DISTRIBUTION SCHEDULE

S. No	Description	TSGENCO								CONSULTANT			Equipment Vendor	Remarks
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/ KTPS	SE/ Civil KTPS	SE/E&M / KTPS	DE Constr. KTPS	Kolkata	HYD	KTPS		
A	**Letter Of Intent or Contract Documents**	1	1	1	S	1	2	2	1	1	1	1	2	
B	**Vendor Drawings**													
1.	Preliminary	1	1	1	2	1	1	2	2	12	1	-	S	
2.	Return preliminary with comments	-	-	1	2	1	1	1	1	S	1	-	1	
3.	Final and any revision thereof													
	a. Civil	1	1	6+1T	1	1	6+1T	1	-	2+1T	1	1	S	
	b. E&M	1	1	1	6+1T	1	1	6+1T	1	2+1T	1	1	S	
C.	**Design Drawings**													
1.	Preliminary													
	a. Civil	1	1	2	1	1	2	1	1	4	1	1	S	
	b. E&M	1	1	1	2	1	1	2	1	4	1	1	S	
2.	Released for construction													
	a. Civil	1	1	2	1	1	6	1	1	1	1	2	S	
	b. E&M	1	1	1	1	2	1	6	1	1	1	2	S	
3.	Return marked 'As built'													
	a. Civil	-	-	1	-	-	1	-	-	1	1	S	1	
	b. E&M	-	-	-	1	-	-	1	1	1	1	S	1	
4.	As built drawings													
	a. Civil	-	-	1+1T	-	2+1T	5+1T	-	1	1+1T	-	1	S	
	b. E&M	-	-	1	2+1T	2+1T	-	5+1T	1+1T	1+1T	-	1	S	

S. No	Description	TSGENCO								CONSULTANT			Equipment Vendor	Remarks
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/ KTPS	SE/ Civil KTPS	SE/E&M / KTPS	DE Constr. KTPS	Kolkata	HYD	KTPS		
D	Progress Report Monthly													
1.	Equipment vendor	1	1	1	2	1	1	2	1	1	1	1	S	
2.	M/s DCPL, Kolkata	1	1	2	2	1	1	2	1	S	1	1	Nil	
E	Test & Inspection Reports													
1.	Equipment manufacturer													
	a. Civil	1	1	1	2	1	1	1	-	11	1	1	S	
s	b. E&M	1	1	-	2	1	-	1	1	11	1	1	S	
2.	M/s DCPL, Kolkata	1	1	-	2	1	-	1	1	S	-	1	-	
F	Instruction Manuals/Data Books													
1.	Equipment manufacturer													
	a. Civil	1	1	1+1T	1	1	6+1T	1	1	2+1T	1	1	S	
	b. E&M	1	1	-	3+1T	1	-	6+1T	2	3+1T	1	1	S	
2.	M/s DCPL, Kolkata	1	1	-	10+1T	1	-	15+1T	-	S	1	1	Nil	
G	M/s DCPL, Kolkata Criteria	1	1	1	8+1T	1	1	2	1	1	1	1	S	
H	Design Calculations	1	1	1	8+1T	1	1	2	1	1	1	1	S	
I	Final consulting Engineering Report	1	1	1	10	1	1	2	1	S	1	1	Nil	

S – Source, T – Transparency & Soft Copy on CD,

Director, Technical, Hyd	:	Director/ Technical, TSGENCO, Vidyut Soudha, Hyderabad – 500 082
CE/ Civil, Hyd	:	Chief Engineer/Civil, Thermal Projects, TSGENCO, Vidyut Soudha, Hyderabad – 500 082
CE/ TPC-I, Hyd	:	Chief Engineer/TPC, TSGENCO, Vidyut Soudha, Hyderabad – 500 082
CE/ O&M/ KTPS	:	Chief Engineer(O&M), KTPS, Kothagudem, Telangana
SE/Civil, KTPS	:	Superintending Engineer (Civil), KTPS, Kothagudem, Telangana
SE/E&M, KTPS	:	Superintending Engineer (E&M), KTPS, Kothagudem, Telangana
DE/Constr./ KTPS	:	Divisional Enginer/Constrcution, KTPS, Kothagudem, Telangana
M/s DCPL, Kolkata	:	M/s DCPL, Kolkata.
M/s DCPL, Hyd	:	M/s DCPL, Hyderabad.
M/s DCPL, KTPS	:	M/s DCPL, KTPS, Kothagudem, Telangana

ANNEXURE: VI

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION (MDL)

Arvind S A Khan Praveen Kishore

4X270 MW BHADRADRI TPS AIR CONDITIONING SYSTEM MASTER DRAWING LIST (MDL)			
DOCUMENTS TO BE FURNISHED BY AC VENDOR			
S. No.	**Drawing / Document No.**	**Drawing / Document Title**	**Submission Schedule (WEEKS)**
1*	PE-V0-391-553-A001	ITEM CATEGORISATION LIST & SUBVENDOR LIST	2
2*	PE-V0-391-553-A002	QAP OF VAM MACHINE	6
3*	PE-V0-391-553-A003	QUALITY PLAN OF SCREW CHILLERS	6
4*	PE-V0-391-553-A004	QUALITY PLAN OF PRECISION PU	7
5*	PE-V0-391-553-A005	QUALITY PLAN OF CENTRIFUGAL PUMPS	7
6*	PE-V0-391-553-A006	QUALITY PLAN OF COOLING TOWER	8
7	PE-V0-391-553-A007	QUALITY PLAN OF AHU	8
8*	PE-V0-391-553-A008	QUALITY PLAN OF MOTOR	9
9*	PE-V0-391-553-A101	HEAT LOAD CALC FOR MAIN CONTROL ROOM AREAS IN TG BLDG, ESP CONTROL ROOM BUILDING AND SERVICE BUILDING.	3
10*	PE-V0-391-553-A102	PRESSURE DROP CALC FOR CHILLED WATER PIPING & CONDENSER WATER PIPING	4
11*	PE-V0-391-553-A103	CONTROL & OPERATION PHILOSOPHY OF AC SYSTEM	11
12*	PE-V0-391-553-A201	TECHNICAL DATA SHEET & G.A DRAWING OF VAPOUR ABSORPTION CHILLER	9
13*	PE-V0-391-553-A202	DATA SHEET AND GA FOR SCREW CHILLER	9
14*	PE-V0-391-553-A203	DATA SHEET AND GA FOR AIR COOLED PRECISION PU	8
15*	PE-V0-391-553-A204	DATA SHEET AND GA FOR AHUs AND FCUs	8
16*	PE-V0-391-553-A205	TECHNICAL DATA SHEET & GA DRAWING FOR CHILLED WATER PUMPS , CONDENSER WATER PUMPS, CONDENSATE PUMPS AND DESUPERHEATING PUMPS	7
17*	PE-V0-391-553-A206	DATA SHEET AND GA FOR COOLING TOWER	7
18*	PE-V0-391-553-A207	DATA SHEET AND GA FOR ONLINE NON CHEMICAL WATER TREATMENT EQUIPMENT	5
19*	PE-V0-391-553-A208	DATA SHEET AND G.A. FOR PRE AND FINE FILTER ALONGWITH FIXING DETAILS.	10
20*	PE-V0-391-553-A209	DATA SHEET AND GA FOR FIRE DAMPER ALONGWITH FIXING DETAILS.	10
21*	PE-V0-391-553-A210	DATA SHEET AND GA FOR FRESH AIR FANS	7
22*	PE-V0-391-553-A211	DATA SHEET AND GA DRAWINGS FOR VLAVES (BALANCING, GATE, NRV, B/F , MOTORISED B/F, Y-STRAINER AND OTHER VALVES AS APPLICABLE)	9
23*	PE-V0-391-553-A212	DATA SHEET AND GA FOR 3 WAY MOTORISED VALVE	8
24*	PE-V0-391-553-A213	DATA SHEET AND GA FOR HEATER PACKAGE	7
25*	PE-V0-391-553-A214	DATA SHEET AND GA FOR PAN HUMIDIFIER	7
26*	PE-V0-391-553-A215	DATA SHEET FOR INSTRUMENTS (TEMPERATURE GAUGE, PRESSURE GAUGE, PRESSURE SWITCH, SENSORS - TEMPERATURE & HUMIDITY, LEVEL GAUGE, LEVEL SWITCH & DIFFERENTIAL PRESSURE SWITCH AND OTHER APPLICABLE INSTRUMENTS).DATA SHEET AND GA FOR WATER SOFTENING PLANT.	9
27*	PE-V0-391-553-A216	DATA SHEET OF INSULATION FOR DUCT, PIPE AND ACCOUSTIC LINING ALONG WITH TYPICAL DETAIL FOR DUCT, PIPE AND ACCOUSTIC INSULATION	5
28*	PE-V0-391-553-A217	DATA SHEET FOR SPLIT AC AND AIR COOLED PAC.	4
29*	PE-V0-391-553-A218	DATA SHEET FOR PIPES	2
30*	PE-V0-391-553-A219	DATA SHEET FOR GI SHEET	2
31*	PE-V0-391-553-A220	DATA SHEET AND GA DRAWING FOR GRILLS / DIFFUSERS / DAMPERS ETC	3

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4X270 MW BHADRADRI TPS
AIR CONDITIONING SYSTEM
MASTER DRAWING LIST (MDL)

DOCUMENTS TO BE FURNISHED BY AC VENDOR

S. No.	Drawing / Document No.	Drawing / Document Title	Submission Schedule (WEEKS)
32*	PE-V0-391-553-A221	GA OF EXPANSION TANK, MAKEUP WATER, SOFT WATER TANK AND CONDENSATE STORAGE TANK	3
33*	PE-V0-391-553-A222	TDS AND GA OF MOTOR (PUMP, COOLING TOWER, AHU)	6
34*	PE-V0-391-553-A223	TDS AND GA OF DESUPERHEATING STATION	7
35*	PE-V0-391-553-A501	P&I DIAGRAM FOR AC SYSTEM	5
36*	PE-V0-391-553-A502	AC PLANT ROOM LAYOUT, COOLING TOWER AREA LAYOUT WITH EQPT FOUNDATION DETAILS FOR TG BUILDING	8
37*	PE-V0-391-553-A503	AC DUCT LAYOUT DRAWING FOR CONTROL ROOM ARES AT 15.5M, ALONG WITH AHU ROOM LAYOUT WITH FOUNDATION DETAILS AT 21.0M FOR TG BUILDING	7
38*	PE-V0-391-553-A504	FCU LAYOUT WITH FIXING DETAIL FOR AC AREA AT 9.0M FOR TG BUILDING	6
39*	PE-V0-391-553-A505	CHILLED & CONDENSER WATER PIPING LAYOUT INSIDE AC PLANT, COOLING TOWER, AHU ROOMS IN ALL BUILDING AND INTERCONNECTING CHILLED WATER PIPE FROM PLANT ROOM TO ALL AHU ROOM.	9
40*	PE-V0-391-553-A506	AC DUCTING & DIFFUSER LAYOUT FOR ESP CONTROL ROOM ALONG WITH AHU ROOM LAYOUT WITH FOUNDATION DETAIL.	7
41*	PE-V0-391-553-A507	AC DUCTING & DIFFUSER LAYOUT FOR SERVICE BUILDING ALONG WITH PU ROOM LAYOUT WITH FOUNDATION DETAIL.	8
42*	PE-V0-391-553-A508	AC DUCTING & DIFFUSER LAYOUT FOR ADMIN BUILDING ALONG WITH PU ROOM LAYOUT WITH FOUNDATION DETAIL.	6
43*	PE-V0-391-553-A509	TYPICAL Details DUCT: FABRICATION, SUPPORT AND ERECTION. INSULATION: DUCTING, PIPING, EQUIPMENTS AND ACOUSTIC LINING. PIPING: FABRICATION, SUPPORT AND ERECTION	3
44*	PE-V0-411-553-A510	SPLIT AC SCHEDULE ALONGWITH HEAT LOAD CALCULATION FOR AUXILIARY BUILDING	4
45*	PE-V0-411-553-A701	TDS OF PLC WITH CONF DIAG, BOM, GA & INTRL WIRG DIAG, LOGIC FLOW DIAG, IO WIRG DIAG , UPS LAYOUT, UPS CALCULATION, BATTERY LAYOUT ETC., PLC ROOM LAYOUT FOR AIR CONDITIONING SYSTEM	8
46*	PE-V0-411-553-A702	I/O LIST FOR AC SYSTEM FOR AIR CONDITIONING SYSTEM	9
47	PE-V0-411-553-A703	ELECTRICAL FEEDER LIST FOR AIR CONDITIONING SYSTEM	6
48	PE-V0-411-553-A704	CABLE SCHEDULE FOR AIR CONDITIONING SYSTEM	8
49	PE-V0-391-553-A901	DEMONSTRATION TEST	5
50	PE-V0-391-553-A902	O & M MANUAL	11

Notes

1 Submission schedule (Week) is from date of LOI to Package vendor.

2 The drawings/ documents submitted by vendor shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non- submission with delays attributable to vendor's account. For any clarification/discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL / Customer's place any number of time as per the requirement for across the table discussions/ finalizations/ submissions of drawings

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4X270 MW BHADRADRI TPS AIR CONDITIONING SYSTEM MASTER DRAWING LIST (MDL)			
DOCUMENTS TO BE FURNISHED BY AC VENDOR			
S. No.	**Drawing / Document No.**	**Drawing / Document Title**	**Submission Schedule (WEEKS)**

3 Star marked (*) documents shall be treated as basic Engineering documents.

4 The above drawing list is tentative and shall be finalized with the successful bidder after placement of order considering various documents covered under individual specification (C&I, Electrical, material handling etc.). While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.

5 Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.

6 Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.

7 All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-

(a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

(b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

(c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

(d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

(e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 ….etc.

(f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

(g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

(h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

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

(j) Bidder to follow the following the drawing submission schedule:

(k) 1st submission of drawings from date of LOI as per the submission schedule.

(l) Every revised submission incorporating comments – within 7 days.

(m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

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ANNEXURE: VII

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

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Format for Operation & Maintenance Manual

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

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	Cover page				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	Description of Plant/System				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4.0	Commissioning Activities (if not covered in separate document i.e. erection				

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	manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/user/operator				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				

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6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	**Statutory and other specific requirements considerations.**				
8.0	**List of reference documents**				
9.0	**Binding as per requirement**				

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ANNEXURE: VIII

SITE STORAGE AND PRESERVATION

Arvind S A Khan Praveen Kishore

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

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

PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

Arvind S A Khan Praveen Kishore

CONTENT

1. SCOPE OF THE DOCUMENT

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

2. PURPOSE OF STORAGE & PRESERVATION

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

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

a) GENERAL STORAGE REQUIREMENTS

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

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

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

b) GENERAL PRESERVATION REQUIREMENTS

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

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

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

    a. Rust preventive fluid (RPF)

    b. Rust protective paints

    c. Tarpaulin covers, in case of outdoor storage

    d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

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

2. Any damages to equipment / materials.

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

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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

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

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

iii Open storage (O)

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

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

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

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

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

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

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

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

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

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

5. CONCLUSION

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

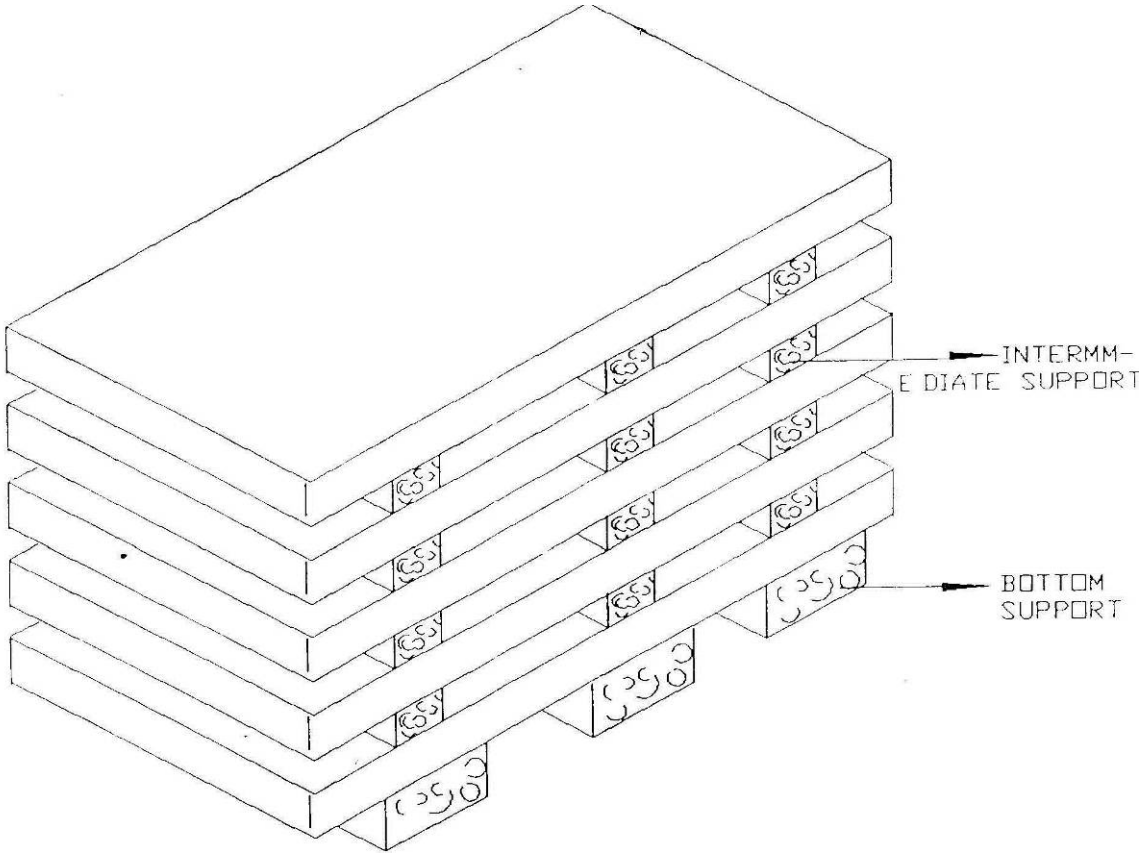

Figure – 1 – PLATE STACKING ARRANGEMENT

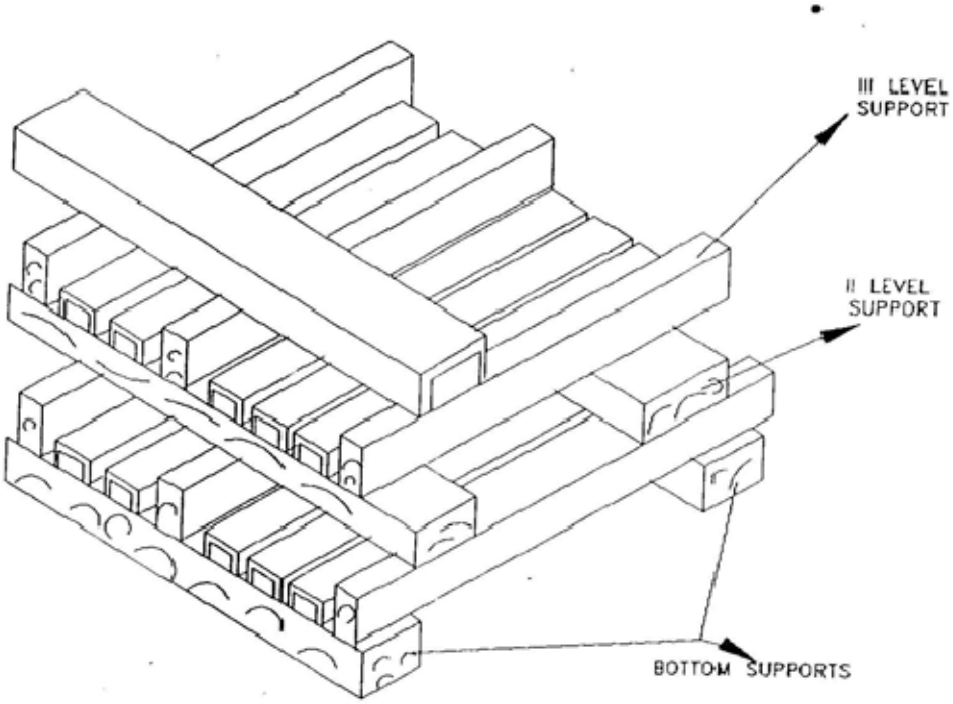

Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

SECTION-D

STANDARD TECHNICAL SPECIFICATIONS

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SECTION-D

CENTRAL AIR CONDITIONING PLANT

Arvind S A Khan Praveen Kishore

1. GENERAL

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

2. CODES & STANDARDS

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

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

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3. DESIGN & CONSTRUCTION REQUIREMENTS

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

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

4. TESTING AND INSPECTION

(Refer standard quality plan)

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

Following minimum tests amongst others shall be conducted.

