भारत हेवी इलेक्ट्रिकल्स लिमिटेड
(भारत सरकार का उपक्रम)
BHARAT HEAVY ELECTRICALS LIMITED
(A Govt. of India Undertaking)

TCN - 03

Ref: PSER:SCT:DPL:M1275:TCN-03 Date: 17-12-2011

Sub	Tender change notice (TCN)-03.	
Job	Design, engineering, manufacturing, supply/ delivery, storage & handling, erection, commissioning, trial run, handing over to customer etc of Ventilation System for 1x250 MW unit at DPL, Durgapur, WB.	
Ref	1.0	TENDER NO. PSER: SCT: DPL:M1275:11.
	2.0	BHEL's NIT, vide reference no PSER: SCT: DPL:M1275:11, Date:19-11-2011.
	3.0	BHEL's TCN-01, vide reference no PSER:SCT:DPL:M1275:TCN-01, Date: 07-12-2011.
	4.0	BHEL's TCN-02, vide reference no PSER:SCT:DPL:M1275:TCN-02, Date: 14-12-2011.
	5.0	All other pertinent issues till date.

With reference to above, following points/ documents, relevant to tender, may please be noted and complied with while submitting offer.

1.0 Revised Volume-II (Rev-01)-(Scope of work, technical specification, drawing etc), superseding Volume-II issued earlier along with NIT.

2.0 Revised BOQ cum price schedule format VOL-III- PRICE SCHEDULE, REV-01 superseding VOL-III PRICE SCHEDULE, REV-00 issued earlier along with NIT.

Bidders are requested to submit their offer as per revised BOQ (Rev-01) only. Offer from bidders in superseded price schedule (Vol-III, REV-00) shall not be considered. Bidders are also requested to submit a declaration in techno-commercial offer that they have submitted their price bid in sealed envelope as per REVISED price schedule format (VOL-III- PRICE SCHEDULE, REV-01).

3.0 Revised `No deviation certificate' is attached. Bidder to submit `No deviation certificate' as per attached format only.

4.0 All other terms & conditions shall remain unchanged.

Thanking you,

Yours faithfully,
for BHARAT HYEAVY ELECTRICALS LTD

ENGR (SCT)

Encl:
1.0 Revised Volume-II (Rev-01)
2.0 Revised BOQ cum price schedule format (VOL-III- PRICE SCHEDULE, REV-01)

पावर सेक्टर पूर्वी क्षेत्र (मुख्यालय)
POWER SECTOR EASTERN REGION, DJ-9/1, SECTOR-II, SALT LAKE CITY, KOLKATA - 700 091
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DURGAPUR PROJECTS LIMITED- WEST BENGAL

1X250 MW DURGAPUR TPS

UNIT # 8

VOLUME - IIB & III

TECHNICAL SPECIFICATION

FOR

VENTILATION SYSTEM

SPECIFICATION NO.: - PE-TS-360-554-A001
REV. - 0
MARCH 2011

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PROJECT ENGIEERING INSTITUTE BUILDING
SECTOR-16A, PLOT NO.-25, NOIDA, INDIA

VOLUME – IIB

SECTIONS	TITLE	SPECIFICATION NO.	No. of Sheets
SECTION-A	**INTENT OF SPECIFICATIONS**	**PE-TS-360-554-A001**	2
SECTION-B	**PROJECT INFORMATION**		2
SECTION-C	**SPECIFIC TECHNICAL REQUIREMENT**	**PE-TS-360-554-A001**	14
	CUSTOMER TECHNICAL SPECIFICATION		87
	TECHNICAL SPECIFICATION (ELECTRICAL PORTION)		25
	TECHNICAL SPECIFICATION (C & I PORTION)		15
	ANNEXURES		
i)	ANNEXURE-I	LIST OF MAKES	2
ii)	ANNEXURE-II	MAKE-UP WATER QAULITY	2
iii)	ANNEXURE-III	LIST OF MANDATORY SPARES	3
SECTION-D	**STANDARD TECHNICAL SPECIFICATIONS**		45
SECTION-E	**INSPECTION AND TESTING**		26
SECTION-F	**LIST OF DRGS./ ENCLOSURES**		
1.	TYPICAL SCHEME OF AIR-WASHER SYSTEM	PE-DG-360-554-A001 R1.	1
2.	TYPICAL SCHEME OF UAF	PE-DG-360-554-A002 R1.	1
3.	SCHEMATIC OF AIR-DISTRIBUTION IN POWER HOUSE BLDG.	PE-DG-360-554-A003 R1.	1
4.	SCHMATIC DIAGRAM FOR HVAC MAKE-UP	PE-DG-360-554-A055 R1.	1
5.	PLOT PLAN	PE-DG-360-100-M001 R5.	1
6.	MAIN EQUIPMENT LAYOUT PLAN	PE-DG-360-100-M002 R1.	1
7.	CROSS SECTION OF T.G. HALL	PE-DG-360-100-M008 R1	1
8.	TG HALL EQPT. LAYOUT PLAN AT 0 M	PE-DG-360-100-M003 R1.	1
9.	TG HALL EQPT. LAYOUT PLAN AT 4.5 M	PE-DG-360-100-M004 R1.	1
10.	TG HALL EQPT. LAYOUT PLAN AT 8.5 M	PE-DG-360-100-M005 R1.	1
11.	TG HALL EQPT. LAYOUT PLAN	PE-DG-360-100-M006 R1	1

	AT 13.5 M		
12.	EQUIPMENT LAYOUT PLAN AT BC BAY FLOORS	PE-DG-360-100-M007 R1	1

VOLUME-III

(DATA SHEET `B` AND SCHEDULES to be furnished by each Bidder along with the Technical Bid.)

SECTIONS	TITLE	No. of Sheets
1.	Suggestive Price Format	4
2.	Guaranteed Power consumption Figures	1
3.	No Deviation Certificate	1
4.	Data sheet – B For Major Ventilation system Eqpts.	7
5.	Deviation Sheet Part B	1
6.	Deviation Sheet Part C	1
7.	Schedule of weight & dimensions.	1
8.	Schedule of equipment manufacture dispatch to site	1
9.	Schedule of deviations	1
10.	Deviation/ Clarification format	1

SECTION – A

SCOPE OF ENQUIRY

1.0 Intent of Specification

1.1 This specification covers proper design, fabrication, manufacture, inspection and testing at manufacturer's works or at sub vendor's works, proper packing, transportation to site, freight and insurance, storage and handling at site, erection and commissioning including trial run at site for VENTILATION SYSTEM for complete Power plant as per different section of technical specification for 1 X 250 MW DURGAPUR TPS in DURGAPUR, WEST BENGAL.

1.2 It is not the intent to specify completely herein all details of design and construction of equipment. However, all the equipments shall conform in all respect to high standards of engineering, design, workmanship and be capable of performing in continuous commercial operation up to desired period.

1.3 The general terms and conditions, instructions to bidder and other attachments referred to else where are made a part of the tender specification. The equipment, materials and works covered by this specification are subject to all the attachments referred in the specification. The bidder shall be responsible for and governed by all the requirements stipulated hereinafter.

1.4 No deviation is permitted in normal case. Deviation if any shall be clearly brought out otherwise it will be presumed that the bidder's offer is in line with what has been stated/asked in this NIT specification.

1.5 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply.

1.6 It is not the intent to completely specify all details of design and construction herein. Nevertheless, the equipment and installation shall conform to high standard of engineering, design and workmanship in all respects and shall be capable of performing in continuous satisfactory commercial operation in a manner acceptable to the Purchaser.

1.7 The purchaser reserves the right to place separate order for any of the specified items without assigning any reason whatsoever. The decision of the purchaser in this regard will be final.

SECTION – B

PROJECT INFORMATION

G E N E R A L I N F O R M A T I O N

1.	**PROJECT NAME**	Durgapur Project Power Station Unit – 8 (1x250 MW)	
1.1	**INTRODUCTION :**	The Durgapur Projects Limited is a Government Company incorporated on 6th September, 1961 , consisting of Coke Oven Batteries, Bye-products Plant, Gas Grid Project, Thermal Power Plant and Water Works. It is under the administrative control of the Department of Power, Government of West Bengal.	
	LOCATION :	Durgapur Projects Power Station, DPL, Durgapur	
	NEAREST RAILWAY STATION :	Durgapur Railway Station (Broad Gauge) is about 2 kM away from the site.	
	ROAD DISTANCES :	NH-2 is adjacent to site.	
	NEAREST AIR PORT :	Kolkata 182 kM away from Durgapur.	
	MODE OF TRANSPORTATION :	Rail/Road	
1.2	▪ **TYPE OF CONTRACT :** EPC.		
1.3	**MAJOR PACKAGES INCLUDED IN SCOPE:** ▪ BFP, C&I, CEP, Chimney, Civil Works, Cooling Towers, Deaerator, Electricals, ESP, Heaters, Power Cycle Piping, Steam Generator, Steam Turbine, Turbo Generator.		
1.4	**ZERO DATE OF CONTRACT :** Yet to be informed		
1.5	**COMPLETION DATES** : As below		

		SYNCHRONISATION	**COMPLETION OF TRIAL OPERATION (COD)**
	UNIT – 8 :	39 Months	42 Months

SECTION – C

SPECIFIC TECHNICAL REQUIREMENT AND CUSTOMER SPECIFICATION

SECTION-C

SPECIFIC TECHNICAL REQUIREMENTS

1. FUNCTION

The purpose of the system is to provide Ventilation for different areas of **1x 250 MW Durgapur Extn unit 8** under the scope of BHEL.

