STATED OTHERWISE.
2. FINISH FLOOR LEVEL = RL (+)209.50 M, CORRESPONDS TO PLANT EL 0.0M (GROUND FLOOR OF TG BUILDING)
3. THE CHAIN LINK FENCING OF HEIGHT 3.0M TO BE PROVIDED FOR ISOLATION OF STAGE-I AREA. 5M HEIGHT FENCING WITH G.I. SHEET NEAR STAGE-I COOLING TOWER IS ALSO TO BE PROVIDED.

REFERENCE DRG:

SL No.	TITLE	DRG. NUMBER	SCOPE
1.	REFERENCE PLOT PLAN	9587-999-POC-F-001	NTPC

LEGEND:

1. ROADS (DOUBLE LINE)
2. ROADS (SINGLE LINE)
3. BOUNDARY WALL
4. FENCING
5. RAILWAY LINE
6. FACILITIES/ BUILDINGS OF STAGE-I
7. WATCH TOWER
8. FORMATION LEVEL
9. LAND ACQUISITION LINE
10. FACILITIES/ BUILDINGS OF STAGE-II
11. FENCING FOR STAGE-II
12. STAGE-II GREEN BELT (TOTAL AREA = 100 ACRES)
13. HIGH LIGHTING MAST (SM-01 TO SM-15)
14. PSS (POWER SUB STATION, PS-01 TO PS-12)

PROGRESSIVE COPY DTD 20.02.2024

01	09.02.24	VKS/AA	GSF/SK	BKA	
1.	DRG. REVISED INLINE WITH NTPC COMMENTS RCVD. LETTER NO: CC-ENG-9587-001-301-POC-F-001 RCVD. DTD. 13/12/2023.				

NOTE:- SCAN QR CODE FOR CHECKING THE LATEST REV. STATUS OF DRAWING.

ग्राहक द्वारा संख्या CUSTOMER DRAWING NO. 9587-001-301-POC-F-001

ग्राहक/CUSTOMER: एन टी पी सी लिमिटेड N T P C LIMITED

कार्य संख्या- JOB NO. 50B

स्थिति STATUS: CONTRACT

परियोजना PROJECT: 2x800 मेजावां लारा सुपर थर्मल पावर परियोजना चरण-II 2x800 MW LARA SUPER THERMAL POWER PROJECT STAGE-II

मुद्रण स्केल मीटर में PRINT SCALE IN METRE: 0 5 10 15 20 25

भारत हेवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD पावर सेक्टर/POWER SECTOR परियोजना अभियांत्रिकी प्रबंधन PROJECT ENGINEERING MANAGEMENT नोएडा (उ.प्र.)/NOIDA (U.P.)

DEPT CODE: M

	नाम NAME	हस्ताक्षर SIGNATURE	दिनांक DATE
तैयारकर्ता/DRN	VKS/AA		Sd/- 21-11-23
डिजाइनकर्ता/DCN	GSF		Sd/- 21-11-23
जाँचकर्ता/CHD	PM		Sd/- 21-11-23
अनुमोदनकर्ता/APPD	BKA		Sd/- 21-11-23

शीर्षक/TITLE: PLOT PLAN

एमपीएल MPL	सिविल CIVIL	इलेक्ट्रिकल ELEC	एसएंडसी S&CE	डब्ल्यूएसई WSE	मैक्स MAX	विभाग DEPT.	स्केल SCALE –

हस्ताक्षर SIGN | दिनांक DATE

ड्राइंग संख्या / DRAWING NO. PE-DG-508-100-M001

शीट SHEET 01 OF 01 पुनरीक्षण REV. 02p

प्रारूप आकार AD FORMAT SIZE A0

	TECHNICAL SPECIFICATION 2X800 MW LARA TPP STAGE II AIR CONDITIONING SYSTEM	PE-TS-508-553-A001 Rev. No. 00 Date : FEB 2024

THERMAL INSULATION

	Insulation Material	Code	Thermal conductivity ($w/m/^oc$	Density Kg/m3
1	Resin bonded glass wool	IS:8183	0.049 at 50oC 0.043 at 50oC	i) 24 (For Glass wool) ii) 48 (For Rockwool) iii) 48(For acoustic insulation)
2	Mineral wool pipe section. Min.Gr.2	IS:9842	0.043 at 50oC	144
3	Closed Cell Elastomeric Nitrile Rubber		0.036 at 20oC	40 – 60
4	Polyurethane Foam		0.03 at 50 oC	34 + 2
5	Polyisocyanurate Foam	IS12436	0.03 at 50 oC	34 + 2
6	All insilation shall be CFC/HCFC free			

THERMAL INSULATION TYPE AND FINISH FOR DIFFERENT APPLICATION

	Surface	Insulation Material	Insulation Form	Thick (mm) / Finish
1	Supply & return air duct of AC System	Resin bonded glass wool or	Roll / Slab	50 / F-3
		Closed Cell Elastomeric Nitrile Rubber	sheet	19 / As per manufacturer std.
		Or Polyisocyanurate Foam	Slab	30/F-3
2	Refrigerant (Suction and liquid lines)	Closed Cell Elastomeric Nitrile Rubber	tube	19 / As per manufacturer std.
		Or Rigid Polyurethane Foam	Pipe Section	50 / F-1 (a)
3	AHU drain pipe	Closed Cell Elastomeric Nitrile Rubber	tube	19 / As per manufacturer std.
		or Rigid Polyurethane Foam	Pipe Section	50 / F-1 (a)
4	AHU condensate pan (insulation if required)	Mineral wool or resin bonded glass wool	Slab	25 / As per manufacturer std.
5	Chilled water piping, valves & specialties	Resin bonded Mineral wool or resin bonded glass wool	Pipe section	75 / F-1/F-3