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

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

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

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

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

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

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

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

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

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4.2 TESTS AT SITE

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

5. PERFORMANCE GUARANTEE

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

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

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

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

6.1 Final version of all drawings & data submitted with the along with technical schedules enclosed in Volume III.

6.2 Drawings including equipment layout, foundation & loading details etc. for civil works for the entire plant. These drawings must cover sufficient details so that design of civil works can be completed.

6.3 Inspection, operation & Maintenance Manuals.

6.4 Manuals for method of testing & calibration of all instruments.

6.5 Equipment description giving complete design calculations, basis of design, selection criteria etc.

6.6 Schematic piping diagrams.

6.7 Layout of piping.

6.8 Electrical drawings.

6.9 Test Certificates.

6.10 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.

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DESCRIPTION		DATA
1.	**GENERAL**	
1.1	Type of AC plant	: Chilled Water Type.
1.2	Plant configuration/capacity.	: Refer to Section-C of Specific Technical Requirements.
1.3	Location of AC plant rooms	: As per Tender drawings.
1.4	Type of lifting facility provided.	: Chain Pulley block with monorail (by BHEL)
1.5	Electrical work scope: -	
	i) MCC for AC plant	: By Others
	ii) Power cables / Control cables.	: By Others
	iii) Drives	: By Bidder.
	iv) Whether separate alarm/annunciation Panel/control panels required	: Yes (By bidder), Refer to Section-C of Specific Technical Requirements.
	v) Termination of cabling & earthling at Equipment end.	: By Bidder for bidder supplied equipment.
2.	**REFRIGERATION COMPRESSOR**	
2.1.	Type	: SCREW CHILLE
2.2.	Nos. (working + standby)	: Refer to Section-C of Specific Technical Requirements.
2.3.	Type of capacity control	: Automatic.
2.4.	Type of drive	: Direct driven.
2.5.	Restart after tripping	: Manual.
2.6.	Type of start	: As per manufacturing standard.
2.7.	Shaft Seal	: Mechanical shaft seal.
2.8.	Purge Recovery unit	: As per manufacturing standard.
2.9.	Type of lubrication	: As per manufacturing standard.
2.10.	Refrigerant used	: Environment friendly HCFC, (CFC is not acceptable)

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3. DESIGN REQUIREMENTS

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

4.0 CONDENSER

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

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iii/ Head ends : Cast Iron.

iv/ Tube sheet material : Steel

v/ Baffle plate : Steel.

4.5 Accessories required

i/ Purge & drain connections with valves. : Yes

ii/ Relief valves : Yes

iii/ Liquid line shut off valve. : Yes

iv/ Isolating valves on water side. : Yes

v/ Flow switch : Yes (interlocked with control of individual refrigeration system)

vi/ Pressure/temperature gauges at inlet/outlet : Yes

vii/ Descaling tee : Yes

viii/Charging valve : Yes

ix/ MS supporting frame work : Yes

viii/Cooling thermostat : Yes

ix/ MS supporting frame work. : Yes

5.0 **CHILLER** (Applicable for chilled water type plant only.)

5.1 Type : Horizontal shell & tube flooded type

5.2 Number required/standby : One no. for each chiller package.

5.3 Design requirements

5.3.1 Fluid to be cooled : Water

5.3.2 Water flow rate (Inside tube) : To suit requirement.

5.3.3 Water inlet temperature : 12 ^{o}C approx.

5.3.4 Water outlet temperature : 7 ^{o}C approx.

5.3.5 Super heating of refrigerant material : By at least 3 deg. C.

5.3.6 Insulation /thickness/finish : As per the manufacture standard.

5.3.7 Design fouling factor : 0.00010(MKS Unit)

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5.3.8 Maximum pressure drop. : 0.6 Kg/cm2 (g)

5.3.9 Tube wall Thickness : Not less than 22 SWG.

5.4 Materials of construction

i/ Shell : M.S. Plate fusion welded.

ii/ Tube : Integrally Seamless copper (internally Corrugated)

iii/ Head ends : Cast Iron.

iv/ Tube sheet material : Steel.

v/ Baffle plate : Steel.

5.5 Accessories required

i/ Purge & drain : Yes

ii/ Gate valves at water inlet/outlet. : Yes

iii/ Flow switch : Yes

iv/ Pressure/temperature gauges at inlet/outlet : Yes

v/ Anti-freeze thermostat : Yes

vi/ Thermostatic expansion valves : Yes

vii/ Pilot solenoid valve : Yes

viii/ Cooling thermostat : Yes

ix/ MS supporting frame work. : Yes

Note :-

The system shall also incorporate:

1) Auto operation of chilling plant for operation of the whole AC system.

2) A Central Control Panel with fault annunciators with provision for remote extension besides local control kiosks.

3) Water Chiller package shall be skid-mounted unit with microprocessor based control panel complete with all accessories and controls are assembled at manufacturing works on single unit.

4) Screw chiller shall be suitable for 415V ± 10 %/50 Hz ± 3%/3 phase operation with voltage & frequency variation as specified with built in starter etc.

5) Only supply feeders shall be provided for chillers.

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SECTION-D

AIR HANDLING UNITS

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1. GENERAL

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

2. CODES AND STANDARDS

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

2.1.1 IS-659 : Safety code for air conditioning

2.1.2 IS-660 : Safety code for mechanical refrigeration

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

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

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

2.1.6 AMCA : 211 and 311

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

3. CONSTRUCTION FEATURES

3.1 The casing of AHU shall be made of insulated double wall construction of min. 24 gauge galvanized sheet steel - IS 277 Gr. 120 (parent sheet: D/DD-IS-513) ribbed and reinforced for structural strength and rigidity with 25 mm thick polyurethane insulation of minimum 40 kg/m^3 density in between. The external wall will be pre-plasticised over GI coating on the outside. Angle irons or channel sections made of 16 gauge galvanized sheet steel shall be used for reinforcing. The casing shall be of sectionalized construction with proper sealing at the joints to make them air tight. Fan section and panels with bearing support shall be reinforced with heavy gauge channels (min. 5 mm thick). Suitable number of forged hot dip galvanized (610 gm/sq.m) U brackets shall be provided for AHU suspended from ceiling/roof.

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

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

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

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

3.4 The filters in the filter section shall be provided as detailed in data sheet A.

3.5 Humidifier shall be Pan type/as specified in the specification.

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

Heaters and branch line shall be of galvanized steel and nozzles shall be of brass (matl. grade) /SS 304.

3.6 Condenser water from coil or surplus water from spray humidifier shall be collected in 16 gauge SS-304 pan. Minimum 50mm dia GI pipe nipple shall be provided on each end for drain connection. The drains for these points shall be extended to the main drain in AHU room.Condensate drain pipe (GI) of required length with sealing loop shall be provided and insulated as specified in the specification for insulation. Minimum requirement For GI Pipes and fittings shall be ERW/Seamless of medium thickness as per IS-1239/3589 and Hot dip galvanized

3.7 Suitable number of Spring type vibration isolators shall be provided for fan and motor assembly. Neoprene rubber pads shall be provided below the AHU.

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

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4. TESTING AND INSPECTION AT MANUFACTURERS WORKS:

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

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

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

4.3 Shaft: Mechanical and chemical.

4.4 Motors (of approved make): Routine TC.

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

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

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

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

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

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

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

5.1 GA drawing of AHU & data- sheet to be submitted along with technical schedules enclosed in Volume III.

5.2 Drawing including equipment layout, foundation & loading details etc. for civil works. These drawings must cover sufficient details so that design of civil works can be completed.

5.3 Inspection, operation & Maintenance Manuals.

5.4 Equipment description giving complete design calculations, basis of design, selection criteria etc.

5.5 Test Certificates.

5.6 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.

5.7 Performance Test Certificates.

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	TITLE	SPECIFICATION NO. PE-TS-411-553-A002.
BHEL	**AIR HANDLING UNIT** **DATA SHEET - A**	VOLUME - II-**B** SECTION - D REV 00 | DATE APRIL 2015 SHEET 1 OF 2

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

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

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SECTION-D

COOLING TOWER

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1. GENERAL

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

2. CODES & STANDARDS

2.1 the design, manufacture, inspection & testing and performance of the cooling tower as specified hereinafter shall comply with the requirements of all applicable latest Indian/British/American standards and codes of practice. the latest editions of the following standards & publications shall be followed in particular:

2.1.1 Cooling tower institute USA bulletin ATP-10S: Acceptance test procedure for industrial water-cooling tower.

2.1.2 PTC-23 ASME performance test code for Atmospheric water-cooling equipment.

2.1.3 In case of any conflict between the above codes & standards and-this specification, the later shall prevail.

3. DESIGN REQUIREMENTS

3.1 the cooling tower shall be designed for continuous operation to cool not less than design flow of water from specified inlet temperature to the outlet temperature at a design ambient wet bulb temperature as indicated under data sheet a.

3.2 all the components shall be capable of safe, proper and continuous operation at all cooling water flows upto & including those specified under data sheet a & shall be designed with regard to case of maintenance, repair, cleaning & inspection.

3.3 the cooling tower shall be of induced draught cross flow or counter flow type and with multiple cells (if specified in data sheet a.) the cooling tower shall be suitable for handling the fluid and also for achieving the specified parameter as per data sheet a. the cooling tower shall be designed such that the drift losses & evaporation losses are minimum.

4. CONSTRUCTIONAL FEATURES

4.1 CASING & LOUVERS

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

4.2 FILL

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

4.3 Drift Eliminators

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

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4.3.2 In case of FRP cooling tower the drift eliminators shall be of multi-blade rotary type.

4.4 Fans & Accessories

4.4.1 The fans shall be multiple blade, low speed, high efficiency axial flow type located above the top deck level of the cooling tower. Fan rotating assembly shall be statically & dynamically balanced. The fan blades shall be preferably adjustable in stand still condition for propeller action. The fan shall be either directly mounted on the shaft of a totally enclosed weather proof motor or shall be suitable for V-belt drive.

4.4.2 The rating of drive motor shall have at least 15% margin over maximum fan power consumption. The design & construction of the drive motor shall be in accordance with enclosed specification for LVAC motors.

4.5 Water basin

4.5.1 The material of construction of water basin shall be FRP or RCC as specified in data sheet A. The basin shall be provided as a part of cooling tower in case of FRP construction. The sump shall have sufficient storage capacity for safe operation of AC plant.

4.6 Hot water distribution system

4.6.1 Manually operated flow control valves shall be provided in hot water distribution piping such that each cooling tower can be isolated without affecting the operation of other cells.

4.6.2 The nozzles shall be spaced to give even distribution of water over entire space occupied by top row of fills. The nozzles shall be made of brass /SS 304/316/316L (brass shall be as per manufacturer's standard) unless specified in data sheet A:

4.6.3 In case of FRP tower water shall be distributed over the fill by means of a multiple area fail safe rotary sprinkler made of PVC pipes fitted on a aluminium alloy (as per manufacturers standard) rotary head and mounted on sealed ball bearings (make) .

4.7 Access

4.7.1 A stair case paddle ladder (as per manufacturer's standard) shall be provided external to the cooling tower at one end of each tower along with stairways hand rails etc give safe & convenient access to the top deck from ground level.

4.8 Painting

4.8.1 The cooling towers shall be painted with suitable anti-corrosive paint as per approval of purchaser. All galvanized external surfaces shall be painted to match colouring scheme. Before painting galvanized surfaces -etch primer to be applied.

5. SHOP INSPECTION & TESTING

5.1 Compliance certificates for nozzles (Or rotary sprinkler), piping, fill material, drift eliminator, louvers components etc.

5.2 Certificate of conformance for all other material components.

5.3 Balancing report for Static & dynamic balancing of fan assembly.

6. TESTS AT SITE

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

7. PERFORMANCE GUARANTEE

7.1 The cooling tower shall be guaranteed to meet the performance requirements as specified & when tested in accordance with ATP-105.

7.2 The vendor shall furnish performance curves for the cooling tower showing variations in performance from design duty point with change in approach to wet bulb temperature, cooling range, water loading of cooling tower.

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

8.1 General arrangement drawing of complete cooling tower (showing plan, front elevation and side elevation) incorporating principal dimensions, limits of scope of supply of piping, limits of civil works included showing extent of platforms, walkways, handrails, access doors, staircase etc. and the limits of scope of supply of electrical works.

8.2 General arrangement and sectional assembly drawings pertaining to the following components of the cooling tower:

i) Tower fill with supporting arrangement.
ii) Drift eliminator installation and details.
iii) Complete hot water distribution system including flow regulating valves, distribution basin/pipes and nozzles etc.

8.3 Cooling tower performance curves showing WBT Vs cold-water temperature for design cooling range, 90% cooling range and 110% cooling range at 100%, 90%, and 110% design flow.

8.4 Performance curves of cooling tower fans.

8.5 Test procedure along with details of tests to be conducted for the offered cooling tower.

8.6 Quality Plan along with complete details of the testing and inspection requirements of mechanical and electrical items of the cooling tower in BHEL format.

8.7 Operation and maintenance instructions.

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A. **GENERAL DATA**

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

B. **DESIGN DATA**

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

C. **MATERIAL**

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

D. ACCESSORIES

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

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

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SECTION-D

CENTRIFUGAL PUMPS

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1. GENERAL

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

2. CODES AND STANDARDS

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

2.1.1 IS-1520 : Horizontal centrifugal pumps for clear, cold and fresh water.

2.1.2 IS-5120 : Technical requirements - Rotodynamic special purpose pump.

2.1.3 IS-1710 : Vertical turbine pumps for clear, cold and fresh water.

2.1.4 BS - 599 : Method of testing Pumps.

2.1.5 PTC - '6' : Centrifugal Pumps Power test code

2.1.6 API - 610

2.1.7 Hydraulic Institute Standards of USA

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

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

3. DESIGN REQUIREMENTS

3.1 The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability.

3.2 The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards..

3.3 All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.

3.4 The pump shall be suitable for handling the fluid as specified in Data Sheet-A.

4. CONSTRUCTION FEATURES:

4.1 **PUMP CASING**

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

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

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

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

4.2 **IMPELLER**

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

4.3 **WEARING RING**

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

4.4 **SHAFT**

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

4.5 **BEARING**

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

4.6 **STUFFING BOX**

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

4.7 **SHAFT COUPLING**

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

4.8 **BASE PLATE AND SOLE PLATE**

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

4.9 **PRIME MOVER**

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

4.10 **LIFTING ARRANGEMENT**

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

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5. PERFORMANCE REQUIREMENTS

5.1 The pump shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the Range of Operation as stipulated in the data specification sheets.

5.2 Pump shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off. Power capacity characteristic will be non-overloading type i.e. 110% of the design flow the power required to drive the pump will be practically the same as that at the design flow.

5.3 Wherever specified in data sheet, pumps of each category shall be suitable for parallel operation. The head vs capacity, input power vs. capacity characteristics, etc., shall match to ensure equal load sharing and trouble free operation throughout the range.

5.4 The pump motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any malfunction of the system.

6. DRIVE RATING

6.1 The power rating of the drive shall be selected such that a minimum margin of 15% is available over the pump input power required at the rated duty point. However, the drive rating shall not be less than the maximum power requirement at any point within the 'Range of Operation' specified.

6.2 In cases where parallel operation of the pumps are specified the actual drive rating is to be selected by the bidder considering overloading of the pumps in the event of tripping of one of the operating pumps.

6.3 The bidder under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.

7. SCOPE OF INSPECTION AND TESTING

7.1 **CASTING**

7.1.1 The Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers. Castings shall have 'as cast' heat numbers unless they require overall machining. For partially machined components manufacturer shall ensure availability of as cast heat nos. on unmachined area.

7.1.2 Identification and correlation with test reports for all tests as per the relevant material specifications for castings of 'Major' nature such as suction bell, discharge elbow, stuffing box, gland, wearing rings, shaft sleeves etc.

7.1.3 Foundry's conformity certificate for castings of 'Minor' nature such as base plates, covers etc.

7.1.4 Verification of Heat treatment charts (as applicable)

7.1.5 Castings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.

7.1.6 Surface finish of Steel castings shall meet MSS SP-55.

7.2 **FORGING**

7.2.1 Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.

7.2.2 Verification of heat treatment charts (time temperature) (as applicable).

7.2.3 Forgings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.

7.3 **FABRICATED ITEMS**

7.3.1 Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.

7.3.2 Approval of welding procedure specifications and qualifications of weld procedures and personnel as per ASME Sec IX.

7.3.3 Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8

7.3.4 Verification of heat treatment charts (time temperature), (as applicable)

7.3.5 **Note:** For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating original test certificates are not available, material shall be identified by Main Vendor and test conducted at NABL approved Laboratory.

7.4 **IN PROCESS INSPECTION AND TESTING**

7.4.1 Identification Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. Permissible defects and acceptance norms need to be specified. On static parts acceptance norms are as per ASME Sec.III NB 2546.

7.4.2 Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness) as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder. Probe shall be of min. 2 MHz frequency.

7.4.3 Acceptance norms for UT for dynamic duty components. the following defects are unacceptable

a) Cracks, flakes, seams and laps

b) Defects giving indications longer than that from a 4mm equivalent flaw.

c) Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%.

d) Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.

7.4.4 For static duty components - as per NB 2542.2 of ASME Sec. III

7.4.5 Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage.

Note : In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures

7.4.6 Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.

7.5 **PERFORMANCE TEST**

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

a) Capacity V/s Head

b) Capacity V/s Power absorbed by pump

c) Capacity V/s pump efficiency

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

7.5.2 NPSH test in case specifically mentioned elsewhere.

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

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

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

7.5.6 Painting and packing as per technical specification.

7.6 **TEST AT SITE**

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

7.7 **PERFORMANCE GUARANTEE**

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

8. CLEANING, PROTECTION , PAINTING & PACKING

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

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

9.1 Fully dimensioned outline GA drawings of the pump motor assembly unit for each type and size offered. This drawing should include:

a) Foundation base plate and sole plate details as applicable

b) Civil foundation and anchor bolts details and loading data

c) Minimum submergence required for the pump (if applicable)

9.2 Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction and/ make with standard applicable codes.

9.3 Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.

9.4 Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.

9.5 Experience list about the supply and successful operation of similar pumps for similar application.

9.6 A comprehensive write up or brochure on the details of manufacturing and testing facilities in the shop of the manufacturer.

9.7 Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer's works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.

9.8 Data sheet-B with all the particulars filled in.

10. MANUFACTURERS NAME AND TAG. PLATES

10.1 Each pump shall have a permanently attached brass/ Stainless steel tag on the body indicating the following information both in Hindi and English:

a) Manufacturer's name and trade mark.

b) Design Capacity and Head.

c) Design.

d) Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

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

11.1 Certified GA drawings of pump motor assembly weights, crane.

11.2 Detailed cross sectional drawings of the pump and motor assembly and all equipment & accessories supplied under the this specification along with details of material of construction with applicable standard codes.

11.3 Foundation drawings with details of foundation pocket indicating static as well as dynamic load and other data with dimensions.