2. SYSTEM DESCRIPTION

2.1 AREAS BEING VENTILATED THROUGH WET VENTILATION SYSTEM

The Ventilation System is provided in the following locations within the Power House by Air washers. Coursing of air in desired direction / areas shall be made by using roof extractors.

2.1.1 TG bay (ground, mezzanine and operating floor), HP/LP heater area, condenser area, Boiler feed pump area Oil cooler area

2.1.2 MCC Rooms.

2.1.3 Cable Spreader Rooms

2.1.4 Switchgear Rooms

Cooled and filtered air from Air Washer Unit shall be distributed by means of ducting to the TG building near various heat sources like turbo-generator, condenser, Boiler feed pump HP & LP heaters etc. The hot air from the hall shall be exhausted by means of roof extractors. The quantity of air exhausted shall be kept lower than the quantity of air supplied in such a way that a little overpressure is maintained inside the hall. This will reduce infiltration of outside hot and dusty air.

The supply air quantity is supplied from four (4) nos. AWU - two (2) nos. being located outside A-Row of TG building at 17.0M floor level and two (2) nos. being placed on B-C bay at 25.5M floor level, such division and location area decided to achieve effective air distribution with less amount of ductwork and less pressure drop in fans.

The Air Washer Units will primarily serve TG hall and the electrical areas like MCC Room, Switchgear Room, and Cable Spreader Room. The washed air supplied to MCC / Switchgear/Cable Spreader Rooms shall be exhausted outside through Back Draft Dampers. Fire dampers are provided in the supply air ducting leading to all electrical rooms (MCC, Switchgear etc.)

The supplied air in the lower level of TG hall after taking the heat load of TG bay rises through different openings to the upper floors and is then finally exhausted by means of roof exhausters placed over the roof of TG Hall. Some quantity of air leaks out through various leakage areas thus maintaining slight positive pressure inside w.r.t. outside.

2.2 VENTILATION PROVISION FOR AUXILIARY BUILDINGS IN VARIOUS LOCATION IS ENVISAGED AS FOLLOWS:

a)	Electrical MCC/Switchgear areas of ESP Control Building.	Washed and filtered air supply from Unitary Air Filtration Unit (UAF) and exhausting it by back Draft Dampers.
b)	CW ACW Pump House	Wall mounted supply fans for the pump area. Hot air will be exhausted through wall mounted louvers. For the associated Electrical room, Pressurised ventilation with wall mounted fan filter units and air exhaust through back draft dampers.

c)	Fuel Oil Pump house	Wall mounted exhaust fans with Motorised fire damper for the pump area. Fresh air will enter the Pump House through wall mounted louvers. For the associated Electrical room, Pressurised ventilation with wall mounted fan filter units and air exhaustthrough back draft dampers.
d)	CW Treatment Plant	Wall mounted exhaust fans for the Chlorination area. Fresh air will enter the Building through wall mounted louvers. For the associated Electrical MCC Room, Pressurised ventilation with wall mounted fan filter units and air exhaust through Back Draft Dampers.
e)	Compressor house	Pressurized ventilation with wall mounted fan filter units and air exhaust through Back Draft Dampers.
f)	Oil room	Wall mounted exhaust fans
g)	Battery room	Wall mounted exhaust fans

Ventilation of any other area in BHEL scope, which is not covered above, shall also be provided with mechanical ventilation.

3. DESIGN CRITERIA:

System Design Criteria:

The outside design conditions considered are as follows:

	Summer	Monsoon	Winter
DBT (°C)	42.2	32.2	11.1
WBT (°C)	25.6	30.0	6.7

The inside design conditions:-

i) For all evaporative cooled areas, the air quantity shall be calculated based on following
   a) Air quantity based on 6 air changes per hour
   OR
   b) Air quantity shall also be calculated such that the inside temperature is maintained 3^0 C below outside DBT during peak summer.

Higher of the air quantity obtained by two methods above shall be selected.

ii) For mechanical ventilated area, the air quantity shall be calculated based on the following air changes -

   a) Pump houses 10
   b) Electrical Room like M.C.C. Room, Switchgear room Of Auxiliary Building 15
   c) Battery Room areas 20
   d) Oil room 20
   e) Toilets 20

All equipment shall be designed for continuous duty.

Fire Dampers (Motorised type electrically operated) shall be provided at the duct / Fan opening of Switch Gear Room. The operation of these automatic dampers shall be interlocked suitably with the Air-washer Local control panel.

The ducting shall be sized to have constant friction drop along its length with air velocity in the ducts normally not exceeding 12 m/sec. for ventilation system. However the air velocity shall be increased more than 12 m/sec., in case of neck formation / transmission piece not exceeding one meter of length.

4. EQUIPMENT AND SERVICES TO BE PROVIDED FOR VENTILATION SYSTEM. :

4.1 AIR-WASHERS

Four (4) Nos. sheet metal type Air washer units (AWU) each having a capacity of

1, 30,000 M^3/Hr with 75 mmwc static pressure for T.G. building.

The air washers shall be containerised type with all the components (i.e. Blowers, Air Washers arrangements, filters, louvers etc) housed in a 4 mm thick sheet steel casing with adequate stiffening arrangement. These Air washers shall be placed outside, exposed to atmosphere.

Each air washer comprises of:

4.1.1 Double inlet double width centrifugal fan units (2 X 50% capacity) with electric drive motor , drive pulleys, v-belt, belt guards, cushy foot mountings, removable drain plug and other accessories as required. Both inside and outside surfaces of all parts of the fans shall be spray galvanized.

4.1.2 Air intake louver with bird screen of GI construction.

4.1.3 Automatically cleanable type Stainless Steel mesh Filters complete with SS / Aluminium frame continuously flooded with water by one bank of spray header with Stainless Steel water spray nozzles spraying water over the filters in the direction of airflow.

4.1.4 Two numbers Horizontally Split casing type Centrifugal pump sets (one running and one standby) complete with drive motor for circulation of water through the above spray header bank and provided with pot type suction strainer with bypass valves, inlet and outlet pressure gauges and filter back wash arrangement.

4.1.5 Fill deck made of cellulose paper in cross fluted configuration duly impregnated with insoluble anti-rot salts, rigidifying saturants and wetting agent and assembled in self supporting pads.

4.1.6 Two numbers centrifugal monobloc pump sets(2 x100 % duty) for circulation of water through the above fill deck and provided with pot type suction strainer with bypass valve, inlet and outlet pressure gauges and filter back wash arrangement.

4.1.7 Moisture eliminators set of die-extruded PVC construction.

4.1.8 Air washer chamber of 4mm thick sheet steel fabricated construction with adequate stiffeners, bracing etc. (duly painted with epoxy resin based paint from inside & outside) covering all components of Air Washer unit including centrifugal fan, but excluding the water circulating pump sets.

4.1.9 Air washer sump of minimum 5 mm thick MS construction with epoxy paint both from inside & outside.

4.1.10 Air filters (SS) complete with fixing frame.

4.1.11 Intake louver with frame & screen.

4.1.12 All valves, pipes, nuts & bolts, pipe hangers, supports, internal fittings and supports including ball float valves for makeup water connection, quick- fill connection with valve, drain piping with valve up to the nearest drain point and overflow connection with siphon.

4.1.13 Inspection door and marine lights.

4.2 UAF

One (1) Nos. Sheet metal type Unitary Air Filtration system (UAF) having capacity of 50,000 CMH at 60 mmwc static pressure for ESP building shall be placed at roof of the ESP bldg.

One (1) no. UAF comprises of:

4.2.1 One (1) No. (1X100%) Centrifugal fan backward inclined, SISW type, complete with electric drive motor, drive Pulleys, V-belt, belt guards, slide rails, cushy foot mount isolators, removable drain plug and other accessories etc. Both inside and outside of surfaces of all parts of the fans shall be spray galvanized.

4.2.2 Fresh air intake louver with bird screen of GI construction.

4.2.3

4.2.4 Two (2) Nos. (2 x100 % duty) Centrifugal mono-bloc pumps for circulation of water. Pump system shall be provided with pot strainer with by-pass valves, inlet and outlet pressure gauge with isolating cock, fitting and accessories, complete with makeup water plumbing with hangers/supports, float valve, internal fittings and supports, over flow connection and drain connection with valve and siphon and filter back wash arrangement.

4.2.5 Automatically cleanable type Stainless Steel mesh Filters complete with SS / Aluminium frame continuously flooded with water by one bank of spray header with Stainless Steel water spray nozzles spraying water over the filters in the direction of airflow.

4.2.6 Moisture eliminator sets of die-extruded PVC construction.

4.2.7 GI sheet metal casing with inspection window, ladder and catwalk, water tank, flexible connection piece with tank.

4.2.8 Distribution plate and moisture eliminators.

4.2.9 UAF chamber of sheet metal (2mm MS) construction with 3mm thick MS tank etc. Both the casing & the water tank shall be of epoxy painted from inside & outside and shall be complete with all valves, pipes, nuts and bolts, pipe hangers, supports, internal fittings and supports, suction pipe connection with coarse strainer, make-up water connection with ball float valve, overflow connection with siphon, drain connection with valve, quick fill connection with valve etc.