		or Rigid Polyurethane Foam	Pipe section	50/F-3
6	Chiller (insulation if required)	As per manufacturer std		
7	Chilled water pumps	Resin bonded Rockwool wool or resin bonded glass wool	Slab	75 / F-1/F-3
		or Rigid Polyurethane Foam	Slab	50/F-3
8	Expansion tank with associated piping	Resin bonded Rockwool wool or resin bonded glass wool	Slab/ Pipe section	75 / F-1/F-3
		or Rigid Polyurethane Foam	Slab	50/F-3
9	Acoustic insulation of duct	Resin bonded Glass wool	Slab	25 / All ducts up to a distance of 5 meters from AHU , Air washer
10	Exposed air duct	Resin bonded Glass wool/Rockwool	Roll/Slab	50 / F-4
		or Polyisocyanurate Foam	Slab	F-4 (a)
DETAILS FOR FINISH OF THERMAL INSULATION				
a)	Finish F-1 (with Resin Bonded Glass Wool/Resin Bonded Mineral Wool)			
	Step-1	Wrapping of Poly-Bonded Hessain (PBH – to act as vapour seal) on outer surface of insulation with 50 mm overlap stitching and sealing of overlap with synthetic adhesive like CPRX or Equivalent compound.		
	Step-2	The surface then shall be wrapped with 19 mm mesh 24 SWG GI wire netting, butting all the joints and laced down with 22 SWG lacing wire.		
	Step-3	Sand cement (4:1) plaster shall be applied in two layers totalling to 12.5 mm thick, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application		
aa)	Finish F-1(a) (With Polyurethane Foam & Polyisocyanurate Foam)			
		Wrapping of two layers of 7 mil 10 x 10 mesh glass cloth dipped in suitable adhesive such as SR 998 or Loid Bond 130 equivalent		
b)	Finish F-2			
	Step-1	Insulation shall be covered with 500g polythene with 50mm overlap and sealing of overlap with synthetic adhesive like CPRX/ Loid Bond 83 or Equivalent compound.		

	Step-2	Same as Step-2 of Finish F-1 above.
	Step-3	Same as Step-3 of Finish F-1 above.
c)	Finish F-3	
	Step-1	Same as Step-1 of Finish F-2 above
	Step-2	The polythene shall be covered with 26 gauge Aluminium sheet and locking of joints with self-locking screws at a pitch of minimum 100 mm.
d)	Finish F-4	
	Step-1	Same as Step-1 of Finish F-1 above.
	Step-2	Same as Step-2 of Finish F-1 above.
	Step-3	Same as Step-3 of Finish F-1 above.
	Step-4	Application of 3 mm thick coat of suitable water proofing compound and wrapped with fibre glass RP tissue followed by final coat of 3 mm thick water proofing compound over the RP tissue.
	Step-5	After the above treatment, 22G Aluminium sheet cladding, properly stiched at all joints shall be provided over the external surface
dd)	Finish F-4(a) (With FR Closed Cell Chemically Cross Linked Polyethylene)	
		Application of aluminium sheet 22G cladding to be provided over the XLPE insulating material. Cladding sheet is held in position with SDST screws @ 150 mm C/c over tongue-in-groove joints applied with a felt for sealing joint against water ingress. All sheet joints to be done in a manner to shed water.

	DETAILS FOR APPLICATION OF THERMAL INSULATION
1	**Application with Glass Wool**
a)	All surfaces to be insulated both thermally and acoustically shall be thoroughly cleaned, dried and an adhesive (CPRX compound of Shalimar Tar Products or Equivalent) be applied @ 1.5 Kg /Sqm on the surface.
b)	Insulation material (either expanded polystyrene foam or Glass Wool/ Glass fiber or Equivalent) shall be struck to the surface. All the joints shall be sealed with bitumen.
c)	Insulation mass to be covered with 500 gauge polythene sheet with 50 mm overlaps and sealing all joints on hot side
d)	Insulation Finish of types specified under shall be provided thereafter.
2	**Application with Nitrile Rubber:**
a)	All surfaces to be insulated shall be properly cleaned.
b)	A suitable adhesive such as SR 998 or equivalent shall be applied over the surfaces to be insulated and insulation material surfaces.
c)	Insulating material shall than be pasted onto the surfaces in a manner to avoid stretching and any air entrapment within.
d)	Two layers of Glass Cloth with a suitable adhesive as SR 998 or equivalent shall be then applied over the insulating material to avoid surface weathering.
3	**Application with Polyurethane Foam & Polyisocyanurate Foam**
a)	All surfaces to be insulated shall be cleaned.
b)	A suitable adhesive such as CPRX or Loid Bond 83 or equivalent shall be applied over the surface to be insulated and insulation material surfaces
c)	Insulating material with aluminum foil lamination shall then be pasted onto the surface in a manner to avoid stretching and any air entrapment within.
d)	Two layers of Glass Cloth with a suitable adhesive as Loid Bond 130 shall be then applied over the insulating material, to avoid surface weathering.
e)	Insulation Finish of types specified under shall be provided thereafter.
4	**Application with FR Closed Cell Chemically Cross Linked Polyethylene Material (XLPE)**
a)	All surfaces to be insulated shall be properly cleaned of any dust, grease and moisture
b)	A suitable adhesive, normally, a pressure sensitive acrylic base, such as SR 998/STAR Glue R242 or Neosole AA 900 or equivalent shall be used to paste the insulating material over the cleaned surface
c)	XLPE cut to size for each surface, with overlaps provided for two faces shall be stuck to the surfaces in a manner to avoid air entrapment. The extent of over-lap shall be equivalent to the thickness of the material to be applied. The adhesive is applied on both the surfaces to be insulated and the insulation foam material.
d)	Application of the insulating material to surfaces should preferably be carried out at ground level, in a clean dust free area
e)	All joints- lateral & longitudinal, shall be taped with self adhesive aluminium foil tape 75 mm wide. The insulation over the surface shall be then held in position with 12mm wide PVC straps at every 600mm, to provide a neat & clean finish.