11.4 Certified characteristics curves (discharge capacity vs. head, BHP and efficiency) of each type of pump and motor.

11.5 Material and other test certificates as required by the application clauses of this specification.

11.6 Motor speed torque curves super imposed on pump speed torque curves.

11.7 Quality plan along with complete details of testing and inspection requirements of centrifugal pumps in BHEL format. Vendor shall also furnish Field Quality Plan.

11.8 Installation , operation and maintenance manual.

11.9 Other drawings and data, if necessary.

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	TITLE	SPECIFICATION NO. PE-TS-411-553-A004.
BHEL	**CENTRIFUGAL PUMPS**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 / DATE APRIL 2015
		SHEET 1 OF 2

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

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15. **ACCESSORIES REQUIRED:-**

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

a) Suction & Discharge pressure gauges. : Yes.

b) Vent connection : Yes.

c) Drain piping up to common drain point in plant room. : Yes

d) Companion flanges. : Yes

e) Common base plate. : Yes.

f) Suction strainer. : Yes

g) Isolating valve : Yes

h) NRV at pump outlet at inlet/outlet : Yes

i) Any special requirements : The Chilled Water pumps shall be suitably insulated as per spec.

j) Inspection & Testing : As per specification enclosed elsewhere.

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SECTION-D

PACKAGE CONDITIONING UNIT

Arvind S A Khan Praveen Kishore

1 GENERAL

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

2 CODES AND STANDARDS

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

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

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

3 DESIGN AND CONSTRUCTIONAL REQUIREMENTS

3.1 Compressor

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

3.2 **CONDENSING UNIT**

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

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3.2.1 Hot gas inlet and liquid outlet connection with shut off valve for liquid.

3.2.2 Drain plug, air vent and test valve.

3.2.3 Water inlet and outlet connection with thermowell and suitable cocks respectively.

3.2.4 Relief valve and air purge valve (Fusible plug in place of relief valve not acceptable)

3.2.5 Any other accessory as recommended by the manufacturer for proper functioning of the equipment.

3.3 AIR HANDLING FAN

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

3.4 FILTERS

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

3.5 COOLING COIL

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

3.6 CONTROLS

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

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

3.7 REFRIGERANT PIPING

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

3.8 CABINET

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

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

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

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

3.9 **OTHER ACCESSORIES**

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

4 CONTROL AND INTERLOCK REQUIREMENTS

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

The interlocking requirement shall be as indicated below:

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

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

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

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

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

5 TEST AND INPSECTION

5.1 Inspection and Testing at Manufacturer's Works

5.1.1 static and dynamic test for fans

5.1.2 Hydrostatic static test on condenser and cooling coil.

5.1.3 vacuum/pressure test for the complete refrigeration circuit.

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

5.1.5 Free running test on compressor.

5.1.6 AIR CAPACITY WITH ANEMOMETER.

5.1.7 NOISE LEVEL- <=85 dB(A).

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

5.2 Inspection and Testing at Site

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

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

5.2.1.1 Condenser inlet and outlet pressure and temperature

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

5.2.1.3 Motor current for the compressor and blower.

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

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Room temperature (Dry & wet bulb)

5.2.1.5 Test to ensure all controls and safety instruments are working properly.

During the above testing, noise level also will be checked to ensure that the same are within acceptable limits. Any undue vibration detected physically will be corrected.

All tools and instruments required for the above testing will be provided by the vendor.

6 PAINTING:

The packaged unit shall be given two coats of primer paint finished with two coats of finish paint as per Manufacturers std. unless specified otherwise elsewhere/ Data sheet 'A'. The colour of finish paint will be as specified in Data Sheet-A.

7 GUARANTEES

The package unit shall be guaranteed for performance measured in terms of the inside temperature maintained.

The packaged unit shall also be free from any manufacturing defects and shall be guaranteed as per contract after the first test as per 5.0 is successfully carried out, and the plant taken over by the purchaser.

8 NAME PLATES

Suitable Name plate as per Data Sheet 'A', depicting the equipment number as designated in Data Sheet A shall be provided for each packaged unit and screwed to a prominent position on the packaged unit.

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9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1 Final technical data as per Data Sheet-B

9.2 G.A. and interior view of packaged unit

9.3 Electrical wiring diagram

9.4 Catalogues for all controls

9.5 O & M Manual

9.6 Erection Manual

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	TITLE	SPECIFICATION NO. PE-TS-411-553-A00.
BHEL	**PACKAGE-CONDITIONING UNIT**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 / DATE APRIL 2015
		SHEET 1 OF 1

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

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SECTION-D

AIR FILTER

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1. GENERAL

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

2. CODES AND STANDARDS

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

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

3. GENERAL

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

3.1 POLY FIBRE AIR FILTERS

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

3.2 DRY FABRIC AIR FILTERS

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

3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

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

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

3.4 AUTOMATIC CLEANING FILTERS

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

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

3.5 ABSOLUTE FILTERS

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

3.6 WATER REPELLANT NYLON FILTERS

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

4. INSPECTION & TESTING

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

4.1 Dimensional inspection of frame & filter media.

4.2 Witnessing of type tests on one per type per size air filters for the following properties.

a) Gravimetric efficiency.

b) Pressure drop in clean & dirty (choked - %age to be specified) condition.

c) Efficiency as per BS EN - 779.

4.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet).

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

5.1 GA Drawing.

5.2 Drawing showing material/construction detail

5.3 Installation and\service manual

5.4 Rating curves/charts

5.5 Test certificates

5.6 Elect. diagrams (when automatic cleaning type)

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	TITLE	SPECIFICATION NO. PE-TS-411-553-A006
BHEL	**AIR FILTER** **DATA SHEET - A**	VOLUME II-B SECTION D REV 00 DATE APRIL 2015 SHEET 1 OF 1

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

Note:-

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

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SECTION-D

LOW PRESSURE AIR DISTRIBUTION SYSTEM

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1. GENERAL

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

2. CODES AND STANDARDS

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

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

a) IS: 655 - Specifications for metal air ducts.

b) IS:277 - Specifications for galvanised steel sheets.

c) IS:737 - Specification for wrought aluminium and aluminium alloy sheet and strip.

3. MATERIAL

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

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

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

4. CONSTRUCTION/FABRICATION

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

4.2 **RECTANGULAR DUCTS**

4.2.1

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

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

4.2.2 All rectangular ducts having either dimension larger than 450mm shall be cross broken except these ducts which are insulated with sand cement plaster. Air outlet connections on ducts need not be cross broken.

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

4.2.4 The flanges used for transverse joints shall be joined together with GI bolts (grade 4.6) and nuts spaced at 125mm centres as per following:

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

4.2.5 The MS angle flanges shall be connected to ducts with rivets at approx. 100mm centres. The flanged joints shall have 6mm thick felt packing stuck to flanges with shellac varnish. The holes in the felt packing shall be burnt through. The ducts are to be tapped 6mm across the MS flanges.

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

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4.3 **ROUND DUCTS**

4.3.1

S.No.	Duct dia-mm	Sheet Thickness		Reinforcing
		(mm) GI	(mm) Al	
a)	Up to 150	0.63 (24G)	0.80	None
b)	151 to 600	0.80 (22G)	1.00	None
c)	601 to 1000	1.00 (20G)	1.50	40x40x3mm girth MS
d)	1001 to1250	1.00 (20G)	1.50	40x40x3mm girth MS angles at 2.0 meter centres
e)	1251 & above	1.25 (18G)	1.80	40x40x3mm girth MS angles at 1.2m centres

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

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

4.4 **DUCT SUPPORTS**

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

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

4.5 **FLEXIBLE CONNECTIONS**

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

4.6 **TRANSFORMATIONS AND BREACHES**

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

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4.7 **CAULKING**

Wherever duct passes through wall, the opening between masonary and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.

4.8 **EASEMENT**

Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.

4.9 **ACCESS DOORS**

Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc.

All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.

4.10 **DAMPERS AND SPLITTERS**

4.10.1 Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.

4.10.2 FIRE DAMPERS

Fire dampers shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal sensor or fusible link type.

4.10.3 VANES

Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.

4.10.4 FLASHING

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

4.11 **DIFFUSERS AND GRILLS**

The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor's reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The diffusers/grills shall be approved by purchaser.

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

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

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

4.12 **PLENUMS AND RA BOXING**

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

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

4.13 **ACCOUSTIC LINING**

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

4.14 **PAINTING**

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

4.15 **THERMAL INSULATION**

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

5. INSPECTION AND TESTING

5.1 **INSPECTION & TESTING DURING FABRICATION**

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

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

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

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

5.1.5 Bend test & wrapping test as per IS-277.

5.1.6 Zinc coating test on samples as per IS-6745.

5.2 **INSPECTION & TESTING AT SITE.**

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

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

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6. BALANCING

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

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

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

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

7.2 Test certificates in line with scope of inspection.

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

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	TITLE	SPECIFICATION NO. PE-TS-411-553-A007
BHEL	**LOW PRESSURE AIR DISTRIBUTION SYSTEM**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 / DATE APRIL 2015
		SHEET 1 OF 1

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

NOTE:

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

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VOLUME: III

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DOCUMENTS TO BE SUBMITTED BY BIDDER ALONG WITH THE BID.

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

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

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COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

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

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

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

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

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

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

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

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

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

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

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

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

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

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

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

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

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PRE-BID CLARIFICATION SCHEDULE

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

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

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

Arvind S A Khan Praveen Kishore

DEVIATION SHEET (COST OF WITHDRAWL)

PROJECT:- 4X270 MW BHADRADRI TPS

PACKAGE:- AIR CONDITIONING SYSTEM

TENDER ENQUIRY REFERENCE:-

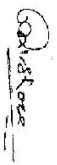
NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION / TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
OMMERCIAL DEVIATIONS									
ARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE									
NAME				**DESIGNATIONS**		**SIGN & DATE**			

NOTES:

1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawl of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.

9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.
14. In case of descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.



AC SYSTEM FOR 4x270 MW BHADRADRI TPP --- SUGGESTIVE PRICE FORMAT ---- REV 00														
SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY						ERECTION AND COMMISIONING				TOTAL
				Unit Price (Rs)	Total ex-works price (Rs)	ED (Inc CESS) (Rs)	CST / VAT (Rs)	Freight (Including service tax, if applicable) (Rs)	TOTAL FOR site price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)	Service Tax (Rs)	TOTAL PRICE (Erection and commissioning including Service tax)	Total Price Supply FIOR site and E&C including service tax (Rs)
1.0	**LUMPSUM PRICES**													
1.1	Total lumpsum firm prices for equipment & Services as specified, Comprising Engineering, design, manufacture, inspection & Testing at manufacturer's/subvendor's works, Painting at manufactures works, duly packed for transportation, delivery to site, unloading, storage & handling at site, fabrication, erection and commissioning, performance and guarantee testing, submission of as built drawing, carrying out acceptance tests at site, and final painting of complete Air Conditioning system on turnkey basis as per specification PE-TS-411-553-A001 including mandatory spares, special tool & tackels for maintenance, commissioning spares, all taxes, duties etc.													
2.0	Break up prices for items covered in clause 1.0 above. In case, price indicated above does not match with item wise break-up given at 2.0, the highest price so calculated shall be considered for evaluation but in case of order, the same shall be placed at lowest price.													
2.1	**AC-Plant-1:** **(CENTRAL CHILLED WATER SYSTEM FOR MAIN CR AREAS COMMON FOR UNIT-1&2.)**													
2.1.1	Water Chilling packages, each of **minimum 250 TR capacity** consisting of (a) **Vapour Absorption Machine** complete with high temparature generator, low temperature generator / condenser assembly, Evaporator / absorber assembly with eliminators, regenerative heat exchangers, purge recovery units, absorbent pumps, refrigerant pumps all interconnecting piping, valve and other accessories, microprocessor based / PLC control panel incorporating controls safety & interlocks, required charge of lithiumbromide solution and refrigerant for all the units, cooling / heating switch valves, structural mounting base for all the components etc and accessories as specified including PRDS, condensate tank, condensate pump and desuperheating pump.	1	NO											
2.1.2	Water chilling packages, each of **minimum 250 TR** capacity consisting of (a) **Screw refrigerant compressor** complete with motors, control panel, multi drive set, controls and interlocks other accessories as specified; (b) Water cooled condenser adequately sized & other accessories and (c) Shell & tube type water chiller & other accessories, as specified.	1	NO											

AC SYSTEM FOR 4x270 MW BHADRADRI TPP --- SUGGESTIVE PRICE FORMAT ---- REV 00														
SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY						ERECTION AND COMMISIONING				TOTAL
				Unit Price (Rs)	Total ex-works price (Rs)	ED (Inc CESS) (Rs)	CST / VAT (Rs)	Freight (Including service tax, if applicable) (Rs)	TOTAL FOR site price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)	Service Tax (Rs)	TOTAL PRICE (Erection and commissioning including Service tax)	Total Price Supply FIOR site and E&C including service tax (Rs)
2.1.3	Sheet metal cabinet type air handling units (double skin as per specification) consisting of chilled water cooling coil, centrifugal blower, TEFC sq cage induction motor, drive set, filters (pre and fine filter), 3 way motorised mixing valve with thermostatic controls and other accessories to meet the AC load of the main **CR areas at 15.5m.**	3	NO											
2.1.4	Fibreglass reinforced plastic (FRP) construction cooling towers complete with fan, motor, FRP basin, nozzles, make-up water & quick fill water connection, Level witch, drains, piping, valves, strainers, ladder & all accessories as specified.	2	NO											
2.1.5	Centrifugal pump sets for condenser water recirculation complete with TEFC motor & all accessories as specified.	2	NO											
2.1.6	Centrifugal pump sets for chilled water recirculation complete with TEFC motor & all accessories, as specified.	2	NO											
2.1.7	Water MS/FRP Storage tank to cooling towers with level switch, pr switch and other accessories as required. Capacity of each tank 8 m3 .	2	NO											
2.1.8	MS/FRP Expansion Tank (insulated) for chilled water with all accessories as required, capacity 1 m3.	1	NO											
2.1.9	Non Chemical water treatment erquipment	1	Sets											
2.1.10	Condenser water piping with necessary fittings, strainers, valves including piping from soft water storage tank to pan humidifiers of AHU room as specified.	1	LOT											
2.1.11	Chilled water piping from AC plant to AHU rooms within power house building complete with valves supports, fittings, strainers, PUF section insulation with finish as per specification.	1	LOT											
2.1.12	MS medium class drain piping upto nearest drain point with and without insulation	1	LOT											
2.1.13	Monsoon reheating/ winter heating kit comprising strip heaters, safety controls, air-stat, contactors, frame work, thermostat & humidistat/ sensors etc.	1	LOT											
2.1.14	Pan type humidifier for each AHU room.	1	LOT											
2.1.15	Fresh air fan (axial flow type), complete with motor, inlet cone, air filters (pre and fine), dampers etc.	1	LOT											
2.2	**AC-Plant-2:** **(CENTRAL CHILLED WATER SYSTEM FOR MAIN CR AREAS COMMON FOR UNIT-3&4.)**													

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AC SYSTEM FOR 4x270 MW BHADRADRI TPP --- SUGGESTIVE PRICE FORMAT ---- REV 00														
SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY						ERECTION AND COMMISIONING				TOTAL
				Unit Price (Rs)	Total ex-works price (Rs)	ED (Inc CESS) (Rs)	CST / VAT (Rs)	Freight (Including service tax, if applicable) (Rs)	TOTAL FOR site price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)	Service Tax (Rs)	TOTAL PRICE (Erection and commissioning including Service tax)	Total Price Supply FIOR site and E&C including service tax (Rs)
2.2.1	Water Chilling packages, each of **minimum 250 TR capacity** consisting of (a) **Vapour Absorption Machine** complete with high temparature generator, low temperature generator / condenser assembly, Evaporator / absorber assembly with eliminators, regenerative heat exchangers, purge recovery units, absorbent pumps, refrigerant pumps all interconnecting piping, valve and other accessories, microprocessor based / PLC control panel incorporating controls safety & interlocks, required charge of lithiumbromide solution and refrigerant for all the units, cooling / heating switch valves, structural mounting base for all the components etc and accessories as specified including PRDS, condensate tank, condensate pump and desuperheating pump.	1	NO											
2.2.2	Water chilling packages, each of **minimum 250 TR** capacity consisting of (a) **Screw refrigerant compressor** complete with motors, control panel, multi drive set, controls and interlocks other accessories as specified; (b) Water cooled condenser adequately sized & other accessories and (c) Shell & tube type water chiller & other accessories, as specified.	1	NO											
2.2.3	Sheet metal cabinet type air handling units (double skin as per specification) consisting of chilled water cooling coil, centrifugal blower, TEFC sq cage induction motor, drive set, filters (pre and fine filter), 3 way motorised mixing valve with thermostatic controls and other accessories to meet the AC load of the main **CR areas at 15.5m.**	3	NO											
2.2.4	Fibreglass reinforced plastic (FRP) construction cooling towers complete with fan, motor, FRP basin, nozzles, make-up water & quick fill water connection, Level witch, drains, piping, valves, strainers, ladder & all accessories as specified.	2	NO											
2.2.5	Centrifugal pump sets for condenser water recirculation complete with TEFC motor & all accessories as specified.	2	NO											
2.2.6	Centrifugal pump sets for chilled water recirculation complete with TEFC motor & all accessories, as specified.	2	NO											
2.2.7	Water MS/FRP Storage tank to cooling towers with level switch, pr switch and other accessories as required. Capacity of each tank 8 m3 .	2	NO											
2.2.8	MS/FRP Expansion Tank (insulated) for chilled water with all accessories as required, capacity 1 m3.	1	NO											
2.2.9	Non Chemical water treatment erquipment	1	Sets											
2.2.10	Condenser water piping with necessary fittings, strainers, valves including piping from soft water storage tank to pan humidifiers of AHU room as specified.	1	LOT											

AC SYSTEM FOR 4x270 MW BHADRADRI TPP --- SUGGESTIVE PRICE FORMAT ---- REV 00														
SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY						ERECTION AND COMMISIONING				TOTAL
				Unit Price (Rs)	Total ex-works price (Rs)	ED (Inc CESS) (Rs)	CST / VAT (Rs)	Freight (Including service tax, if applicable) (Rs)	TOTAL FOR site price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)	Service Tax (Rs)	TOTAL PRICE (Erection and commissioning including Service tax)	Total Price Supply FIOR site and E&C including service tax (Rs)
2.2.11	Chilled water piping from AC plant to AHU rooms within power house building complete with valves supports, fittings, strainers, PUF section insulation with finish as per specification.	1	LOT											
2.2.12	MS medium class drain piping upto nearest drain point with and without insulation	1	LOT											
2.2.13	Monsoon reheating/ winter heating kit comprising strip heaters, safety controls, air-stat, contactors, frame work, thermostat & humidistat/ sensors etc.	1	LOT											
2.2.14	Pan type humidifier for each AHU room.	1	LOT											
2.2.15	Fresh air fan (axial flow type), complete with motor, inlet cone, air filters (pre and fine), dampers etc.	1	LOT											
2.3	**AC Plant -3, 4, 5 and 6 (ESP building) Unit-1, 2, 3 & 4**													
2.3.1*	Air-Cooled Precision Package AC of **15TR** (Net) complete with all accessories as specified	16	Nos*											
2.3.2	MS medium class drain piping insulated and cladded upto the nearest drain point.	4	LOT											
2.3.3	Fresh air fan (axial flow type), complete with motor, inlet cone, air filters (pre and fine), dampers etc.	4	LOT											
2.4	**AC-Plant-7: PAC SYSTEM FOR ADMINISTRATIVE BUILDING, SERVICE BLDG, CANTEEN AC AREAS,**													
2.4.1*	AIR COOED PAC 15TR	18	NO*											
2.4.2*	AIR COOED PAC 10TR	14	NO*											
2.4.3	MS medium class drain piping insulated and cladded upto the nearest drain point for Service building	1	LOT											
2.4.4	MS medium class drain piping insulated and cladded upto the nearest drain point for Admin building	1	LOT											
2.4.5	Fresh air arrangement with bird screen louvers and dampers for Service Building	1	LOT											
2.4.6	Fresh air arrangement with bird screen louvers and dampers for Admin Building	1	LOT											
2.5	**ITEMS COMMON TO ALL AC PLANTS**													
2.5.1*	Fan coil unit (FCU) consisting of chilled water cooling coil, blower, motor, drive set, filters (pre filter), 3 way motorised mixing valve with thermostatic controls and other accessories. All accessories like vibration isolation pads, hanger rods, supporting arrangement, canvass connection, nuts, bolts, washers and other items required to make the installation complete in all respect shall be supplied in adequate quaintity along with the FCUs.													