4.2.10 Intake louver with frame & screen.

4.2.11 Inspection door with ladder, marine light and cat walk in the spray chamber

4.2.12 Air pressure breaker valve, Siphon, etc.

4.3 CENTRIFUGAL FLOW FAN UNITS

Each centrifugal fan shall be complete with

4.3.1 Fan impeller (backward curved) with casing & supports.

4.3.2 Electric drive motor.

4.3.3 Drive Pulleys, V-belt, belt guards, slide rails etc.

4.3.4 Dampers and flexible connection with matching flanges.

4.3.5 Vibration isolators, foundation bolts and nuts.

These fans shall cater to the areas as indicated in the fan schedule of ventilation system.

4.4 WALL MOUNTED AXIAL FLOW FAN

Each wall mounted axial flow fan shall be complete with

4.4.1 Fan impeller & casing/short duct as required.

4.4.2 Electric drive motor with coupling if any, including motor brackets.

4.4.3 Inlet cone and grouting framework, if any.

4.4.4 Rain protection cowl with bird-screen.

4.4.5 All supply air axial flow fans shall be provided with pre-filters (and also fine filters for MCC/switchgear room).

These fans shall cater to the areas as indicated in the fan schedule of ventilation system.

4.5 ROOF EXTRACTOR UNIT

Each wall roof extractor unit shall be complete with

4.5.1 Fan wheel, electric drive motor with motor coupling if any and motor bracket.

4.5.2 Short duct mounting/axial fan casing having inspection door and base

4.5.3 Grouting framework & foundation bolts including screen at bottom.

4.5.4 Rain protection cowl with bird-screen (provided with roof – hood with limit switch) .

These fans shall cater to the areas as indicated in the fan schedule of ventilation system.

4.6 DUCTWORK

4.6.1 GSS supply air ducting (as per IS 655) fabricated with GSS sheet (as per IS 277) having zinc coating of 180 g/sqm. The ducting shall be complete with vanes, splitters, dampers, hangers, supports, anchor bolts, sealing components, gaskets etc). The air velocity in the ducts shall not exceed 12.0 m/sec. for ventilation system. All ducting shall be designed on equal friction method.

4.6.2 Splitters and dampers shall be in minimum 16 gauge GS sheet of quadrant type with suitable locking device, mounted outside of duct in accessible position.

4.6.3 Gravity operated back draft dampers shall be installed in association with supply air system in order to maintain positive pressure inside the ventilated area.

4.6.4 Volume control dampers shall be provided in all branch ducts at connection to main duct but as for as possible away from grille and also for each area to control the quantity of air supplied.

4.6.5 Motorised type electrically operated fire damper will be installed in the ventilation supply air duct/fans at locations as specified. The motorized fire dampers shall be electrically operated by 240 V, 50 Hz single phase AC supply. Motors shall remain energised in normal condition to effect opening of dampers. In the case of fire, signal from Fire Alarm Panel would be transmitted to the fire damper, the motors will be de-energised and the damper will close

4.6.6 Diffusers, Grills & Dampers

i. Supply air diffusers / grills with volume control dampers be provided for all evaporative cooling areas.

ii. Exhaust air grills with volume control damper shall be provided for Battery rooms.

iii. Inlet / Exhaust air grills / louvers are required for all negatively pressure ventilated areas.

iv. Pressure relief dampers (gravity type) shall be provided for all areas pressurized under ventilation system.

v. The diffusers / grills shall be mild steel and suitably protected with two coats of chlorinated rubber paint.

vi. Supply air grills shall be of double deflection type.

vii. All volume control (VC) damper shall be operated by a key from the front of the grills / diffusers.

viii. The thickness of frames of Diffusers, grills & VC dampers shall be of minimum 20 gauge and thickness of louvers shall be of minimum 26 gauge.

4.6.7 All plenum chambers of connections to fans, dampers etc. shall be constructed in 18 gauge GS sheet and supported on MS angle frames.

4.6.8 All ducting surfaces coming in contact with corrosive fumes or gases shall be painted with three coats of epoxy paint over a coat of suitable primer.

4.6.9 Thermal insulation on the ducting which is exposed to the atmosphere.

4.7 WATER PUMP SETS

Each circulating water pump set for air washer shall comprise of the following

4.7.1 Centrifugal pump Horizontal split casing / Back Pull out type of adequate capacity to match the system requirement for Air washer & Mono Block type Centrifugal Pump of adequate capacity to match the system requirement for AW & UAF.

4.7.2 One no. adequately sized TEFC sq. cage induction motor suitable for 415V, 3 phase, 50 Hz AC supply.

4.7.3 One no. Pot type strainer at inlet complete with screen, drain arrangement etc.

4.7.4 150 mm dia. Dial Type pressure gauges one each at suction & discharge side of the pump set.

4.7.5 Gate valve, one each at suction and Globe valve, one each at discharge side of the pump set.

4.7.6 One no. non-return (check) valve at discharge side of each pump set .

4.7.7 One set of base plate, coupling, coupling guard, anti-vibration mountings, foundation bolts etc.

Each circulating water pump set for UAF shall comprise of the following

4.7.8 Mono Block type Centrifugal Pump of adequate capacity to match the system requirement for UAF.

4.7.9 One no. Pot type strainer at inlet complete with screen, drain arrangement etc.

4.7.10 150 mm dia. Dial Type pressure gauges one each at suction & discharge side of the pump set.

4.7.11 Gate valve, one each at suction and Globe valve, one each at discharge side of the pump set.

4.7.12 One no. non-return (check) valve at discharge side of each pump set .

4.7.13 One set of base plate, anti-vibration mountings, foundation bolts etc.

4.8 MATERIALS OF CONSTRUCTION

4.8.1 CENTRIFUGAL FAN

Fan Scroll	Heavy Gauge MS (IS-2062)
Fan Casing (side plates & stiffeners)	Mild Steel Sheets/plate to IS: 2062/IS: 1079/Eq.
Impeller	M.S. sheet/plate (IS-2062)
Impeller hub	Mild Steel.
Impeller back plate blade & shroud	Mild Steel to IS:2062.
Shaft	C-45, IS-1570 or class -IV, IS-1875 or eqv.
Shaft sleeve	-do-
Fan Supports, frames and structure.	Mild Steel (IS-2062)
Flexible connection at outlet/inlet	Fire resistant type plastic impregnated canvas with M.S. flange and cleats (3 mm Thick).
V Belt (matched sets)	ISI marked (Reinforced rubber section to IS: 4776)
V Pulley	Cast Iron multigroove to Gr-20 as per IS: 210.
Slide rails	M.S./C.I.
Connection pieces	G.I. according to supplier's design.
Bolts & nuts	M.S. (Epoxy painted)
Vibration isolating pads, washers and spring if any.	Hard synthetic rubber of hardness 40° shore.
Dampers	Heavy Gauge MS(IS-2062).

4.8.2 AXIAL FAN

1	Casing	Mild Steel. (IS-2062)
2	Impeller	Cast ALuminium. (Alloy A-6M, IS-617)
3	Hub	As per manufacturer std.
4	Support frame and structure.	M.S. (Mild Steel) of adequate thickness (painted) IS-2062.
5	Neoprene rubber pads	As required.
6	Coned inlet for wall exhausters/ supply fans	MS (Mild Steel) (IS-2062)
7	Supporting frame for mounting.	Required.
8	Protective screen at inlet	**Yes** (Min 14 SWG (standard wire Gauge) Galvanized wire Knitted in 1" square mesh).

9	Rain Protection Cowl	Suitably painted after fabrication from MS
10	Mounting flange on casing	At inlet and outlet.

4.8.3 **ROOF EXTRACTOR UNIT**

1	Casing/cowl/hood	M.S. (Mild Steel) Sheet to IS: 2062 (Short duct casing).
2	Impeller	Cast A1uminium. (Alloy A-6M, IS-617)
3	Support frame and structure	M.S. (Mild Steel) of adequate thickness (IS-2062).

4.8.4 AIR WASHER

4.8.5 Moisture Eliminators plates: 24 SWG Galvanised Sheet (Vertical and brake type) / 100% virgin PVC of minimum finished thickness of 2 mm.

Moisture Eliminator Frame:	22 SWG G.I. sheets.
Distribution plates:	18 G GSS to have 50% free area.
Tank:	Black MS (6 mm) for sheet metal Air Washer width of cat walk shall be 600 mm
Casing:	Black M.S. (4 MM thick)
Piping:	Heavy class Galvanised to IS: 1239 Part I
Suction Screen Water:	Brass(40 mesh size 2 nos for each air washer)
Spray nozzles:	Nylon/Polymer.
Flooding Nozzles:	Nylon/Polymer.
Banks:	Two spray banks each connected to individual header.

4.8.6 PRE FILTER:

1	Filter Media	Synthetic non-woven for fresh air pressurization & for Air Washer system.
2	Efficiency	90% down to 10 microns
3	Allowable pressure drop	For HDPE (High density Poly Ethylene) Synthetic Non Woven (SNW) - 2.5 mm WG during clean condition. - 6.0 mm WG during dirty condition.
4	Frame Work	18 G, GSS (Galvanized steel sheets).
5	Size	600x600 mm (approx.)

5. CONTROL PHILOSOPHY:

5.1 VENTILATION FAN MOTORS

All ventilation 3 phase fan motors except Air Washer / UAF Units shall be controlled from Local Starter Panel.

All 240V, 1ph fans (up to 0.25KW motor rating and below ratings) will be operated by Switches located near the individual fans.

LPBS will be provided for the fans which are not visible from the LSP. Emergency Stop P.B. shall be pressed to latch and turn to release type.