ANNEXURE 2

REV-00, DATE: 20.02.2024

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: AIR CONDITIONING SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT:

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	a) 240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL as per load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. b) Emergency supply feeder provided (if required) shall be 3 phase 3 wire only. Any other voltage level (AC/DC/Single ph emergency AC) required will be derived by the vendor. c) 230 V AC UPS Power supply shall be provided by BHEL at a single point, All necessary hardware for deriving other power supply from given feeder shall be in Vendor's scope.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL	 BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
5	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL BHEL	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
6	Cable glands ,lugs and bimetallic washers for equipment supplied by Vendor	Vendor	Vendor	Bimetallic washers shall be used for bimetallic connections.
7	Conduit and conduit accessories for cabling between equipment supplied by vendor	BHEL	Vendor	
8	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: AIR CONDITIONING SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT:

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	
13	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination

ANNEXURE 3

CABLE SCHEDULE FORMAT

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

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

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

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

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

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

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

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

(C) CABLE CODES

PVC Copper

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

PVC Aluminium

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

XLPE Copper

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

XLPE Aluminium

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

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

ANNEXURE 4

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (dc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

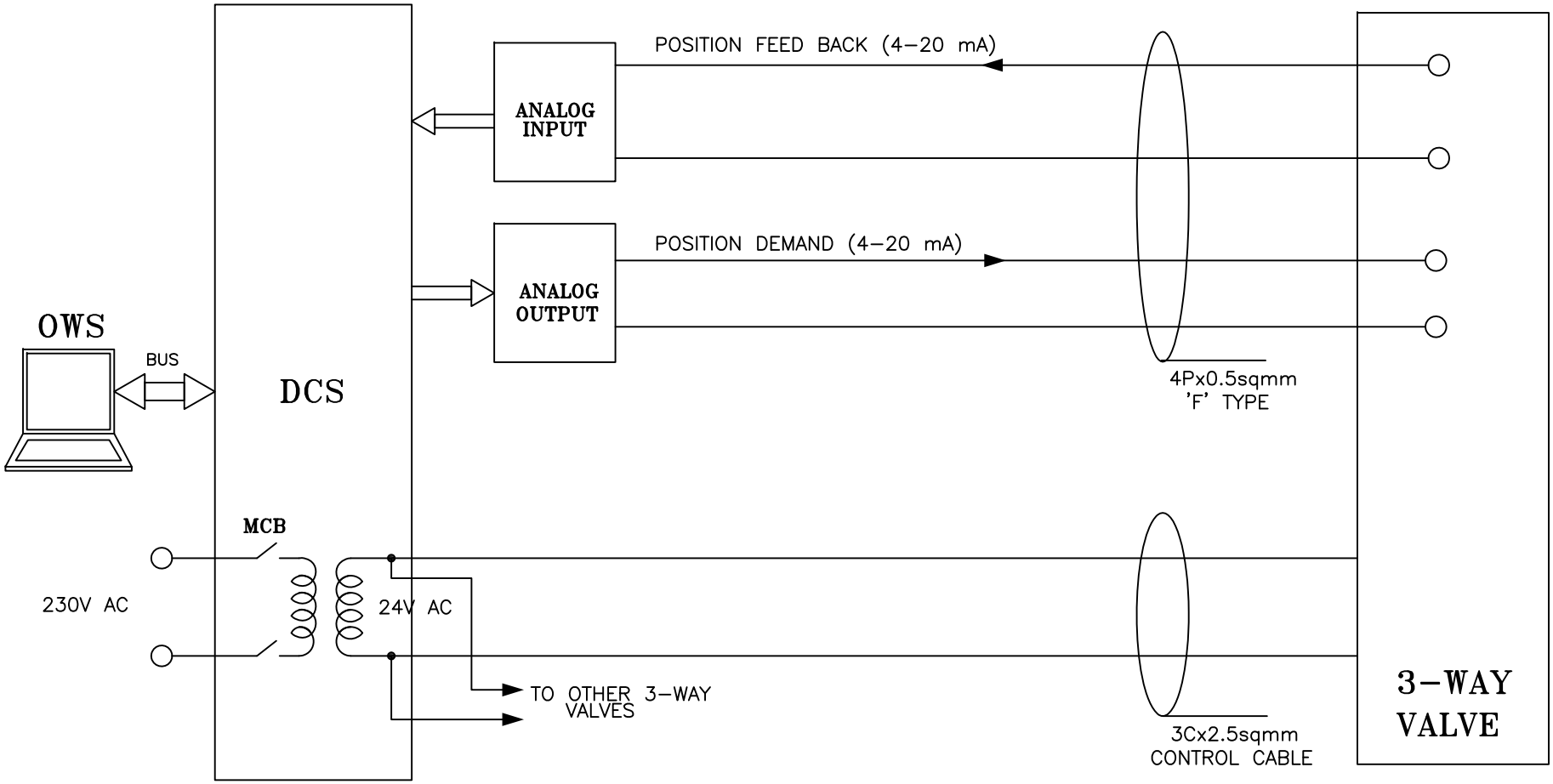
	LOAD DATA (ELECTRICAL)	JOB NO.		ORIGINATING AGENCY		PEM (ELECTRICAL)
		PROJECT TITLE		NAME		DATA FILLED UP ON
		SYSTEM / S	CHLORINE DI OXIDE DOSING SYSTEM	SIGN.		DATA ENTERED ON
		DEPTT. / SECTION		SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