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AC SYSTEM FOR 4x270 MW BHADRADRI TPP --- SUGGESTIVE PRICE FORMAT ---- REV 00														
SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY						ERECTION AND COMMISIONING				TOTAL
				Unit Price (Rs)	Total ex-works price (Rs)	ED (Inc CESS) (Rs)	CST / VAT (Rs)	Freight (Including service tax, if applicable) (Rs)	TOTAL FOR site price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)	Service Tax (Rs)	TOTAL PRICE (Erection and commissioning including Service tax)	Total Price Supply FIOR site and E&C including service tax (Rs)
a*	5TR	16	NO*											
b*	3 TR	12	NO*											
c*	2 TR	2	NO*											
d*	1.5 TR	2	NO*											
2.5.2*	Fire damper.													
a*	Fire damper with auto resetting, limit switches, indication lamps etc.	40	SQM*											
b*	Motorized actuator with single phase power supply for the above fire damper.	45	NO*											
2.5.3*	GSS zinc coating **180** gms/ m^2 ducting complete with hangers/ supports, dampers, grilles, diffusers (with & without VCD) etc.													
a*	18G.	1500	SQM*											
b*	20G.	1500	SQM*											
c*	22G.	2200	SQM*											
d*	24G.	4000	SQM*											
e*	SUPPLY AIR DIFFUSERS / GRILLS with VCD (Extruded Aluminium powder coated) complete with fixing frames, nuts, bolts, gaskets, washers etc	70	SQM*											
f*	RETURN AIR DIFFUSERS / GRILLS without VCD (Extruded Aluminium powder coated) complete with fixing frames, nuts, bolts, gaskets, washers etc	90	SQM*											
g*	VOLUME CONTROL DAMPERS in GI construction as per specifications for supply / return ducts complete with fixing arrangement.	30	SQM*											
2.5.4	Acoustic insulation of the first 6 of ducting from AHU outlets with material and finish as per specifications.	1	LOT											
2.5.5*	Thermal insulation of supply air duct & return air duct with finish as specified.	9200	SQM*											
2.5.6	Field instruments like pressure gauge, temperature gauge, pressure switch, differential pressure switch, flow switch, flow meter etc.	1	LOT											
2.5.7	PLC control system complete with PLC panels , RIO panels and all accessories as specified in the specification.	1	LOT											
2.5.8*	Fiber optic cable	1000	Meter*											
2.6	**Air conditioning system for aux control rooms as specified.**													

AC SYSTEM FOR 4x270 MW BHADRADRI TPP --- SUGGESTIVE PRICE FORMAT ---- REV 00														
SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QTY	UNIT	SUPPLY						ERECTION AND COMMISIONING				TOTAL
				Unit Price (Rs)	Total ex-works price (Rs)	ED (Inc CESS) (Rs)	CST / VAT (Rs)	Freight (Including service tax, if applicable) (Rs)	TOTAL FOR site price SUPPLY (Rs)	Unit Price (Rs)	Total price (Rs)	Service Tax (Rs)	TOTAL PRICE (Erection and commissioning including Service tax)	Total Price Supply FIOR site and E&C including service tax (Rs)
2.6.1*	Air-cooled split type AC units consisting of condensing unit & evaporating unit including refrigerant pipes & fittings with insulation etc. (Minimum BEE Rating 5 Star for non ductable units)													
2.6.1.1*	5.0 TR capacity (ductable type, 415 V, 3 phase with isolation switch).	2	NO*											
2.6.1.2*	2.0 TR capacity (non-ductable type, 240 V, 1 phase isolation switch) with isolation switch , i.e MCB of suitable rating as specified.	35	NO*											
2.6.1.3*	1.5 TR capacity (non-ductable type, 240 V, 1 phase isolation switch) with isolation switch , i.e MCB of suitable rating as specified.	70	NO*											
2.7*	Handling arrangement as per specification													
a*	Electric Hoist with traveling trolley of 5T capacity	2	NO*											
b*	Manual trolley	3	LOT*											
2.8	Total lumpsum price for special tools & tackles for maintenance inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).	1	LOT											
2.9	Total lumpsum price for commissioning spares inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).	1	LOT											
2.10	Total lumpsum price for mandatory spares inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).	1	LOT											

NOTES

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

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

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

4 Items like drain piping with insulation, Duct work with accessories, insulation etc are commom for all the AC plants

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

MANDATORY SPARE LIST - 4 x 270 MW BHADRADRI TPS, AIR CONDITIONING SYSTEM									
SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY	UNIT	SUPPLY					
				Unit Price (Rs)	Total ex-works price (Rs)	ED including CESS (Rs)	CST / VAT (Rs)	FREIGHT including Service Tax, If applicable (Rs)	TOTAL F.O.R. Site Price Supply (Rs)
1.1	**Vapour absorption machine**								
1.1.1	Manometer	1 no							
1.1.2	Diaphragm	1 set							
1.1.3	Sampling kit	1 set							
1.1.4	Generator temp. sensor	1 no							
1.1.5	Generator pressure switch	1 no							
1.1.6	Anti-freeze thermostat	1 no							
1.1.7	Service valve	1 no							
2.1	**Screw Chiller**								
2.1.1	Bearing for the compressor	1 Set for each rating of compressor							
2.1.2	Gaskets as applicable for Condenser & Chiller Heads	1 Set for each rating of chiller							
2.2	**Centrifugal Pump**								
2.2.1	Bearings for each pump and motor	1 Sets for each rating of pump & motor							
2.2.2	Mechanical seal / gland packing as applicable, wearing rings and lantern rings for shaft and impeller	1 Set for each type and rating of pump							
2.2.3	Complete Impeller Assembly	1Set for each application and ratings of Pumps							
2.2.4	Key for impeller	1No. for each application and ratings of Pumps							
2.2.5	Pump shaft	1No. for each application and ratings of Pumps							
2.2.6	Coupling	1No. for each application and ratings of Pumps							
2.3	**Cooling Tower**								
2.3.1	Spray nozzles	10% of each rating of cooling tower							
2.3.2	Set of fills	10% of each rating of cooling tower							
2.3.3	Bearings for each fan and motor	1 Sets for each rating of fan & motor							
2.4	**Refrigerant & Oil**								
2.4.1	Refrigerant gas in a non-returnable cylinder	15% of installed charge							
2.4.2	Filter oil in sealed tins for the full set for 6 operations of cleaning	As required							
2.5	**Air Handling Units**								
2.5.1	Bearings for each AHU fan & motor	1 Set for each rating of fan							
2.5.2	V-Belts	1 Set for each type of AHU							
2.5.3	Filters of each type	1 Set for each type of AHU							
2.6	**Centrifugal fans**								
2.6.1	Bearings for fan & motor	1 Sets for each rating of fan & motor							
2.6.2	V-belts	1 Set for each rating of fan							
2.6.3	Vibration Isolators	1 set for each rating of fan							
2.7	**Precision Air Conditioners / Package Air Conditioners**								
2.7.1	Filters	1 set for each PAC unit							

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SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY	UNIT	SUPPLY					
				Unit Price (Rs)	Total ex-works price (Rs)	ED including CESS (Rs)	CST / VAT (Rs)	FREIGHT including Service Tax, If applicable (Rs)	TOTAL F.O.R. Site Price Supply (Rs)
2.7.2	Bearings	1 set for each rating of PAC unit (both for condenser & Indoor Unit)							
2.7.3	Expansion valve	1 set for each rating of PAC unit							
2.8	**Mandatory Spares for Programmable Logical Control (PLC) and other Electronic System / Subsystem / PLC**								
2.8.1	Function controller and control modules (10% of number for each type or minimum of 4 number for each type whichever is high.)	2 Lot							
2.8.2	Process I/O cards and drive modules (10% of the number of cards offered for the project from each category.)	2 Lot							
2.8.3	All other type of electronic modules like CPU of workstation, Power supply modules, communication modules, modules for Data highway / modules for LAN, controllers not covered above (10% of each type or minimum of 2 nos. of each type whichever is more).	2 Lot							
2.8.4	All cards, controllers, lamp and other components used in LVS.	2 Lot (10%)							
2.8.5	control logic power supply fuses at each current rating (Three times the one hundred percent spare replacement).	2 Lot							
2.8.6	Electric to pneumatic converters (10% of each type utilized with automatic control system using pneumatic drives or a minimum of one of each type, whichever is more.)	2 Lot							
2.8.7	Plug-in type keyboard	2 No. of each type							
2.8.8	Dot matrix Printer	2 No.							
2.8.9	CRT	2 No.							
2.8.10	DVDs	40 Nos.							
2.8.11	Printer ribbons /inking mechanism for colour printer.	20 Nos.							
2.8.12	Ribbons for dot matrix printer.	60 Nos.							
2.8.13	Data highway cable with adequate connectors.	500 Meters							
2.8.14	Hard disc drive unit as offered for system complete with accessories.	2 No.							
2.8.15	Interface cables for each type	4 Sets							
2.8.16	Power supply modules of each type and rating	2 Lot (10%)							
2.8.17	Interposing / coupling relays of each type.	2 Lot (5% of total quantity)							
2.9	**Mandatory Spares for Control Panels / Desks**								
2.9.1	Crimping Pins	2 Roll							
2.9.2	Bulbs for indicating lights (Three times the one hundred percent spare replacement)	2 Lot							
2.9.3	control circuit fuses of each current rating (Three times, the one hundred percent spare replacement)	2 Lot							
2.9.4	Push buttons, electrical control switches and Illuminated push buttons etc	2 Lot (20%)							
2.10	**Mandatory Spares for Un-Interruptible Power Supply System :**								
2.10.1	Fuses (3 times, the one hundred percent spare replacement fuses shall be furnished with each panel board.)	2 Lot							

SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY	UNIT	SUPPLY					
				Unit Price (Rs)	Total ex-works price (Rs)	ED including CESS (Rs)	CST / VAT (Rs)	FREIGHT including Service Tax, If applicable (Rs)	TOTAL F.O.R. Site Price Supply (Rs)
2.10.2	Electronic modules for UPS , Charger, static switch & stabilzer and DC power supply system with each set consisting of atleast one number of each type of electronic module for inverters, chargers, static switch, stabiliser etc.	2 Set							
2.10.3	Battery cells	2 Lot (10%)							
2.10.4	Thyrister without heat sink	2 Lot (10%)							
2.10.5	Semiconductor fuse	2 Lot (10%)							
2.11	**LP VALVES**								
2.11.1	LP Piping valves & traps - Complete assembly	5% or min. 1 no. (whichever is more) for each size, type & rating for total population							
2.11.2	Steam traps - Complete assembly	5% or min. 1 no. (whichever is more) for each size, type & rating for total population							
2.12	**Mandatory Spares for Temperature Elements and Thermowells**								
2.12.1	Thermocouple / RTD elements (10% of each type and length of elements , or a minimum of one number, whichever is more.)	2 Lot							
2.12.2	Thermowells for each type of temperature sensors (10% or a minimum of one for each type, whichever is more.)	2 Lot							
2.13	**Mandatory Spares for Electronic Transmitters (for pressure, DP, Flow, level, Temperature) and Electrical Transducers.**								
2.13.1	Transmitters and Electrical Transducers (10% of total number of offered for each model and type for the project or a minimum of one number, whichever is more)	2 Lot							
2.14	**Mandatory spares for local gauges/switch (for Pressure, DP, Temperature, Flow, level , etc.)**								
2.14.1	Local gauges/ Switch (for Pressure, DP, Temperature, Flow, level , etc.) (10% of total number of instruments offered for each model and type for the project or a minimum of one number, whichever is more.)	2 Lot							
2.15	**CONTROL VALVES**	**FOR 1 UNIT**							
2.15.1	DIAPHRAGM	2 NOS. OF EACH TYPE OF ACTUATOR							
2.15.2	GLAND PACKING	1 SET FOR EACH TYPE OF VALVE							
2.15.3	TRIM	1 SET FOR EACH TYPE OF VALVE							
2.15.4	GASKET	2 SET FOR EACH TYPE OF VALVE							
2.15.5	POSITION TRANSMITTER COMPLETE SET	10 % of total quantity used in the system							
2.15.6	complete set of solenoid valve for on/off valve	5 nos.for each type & ratings							
2.15.7	Position limit switch	5 nos.for each type & ratings							

Arvind

S A Khan

Praveen Kapoor

SL No	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY	UNIT	SUPPLY					
				Unit Price (Rs)	Total ex-works price (Rs)	ED including CESS (Rs)	CST / VAT (Rs)	FREIGHT including Service Tax, If applicable (Rs)	TOTAL F.O.R. Site Price Supply (Rs)
2.16	**Electrical Spares for Motors**								
2.16.1	Motor bearing set for AHU fan motor	1 set for each type and rating of fan motor							
2.16.2	Motor bearing set for fresh air fan motor	1 set for each type and rating of fan motor							
2.17	**Material handling equipment spares as applicable**	**As specified under Section C-4 of Volume II-B "Material handling equipment specification".**							

NOTE:	
1	**Unless stated otherwise, a "set" or "Lot" means items required for complete replacement in one equipment of each type / size/ range.**
2	**Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the population of the item required for one unit of 270 MW in the station (project), unless specified otherwise.**
3	**In case of Bought Out items, itemised spares list may be vendor specific and may differ from the list of spares mentioned above. In such cases, The quoted price shall be considered for applicable items only without any change in the contract price.**

Arvind

S A Khan

Pravin Kalore

APPENDIX - A
Percentage breakup for Air Conditioning Package
4x270 MW BHADRADRI TPS

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	Percentage of total price
1	Total lumpsum firm prices for equipment & Services as specified, Comprising Engineering, design, manufacture, inspection & Testing at manufacturer's/subvendor's works, Painting at manufactures works, duly packed for transportation, delivery to site, unloading, storage & handling at site, fabrication, erection and commissioning, performance and guarantee testing, submission of as built drawing, carrying out acceptance tests at site, and final painting of complete air conditioning system on turnkey basis as per specification PE-TS-411-553-A001 for 4x270 MW BHADRADRI TPS including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc. (Without mandatory spare - Sr. No. 2.10 of suggestive price format)	**100%**
2.0	**BREAK-UP OF PRICES GIVEN IN 1.0 ABOVE (To be used during contract execution for payment)**	
2.1	Total lump sum firm price for EQUIPMENT (SUPPLY) for Engineering, design, manufacture, inspection & Testing at manufacturers works/subvendor's work, Painting at manufactures works, duly packed for transportation, delivery to site, unloading storage & handling at site, for the complete scope of supply of air conditioning system and as defined in the technical specification (PE-TS-411-553-A001) for 4x270 MW BHADRADRI TPS.	**80%**
2.1	Erection & commissioning, carrying out acceptance tests at site, final painting and handing over to customer the complete AC system on turnkey basis as per specification PE-TS-411-553-A001 including all taxes, duties etc..	**20%**
3.0	**Break-up (%) of prices given at Sl No-2.1 above (To be used during contract execution for payment)**	**Percentage of total price of SL No 2.1 above**
3.1	Water Chilling machine - VAM - (Item no 2.1.1 & 2.2.1 of Suggestive price format)	**10.00%**
3.2	Water Chilling machine - Screw Chiller - (Item no 2.1.2 & 2.2.2 of Suggestive price format)	**9.00%**
3.3	Air handling units (Item Nos 2.1.3 & 2.2.3 of Suggestive price format)	**6.50%**
3.4	Cooling Towers (Item no 2.1.4 & 2.2.4 of Suggestive price format)	**2.00%**
3.5	Pumps (Item no 2.1.5, 2.1.6, 2.2.5, 2.2.6 of Suggestive price format)	**1.50%**
3.6	Tanks (Item Nos 2.1.7, 2.1.8, 2.2.7, 2.2.8 of Suggestive price format)	**1.00%**
3.7	Water treatment equipment (Item no 2.1.9, 2.2.9 of Suggestive price format)	**0.80%**
3.8	Condenser water piping (Item no 2.1.10, 2.2.10 of Suggestive price format)	**5.50%**
3.9	Chilled & Drain water piping (Item no 2.1.11, 2.1.12, 2.2.11, 2.2.12, 2.3.2, 2.4.3, 2.4.4 of Suggestive price format)	**8.50%**
3.10	Heaters and humidifiers (Item no 2.1.13, 2.1.14, 2.2.13, 2.2.14 of Suggestive price format)	**2.50%**
3.11	Fresh air Fans and Fresh air arrangement (Item no 2.1.15, 2.2.15, 2.3.3, 2.4.5, 2.4.6 of Suggestive price format)	**1.00%**

3.12	Air cooled Precision AC - (Item no 2.3.1 of Suggestive price format)	**15.00%**
3.13	Air cooled PAC units (Item no 2.4.1, 2.4.2 of Suggestive price format)	**6.20%**
3.14	Air cooled split type AC units (Item no 2.6.1, 2.6.1.1, 2.6.1.2, 2.6.1.3 of Suggestive price format)	**3.50%**
3.15	Fan coil units (Item no 2.5.1 of Suggestive price format)	**0.50%**
3.16	Fire Dampers (Item no 2.5.2 of Suggestive price format)	**1.00%**
3.17	GSS Duct work with airline accessories (Item no 2.5.3 of Suggestive price format)	**7.00%**
3.18	Acoustic insulation (Item no 2.5.4 of Suggestive price format)	**1.00%**
3.19	Thermal Insulation (Item no 2.5.5 of Suggestive price format)	**7.00%**
3.20	Field instruments - (Item no 2.5.6 of Suggestive price format)	**2.00%**
3.21	PLC including cable (Item no 2.5.7, 2.5.8 of Suggestive price format)	**7.00%**
3.22	Handling Arrangment (Item no 2.7 of Suggestive price format)	**1.00%**
3.23	Special Tools tackles & Commissioning Spares (Item no 2.8, 2.9 of Suggestive price format)	**0.50%**

4X270 MW BHADRADRI TPS

AIR CONDITIONING SYSTEM

GUARANTEED POWER CONSUMPTION FIGURES

S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL GUARANTEED POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW)	DUTY FACTOR	TOTAL KW
		WORKING	STANDBY			
		3A	3B	4	5	6=3Ax4x5
1	**AC-Plant-1: (CENTRAL CHILLED WATER SYSTEM FOR MAIN CR AREAS COMMON FOR UNIT-1&2.)**					
1.1	Refrigerant pump, solution pump, control panel etc. for VAM package	1	0		1	
1.2	Water chilling machine -Screw chiller	0	1		1	
1.3	AHUs for Common control room areas, CER, computer room etc	2	1		1	
1.4	Cooling tower fans for AC plant	1	1		1	
1.5	Condenser water pumps for AC plant	1	1		1	
1.6	Chilled water pumps for AC plant	1	1		1	
1.7	Fresh air fans for above AHU room	1	0		1	
2	**AC-Plant-2: (CENTRAL CHILLED WATER SYSTEM FOR MAIN CR AREAS COMMON FOR UNIT-3&4.)**					
2.1	Refrigerant pump, solution pump, control panel etc. for VAM package	1	0		1	
2.2	Water chilling machine -Screw chiller	0	1		1	
2.3	AHUs for Common control room areas, CER, computer room etc	2	1		1	
2.4	Cooling tower fans for AC plant	1	1		1	
2.5	Condenser water pumps for AC plant	1	1		1	
2.6	Chilled water pumps for AC plant	1	1		1	
2.7	Fresh air fans for above AHU room	1	0		1	
3	**AC PLANT-3 (ESP Building- UNIT- 1)**					
3.1	Precision AC for ESP-1	2	1		1	
3.2	Fresh air fans for above PAC room.	1	0		1	
4	**AC PLANT-4 (ESP Building- UNIT- 2)**					
4.1	Precision AC for ESP-2	2	1		1	
4.2	Fresh air fans for above PAC room.	1	0		1	
5	**AC PLANT-5 (ESP Building- UNIT- 3)**					
5.1	Precision AC for ESP-3	2	1		1	
5.2	Fresh air fans for above PAC room.	1	0		1	
6	**AC PLANT-6 (ESP Building- UNIT- 4)**					
6.1	Precision AC for ESP-4	2	1		1	
6.2	Fresh air fans for above PAC room.	1	0		1	
				TOTAL (KW)		**520**

NOTES:

Arvind S A Khan Praveen Kishore

1 Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as **520** KW. So long bidder's quoted guaranteed power consumption (GPC) above remains within this EPC, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds EPC, there shall be technical loading of bid for evaluation @ **Rs 2,52,000/-** per KW of additional power over EPC.