5.2 AIR WASHER / UAF UNITS

Each Air Washer / UAF Unit will have one Local Starter cum Control Panel (LSCP) located near each Air Washer / UAF Unit for its operation & control.

a) HUMIDITY CONTROL (APPLICABLE FOR AIR WASHER ONLY).

To protect the equipment located in the ventilation space (mainly for the MCC/ Switchgear Room) from effects of high humidity, the control device using humidistat is interlocked with Cell deck pump motor of the AWU and shall be used in electrical areas. Humidity beyond 60% RH in these ventilated spaces shall automatically trip the respective cell deck pump. The pump may be restarted automatically at about 50% RH. However, manual over-ridding facility shall be provided for these humidistat controlled pumps. Selection and starting of stand-by pump shall be manual.

Relative humidity inside the ventilated areas shall also be displayed digitally on the LSCP.

b) AWU / UAF UNIT SUMP WATER LEVEL CONTROL.

The water sump of each Air Washer / UAF Unit shall be provided with a low level switch which will initiate an alarm & will trip the pump, in case water level falls below a pre-determined mark. At the delivery pipe of each pump a pressure switch will be provided along with pressure indicator.

c) Following visual indications are to be provided in local starter-cum-control panel for Air Washer Units.

I. FAN RUNNING.

II. FAN STOP.

III. PUMP – 1 RUNNING (FOR SPRAY SET ARRANGEMENT).

IV. PUMP – 1 STOP (FOR SPRAY SET ARRANGEMENT).

V. PUMP – 2 RUNNING (FOR SPRAY SET ARRANGEMENT).

VI. PUMP – 2 STOP (FOR SPRAY SET ARRANGEMENT).

VII. PUMP – 3 RUNNING (FOR CELL DECK ARRANGEMENT)

VIII. PUMP – 3 STOP (FOR CELL DECK ARRANGEMENT)

IX. PUMP – 4 RUNNING (FOR CELL DECK ARRANGEMENT)

X. PUMP – 4 STOP (FOR CELL DECK ARRANGEMENT)

XI. FAN MOTOR OVER LOAD TRIP.

XII. PUMP - 1 MOTOR OVER LOAD TRIP.

XIII. PUMP - 2 MOTORS OVER LOAD TRIP.

XIV. PUMP - 3 MOTOR OVER LOAD TRIP.

XV. PUMP - 4 MOTOR OVER LOAD TRIP.

XVI. RH HIGH.

XVII. RH LOW.

XVIII. SUMP WATER LEVEL LOW.

Provision of alarm (audio-visual) for Trip of any motor & low water level in the sump shall also be kept in the Local Starter cum Control Panel.

d) Following visual indications are to be provided in Local Starter-cum-Control Panel for UAF.

I. FAN RUNNING.

II. FAN STOP.

III. PUMP – 1 RUNNING (FOR SPRAY SET ARRANGEMENT).

IV. PUMP – 1 STOP (FOR SPRAY SET ARRANGEMENT).

V. PUMP – 2 RUNNING (FOR SPRAY SET ARRANGEMENT).

VI. PUMP – 2 STOP (FOR SPRAY SET ARRANGEMENT).

VII. FAN MOTOR OVER LOAD TRIP.

VIII. PUMP - 1 MOTOR OVER LOAD TRIP.

IX. PUMP - 2 MOTORS OVER LOAD TRIP.

X. RH HIGH.

XI. RH LOW.

XII. SUMP WATER LEVEL LOW.

Provision of alarm (audio-visual) for Trip of any motor & low water level in the sump shall also be kept in the Local Starter cum Control Panel.

5.3 OPERATION OF ELECTRICAL TYPE FIRE DAMPER

Motorised type electrically operated fire dampers shall be provided in the ventilation supply air ducting/fans leading to like various MCC rooms, Switchgear rooms, cable spreader rooms and in the exhaust path of oil room and oil tank area. These dampers shall be operated with the help of signal from smoke detectors/thermal sensors. Motors shall remain energised in normal condition to effect opening of dampers. In the event of fire, the motors will be de-energised and the damper will close due to spring action. Smoke detector/thermal sensors will be supplied by the Bidder.

In case of fire, all the motorized fire dampers provided in the supply air duct will close and the relevant fan motors will be tripped at the same time. The signals for this operation will come from zonal fire panel.

In case of fire in the TG Hall or in the electrical rooms, all the supply fans of AWUs shall be stopped automatically with the sense from smoke detectors / thermal sensors through zonal fire panels.

5.4 OTHER CONTROLS – VENTILATION SYSTEM

ON/OFF controls of each drive and equipment like air washer pumps, air washer fans etc located adjacent to air washer shall be provided in local control panel located near air washer. ON/OFF indication shall also be provided on this panel. Emergency stop push button (Mushroom head press to lock and key to release) shall be provided for all drives in air washer rooms. Air Washers pumps shall be interlocked with Humidistat. All other drives associated with ventilation system like fresh air fans, exhaust fans, roof extractor etc shall be fed from respective MCC.

6. POWER SUPPLY ARRANGEMENT

6.1.1 The AC power supply (rated voltage, frequency, no. of phase etc.) of Ventilation system equipments shall be as applicable as mentioned in the Electrical Specification.

7. GENERAL:

7.1.1 Ventilation Plant Supplier to furnish characteristic curves for all major equipment offered indicating duty point.

7.1.2 Proper lighting arrangement shall be provided for each Air-washer of Ventilation system.

7.1.3 All the annunciations related to failure of equipments, tripping of equipments source of failure / reason due to which the equipment is stopped / tripped low & high limits of parameters such as level, temperature, pressure drop pressure etc. shall be provided for each pump, fan, etc. in the respective panel.

7.1.4 The fan (both supply and exhaust fans) associated with mechanical ventilation system shall be operated locally.

7.1.5 Vertical ducts shall be supported at each floor level.

7.1.6 The Ventilation system equipment (Air washer unit, fans and roof extractors) shall be interlocked with the fire alarm system. Under fire condition the fire alarm system shall automatically stop operation of the Ventilation system.

7.1.7 All interlocks for safe operation of the equipment shall be provided by the contractor.

7.1.8 The material of make-up water piping, after the battery limit shall be Heavy class galvanized steel or Polystyrene piping as per standard.

7.1.9 Basis of design, all calculations including ventilation system capacity calculations, equipment selection, layout drawings/schemes, GA drawing and documents like data sheet/technical particulars etc. are subject to customer and BHEL approval during detail engineering stage.

7.1.10 The capacities/sizes/parameters of equipment and systems specified under this contract have been designed / selected to meet the design goals stated in this specification and are minimum requirements only. It is the contractor responsibility to check and verify that these capacities/sizes/parameters are adequate to meet the stated design goals of the Ventilation system. If in the contractor's opinion the capacities/sizes/parameters for any of the equipment / systems are inadequate or undersized, then the required capacity to be provided to meet the system requirements.

7.1.11 Base plates and foundation bolts including anchor bolts, nuts, loose fittings etc. for equipment and as would be necessary for erection and complete anchoring of steel materials for the pipes, hangers and duct supports etc. Anchor fasteners shall be in the scope of bidder.

7.1.12 Supply of special tools and tackles including toolbox required for operation, maintenance and overhauling of the system shall be in the scope of bidder.

7.1.13 Drawings, Data and instruction manual for the system as per drawings/documents distribution schedule required by customer shall be in the scope of bidder.

7.1.14 The bidder offer shall be for equipment in accordance with the technical specification. Locations of the ventilation equipments are tentatively finalised and may be subject to minor alterations during detailed engineering. Bidder shall furnish space requirements along with the offer for major areas.

7.1.15 The bidder must indicate make of various equipment clearly in the offer. The words "equivalent/reputed make" are not acceptable.

7.1.16 The bidder shall furnish complete Tech. particulars in data sheet and schedules enclosed in Volume-III of this specification, in absence of which the offer may be treated as incomplete and shall be liable to be rejected.

7.1.17 Tender drawings enclosed form the part of specification and the bidder shall check the space requirements etc.

7.1.18 Makes of equipment shall be as per List of Makes, attached elsewhere in the specifications.

7.2 EXCLUSIONS :

7.2.1 EQUIPMENT AND SERVICES TO BE PROVIDED BY PURCHASER :

Following items shall be supplied, and / or installed by the purchaser unless otherwise, mentioned specifically.

7.2.2 Civil works related to Air-washer rooms, including foundations of major Ventilation system equipments i.e. Centrifugal Fans, pumps, except grouting and dressing of foundations etc., fixing, grouting & dressing of foundations shall be in bidder's scope.

7.2.3 Openings in walls, floors, roof etc. for piping and ducting, floor drain points in Air-washer rooms etc. however civil works like grouting of foundation bolts, dressing of pockets, sealing of openings, minor chipping for anchoring etc. shall be included in bidder's scope.

7.2.4 Provision of drain traps / points.

7.2.5 All electrical works like MCC / switchgear, power and control cables, etc. However, termination of power & control cables of Ventilation Plant supplier supplied equipments shall be done by Ventilation plant supplier. Lighting of Ventilation plant rooms/areas. For further clarity, bidder to note the electrical scope between BHEL and Vendor enclosed elsewhere in the specification.

8. PERFORMANCE REQUIREMENTS

8.1 GUARANTEES TO BE FURNISHED BY BIDDER

8.1.1 Besides the system guarantee as above, bidder shall guarantee major technical parameters of various equipments as per design basis / details furnished.