TECHNICAL SPECIFICATION OF CABLE GLANDS AND LUGS

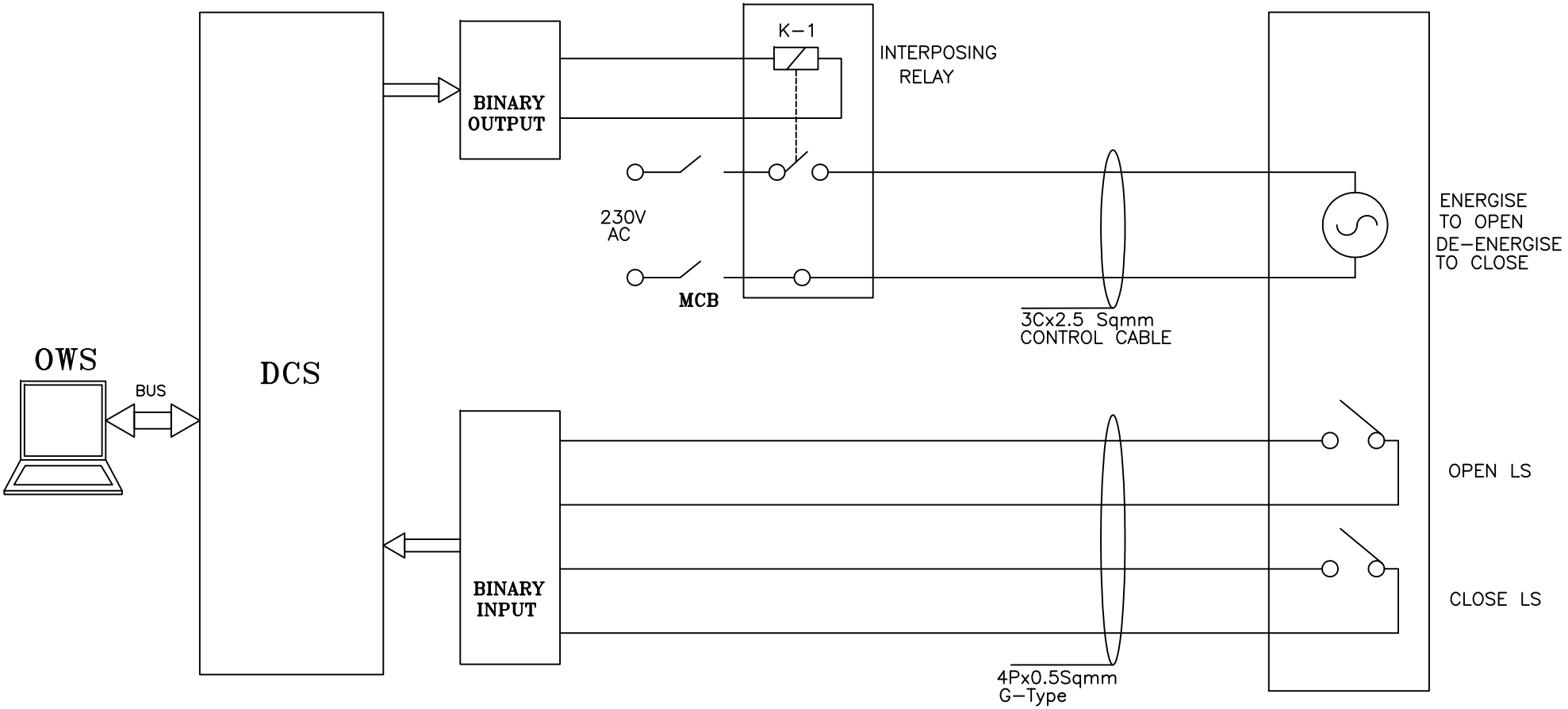
Cable glands shall conform to BS:6121. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and Hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene or better synthetic material and of tested quality.

Cable lugs/ferrules shall be solderless crimping type suitable for power and control cables as per the DIN 46239. Aluminium solderless crimping lugs/ ferrules shall be used for Aluminium cables and Copper lugs/ferrules shall be used for Copper cables. Bimetallic washers or bimetallic type lugs shall be used for bimetallic connections