2 Bidder’s guaranteed power consumption at motor input terminals (not shaft power) as furnished in relevant schedule shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than EPC / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ **Rs 2,52,000/-** per KW shall be levied on vendor.

Arvind S A Khan Praveen Kishore

INDUCED DRAFT COOLING TOWER
(1 WORKING & 1 STANDBY)
AT 21.0MT. LVL.

CT – 1 | CT – 2

CDS INLET PIPE | INLET | CT1 | CT2 | SUCTION SCREEN | OUTLET | CDS OUTLET PIPE | MAKE-UP | DRAIN | OVER FLOW | EQUALISER | NB #150 MAKE-UP | NB #100 EQUALISER

DRAIN PIPE HEADER LINE
CONNECTED TO NEAREST DRAIN POINT

MAKEUP WATER (8 Cu. M)
STORAGE TANK FOR COOLING TOWER
AT 23 MT. LVL. approx.

MAKE-UP WATER | AC SUPPLIER | BHEL | HLS | LLS | VENT | EXPANSION TANK (1 Cu. M) | INSULATION | DRAIN & OVERFLOW TO BE CONNECTED NEAREST DRAIN POINT

SHOULD BE PLACED AT LOWER LEVEL W.R.T. MAKE UP WATER TANK TO MAINTAIN GRAVITY FLOW AT 21 MT. LVL.

COLD WATER RETURN FROM COOLING TOWER

HOT WATER RETURN FROM CONDENSER TO C.T.

NOTE –
TEMPERATURE SENSOR(TS) IS INTEGRAL PART OF CHILLER, NECESSARY COMMAND WILL BE CARRIED OUT FROM PLC

CHILLER | CONDENSER | Motorised Butterfly Valve | Globe Valve | Motorised Butterfly Valve

SCREW CHILLER PACKAGE–1
(NORMALLY STANDBY)

INSULATION (typ.) | from expansion tank | from makeup | ISOLATION VALVE | SUPPLY AIR DUCT | 9kw STRIP HEATER | DPS | DW HUMIDIFIER

AHU–1 | AHU–2 | AHU–3 | F/A UNIT WITH FAN PREFILTER, FINE FILTER, DAMPER, COIL, BIRD SCREEN (TYP.) (1 X 100% DUTY) | FRESH AIR | MOTORISED BUTTERFLY VALVE | PRE FILTER | FINE FILTER | COIL | FAN | DRAIN | T.S | R.H.S | DUCTING AIR FOR CONTROL ROOM | DUCTING AIR FOR EQUIPMENT ROOM

AIR HANDLING UNIT
(2 WORKING & 1 STANDBY)

AHU ROOM AT 21 M LEVEL

INSULATED SA DUCT | INSULATED RA DUCT

COMMON CONTROL ROOM, CONTROL EQUIPMENT ROOM,
COMPUTER & PROGRAMMERS ROOM,
FOR UNIT # 1 & 2.
AC AREA AT 15.5 M LEVEL

TYPICAL INSULATION PIPE

CONDENSATE PIPE | PIPE INSULATION TYPICAL | ISOLATION VALVE | VENT | CONDENSATE TANK (INSIDE A/C PLANT ROOM) | VENDOR | BHEL | DRAIN

VAM | VAM 1 | (NORMALLY WORKING)

VAPOUR ABSORBTION MACHINE PACKAGE–1
(NORMALLY WORKING) AC PLANT ROOM–1

COLD WATER FROM CONDENSER WATER PUMPS

HOT WATER FROM CHILLED WATER PUMPS

CONDENSATE (1W+1S) | AC Supplier | CONDENSATE | BHEL | DESUPERHEATING PUMP | STEAM PIPE

PRESSURE REDUCING VALVE | STATION PRESSURE REDUCING | STEAM INLET | Isolation Valve | AC VENDOR | BHEL

STEAM PIPING WITH ISOLATION VALVE SHALL BE PROVIDED AT ONEPOINT IN AC PLANT RM. BY BHEL

CONDENSATE LINE FOR DE SUPER HEATING

ISOLATION VALVE | FCU–1 | FCU–2 | FCU–3 | FCU–4

FAN COIL UNIT
Adequate quanity and capacity
All are WORKING
FCU FOR SWAS ROOM & UPS Room at 9.0M EL.
UNIT # 1 & 2 OF TURBINE BUILDING

YSTR | NRV | DRAIN

2 x 100% CHILLED WATER PUMP
(1 W + 1 SB)

2 x 100% CONDENSER WATER PUMP
(1 W + 1 SB)

LEGEND :–

WFS	WATER FLOW SWITCH	CONDENSER,CHILLER OUTLET
PS	PRESSURE SWITCH	CDSWTR,CHWTR PUMP OUT,AHU FAN DISH.
	STRIP HEATER	SUPPLY AIR DUCT LINE
	DUCT	SUPPLY AIR DUCT
	FINE FILTER	AS SHOWN
	PRE FILTER	AS SHOWN
VCD	VOLUME CONTROLDAMPER	AS SHOWN
LG	LEVEL GAUGE	EXPANSION TANK,SOFTWATER TANK, STORAGE TANK
LS	LEVEL SWITCH	COOLING TOWER & EXPANSION TANK, SOFT WATER TANK,STORAGE TANK
MNRD	MOTORISED NON RETURN DAMPER	AFTER AHU MOUTH (EACH)
	PUMP	COND.WTR ,CHILLED WTR & MAKE–UP WATER
	PIPE	CONDENSER WATER PIPE
	PIPE	CHILLED WATER PIPE SUPPLY
	PIPE	CHILLED WATER PIPE RETURN
TG	TEMP.GAUGE.	COND–IN/OUT, CHILLER IN/OUT, AHU – IN/OUT
PG	PRESSURE GAUGE	COND–IN/OUT, CHILLER IN/OUT, PUMP–IN/OUT AHU – IN/OUT
T.S	TEMP.SENSOR	AS SHOWN
R.H.S	R.H.SENSOR	AS SHOWN
P.H	PAN HUMIDIFIER	IN SIDE A.H.U ROOM
	SA. FIRE DAMPER MOTOR OPERATED	SUPPLY AIR AS SHOWN (AT WALL)
	RA. FIRE DAMPER MOTOR OPERATED	RETURN AIR AS SHOWN (AT WALL)
	Y– STRAINER	ALL PUMP INLET
	FLOAT VALVE	ALL COOLING TOWER/ EXPANSION TANK PAN HUMIDIFIER
	NON RETURN VALVE	ALL PUMP OUT LET
	3–WAY–MIXNG.VALVE	ALL AHU CHWTR. RETURN LINE
	BALANCING VALVE	ALL AHU CHWTR. RETURN
	GATE VALVE	CDSW.PUMP INLET/OUTLET/CHW.PUMPIN&OUT COOLING TOWER OUT/CONDACHILLER IN/AHU IN ALL MAKE–UP/QUICK FILL/DRAIN.
MBV	MOTORISED BUTTER FLY VALVE	CONDENSER OUTLET/ CHILLER OUTLET COOLING TOWER INLET/AHU OUTLET
	BALL VALVE	
FM	FLOW METER	CONDENSER WATER OUTLET/CHILLED WATER OUT LINE
	ORIFICE PLATE	CONDENSER WATER OUTLET/ CHILLED WATER OUT LINE
GV	GLOBE VALVE	CONDENSER OUTLET / CHILLER OUTLET
VV	VENT VALVE	ASL SPRINKCHWTR. RETURN LINE
AT	AIR STAT	AS SHOWN
GT	GYSERSTAT	IN PAN HUMIDIFIER OR NEAR
DPS	DIFFERENTIAL PRESSURE SWITCH	AS SHOWN

GENERAL:–
1. THIS DRG. SHALL BE READ IN CONJUCTION WITH TECH SPEC NO. PE–TS–411–553–A001

NOTES :–

1. ALL PRESSURE & TEMPERATURE GAUGES WILL BE OF 150MM DIAL TYPE.
2. P/D MAY CHANGED DURING DETAIL ENGINEERING
5. P&ID shows only the bare minimum requirement of valves and instruments. Any instrumentation & valves as required for the completion of the system in line with technical specification shall be provided by bidder during detailed engineering without any commercial implication.

Similar PID shall follow for Main AC Plant–2 for Unit 3 & 4.

FOR TENDER

CUSTOMER : TSGENCO

PROJECT: 4X270 MW BHADRADRI TPS

BHARAT HEAVY ELECTRICALS LTD.
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, (UP)

	NAME	SIGN.	DATE
DRAWN			
DESIGN			
CHECKED			
APPROVED			

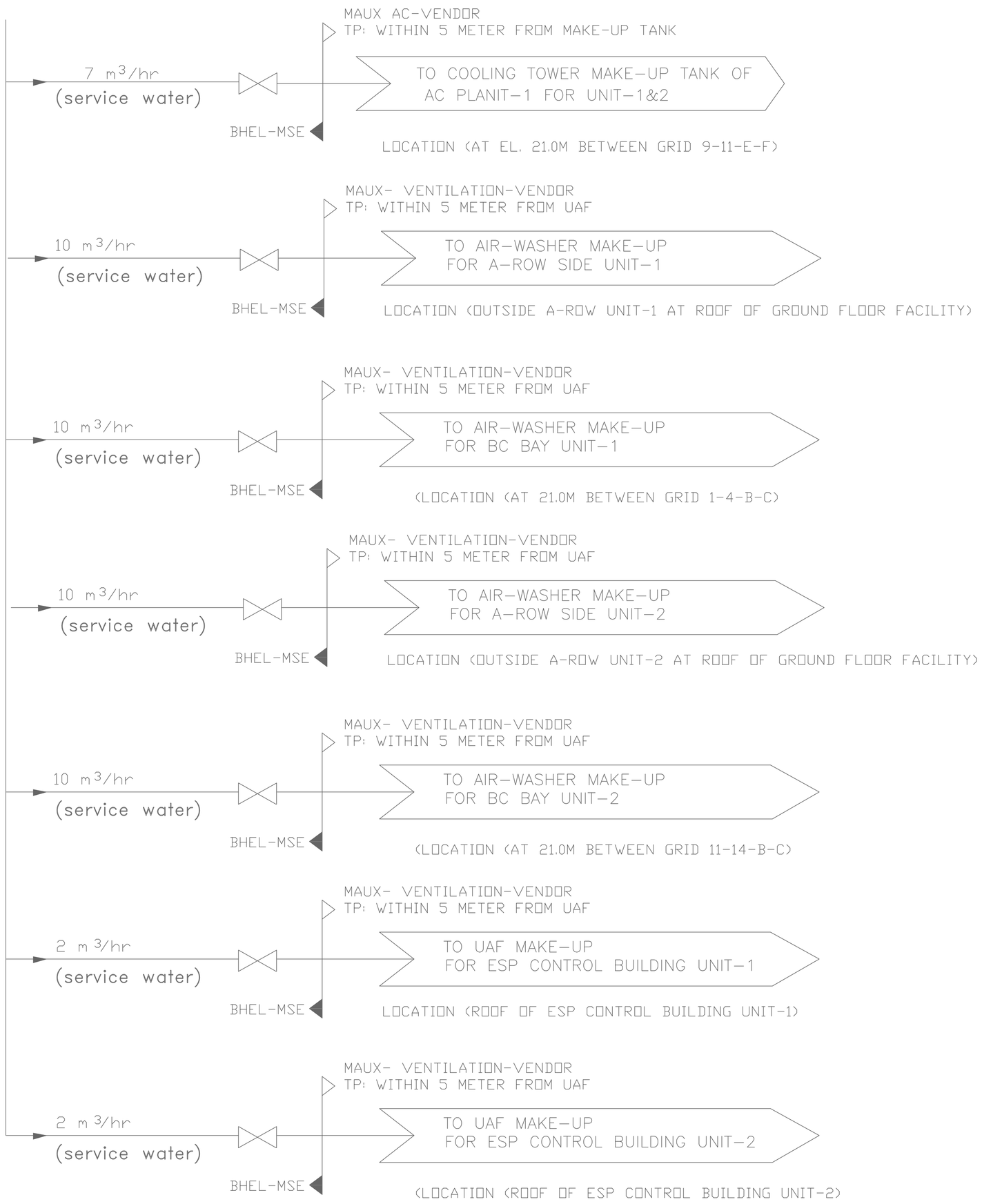
REV NO.	DATE	REMARKS	NAME CHECKED	SIGN	NAME APPROVED	SIGN

TITLE : P&I DIAGRAM FOR CONDENSER & CHILLED WATER SYSTEM FOR MAIN PLANT–1 FOR UNIT 1&2.

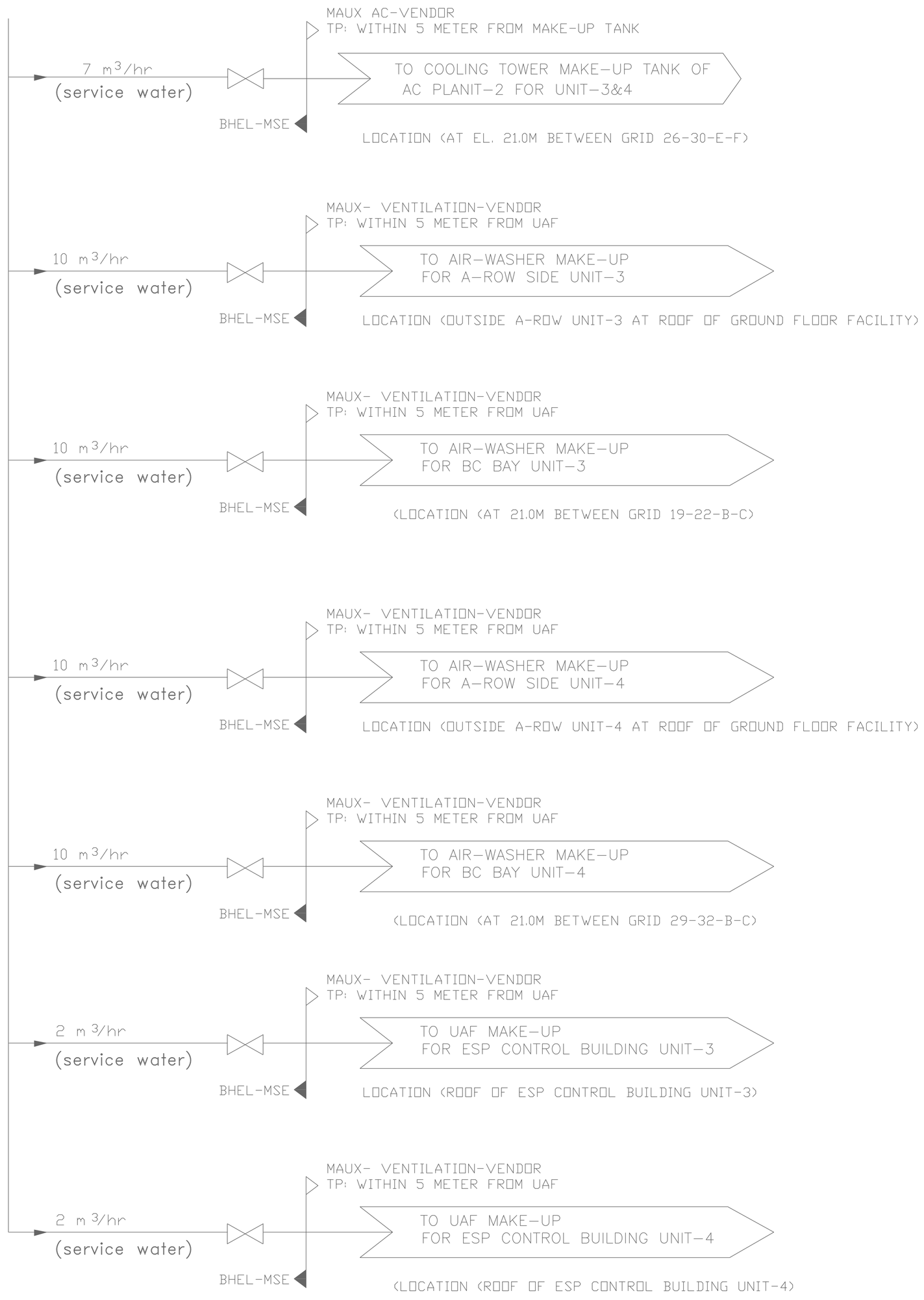
Drg No. PE–DG–411–553–A001

SCALE – NTS. | SHEET 1 OF 1 | REV. 00

4X270 MW BHADRADRI TPS FOR UNIT-1&2



4X270 MW BHADRADRI TPS FOR UNIT-3&4

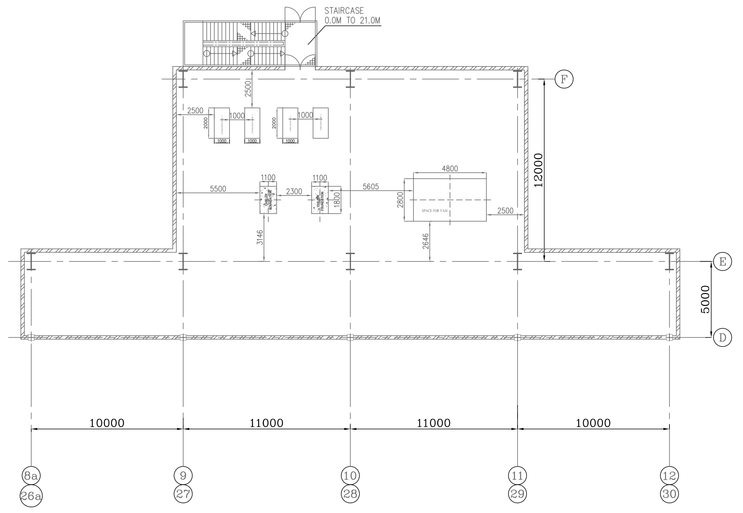


NOTE:-

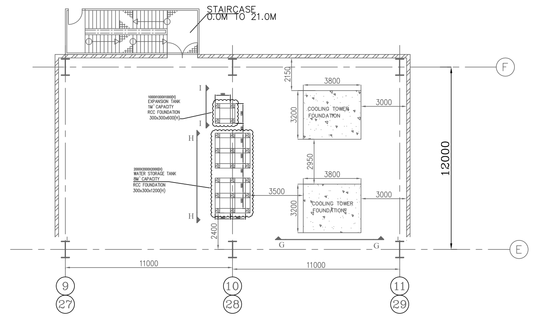
1. HVAC MAKE-UP WATER PIPING INCLUDING FITTINGS SHALL BE TERMINATED WITHIN THE RANGE OF 5 METER DISTANCE FROM MAKE-UP WATER TANK / AIR-WASHER BY BHEL FURTHER PIPING SHALL BE DONE BY VENDOR AS MARKED IN THIS DRG.