8.1.2 Tests to prove guaranteed performance of Centrifugal Fans, Pumps and axial Fans shall be carried out at site after proper installation. The site test shall include performance testing of equipment for 72 continuous hours. Bidder, as may be required to carry out site tests shall arrange all instruments, tools etc.

8.1.3 TEST INSTRUMENTS

8.1.4 All calibrated instruments to be used for the tests at manufacturer's works/site shall be arranged by the bidder.

9. DRAWINGS & DOCUMENTS REQUIRED TO BE SUBMITTED BY THE BIDDER FOR TECHNICAL EVALUATION ALONG WITH THEIR TECHNICAL OFFER:

9.1.1 Design Calculation supporting sizing of Ventilation equipment.

9.1.2 System write-up for Ventilation System.

9.1.3 Technical Data sheet duly filled up.

9.1.4 Bidder to confirm that there is no deviation from the tech specification. If any deviation is there then same to be indicated separately under the heading “DEVIATION OF TECH. SPECIFICATION”. Bidders shall also note that the deviation in any other form except above is not acceptable (i.e. in data sheet or other Annexure or elsewhere in the offer) and same shall not be considered for review/evaluation purpose/comments and it would be assumed that the system/material/equipment has been offered strictly in line with specifications/requirements.

9.1.5 Scope of work including the bill of material for major equipment / items.

9.1.6 Guaranteed Power Consumption figure for the Ventilation System shall be indicated.

9.1.7 Any other information, as required for the completeness of the Technical offer, shall also be furnished by the bidder.

10. CODES AND STANDARD

10.1.1 All equipment, system and works covered under this specification shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Also, all equipment shall conform to the latest applicable Indian or International Standards established to be equivalent or superior to the Codes and Standards specified in Section-D and listed below. In case the BIDDER offers equipment conforming to any standards other than those specified in component specifications, the BIDDER shall furnish copies of standards translated in English while submitting his proposal.

IS 277	Galvanised Steel Sheets
IS 325	Three phase induction motors
IS 655	Metal Air ducts
IS 7613	Method of testing panel type air-filters for air-conditioning and Ventilation system.
IS 3588	Electric axial fans
IS 4894	Centrifugal fans
UL 555	Fire dampers

internationally accepted safe and non-toxic fire fighting agent shall be used.

Fire protection and detection systems shall include remote indication/ alarm facilities, zoning of fire protection and detection installations, and facilities for the containment/ removal of smoke and the containment/ removal of spray water.

In control buildings and other areas where cable fires could result in unacceptable corrosion damage and/ or the obstruction of fire fighting work, cable routes containing more than 3.5 l / m of combustible cable volume shall be enclosed, the enclosure to have a minimum fire rating of one hour to BS.476 Part 20 [or equivalent standard].

All fire barriers proposed for the containment of smoke or fire shall have a minimum fire rating of one hour to BS.476 Part 20 [or equivalent standard].

The bidder shall identify the fire risks presented by the proposed plant and provide appropriate fire protection equipment accordingly. It is expected that these will include (but not necessarily be limited to) the following:

a) Electrical Bays (switch gear room, MCC room, cable spreader room etc.)

b) Control rooms

c) Records and library rooms

d) Fuel (coal and oil) handling and storage plant including oil pump house, coal conveyors, terminal buildings, crusher house, coal stock pile, track hopper, coal bunkers and coal mills.

e) Steam generator burner zone

f) Steam Turbine Generator oil systems

g) Boiler feed pump set oil systems

h) Oil filled transformers

i) Diesel engines and fuel tanks

j) Boiler light-up gas store and pipe-work

k) Hydrogen filled machines, store and pipe-work

l) Cables

m) All other indoor and outdoor stores where any inflammable substance may be present.

At least one (1) nos. fully equipped mobile fire tenders shall be provided.

22.00.00 (A) AIR-CONDITIONING AND VENTILATION SYSTEM

1.00.00SYSTEM DESCRIPTION

This specification covers the Air Conditioning & Ventilation system required for Main Plant Package of Two (2) nos. extension Units – 8 & 9 each of 250 MW of the existing Thermal Power Station of The Durgapur Projects Limited at Durgapur in West Bengal.

1.01.00 The air conditioning system shall be provided for the following areas:

a) TG Building

i) Central Control Room

ii) Control Equipment Rooms (CER)

iii) Computer Rooms

iv) Uninterrupted Power Supply (UPS) Room.

v) Shift-Charge Engineer's Room

vi) Steam and Water Analyzer (SWAS) Panel Room

vii) Conference room on operating floor

viii) Other Office areas telephone exchange room, library and Laboratory etc, if any, on the operating floor

ix) AC Plant Control Room

b) ESP Control Room

c) Dining Hall of Canteen Building

d) Chemical, C & I, Electrical & Environmental lab

e) Fire station Control Room

f) Rooms / cubicles housing Programmable Logic Controllers (PLC) and other Input / Output (I/O) modules for each Unit.

g) Office area of the Security, Gate house

h) Control Room of CW and ACW Pump house

i) Compressor House Control Room

j) Any other area requiring Air conditioning

1.01.01 All the buildings described above shall preferably be provided with separate air conditioning systems because they are far apart from each other.

1.01.02 One Common Central Chilled Water Plant shall be provided to serve Turbine Buildings for two Units.

The Central Chilled water Plant consists of 3 x 50% capacity Water cooled Screw Chiller Units associated with 3 x 50% capacity Chilled water pumps, 3 x 50% capacity Condenser water pumps, 3 x 50% capacity Cooling towers and individual Air Handling Units / Fan-Coil Units (as applicable) to serve the above mentioned areas of the TG building.

For each AHU room at least two nos. AHUS shall be provided.

For SWAS rooms and Other Office areas like Conference room, telephone exchange room, library and Laboratory etc, if any, individual AHUs/ Fan Coil Units shall be provided.

1.01.03 Water Cooled Packaged Units (Precision Type) shall be used for air conditioning of the ESP Control room in each ESP Control Building. At least one module of Precision Air Conditioner shall be kept as stand-by for each ESP building. No separate cooling tower and condenser cooling water pump have been envisaged for this system. Condenser cooling water will be supplied to this building from the main cooling towers of air conditioning (AC) system of Turbine Building. Bidder shall calculate and estimate the size of the cooling towers and Condenser water pumps of Turbine Building accordingly.

1.01.04 Air Cooled Duct-able Split Air Conditioners of 2 x 50% capacity shall be provided for the Dining Hall of Canteen Building.

1.01.05 Air Cooled Non-Duct-able Split Air Conditioners capacity shall be provided for each area of Chemical, C & I, Electrical and Environmental lab, Control room of CW and ACW Pump house, Compressor House Control room, Fire station Control Room and Control room of CW Treatment plant. At least one module of Split Unit shall be kept as stand-by for each AC area.

1.01.06 Air Cooled Non-Duct-able Split Air Conditioners /Window type air conditioning units each of 100% capacity shall be provided for the Office of the Security Gate house.

1.01.07 Window type air conditioning units shall be provided for all rooms/ cubicles housing PLC and other I/O units. Required no. of suitable capacity should be selected.

1.02.00 Mechanical Ventilation system shall be provided for the following areas:

a) TG Building

i) TG Hall

ii) MCC, Switchgear rooms and cable spreader rooms

iii) Battery Rooms

iv) Battery Charger Rooms

v) Coal Conveyor Tripper floor

vi) Elevator Machine Rooms

vii) AC Plant Room

viii) Toilets

b) ESP Control Building –MCC/ Switchgear room

c) CW & ACW Pump house

d) Fuel Oil Pump house

e) CW Treatment plant building

f) Central Store building

g) Workshop building

h) Kitchen and toilet areas of Canteen building

i) Toilet, Store & Kitchen areas (if any) of Fire Station building

j) Compressor house

k) DG room

l) Toilet of Gate house

1.02.01 Evaporative cooling system by adopting Air Washer Unit (AWU) is to be provided for the ventilation of turbine building. Cooled and filtered air from Air Washer Units should be distributed by means of ducting to the TG building near various heat sources like turbo-generator, condenser, boiler feed pump, HP & LP heaters, oil coolers etc. The quantity of air exhausted should be kept lower than the quantity of air supplied (usually 60-65% of the supply air is exhausted) in such a way that a little overpressure is maintained inside the hall. This will reduce infiltration of outside hot and dusty air.

On the basis of net heat gain and assumed temperature rise as explained in the Design Criteria (4.00.00), the supply air quantity for TG hall is to be worked out. This air quantity is supplied from four (4) AWU - two (2) being placed on B-C bay over De-aerator floor and two (2) being located outside A row of TG building. Such division and location area is decided to achieve effective air distribution with fewer amounts of duct work and less pressure drop in fans with no cross-over of ducting across A-B bay.

The Air Washer Units will primarily serve TG hall and the electrical areas like

MCC Room, Switchgear Room and Cable Spreader Room. The washed air supplied to MCC/Switchgear/Cable Spreader Rooms will be exhausted outside through gravity dampers/ exhaust fans. Fire dampers (Motorised) should be provided in the supply air ducting/fans leading to all electrical rooms (MCC, Switchgear etc.).

The supplied air in the lower level of TG hall after taking the heat load of TG bay rises through different openings to the upper floors and is then finally exhausted by means of Roof exhausters placed over the roof of TG Hall. Some quantity of air leaks out through various leakage areas due to the overpressure maintained inside the TG Hall.