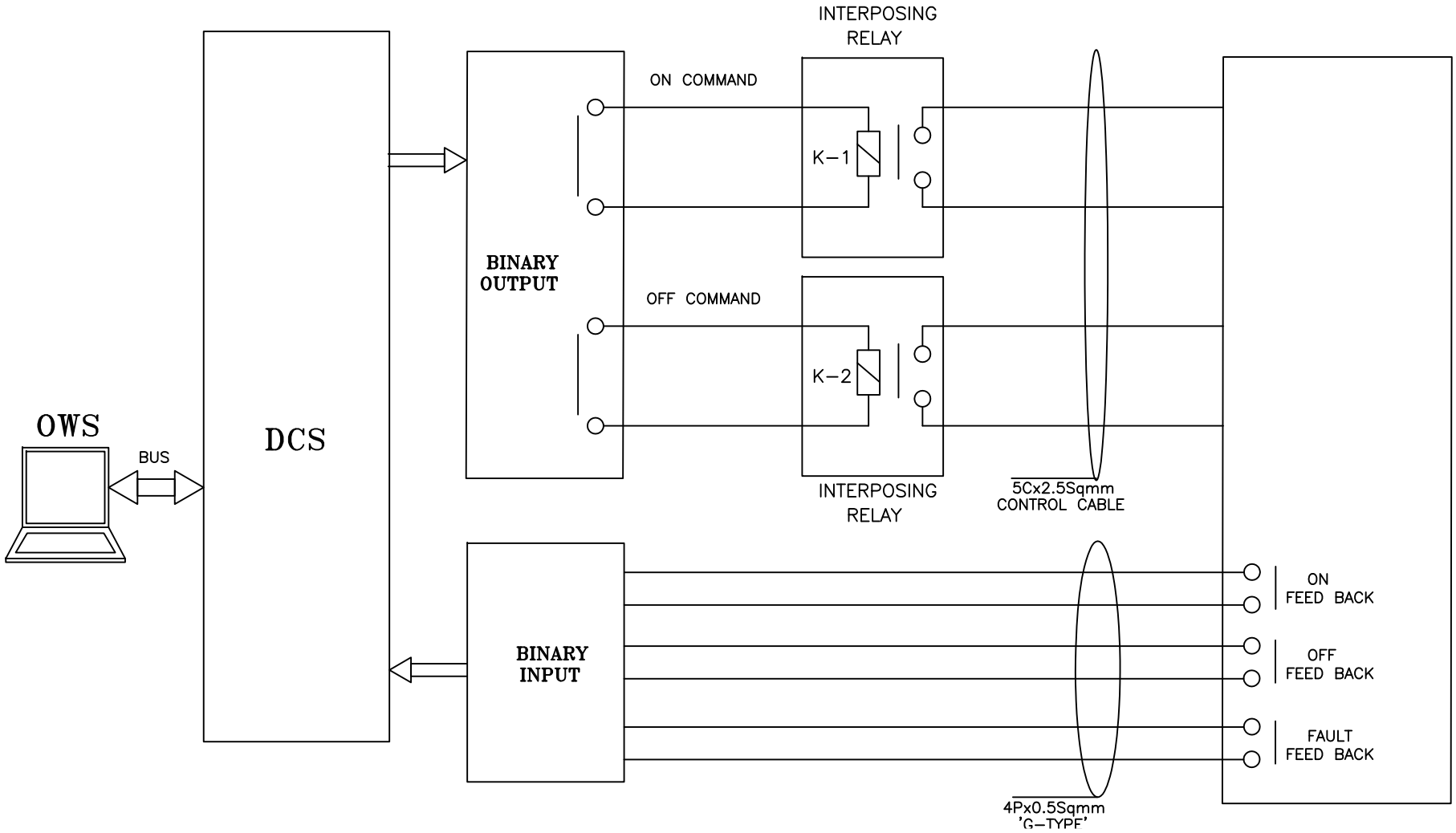
DCS INTERFACE FOR 3–WAY MIXING VALVE (MOD–AC)



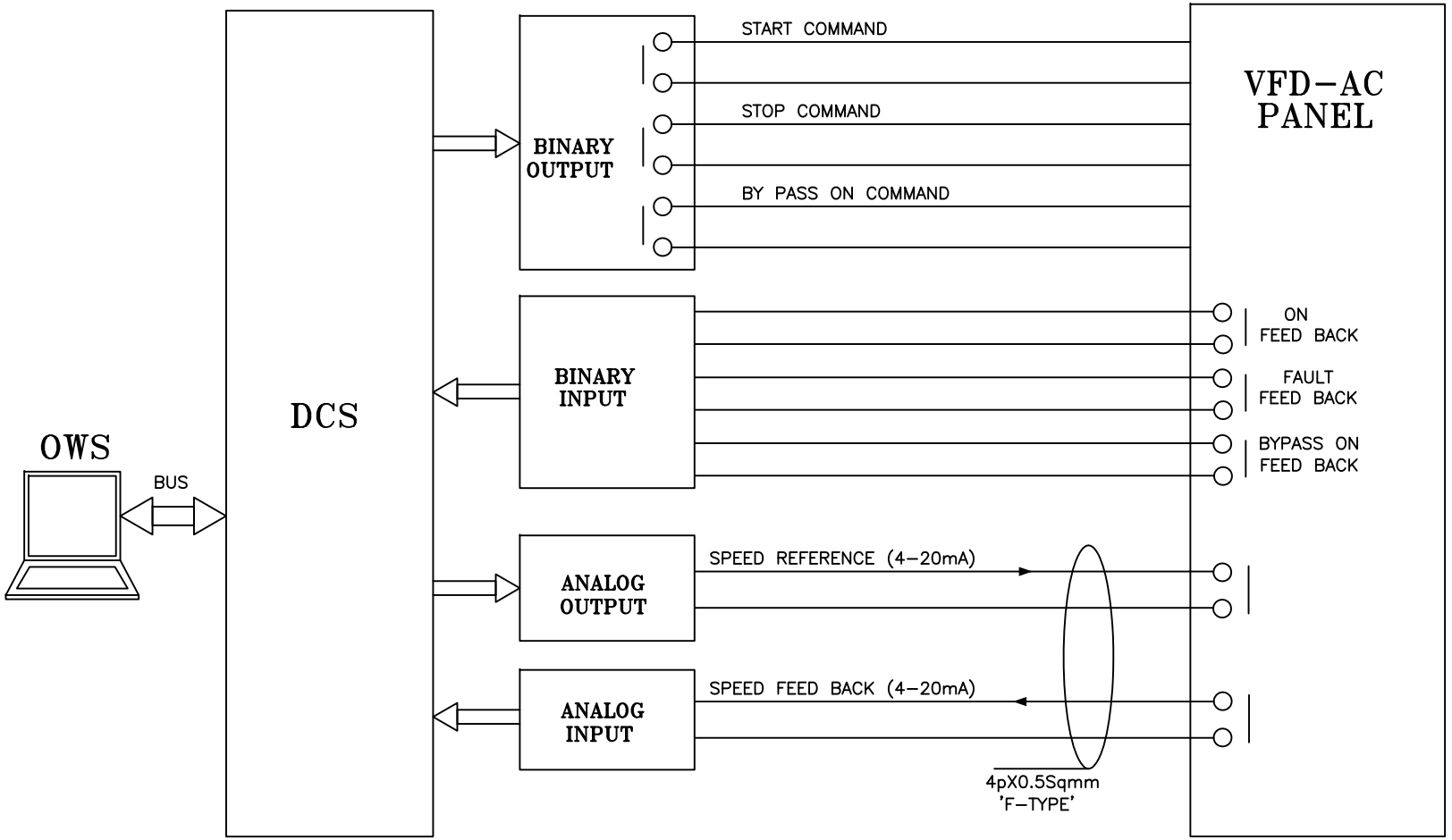
DCS INTERFACE FOR MOTORIZED OPERATED FIRE DAMPER (BID–FD)