PROJECT TITLE	4X270 MW BHADRADRI TPS
TITLE	MAKE UP WATER SCHEME FOR HVAC SYSTEM
	DRG. NO. PE-DG-411-553-A003 REV 00
SCALE NTS	DATE / DRAWN / CHECKED / APPROVED

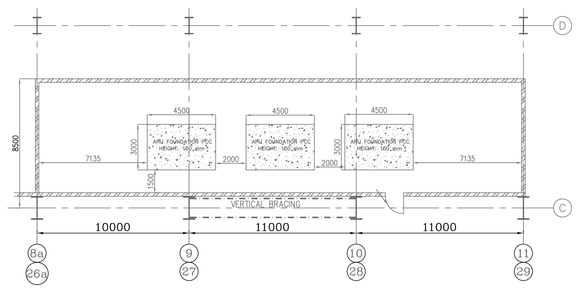
NORTH



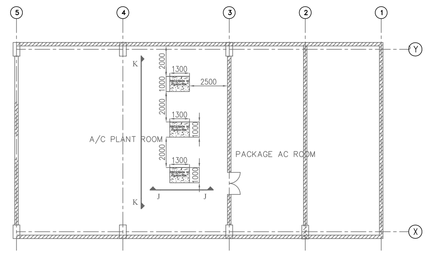
AC PLANT-1 & 2 AT EL 0.0M
PLAN AT EL. 0.0M



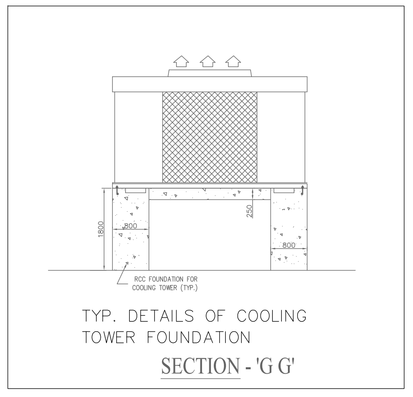
COOLING TOWER ETC.
AT ROOF OF CER ROOM FOR ACP 1 & 2.
PLAN AT 21.0M



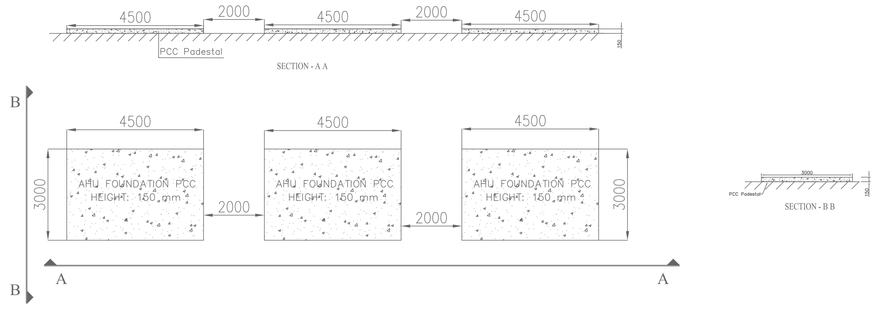
AHU ROOM
PLAN AT 21.0M



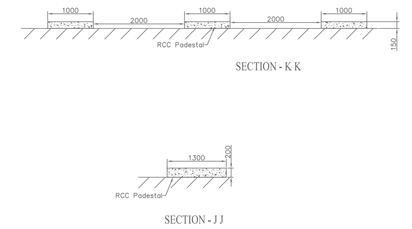
AC PLANT-3,4,5 & 6
FOR ESP BLDG UNIT-1,2,3 & 4



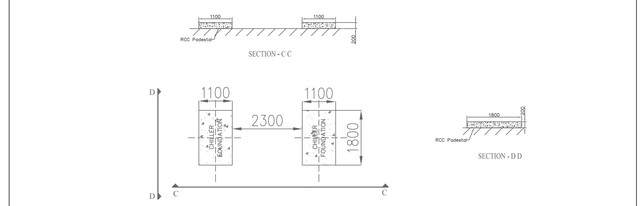
TYP. DETAILS OF COOLING TOWER FOUNDATION
SECTION - 'G G'



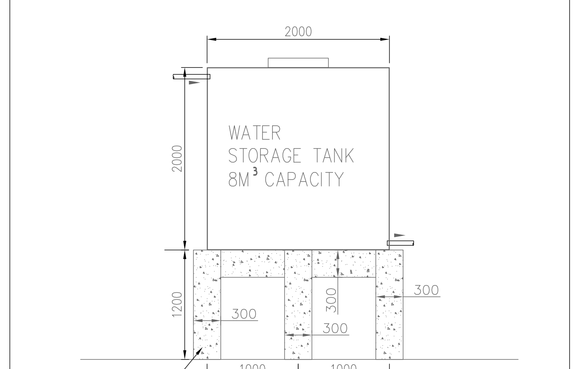
DETAILS OF AHU FOUNDATION (PCC BLOCK)
AT 21 M TG BLDG



TYP. DETAILS OF PRECESSION AC
FOUNDATION FOR ESP BLDG.



TYP. DETAILS OF CHILLER FOUNDATION
AT 0.0 M AC PLANT TG BLDG



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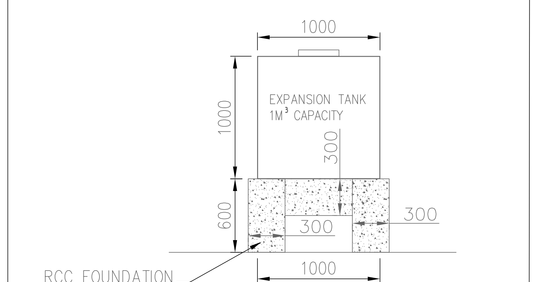
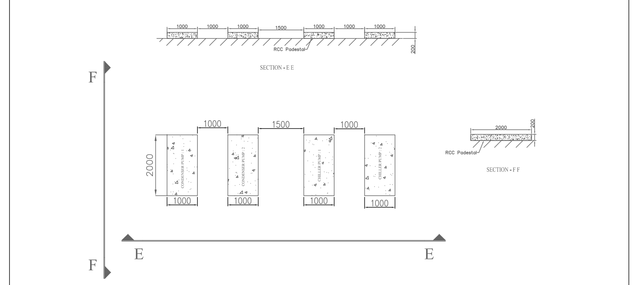


SECTION –'II'



TYP. DETAILS OF CHILLED AND CONDENSE
WATER PUMP AT 0.0 M AC PLANT TG BLDG

NOTE:-

1.) Flat, platform type RCC / PCC foundation shall be provided for installing Air washer / UAF and UAF fan / pumps etc.

2.) Bidder shall fix the equipment using proper anchor fastener to secure the equipment and obtain parameter related to vibration and noise.

FOR TENDER ONLY

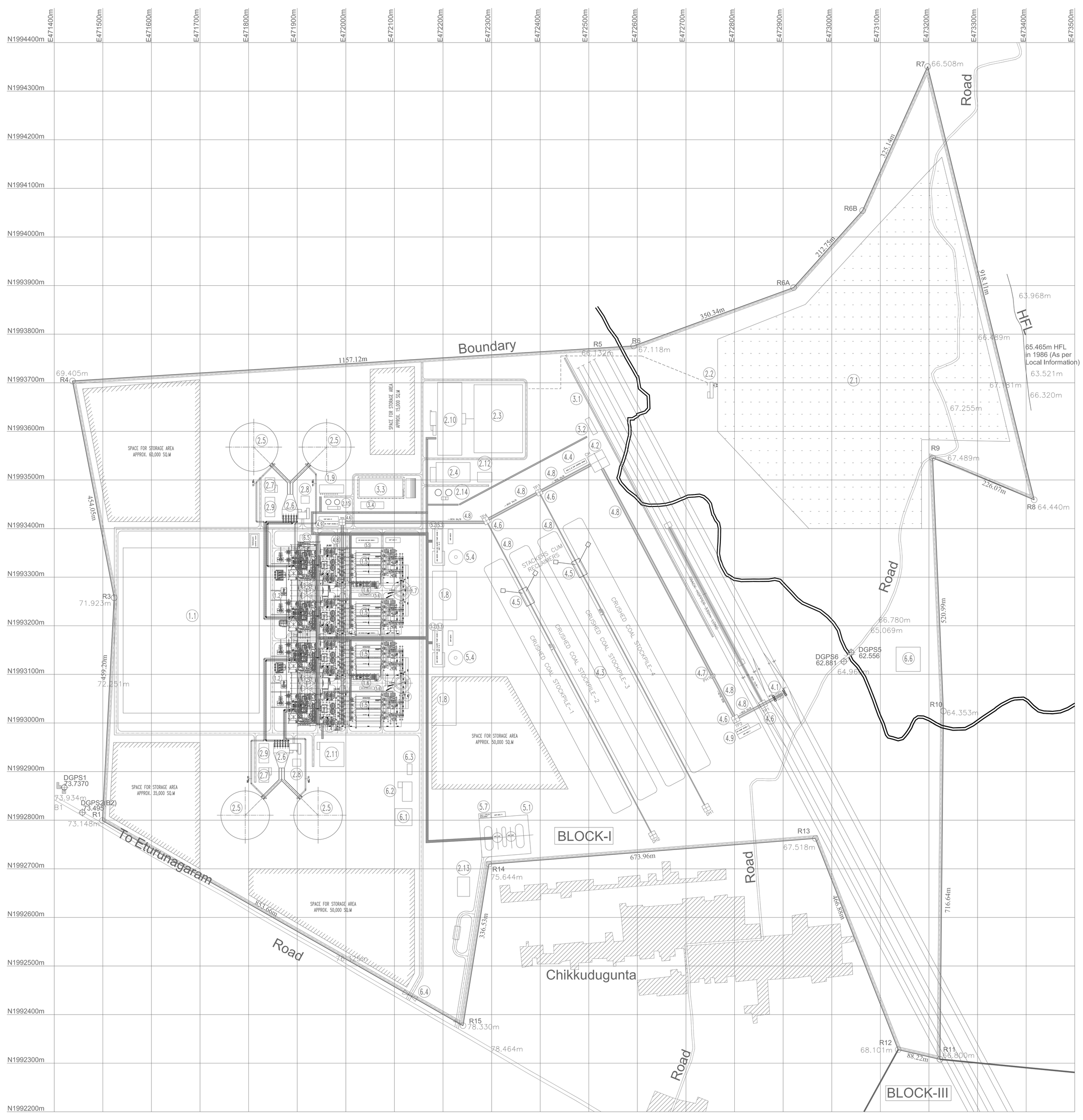
CUSTOMER	TELANGANA STATE POWER GENERATION CO. LTD.
CUSTOMER'S CONSULTANT	
JOB No. 411	4X270 MW BHADRADRI TPP
STATUS TENDER	
DISTRIBUTION	
TO	BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT, NEW DELHI
No.OFF	TITLE: FOUNDATION DETAIL FOR AC EQUIPMENT TG BUILDING & ESP BLDG

REV	DATE	ALTD	CHD	APPD

DEPT CODE		NAME	SIGN	DATE
A	DRN	AK		08.04.2015
	DESN	AK		08.04.2015
	CHD	SAK		08.04.2015
	APPD	SAK		08.04.2015

MPL	C	MSE	I	MAX	E	DEPT.	SCALE 1:200	DRAWING No. PE-DG-411-553-A003
						SIGN		
						DATE		SHEET 1 OF 1 REV 00

SIZE-A0



NORTH

TABLE

FACILITY	DESCRIPTION OF FACILITIES
1.0	**MAIN PLANT AREA**
1.1	SWITCH YARD
1.2	TRANSFORMER YARD
1.3	TURBINE BUILDING
1.4	BOILER
1.5	ESP
1.6	ESP CONTROL ROOM
1.7	CHIMNEY
1.8	SPACE FOR FGD
1.9	IA & SA COMPRESSOR HOUSE
2.0	**WATER SYSTEM**
2.1	RAW WATER RESERVOIR
2.2	RAW WATER PUMP HOUSE
2.3	PT PLANT
2.4	DM PLANT
2.5	IDCT
2.6	CW PUMP AREA
2.7	CW CHLORINATION PLANT FOR CW SYSTEM
2.8	CW TREATMENT PLANT FOR CW SYSTEM
2.9	SIDE STREAM FILTRATION
2.10	CLARIFIED WATER STORAGE TANK & PUMP HOUSE
2.11	EFFLUENT TREATMENT PLANT
2.12	CHEMICAL LAB
2.13	SEWAGE TREATMENT PLANT
2.14	DM TANKS & DM TRANSFER PUMPS
2.15	CONDENSATE STORAGE TANKS AND CONDENSER MAKE UP & BOILER FILL PUMPS
3.0	**FUEL OIL SYSTEM**
3.1	FUEL OIL UNLOADING TRENCH
3.2	FUEL OIL UNLOADING AND PRESSURISING PUMP HOUSE
3.3	FUEL OIL STORAGE TANK AREA
3.4	FUEL OIL FORWARDING PUMP HOUSE
4.0	**COAL HANDLING PLANT**
4.1	WAGON TIPPLER
4.2	CRUSHER HOUSE
4.3	CRUSHED COAL STOCKPILE
4.4	CHP CONTROL ROOM
4.5	STACKER RECLAIMER
4.6	TRANSFER POINT (TP)
4.7	PENT HOUSE (PH)
4.8	COAL BELT CONVEYOR
4.9	DUST SUPPRESSION PUMP HOUSE
5.0	**ASH HANDLING PLANT**
5.1	FLY ASH SILOS
5.2	ASH SLURRY PUMP HOUSE
5.3	ASH WATER PUMP HOUSE
5.4	AHP CLARIFIER
5.5	AHP VACUUM CUM COMPRESSOR HOUSE
5.6	AHP VACUUM PUMP HOUSE
5.7	SILO UTILITY BUILDING
6.0	**NON – PLANT BUILDING**
6.1	ADMN. BUILDING
6.2	CANTEEN
6.3	FIRE STATION
6.4	MAIN GATE
6.5	SERVICE BUILDING
6.6	RAIN WATER HARVESTING POND

LEGENDS:

- Area Boundary
- Road
- River, Stream
- DGPS Point with MSL Level in Metres — DGPS-5 62.556
- Village
- Pipe/Cable Rack

NOTES:–

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. PIPE RACK FROM ASPH TO ASHDYKE NOT SHOWN AS LOCATION OF ASHDYKE IS TO BE FINALISED

FOLLOWING ARE THE ASSUMPTIONS AS PER INFORMATION RECEIVED FROM TEAM VISITED SITE:

1. BLOCK–I IS TO BE USED FOR 4x270MW EPC.
2. WIND ROSE IS FROM WEST TO EAST.
3. RAW WATER RESERVOIR LOCATION CONSIDERED AS RIVER WATER INTAKE IS FROM GODAVARI RIVER.
4. POWER EVACUATION DIRECTION.
5. RAILWAY TRACKS PLANNED SUCH THAT THEY PASS THROUGH BLOCK–II & III PROVIDING THEIR ACCESS.
6. MAIN GATE LOCATION.

REV	DATE	ALTD	CHD	APPD
0A	05.12.14	RK	LKJ	SPV/JJ

1. SPACES FOR STORAGE AREA MARKED, FACILITY 2.8 RELOCATED.
2. CW CHANNELS & CW PIPES ROUTING MODIFIED.
3. DG BLDGS., AIR WASHERS & CENTRAL LUBE OIL ROOM RELOCATED.

CUSTOMER: TELANGANA STATE POWER GENERATION CO. LTD.

CUSTOMER'S CONSULTANT

JOB No. 411

STATUS: CONTRACT

DISTRIBUTION

TD

No.OFT

4X270 MW BHADRADRI TPP

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE		NAME	SIGN	DATE
M	DRN	RK		12.11.2014
	DESN	RK		12.11.2014
	CHD	LKJ/SPV		12.11.2014
	APPD	JJ		12.11.2014

TITLE: PLOT PLAN

SCALE: 1:3000

DRAWING No. PE–DG–411–100–M001

SHEET 1 OF 1 REV P0A

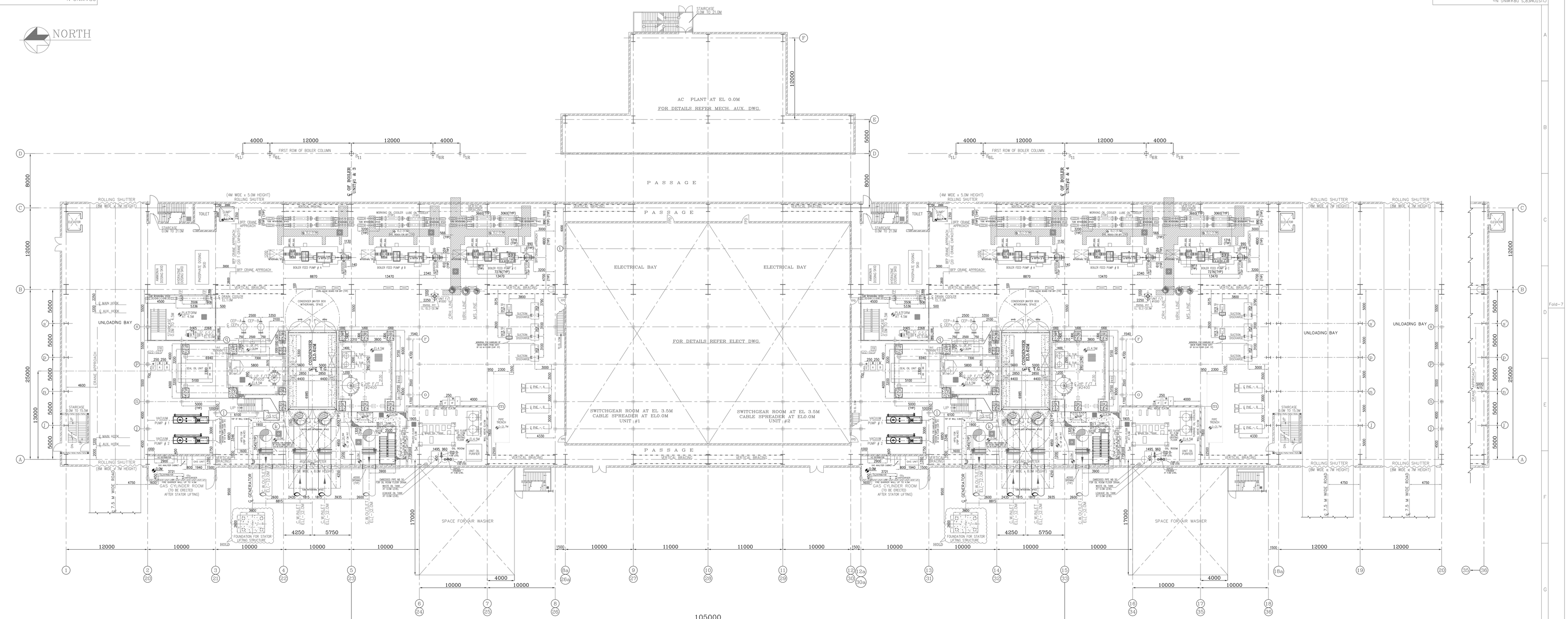
SIZE–A0

DRAWING No. PE-DG-411-100-M003

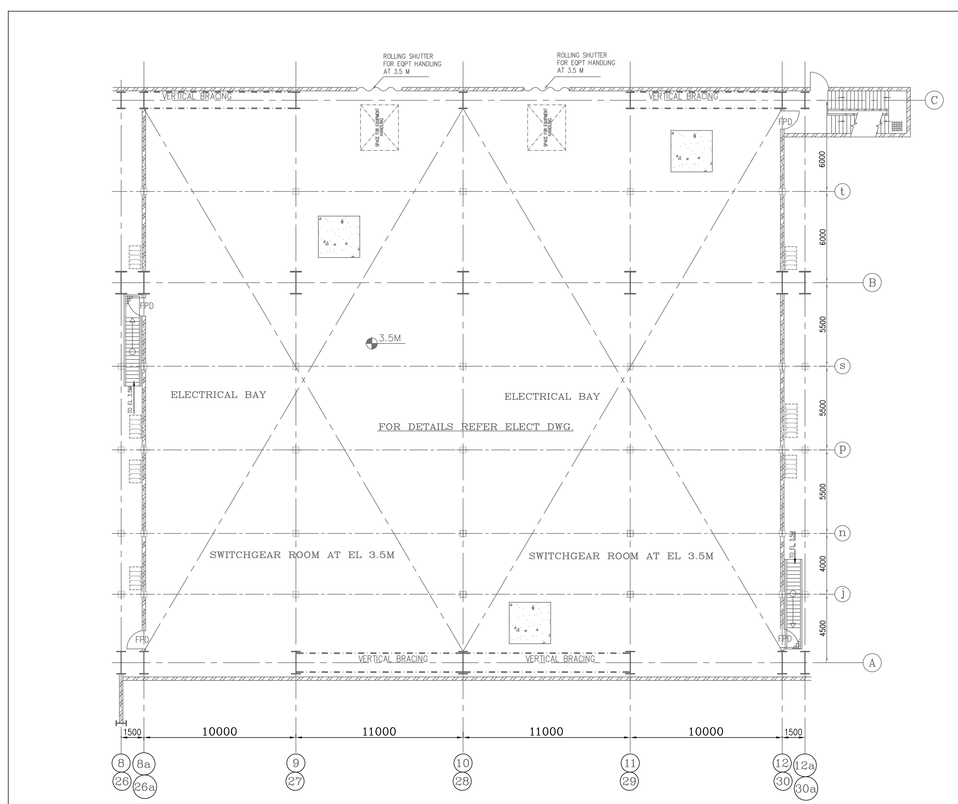
CUSTOMER'S DRAWING No.