All these Air Washer Units should be of package type construction enclosed in sheet metal casing to avoid the problem of water seepage and also to reduce load on building structure. All accessories (except water circulation pumps with drive motors, strainers and some portion of piping) shall be placed inside the AWU casing.

1.02.02 Exhaust (pull type) ventilation to be adopted for the battery rooms by providing 2x100% bifurcated type axial flow exhaust fans with the motor outside the air stream. One of these fans will act as stand-by. The air from the battery rooms contains acid fumes and therefore it should be discharged outside the TG hall at a place away from the steel piping or structures nearby.

All parts of such exhaust system coming in contact with the corrosive acid fumes shall be epoxy painted. The exhaust fans for the system will be of spark-proof construction. The fan motor shall be of flameproof construction.

Cooled and Filtered air supplied in the adjacent Battery Charger rooms from the Evaporative Cooling units of the Turbine Building shall be drawn into the Battery rooms through the wall mounted Manually operated Louver Shutters by the Exhaust fans of the Battery rooms.

1.02.03 Coal conveyor floor and Coal Terminal Room shall be ventilated by means of Roof extractors. Air intake louvres should be provided at lower level for air entry to the coal tripper floor.

1.02.04 Pressurized Ventilation system shall be provided for the Elevator Machine rooms with the help of wall mounted Fan-Filter Units. Air will be exhausted through Back Draft Dampers.

1.02.05 Air from the TG Hall shall be drawn into the adjacent AC Plant Room and Oil Cooler Rooms by means of wall mounted exhaust fans. Exhaust system for Oil Cooler rooms shall be provided with fusible link type fire damper.

1.02.06 Exhaust Ventilation system shall be provided for the Toilets by installing wall mounted type exhaust fans. Air will enter the toilets through door grilles.

1.02.07 Ventilation provision for Auxiliary Buildings in various locations shall be done

as follows:

Electrical MCC/Switchgear areas of ESP Control Building.	Washed and filtered air supply from Unitary Air Filtration Unit (UAF) and exhausting it by back Draft Dampers.
CW ACW Pump House	Wall mounted supply fans for the pump area. Hot air will be exhausted through wall mounted louvers. For the associated Electrical room, Pressurised ventilation with wall mounted fan filter units and air exhaust through back draft dampers.
Fuel Oil Pump house	Wall mounted exhaust fans with Motorised fire damper for the pump area. Fresh air will enter the Pump House through wall mounted louvers. For the associated Electrical room, Pressurised ventilation with wall mounted fan filter units and air exhaust through back draft dampers.
CW Treatment Plant	Wall mounted exhaust fans for the Chlorination area. Fresh air will enter the Building through wall mounted louvers. For the associated Electrical MCC Room, Pressurised ventilation with wall mounted fan filter units and air exhaust through Back Draft Dampers.
Workshop	Wall mounted exhaust fans and fresh air entry through wall mounted louvers/other openings.
Central Store	Supply air by wall mounted Fans (without filter) and air exhaust through louvers. For the associated Electrical MCC Room, Pressurised ventilation with wall mounted fan filter units and air exhaust through Back Draft Dampers.
Kitchen and Toilet areas of Canteen building	Wall mounted exhaust fans and fresh air entry through wall mounted louvers and dry panel filters for the Kitchen. For Toilets wall mounted exhaust fans and fresh air entry through door grilles/ louvers.
Fire Station Building	Wall mounted exhaust fans for Toilets, Store and Kitchen area and fresh air entry through door grilles/ louvers.

Compressor house	Pressurized ventilation with wall mounted fan filter units and air exhaust through Back Draft Dampers.
Gate house	Wall mounted exhaust fans for Toilets and fresh air entry through door grilles.
DG Room	Wall mounted exhaust fans and fresh air entry through door grilles.

1.03.00 The systems described above are only minimum requirement. Any other area/areas, if felt by the Bidder himself or by the Purchaser/their consultant, or if demanded by the process/equipment should be air conditioned / ventilated and shall be included in Bidder's scope of work.

1.04.00 The foregoing and subsequent clauses specify the equipment/system for general guidance only. Any other equipment and /or materials necessary to ensure safe and satisfactory erection, commissioning and operation of the plant shall be supplied by the bidder.

2.00.00 SCOPE OF SUPPLY

2.01.00AIR CONDITIONING SYSTEM:

Scope defined under subsequent Clauses is typical for one unit and shall repeat for the other unit except for the items common for both the units.

Central Chilled water plant (common for two units) consists of the following equipment.

2.01.01Water Cooled Screw Chiller Unit of adequate capacity ……Three (3) Nos. (2 Running &1 Stand-by)

Each consisting of:

A. Screw Compressor ……. One (1) No.

Type	:	Rotary Screw type, hermetic, directly driven, R-134a duty.
Accessories	:	Suction and discharge valves, Oil Separator, HP, LP, OP (if applicable) Motor overload cutout, Automatic capacity control arrangement with automatic unloaded starting device, Anti Recycle device, Heater, Setting and Overhauling tools, foundation bolts, vibration isolating device etc.
Drive motor for above	:	Adequately sized Induction Motor suitable for AC 415V±10%, 3-Phase, 50Hz±5% power supply

B.	Refrigerant Condenser …….		One (1) No.
	Type	:	Water cooled, horizontal, shell and tube R-134a duty & capacity to match the above compressor with integrally finned copper tubes with steel shell having adequate surface area to cater to the requirement of the above compressor & to provide sub-cooling by 2 Deg. C at least.
	Design fouling factor	:	Not less than .0002 Hr. Sq. M. Deg. C/Kcal (.001 Hr-Sq. ft Deg. F/BTU).
	Heat removal and water flow rate	:	To be calculated and furnished by the Bidder.
	Accessories	:	Relief valve, vent connection with valve, De-scaling connection, charging connection, water flow switch, drain connection with valve. Thermo-well connection on water side, liquid trap etc.
C.	Refrigerant Chiller…….		One (1) No.
	Type	:	Horizontal shell and tube direct expansion type R-134a/water duty with copper tube having adequate surface area to provide superheating by 3 Deg.C.
	Design fouling factor	:	Not less than 0.00013 hr-Sq. m. C/Kcal (0.00065hr-Sq.ft.-Deg.F/BTU)
	Heat removal and Water flow rate	:	To be calculated and furnished by the Bidder.
	Accessories	:	Liquid and water connection provided with thermo-wells, water flow switch and pressure gauge connections. At least 39 mm thick insulation of Aluminium foil faced Nitrile Rubber foam/XLPE or equal, with removable type insulated flange cover, water side drain connection with valve in every portion of the chiller isolated by baffle plates.
D.	Piping & Auxiliaries	:	Common base frame for compressor, condenser, chiller unit fabricated of M.S.

angles, channels etc. anchor bolts, nuts, hot gas piping, cold gas piping, liquid refrigerant piping all of seamless steel or ERW steel pipes, insulation of cold gas piping with minimum 39 mm thick Aluminium foil faced Nitrile Rubber foam/XLPE or equal liquid valves, muffler if needed, gauges and instrument piping, filters, drier, moisture indicator isolating valves etc. as may be required for safe and trouble free operation. The entire chiller package assembly shall be installed with spring type vibration isolation devices ... (One set for each chiller unit)

E. Controls : Expansion valve, solenoid valve in the refrigerant circuit, operating thermostat / temperature sensor and anti freeze thermostat.

Microprocessor based control panel of each chiller unit will provide safety against high & low refrigerant pressure, low oil pressure, freezing of chilled water, overload, winding heating and single phasing and phase reversal of compressor by means of high & low pressure transmitter, oil pressure transmitter, temperature sensors & transmitter, O/L relays, thermistor relays, etc. It will also provide capacity control by sensing low chilled water return temperature through operating thermostat/temperature sensor flow switches for the condensers and chillers, compressor unloaded starting device (One set for each chiller).

2.01.02 Oil and Refrigerant : First charge of refrigerant R-134a and oil for the above chiller units.

2.01.03 Condenser cooling water piping between cooling towers and condensers including the condenser cooling water pumps complete with valves, bends, strainers, fittings, instruments, hangers and supports etc. Equipment drain water connection and valves, fittings etc. up to the nearest drain point shall also be included. A single line diagram in this connection is to be furnished by the Bidder.

2.01.04 Chilled water piping connecting the Chillers, Chilled water Pumps and cooling coils of Air Handling Units / FCUs and Expansion tank, complete with valves, bends, strainers, fittings, instruments, hangers and supports, insulation etc.

Equipment drain water connection with siphon and valves, fittings etc. up to the nearest drain point with proper insulation shall also be included. A single line diagram in this connection is to be furnished by the Bidder.

The insulation shall be at least 39mm thick Aluminium foil faced Nitrile Rubber foam/XLPE or equal (Refer elsewhere for detailed specification of insulation). For Chilled water drain pipes the insulation thickness shall be at least 26 mm.

2.01.05 Condenser Cooling Water Pumps : 3 Nos. (2 working + 1 Stand-by) to meet the requirement of the CHW plant of Turbine Building and PAC units of ESP Control Building.

Type : Centrifugal, horizontally split casing, single stage directly coupled to electric motor and mounted on a common base frame.

Speed : Preferably not more than 1500 rpm.

Capacity and Head : To be calculated and furnished by the Bidder.

Duty : Continuously running

Accessories : Pressure gauges at suction and discharge, isolating valves, all integral piping, required for sealing, cooling etc. strainers, check valves, flexible coupling guard, foundation bolts and nuts etc. and other standard accessories as may be necessary for successful operation. Vibration isolators shall also be supplied.