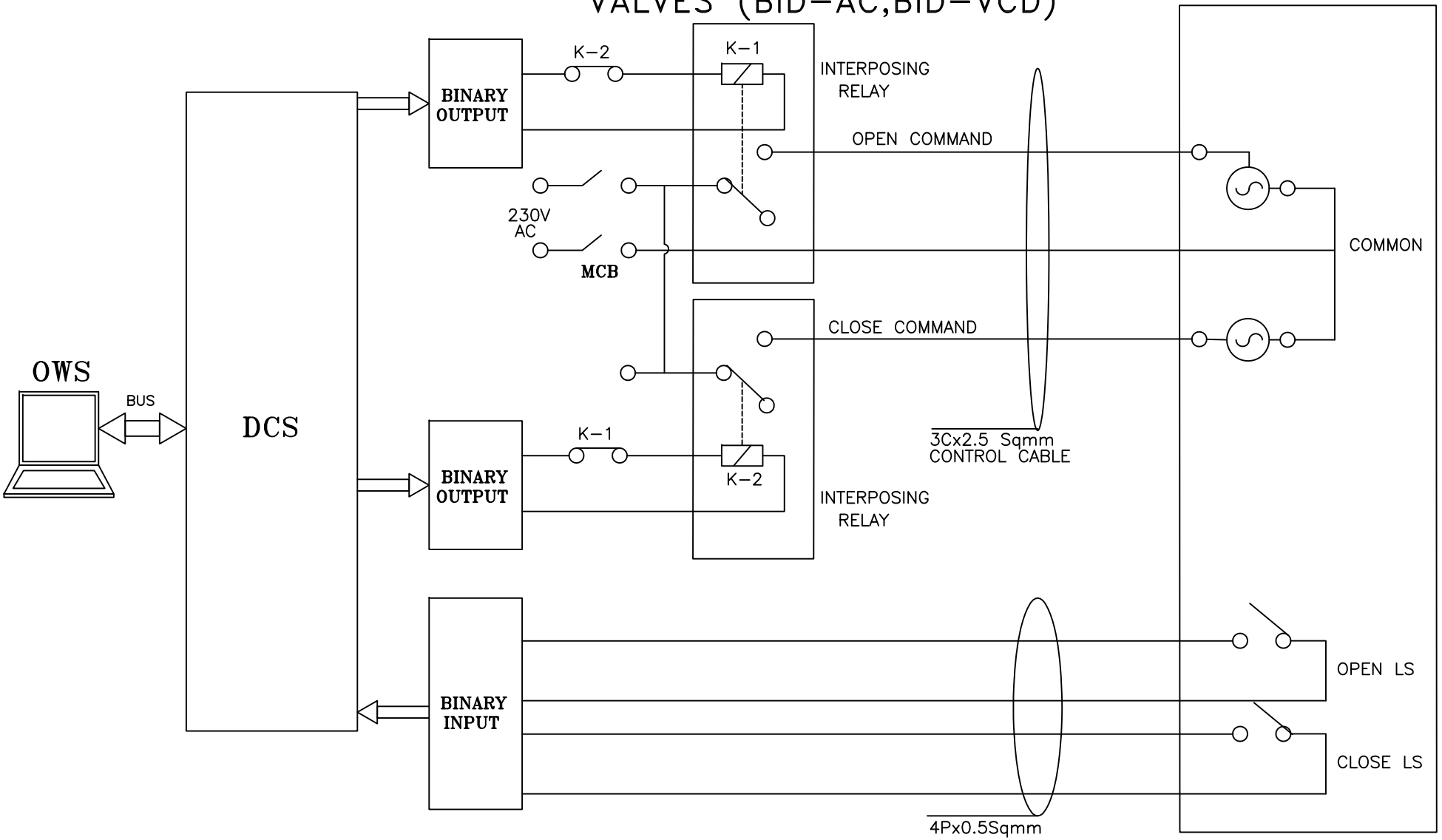
HOOK–UP DIAGRAM FOR **ACCU/SCREW CHILLER/PAC**