FIRST ANGLE PROJECTION — ALL DIMENSIONS ARE IN MM

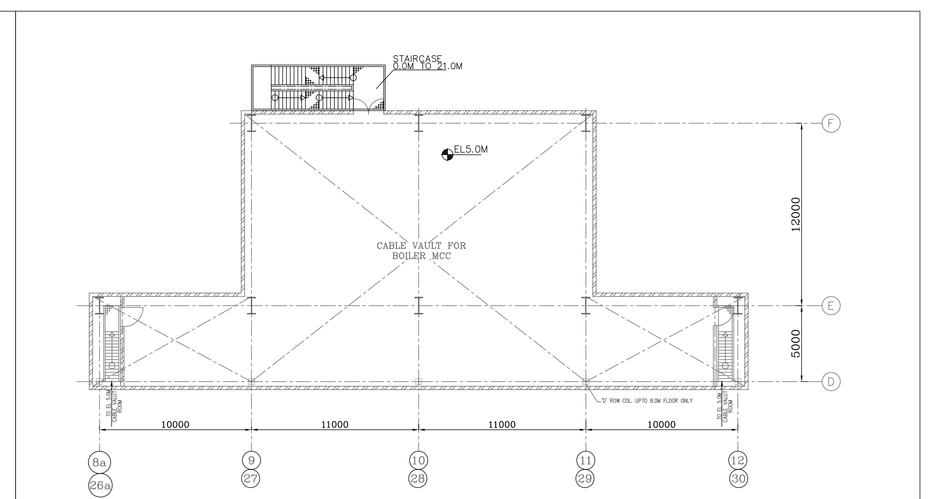
NORTH



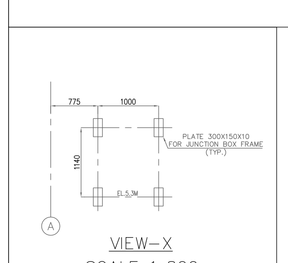
PLAN AT EL. 0.0M



PLAN AT EL. 3.5M



PLAN AT EL. 5.0M



VIEW–X
SCALE 1:800

LEGENDS:–

- CHEQUERED PLATE FLOORING
- REMOVABLE CHEQUERED PLATE
- GRATED FLOORING
- REMOVABLE GRATING
- CONCRETE BLOCK
- CUT OUTS
- HAND RAILING
- PARAPET WALL
- GLASS PARTITION
- BRICK WALL

NOTES:–

1. ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METERS UNLESS STATED OTHERWISE.
2. ALL ELEVATIONS ARE REFERRED TO POWER HOUSE FINISHED GROUND FLOOR ELEVATION 0.0M.
3. FOR LOADING OF EQUIPMENTS, RESPECTIVE EQUIPMENT DWG. SHOULD BE REFERRED.
4. FOR TG COLs & FLOOR FRAMING REFER CIVIL DRGs SEPARATELY.
5. ALL CIVIL DETAILS SUCH AS DOORS/WALLS/CLADINGS/OPENINGS/TOILETS/STAIRCASES ETC. ARE INDICATIVE ONLY & FOR EXACT DETAILS REFER CIVIL/ARCHITECTURE DRAWINGS.

* DETAILS OF PANELS/JUNCTION BOXES (HOLD)

A – CXW01A – STARTER CABINET FOR DC SEAL OIL MOTOR [800(W)X800(D)X2200(H)]
B – CXW01B – GENERATOR INSTRUMENTATION CABINET [800(W)X800(D)X2200(H)]
C – CXW01C – GENERATOR ANALYSER CABINET [1200(W)X800(D)X2110(H)]
A' – ANK01A – STARTER CABINET FOR DC JACKING OIL MOTOR [800(W)X800(D)X2200(H)]
B' – ANK01B – STARTER CABINET FOR DC EMERGENCY LUBE OIL MOTOR [800(W)X800(D)X2200(H)]
D – RESISTANCE BOX FOR DC SEAL OIL MOTOR – [600(W)X600(D)X500(H)]
E – RESISTANCE BOX FOR DC JOP – [700(W)X780(D)X975(H)]
F – RESISTANCE BOX FOR DC EOP – [1300(W)X750(D)X1150(H)]

REFERENCE DRGS:–

1.	T.G. HALL EQUIPMENT LAYOUT PLAN AT MEZZANINE FLOOR	PE-DG-411-100-M004
2.	T.G. HALL EQUIPMENT LAYOUT PLAN AT OPERATING FLOOR	PE-DG-411-100-M005
3.	T.G. HALL EQUIPMENT LAYOUT PLAN AT MISC FLOORS ABOVE OPERATING FLOOR IN BC BAY	PE-DG-411-100-M006
4.	CROSS – SECTION OF T.G. BUILDING	PE-DG-411-100-M007

PROGRESSIVE COPY
25.02.2015

CUSTOMER	TELANGANA STATE POWER GENERATION CO. LTD.
CUSTOMER'S CONSULTANT	
JOB No. 411	4X270 MW BHADRADRI TPP
STATUS CONTRACT	
DISTRIBUTION TO No.OF	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI

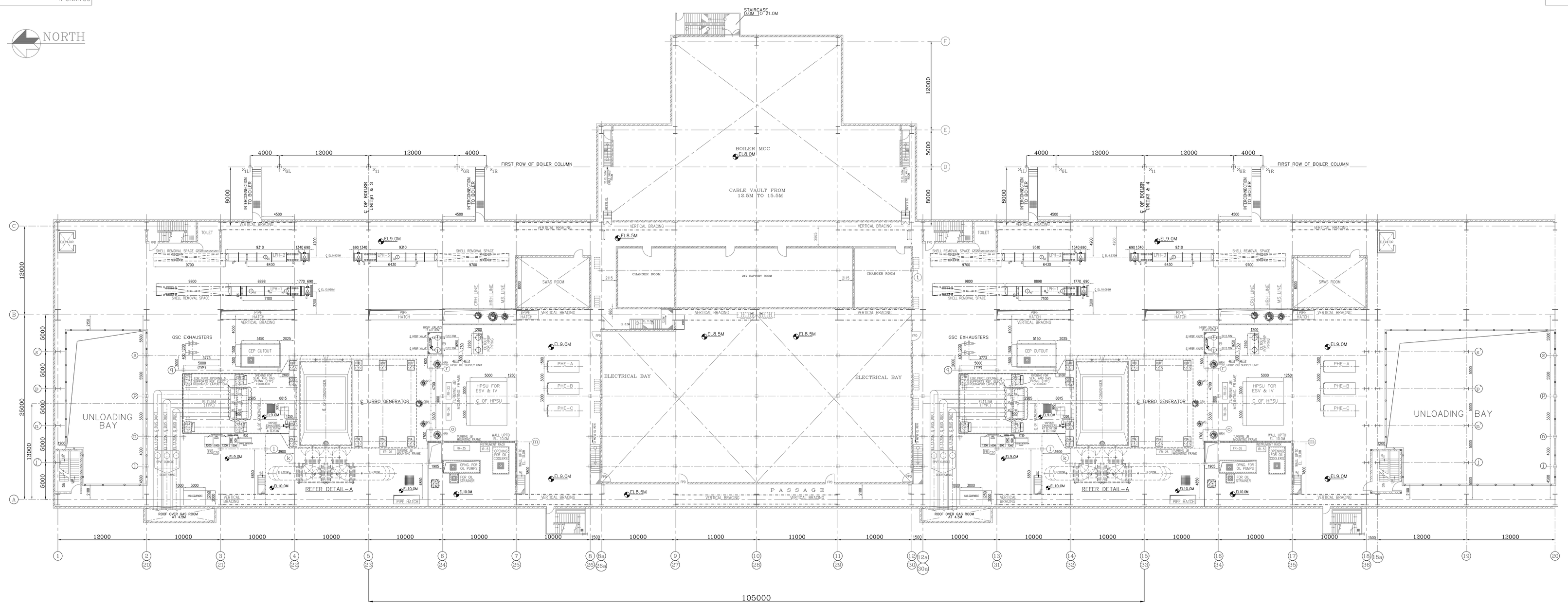
REV	DATE	ALTD	CHD	APPD

DEPT CODE		NAME	SIGN	DATE
M	DRN	RK		10.12.2014
	DESN	RK		10.12.2014
	CHD	LKJ		10.12.2014
	APPD	SPV		10.12.2014

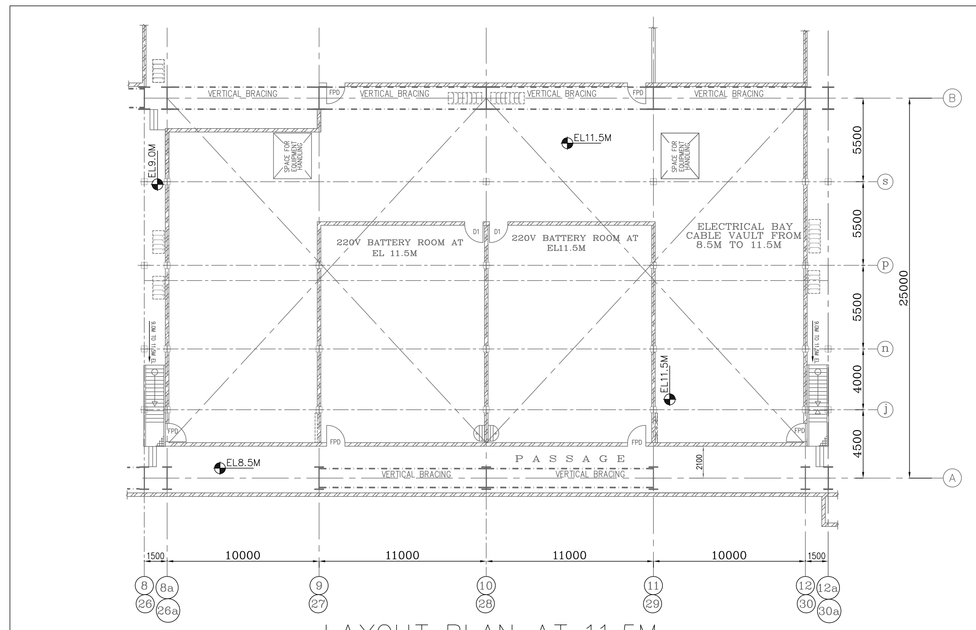
TITLE: T.G. HALL EQUIPMENT LAYOUT PLAN AT GROUND (0.0M) FLOOR

MPL	C	MSE	I	MAX	E	DEPT.	SCALE 1:200	DRAWING No. PE-DG-411-100-M003
						SIGN		
						DATE		SHEET 1 OF 1 REV 0A

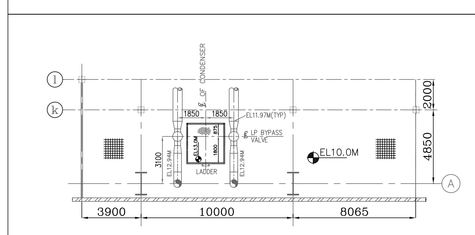
SIZE-A0



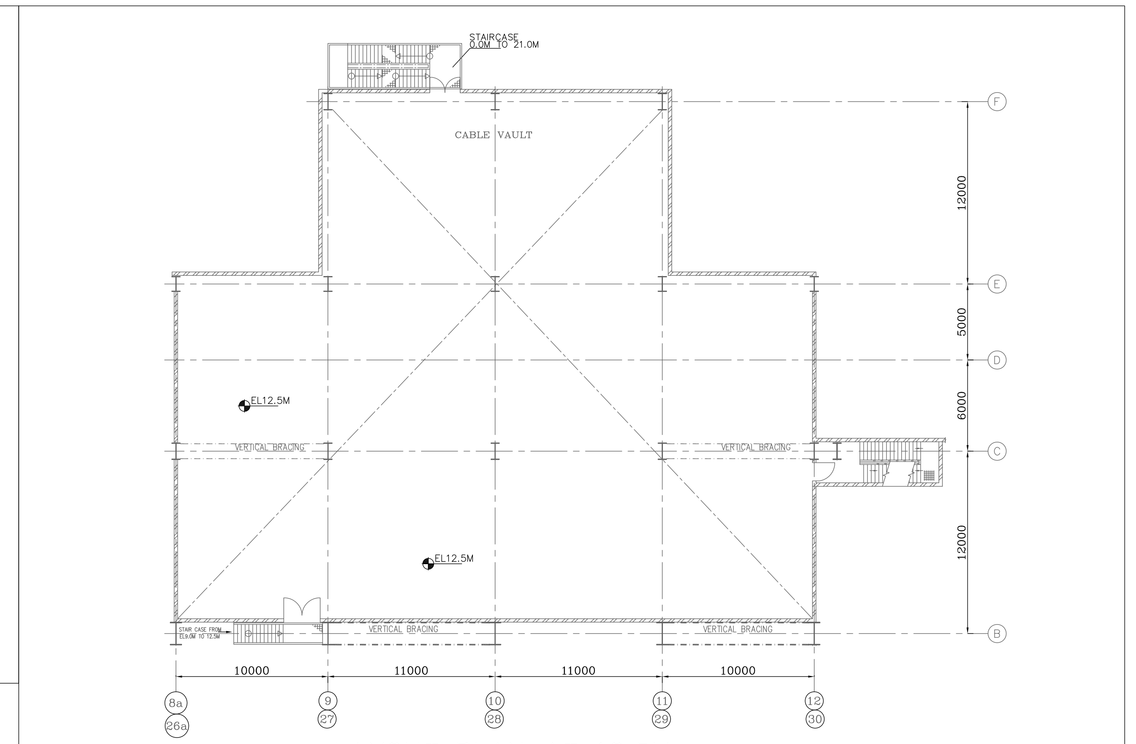
PLAN AT EL. 9.0M



LAYOUT PLAN AT 11.5M



DETAIL-A



LAYOUT PLAN AT 12.5M

LEGENDS:-

- CHEQUERED PLATE FLOORING
- REMOVABLE CHEQUERED PLATE
- GRATED FLOORING
- REMOVABLE GRATING
- CONCRETE BLOCK
- CUT OUTS
- HAND RAILING
- PARAPET WALL
- GLASS PARTITION
- BRICK WALL

NOTES:-

1. ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METERS UNLESS STATED OTHERWISE.
2. ALL ELEVATIONS ARE REFERRED TO POWER HOUSE FINISHED GROUND FLOOR ELEVATION 0.0M.
3. FOR LOADING OF EQUIPMENTS, RESPECTIVE EQUIPMENT DWG. SHOULD BE REFERRED.
4. FOR TG COLs & FLOOR FRAMING REFER CIVIL DRGs SEPARATELY.
5. ALL CIVIL DETAILS SUCH AS DOORS/WALLS/CLADINGS/OPENINGS/TOILETS/STAIRCASES ETC. ARE INDICATIVE ONLY & FOR EXACT DETAILS REFER CIVIL/ARCHITECTURE DRAWINGS.

REFERENCE DRGS:-

1.	T.G. HALL EQUIPMENT LAYOUT PLAN AT GROUND FLOOR	PE-DG-411-100-M003
2.	T.G. HALL EQUIPMENT LAYOUT PLAN AT OPERATING FLOOR	PE-DG-411-100-M005
3.	T.G. HALL EQUIPMENT LAYOUT PLAN AT MISC FLOORS ABOVE OPERATING FLOOR IN BC BAY	PE-DG-411-100-M006
4.	CROSS - SECTION OF T.G. BUILDING	PE-DG-411-100-M007

PROGRESSIVE COPY
25.02.2015

REV	DATE	ALTD	CHD	APPD

REV	DATE	ALTD	CHD	APPD
0A		RK		

1. 24V BATTERY ROOM & CHARGER ROOM LAYOUT MODIFIED.

CUSTOMER: TELANGANA STATE POWER GENERATION CO. LTD.

CUSTOMER'S CONSULTANT:

JOB No. 411

STATUS: CONTRACT

DISTRIBUTION

TO

No.OFF

4X270 MW BHADRADRI TPP

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

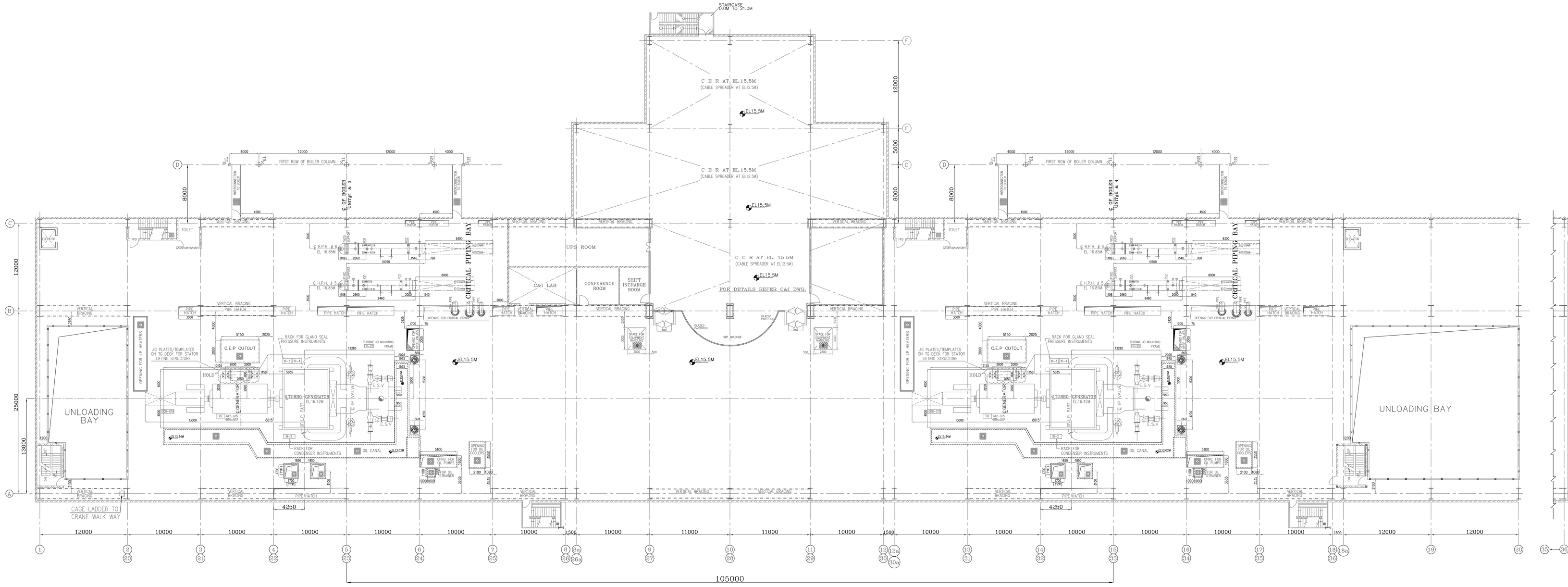
DEPT CODE		NAME	SIGN	DATE
M	DRN	RK		10.12.2014
	DSGN	RK		10.12.2014
	CHD	UKJ		10.12.2014
	APPD	SPV		10.12.2014

TITLE: T.G. HALL EQUIPMENT LAYOUT PLAN AT MEZZANINE (9.0M) FLOOR

MPL	C	MSE	I	MAX	E	DEPT.	SCALE 1:200	DRAWING No. PE-DG-411-100-M004
						SIGN		
						DATE		SHEET 1 OF 1 REV 0A

SIZE-A0

NORTH



PLAN AT 15.5M

LEGENDS:–

- CHEQUERED PLATE FLOORING
- REMOVABLE CHEQUERED PLATE
- GRATED FLOORING
- REMOVABLE GRATING
- CONCRETE BLOCK
- CUT OUTS
- HAND RAILING
- PARAPET WALL
- GLASS PARTITION
- BRICK WALL

NOTES:–

1. ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METERS UNLESS STATED OTHERWISE.
2. ALL ELEVATIONS ARE REFERRED TO POWER HOUSE FINISHED GROUND FLOOR ELEVATION 0.0M.
3. FOR LOADING OF EQUIPMENTS, RESPECTIVE EQUIPMENT DWG. SHOULD BE REFERRED.
4. FOR TG COLs & FLOOR FRAMING REFER CIVIL DRGs SEPARATELY.
5. ALL CIVIL DETAILS SUCH AS DOORS/WALLS/CLADINGS/OPENINGS/TOILETS/STAIRCASES ETC. ARE INDICATIVE ONLY & FOR EXACT DETAILS REFER CIVIL/ARCHITECTURE DRAWINGS.