Motor for the above : Adequately sized TEFC, squirrel cage induction motor, suitable for 415 V ±_10%, 3 pH, 50 Hz ± 5% supply.

2.01.06 Chilled Water Circulating Pumps : 3 Nos. (2 working + 1 stand-by) for all areas As described in Clause 1.01.02

Type : Centrifugal, horizontally split casing, single stage directly coupled to electric motor and mounted on a common base frame.

Speed : Preferably not more than 1500 rpm.

	Capacity and Head	:	To be calculated and furnished by the Bidder.
	Accessories	:	Pressure gauges at suction and discharge, isolating valves, all integral piping required for sealing, cooling etc. strainers, check valves, flexible coupling guard, foundation bolts and nuts, complete insulation with minimum 39 mm thick Nitrile Rubber foam/XLPE or equal with 24G aluminium sheet cladding. For the pumps, vibration isolators shall also be supplied.
	Duty	:	Continuously running.
	Motor for the above	:	Adequately sized, TEFC squirrel cage induction motor suitable for 415 V ± 10%, 3 Phase, 50 Hz ±5% supply.
2.01.07	Cooling Tower	:	3 Nos. (2 working + 1 stand-by)
	Type	:	Induced draft cross/counter flow type.
	Duty	:	To meet the requirement of the Chilled water plant and PAC units for ESP Control Building.
	Design Wet bulb temp.	:	30.0 Deg.C.
	Approach (Maximum)	:	4.0 Deg.C.
	Construction		
	• Casing	:	FRP
	• Louvre	:	FRP
	• Fill	:	PVC
	• Drift eliminator	:	PVC
	• Strainer	:	Brass wire mesh
	• Headers and pipe connection	:	G.I.
	• Basin	:	R.C.C/FRP

- Nuts and Bolts etc. : Suitable corrosion resistant material i.e. G.I. or cadmium plated.

- Accessories : Supports, supporting structure, make-up water piping with float valve, drain connection with siphon and valve, over flow and quick fill connections etc.

2.01.08Expansion Tank

The expansion tank shall be made of G.I or FRP and shall be of adequate thickness & suitably reinforced. It shall be complete with make-up connection with float valve, quick fill connection, overflow connection and drain connection with valve. The tank shall be provided with level gauge glass and shall be completely insulated with 6 mm thick Aluminium foil faced Nitrile Rubber foam/XLPE or equal. The capacity shall be selected based on 1.2% of circulated chilled water capacity. Soft and filtered water shall be supplied as make-up.

2.01.09 Make-up water Tank

The Make-up water tank shall be made of G.I or FRP and shall be of adequate thickness & suitably reinforced. It shall be complete with make-up connection with float valve, quick fill connection, overflow connection and drain connection with valve. The tank shall be provided with level gauge glass. This tank will supply make-up water to Cooling towers, Expansion tank and humidifiers.

2.01.10 Make-up Water Booster pump ……..Two (2) Nos.

(1R+ 1S)

Mono block type centrifugal pump to supply make-up water from the Make-up water tank to the Cooling towers, Expansion tank and humidifiers, each complete with drive motor, common base plate, isolating valves, non return valve etc.

2.01.11Non Chemical Water Treatment Equipment……One (1) No.

Type & Accessories : On line Non-chemical water treatment equipment to suit the common header of the condenser water pumps. The equipment shall be complete with flanges at ends and supports.

2.01.12Air Handling Units : Number and individual capacities of Air Handling Units/Fan Coil Units should be calculated and furnished by the Bidder. Each A.H.U. shall consist of the following:

A Fan

	Type	:	Centrifugal, DIDW with forward curved blades, belt driven.
	Accessories	:	Suitably painted M.S. Scroll casing, v-belts, belt guard, supporting frame, volume control damper etc.
	Motor	:	Suitable for above fan and AC 415V ± 10%, 3 Ph, 50 Hz ±5% supply, TEFC squirrel cage Induction motor.

NOTE: For small F.C.U's single phase motors shall be used.

B	Cooling Coil	:	1 No. in each unit.
	Type	:	Chilled water circulating type.
	Construction	:	Seamless copper tubes with aluminium fins, number of fins as per manufacturer's standard but not greater than five (5) per Cm. [thirteen (13) per inch].
	Design fouling factor	:	0.00013 hr-Sq.m.- Deg.C/Kcal
C	Filter	:	Panel type dry HDPE filter having an efficiency of 90% down to 10 micron size particles.

D One set of operating controls consisting of motorized modulating 3-way mixing valve with cooling coils of AHUs and FCUs with temperature sensor and associated transmitter, and modulating motor for controlling the flow of chilled water. Small FCUs shall have multi-speed motor.

E Double skin Powder coated G.I casing (Sand witched panel with internal insulation of min.25mm thick TF quality Expanded polystyrene / PUF in between two GI skin s each of minimum 24G) with inspection facilities, supports made in a 16-G M.S. structure of sectionalized construction with one coat of rust proof anticorrosive paints followed by two coat of final paint and complete with insulated SS drain pan, insulated drain piping etc. The AHU's shall be cabinet type with Fan section, Coil section and filter section.

2.01.13 Fresh air unit each consisting of a tube axial flow/centrifugal fan with drive motor, inlet louver with bird screen, dry panel HDPE filters, volume control damper, supports, supporting structures etc. for each AHU station/room for critical areas. 1 x100% capacity Fresh air unit shall be provided in each AHU room.

For Fan coil units, suitable arrangement of fresh air intake from the nearest evaporative cooling units shall be made. For Non-critical areas fresh air opening air inlet louver and a volume control damper shall be provided in the AHU room.

2.01.14 High efficiency filter having an efficiency of 99 % down to 5 microns mounted in

supply air duct is to be provided for air conditioning of all control rooms and allied area.

2.01.15 Electrode humidifier complete with high temperature Polypropylene water tank, electrodes, auto flash cycle activated on demand from the microprocessor based control system with humidity sensor, located in the AHU room. Such Humidifier shall be controlled by its own stand-alone microprocessor based control panel. Alarm indication will be provided for low water level in the water tank.

2.01.16 Electric strip heaters of adequate capacity mounted in supply air duct with thermostat, humidistat, airstat/safety thermostat etc. (For winter heating purpose and for monsoon reheat purpose.)

2.01.17 All ducting work including:

a) G. I. Duct having zinc deposition of at least 180 gm/m².

b) Damper with control arrangement at each branch off and wherever necessary.

c) All supply & return air grilles and diffusers made of extruded aluminum powder coated and complete with volume control dampers (for SA grilles/diffusers only) and supporting frames.

d) Flexible connections of rubberized canvas.

e) Hangers and supports.

f) Sealing compound and jointing gasket for ducts.

g) 13 mm thick Aluminium foil faced Nitrile Rubber foam/XLPE or equal or equivalent thermal insulation for the entire air conditioning ducting.

h) Acoustic insulation of 25 mm thick fibreglass covered with Fibreglass cloth and perforated aluminum sheet with 30% perforation shall be provided in the ducting up to a length of 6 M from the outlets of AHUs and Precision ACs / Duct able Split AC.

i) Motorized fire damper with sensors, control etc. at strategic locations, as required.

2.01.18 Water Cooled Precision Air Conditioners complete with scroll compressors (suitable for R-407C / 410 A refrigerant) and water cooled shell and tube condensers, interconnecting refrigerant piping (duly insulated) between condensers and PAC units, evaporator fans with drive motor and drive accessories, high efficiency filters, cooling coils with electronic expansion valve, insulated SS drain pan, electrode type humidifiers with controls, electric strip heaters and built-in microprocessor based control panel thermally and acoustically lined powder coated MS casing and insulated drain piping for the ESP Control Rooms. Such

Air Conditioners will be associated with air distribution system consisting of a GI duct - work as elaborated in clause no. 2.01.17 (a to i) above.

2.01.19 Air Cooled Duct-able Split Air Conditioners complete with scroll compressors and air cooled condensers in the outdoor units with powder coated GI casing, built-in electrical items & supports and Indoor units housing dry panel type HDPE filters, cooling coils with insulated drain pan, thermostatic expansion valve, evaporator fans with drive motors, built in microprocessor based control panel all encased in powder coated GI casings and interconnecting refrigerant piping (duly insulated) between outdoor and indoor units and insulated drain piping from the Indoor Units. Such Indoor units will be associated with air distribution system consisting of a GI duct - work as elaborated in clause no. 2.01.17 (a to i) above. These equipment will serve the Dining Hall of the Canteen.

2.01.20 Air Cooled Non Duct-able Split Air Conditioners complete with hermetically sealed rotary compressors and air cooled condensers in the outdoor units with powder coated GI casing, built-in electrical items & supports and Indoor units housing dry panel type HDPE filters, cooling coils, evaporator fans with two speed drive motors, all encased in powder coated GI casings with swiveling type supply air grilles and decorative RA grilles and interconnecting refrigerant piping (duly insulated) between outdoor and indoor units and insulated drain piping, microprocessor based cordless remote control panel and a connecting cable with plug top for each split unit. This equipment will serve Control room of CW and ACW Pump house, Compressor House Control room, Fire station Control Room and Control room of CW Treatment plant.

Air Cooled Non-Duct-able Split Air Conditioners of required capacity and quantity shall also be provided for each area of Chemical, C & I, Electrical and Environmental lab.