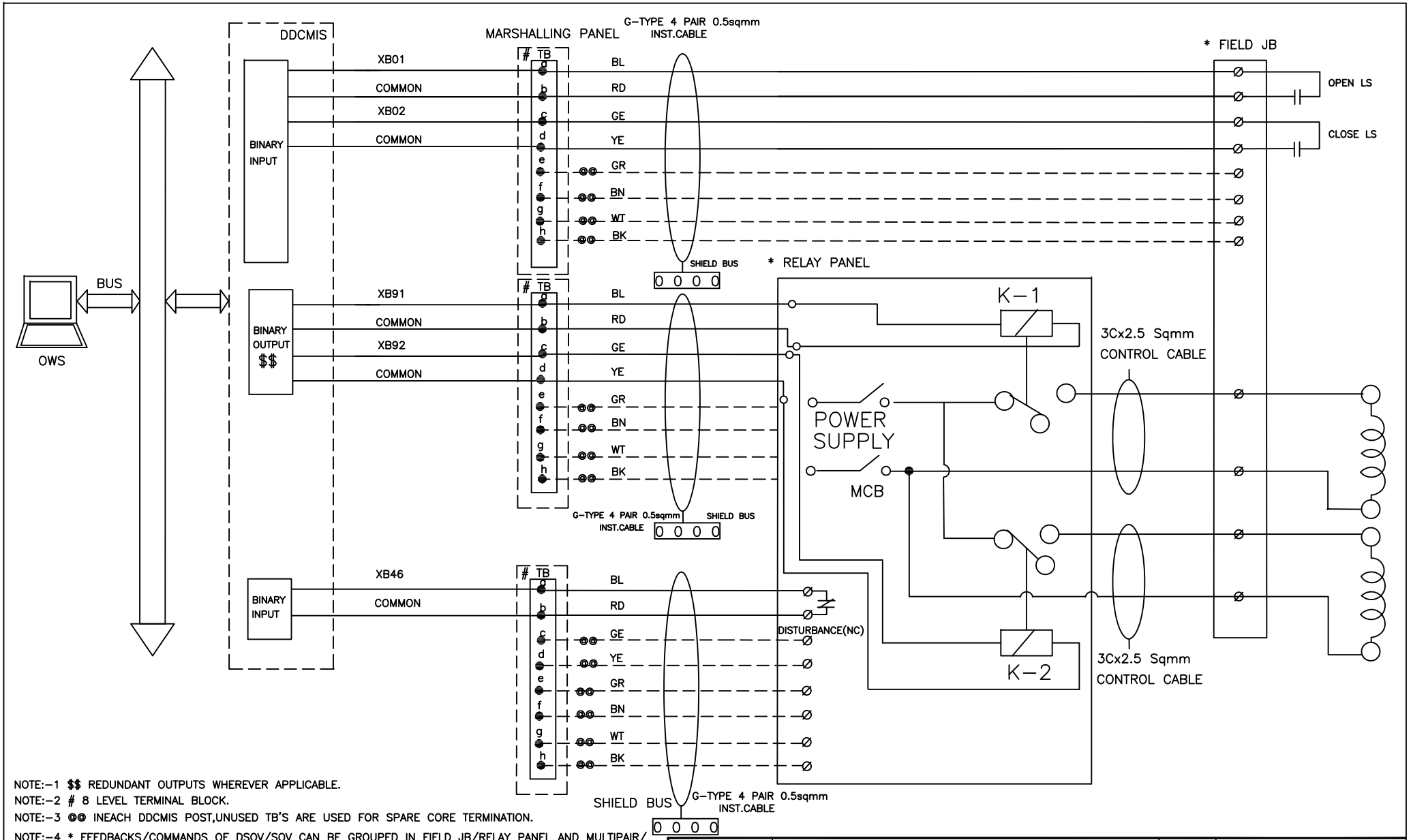
DCS INTERFACE FOR AHUs VFD(VFD-AC)



DCS INTERFACE FOR MOTORIZED OPERATED VALVES (BID-AC,BID-VCD)



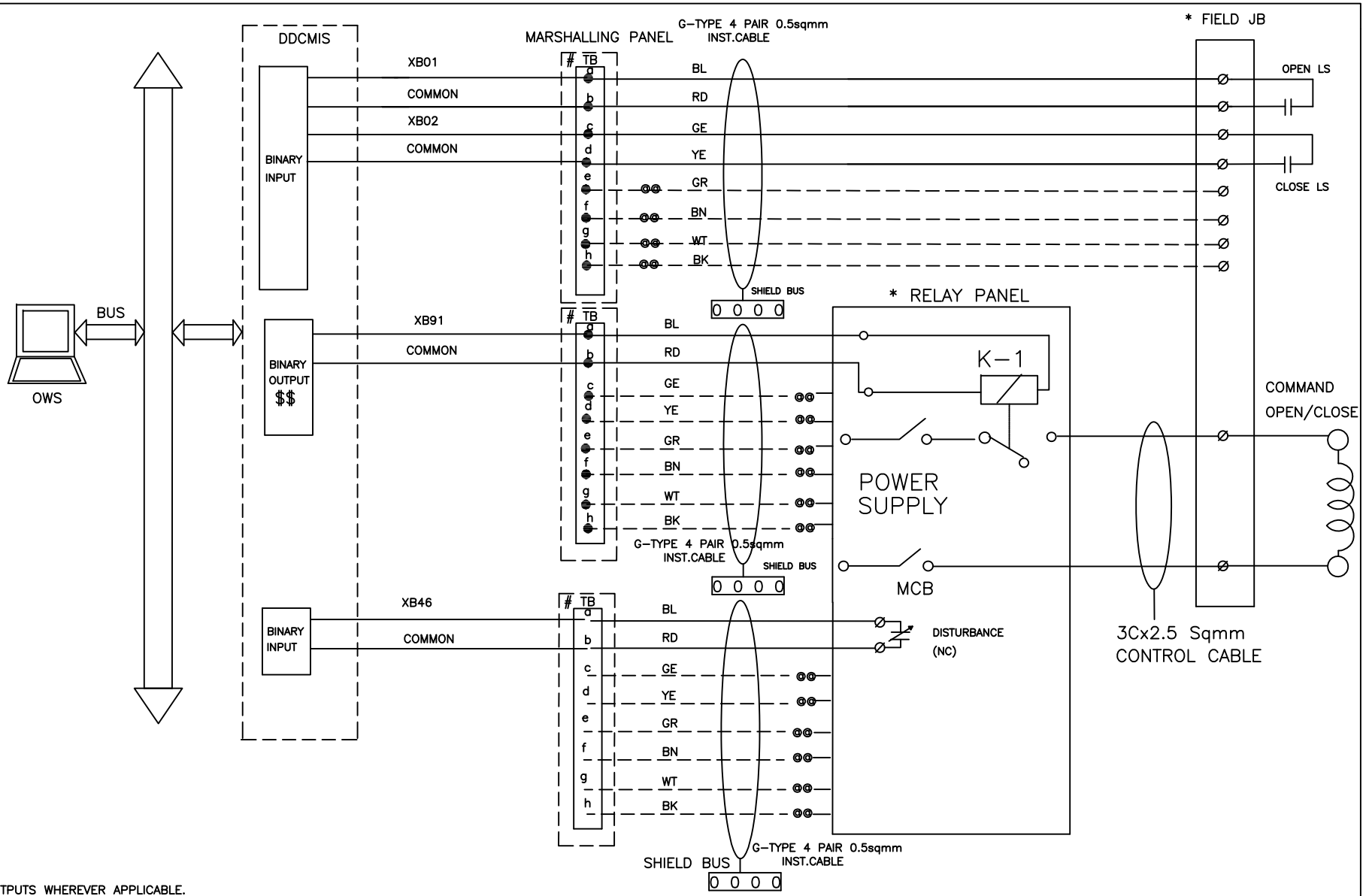
DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L)