REFERENCE DRGS:–

1.	T.G. HALL EQUIPMENT LAYOUT PLAN AT GROUND FLOOR	PE-DG-411-100-M003
2.	T.G. HALL EQUIPMENT LAYOUT PLAN AT MEZZANINE FLOOR	PE-DG-411-100-M004
3.	T.G. HALL EQUIPMENT LAYOUT PLAN AT MISC FLOORS ABOVE OPERATING FLOOR IN BC BAY	PE-DG-411-100-M006
4.	CROSS – SECTION OF T.G. BUILDING	PE-DG-411-100-M007

PROGRESSIVE COPY
25.02.2015

REV	DATE	ALTD	CHD	APPD	REV	DATE	ALTD	CHD	APPD

CUSTOMER: —

TELANGANA STATE POWER GENERATION CO. LTD.

CUSTOMER'S CONSULTANT:

JOB No. 411

STATUS: CONTRACT

DISTRIBUTION

TO:

No.OFT:

4X270 MW BHADRADRI TPP

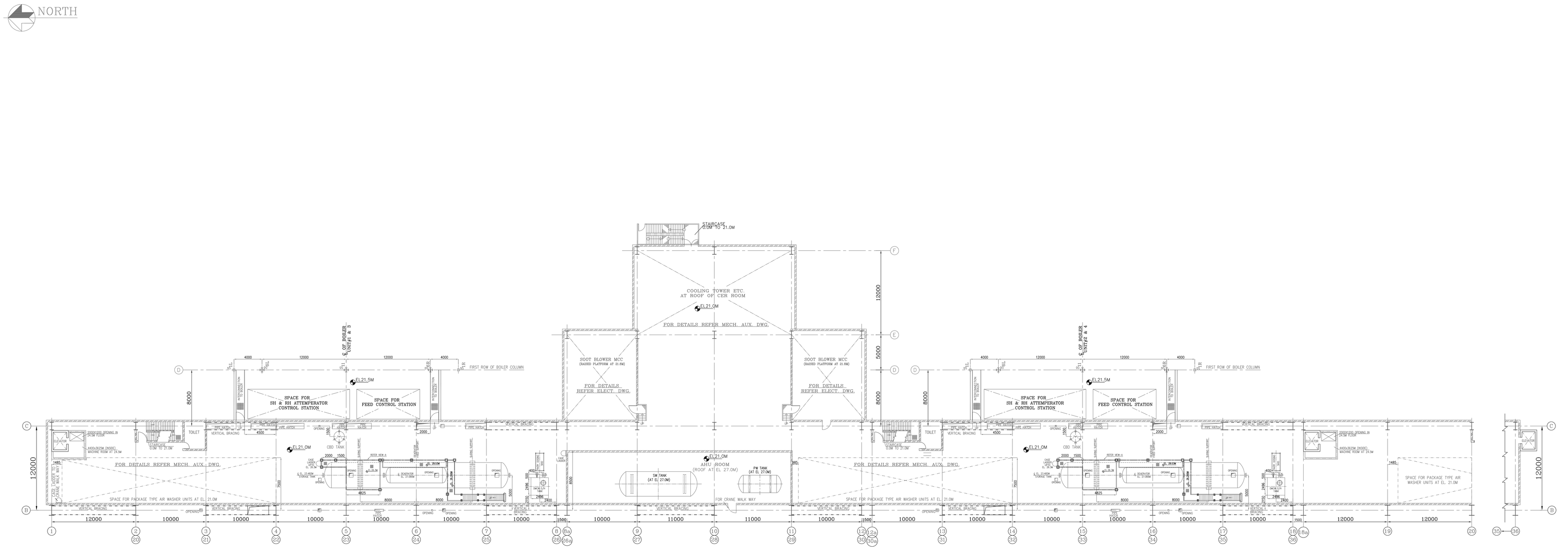
BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE		NAME	SIGN	DATE
M	DRN	RK		10.12.2014
	DESN	RK		10.12.2014
	CHD	UKJ		10.12.2014
	APPD	SPV		10.12.2014

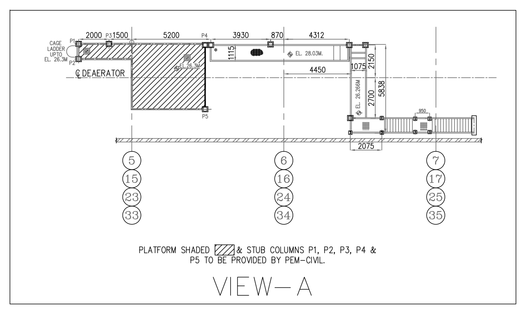
TITLE: T.G. HALL EQUIPMENT LAYOUT PLAN AT OPERATING (15.5M) FLOOR

MPL	C	MSE	I	MAX	E	DEPT.	SCALE 1:200	DRAWING No.
						SIGN		PE-DG-411-100-M005
						DATE		SHEET 1 OF 1 REV 0A

SIZE-A0



PLAN AT 21.0M



LEGENDS:-

- CHEQUERED PLATE FLOORING
- REMOVABLE CHEQUERED PLATE
- GRATED FLOORING
- REMOVABLE GRATING
- CONCRETE BLOCK
- CUT OUTS
- HAND RAILING
- PARAPET WALL
- GLASS PARTITION
- BRICK WALL

NOTES:-

1. ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METERS UNLESS STATED OTHERWISE.
2. ALL ELEVATIONS ARE REFERRED TO POWER HOUSE FINISHED GROUND FLOOR ELEVATION 0.0M.
3. FOR LOADING OF EQUIPMENTS, RESPECTIVE EQUIPMENT DWG. SHOULD BE REFERRED.
4. FOR TG COLs & FLOOR FRAMING REFER CIVIL DRGs SEPARATELY.
5. ALL CIVIL DETAILS SUCH AS DOORS/WALLS/CLADINGS/OPENINGS/TOILETS/STAIRCASES ETC. ARE INDICATIVE ONLY & FOR EXACT DETAILS REFER CIVIL/ARCHITECTURE DRAWINGS.

REFERENCE DRGS:-

1.	T.G. HALL EQUIPMENT LAYOUT PLAN AT GROUND FLOOR	PE-DG-411-100-M003
2.	T.G. HALL EQUIPMENT LAYOUT PLAN AT MEZZANINE FLOOR	PE-DG-411-100-M004
3.	T.G. HALL EQUIPMENT LAYOUT PLAN AT OPERATING FLOOR	PE-DG-411-100-M005
4.	CROSS - SECTION OF T.G. BUILDING	PE-DG-411-100-M007

PROGRESSIVE COPY
25.02.2015

CUSTOMER	TELANGANA STATE POWER GENERATION CO. LTD.
CUSTOMER'S CONSULTANT	
JOB No. 411	4X270 MW BHADRADRI TPP
STATUS CONTRACT	
DISTRIBUTION	

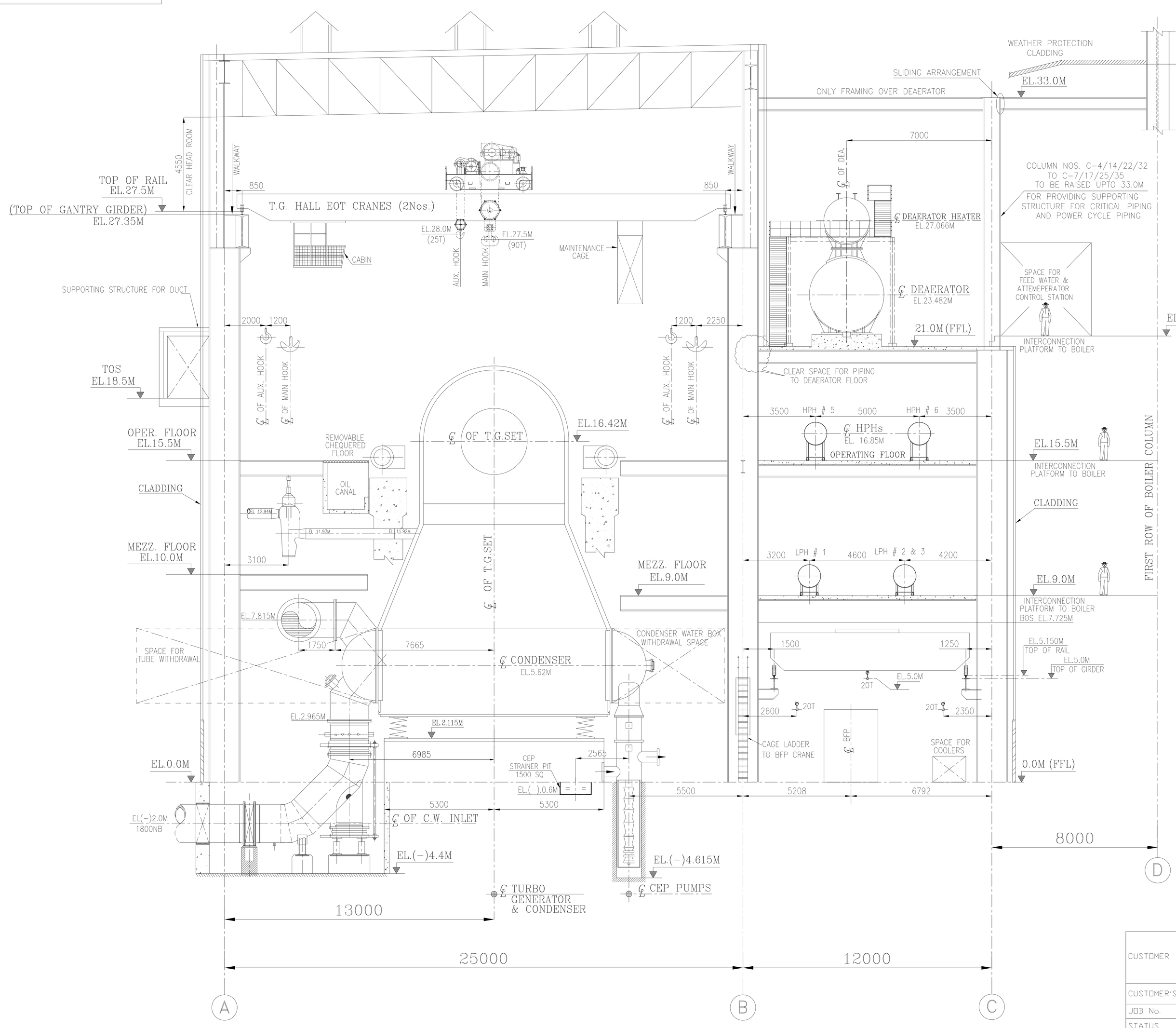
BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE		NAME	SIGN	DATE
M	DRN	RK		10.12.2014
	DESN	RK		10.12.2014
	CHD	LKJ		10.12.2014
	APPD	SPV		10.12.2014

TITLE: T.G. HALL EQUIPMENT LAYOUT PLAN AT MISC FLOOR ABOVE OPERATING FLOOR (21.0M) IN BC BAY

MPL | C | MSE | I | MAX | E | DEPT. | SCALE 1:200 | DRAWING No. PE-DG-411-100-M006
SIGN
DATE
SHEET 1 OF 1 | REV 0A | SIZE-A0

REV	DATE	ALTD	CHD	APPD	REV	DATE	ALTD	CHD	APPD
					TO				
					No.OFT				



LEGENDS:

- CHEQUERED PLATE FLOORING
- REMOVABLE CHEQUERED PLATE
- GRATED FLOORING
- REMOVABLE GRATING
- CONCRETE BLOCK
- CUT OUTS
- HAND RAILING
- PARAPET WALL
- GLASS PARTITION
- BRICK WALL

NOTES:-

1. ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METERS UNLESS STATED OTHERWISE.
2. ALL ELEVATIONS ARE REFERRED TO POWER HOUSE FINISHED GROUND FLOOR ELEVATION 0.0M.
3. FOR LOADING OF EQUIPMENTS, RESPECTIVE EQUIPMENT DWG. SHOULD BE REFERRED.
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REFERENCE DRGS:-

1.	T.G. HALL EQUIPMENT LAYOUT PLAN AT GROUND FLOOR	PE-DG-411-100-M003
2.	T.G. HALL EQUIPMENT LAYOUT PLAN AT MEZZANINE FLOOR	PE-DG-411-100-M004
3.	T.G. HALL EQUIPMENT LAYOUT PLAN AT OPERATING FLOOR	PE-DG-411-100-M005
4.	T.G. HALL EQUIPMENT LAYOUT PLAN AT MISC FLOORS ABOVE OPERATING FLOOR IN BC BAY	PE-DG-411-100-M006

REV	DATE	ALTD	CHD	APPD

REV	DATE	ALTD	CHD	APPD

CUSTOMER: TELANGANA STATE POWER GENERATION CO. LTD.

CUSTOMER'S CONSULTANT:

JOB No. 411

STATUS CONTRACT

DISTRIBUTION

TO

No.OFF

4X270 MW BHADRADRI TPP

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	RK		10.12.2014
	DESN	RK		10.12.2014
	CHD	LKJ		10.12.2014
	APPD	SPV		10.12.2014

TITLE: CROSS SECTION OF T.G. HALL

DEPT. SIGN DATE

SCALE 1:100

DRAWING No. PE-DG-411-100-M007

SHEET 1 OF 1 REV 0

SIZE-A1

COMPUTER FILE NAME: 411_100_M007_R0

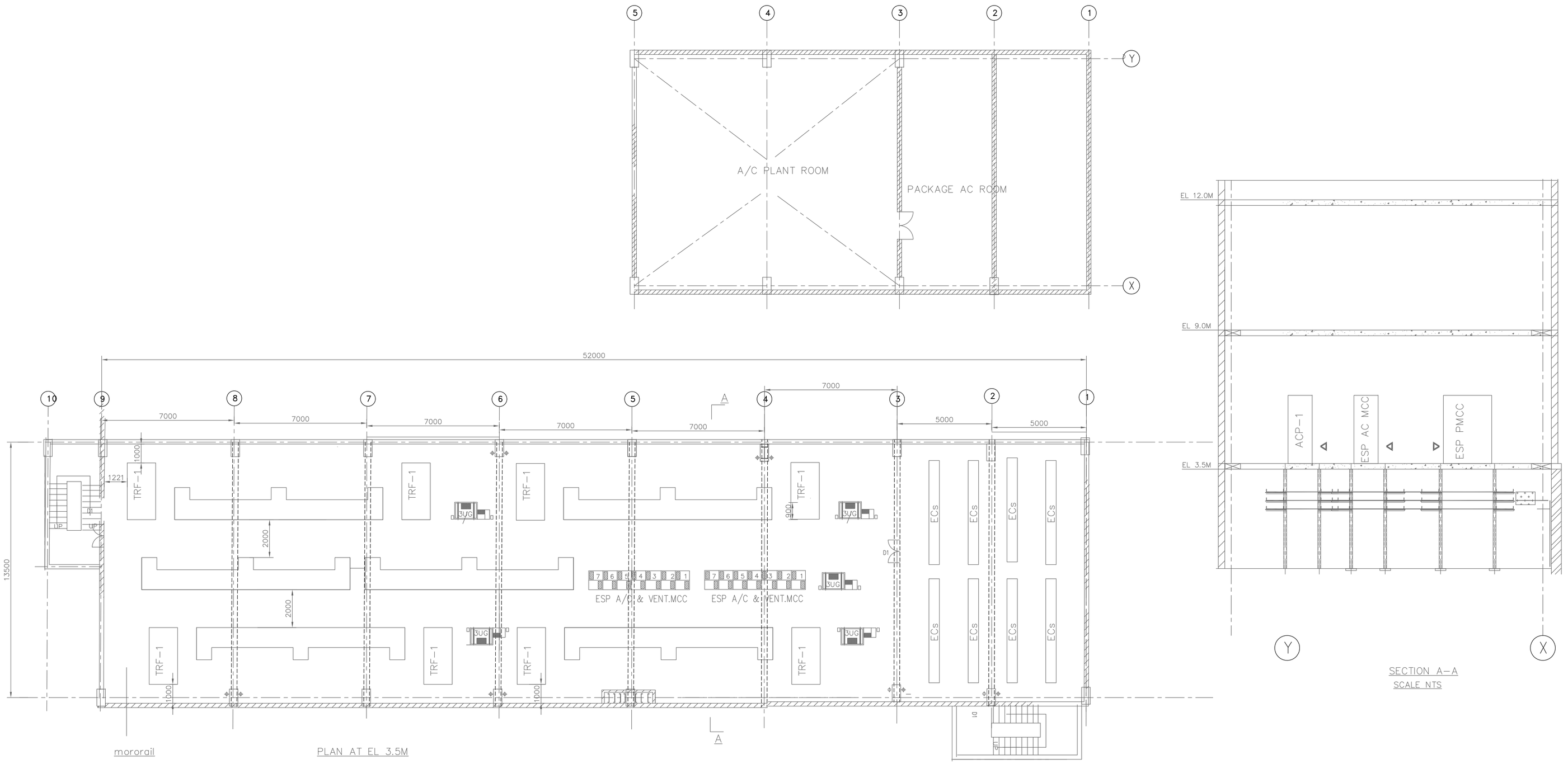
COMPUTER FILE NAME: 281_100_E008_R0

DRAWING No. PE-DG-K27-100-E008

CUSTOMER'S DRAWING No.

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



LEGEND

PANEL OPERATING FRONT

BRICK WALL

FOR TENDER ONLY

CUSTOMER	TSGENCO, HYDERABAD
JOB No. K27	
STATUS PROPOSAL	4 X 270MW TSGENCO BHADRADRI TPS
DISTRIBUTION	

TO					
No.OFF					
REV	DATE	ALTD	CHD	APPD	

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
E	DRN	HK		
	DESN	HK		
	CHD	MS/RG		
	APPD	MK		

TITLE: ESP CONTROL ROOM BUILDING ELECTRICAL EQUIPMENT & CABLING LAYOUT

MPL	C	MSE	I	MAX	E	DEPT.	SCALE 1:150	DRAWING No. PE-DG-411-100-E008
						SIGN		
						DATE		SHEET 1 OF 1 REV 00

SIZE-A0