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

BHEL	2x800 MW LARA STPP STAGE-II	DRG.NO.	9587-001-405-PVI-B-152B
	DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L)	SHT	10 OF 30

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



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

BHEL	2x800 MW LARA STPP STAGE-II	DRG.NO.	9587-001-405-PVI-B-152B
	DDCMIS INTERFACE WITH SOV/O/L(WITH FEEDBACKS)	SHT	12 OF 30

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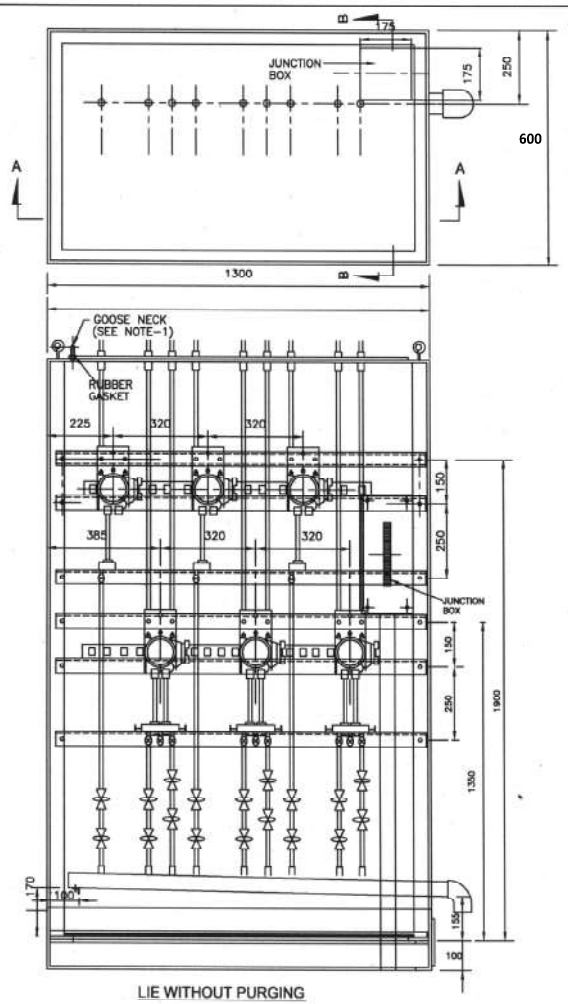
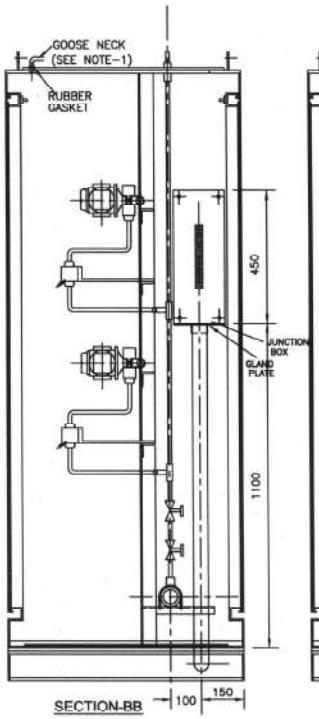
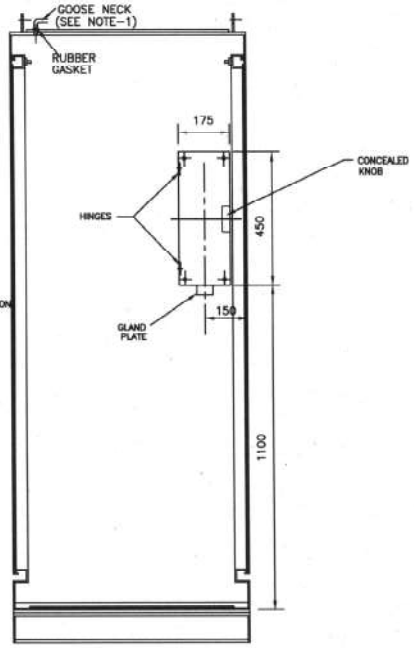


LIE WITHOUT PURGING



SECTION-BB



SIDE ELEVATION

NOTES:-

1. TO BE PROVIDED FOR LIEs USED IN STEAM & WATER APPLICATION.
2. MATERIAL OF JBs FOR LIEs SHALL BE SAME AS THAT OF LIE.

FOR TENDER PURPOSE ONLY

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE						T.G.				21.08.12

CLEARED BY

एन टी पी सी NTPC **N T P C LIMITED**
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: TYPICAL GA OF LOCAL INSTRUMENT ENCLOSURE / RACK

SIZE	SCALE	DRG. NO.	REV. NO.
A2	N.T.S.	0000-999-POI-A-064 SHEET 01 OF 03	B