2.01.21 Window type air conditioning Units sealed rotary compressors and cordless remote control panel and a connecting cable with plug top for each Window conditioner, for all cubicles as applicable.

2.01.22 Electrical Items

A One (1) 415 V Motor Control Centre (MCC) cum Power Distribution Board (PDB) for operation and control of the complete AC system required for the Turbine Building. The MCC cum PDB shall be located in the central Air-conditioning Plant room. This MCC cum PDB will house Incoming Switch-fuse units, bus bars, outgoing switch –fuse units for chillers, all LSPs & FCUs for AC Plant Control room and starter switch-fuse units as applicable for all the drives located in the AC Plant room and indication lamps, contactor O/L relay, Local/Remote selector switches, meters etc.

Each MCC cum PDB shall be fed by 2x100% incoming feeders, which shall be located at either end of the panel.

The MCC cum PDB shall be as per technical specification on electrical work, VOLUME: II-F/1.

B One (1) no. Local Starter Panel (LSP) for each AHU room of Turbine Building. This LSP will house In-coming SFU, outgoing starter switch fuse unit for all drives located in AHU room and SFU for heaters, humidifiers and FCUs.

C One (1) 415V Power Distribution Board (PDB) each for supplying power to the PAC units of ESP Control rooms. This PDB will house incoming SFU, Bus-Bars , outgoing SFU for each PAC units and fire dampers.

D One (1) 415V Power Distribution Board (PDB) each for supplying power to the Duct-able Split units of Dining Hall of Canteen Building. This PDB will house incoming SFU, Bus-Bars, outgoing SFU for each SAC units and ventilation fans.

E DDC Panels

DDC Panels with two work stations (one operating and the other Engineering cum operating) for operation and control of all the equipment and accessories of the AC system for Power House Building.

Quantities are to be decided by the Bidder depending on I/O counts.

DDC panels shall be as per ATTACHMENT (TECHNICAL SPECIFICATION FOR DIRECT DIGITAL CONTROLLERS)

Various controls and annunciations to be provided in DDC panels shall be as per clause no. 3.00.00: Control Philosophy.

F Local Push Button Stations.

Local Push Button Stations shall be provided for each drive motor and equipment (cooling tower fan motors, make-up water booster pump motors etc.), suitably located near drives and equipment of each AC system. P. B. Stations in common enclosures may be provided for AHU fan motor, heaters depending on their relative locations.

Local Push Button Stations shall be as per SECTION-VIII of VOLUME: II-F/1 of specification.

Local Push Button Stations shall be of the following basic type

Type - D	:	For each drive motor located inside the AC Plant room.
Type - A	:	For each drive motor and equipment which are not located inside the AC Plant room.

G Drive Motors

All motors of all equipment shall be squirrel cage induction type of required BHP rating considering at least 15% margin over their driven equipment rated BHP including drive loss.

All motors shall be suitable for direct-on-line starting. The motors shall be rated to suit the following:

i) Supply voltage of 415 V ± 10%, 3 Ph, 50 ± 5% Hz with a combined voltage and frequency variation of ± 10%.

ii) Ambient temperature 50 Deg. C for all equipment except AHU motors and 45 Deg. C for AHU motors.

iii) Class-F insulation with Class-B temperature rise.

iv) Enclosure TEFC, IP-55

v) All motors rated 250 W and below shall be suitable for single phase 240 V ± 10%, 50 ± 5% Hz. Motor rated above 250 W shall be 3 phase and suitable for 415 V ± 10%, 50 ± 5% Hz.

All motors of non-ductable split units (below 3TR rating) and window conditioners shall be suitable for single-phase 240 V ± 10%, 50 ± 5% Hz supply.

Each motor terminal box shall be provided with cable gland and lugs suitable for the size and type of cable of the respective motor – as specified.

All motor should have threaded centre holes in their shafts.

All drive motors shall be as per SECTION-II of VOLUME: II-F/1 of specification.

H Power and Control Cabling

Power cabling shall be of 1100 Volt grade, heavy duty power cables with stranded copper / Aluminium conductors, XLPE / HRPVC insulation, extruded PVC inner sheath, round wire Armour and extruded FRLS PVC overall sheath.

XLPE insulation shall be suitable for continuous conductor temperature of 90°C and short circuit temperature of 250°C. HRPVC shall be suitable for continuous conductor temperature of 85°C and short circuit conductor temperature of 160°C.

The minimum size chosen shall be as follows:

a) Aluminium: 10 Sq. mm.

b) Copper:2.5 Sq. mm.

All drives of small rating where terminations with 10 Sq. mm. cables are not feasible, shall have copper cable.

Power Cabling including cable trays and racks shall be required between:

a) MCC cum PDB and all the drives and chiller starter panels, located in the AC plant room.

b) MCC cum PDB and DDC panels.

c) MCC cum PDB and LSPs located in the AHU rooms.

d) MCC cum PDB and CT fans.

e) MCC cum PDB and AC Plant Ventilation fans.

f) MCC cum PDB and FCU unit for AC Plant Control room.

g) DDC panel to Work stations.

h) DDC panel to the common Hooter.

i) Each LSP and all drives, electric heaters and humidifiers located in the corresponding AHU Room.

j) LSP and FCUs for SWAS room.

k) Power Distribution Boards to corresponding PAC / Duct able SAC units.

l) Outdoor and Indoor units of respective PAC unit / Duct able SAC units.

Control cabling shall be of 1100 Volt grade, 70°C rating, control cables with stranded copper conductor, PVC insulation. Extruded PVC inner sheath, round wire Armour and extruded FRLS PVC overall sheath.

No. of cores of control cables shall be restricted to 3,5,7,12 & 16 including one core as spare.

All control cables shall be 2.5 Sq. mm. copper cable.

Multi core control cable will generally have spare conductors (s) in accordance with the following chart: (however this is subject to purchaser's approval during detailed engineering.)

Conductors Required	Cables
1 or 2	1-3/C
3 or 4	1-5/C
5 or 6	1-7/C
7 or 8	1-9/C
9 or 10	1-12/C

11, 12 or 13	1-15/C 1-15/C
14 to 18	1-20/C
above 19	Two(2) or more of above

Control cabling shall be required between :

DDC Panels and MCC cum PDB.
DDC Panels and Chiller's Microprocessor based control panels.
DDC Panels and LSPs located in each AHU room.
DDC Panels and Field sensors and transmitters like Temperature sensors, RH sensors and duct mounted smoke detectors, if any.
DDC Panels and zonal fire Panels.
DDC Panels and Work Stations.
DDC Panels and Hooter

I Grounding of all drive motors, panels & equipment.

2.02.00VENTILATION SYSTEM:

2.02.01Centrifugal Fan unit each complete with:

a) Fan impeller (backward curved) with casing & supports and required steel frame / supporting structure, if any.

b) Electric drive motor of suitable rating.

c) Drive Pulleys, V-belt, belt guards, slide rails etc.

d) Dampers at fan outlet and flexible connection (Rubberized Canvas) with matching flanges.

e) Vibration isolators (rubber in shear type / neoprene rubber pad), foundation bolts and nuts.

f) Removable drain plug with the fan casing.

NB. These Centrifugal fans also cover those required for Air Washer Units and UAF Units.

2.02.02 Wall mounted axial flow fans each complete with:

a) Fan impeller of cast alloy aluminium construction (LM-6 Grade) with

blades of aerofoil design

b) Electric drive motor including motor brackets.

c) Vibration Isolators

d) Short duct (wherever required)

e) Coned inlet and grouting framework, if any.

f) Rain protection cowl with bird-screen made of GI, Foundation Bolts etc.

g) Dry filters including fixing framework (wherever required). For air supply to electrical rooms through fan filter unit, both pre-filter and fine filter are to be provided.

h) Protective wire netting inside the room, wherever required.

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2.02.03 Roof mounted axial flow fans each complete with:

a) Fan impeller of cast alloy aluminium construction (LM-6 Grade) with blades of aerofoil design

b) Electric drive motor including motor brackets.

c) Vibration Isolators

d) Short duct mounting having inspection door and base with proper water sealing arrangement

e) Grouting Frame

f) Fan casing of heavy gauge sheet steel construction

g) Rain protection hood / cowl with bird screen and disconnection switch, foundation bolts etc.

2.02.04 Sheet metal type Air washer Units (AWU), each complete with:

a) Air Intake Louver with bird screen of GI construction.

b) Automatically cleanable type Stainless Steel mesh Filters complete with SS / Aluminium frame continuously flooded with water by one bank of spray header with Stainless Steel water spray nozzles spraying water over the filters in the direction of airflow.

c) Two numbers Horizontally Split casing type Centrifugal pump sets (one running and one standby) complete with drive motor for circulation of water through the above spray header bank and provided with pot type suction strainer with bypass valves, inlet and

outlet pressure gauges and filter back wash arrangement.

d) Fill deck made of cellulose paper in cross fluted configuration duly impregnated with insoluble anti-rot salts, rigidifying saturants and wetting agents and assembled in self supporting pads.

e) Two numbers Centrifugal Monobloc pump sets (one running and one standby) for circulation of water through the above fill deck and provided with pot type suction strainer with bypass valves, inlet and outlet pressure gauges and filter back wash arrangement.

f) Moisture eliminator sets of die-extruded PVC construction.

g) Inspection doors and marine lights for different sections and cat walks as required.

h) All valves, pipes with fittings, nuts and bolts, internal fittings and supports, including ball float valves for make-up water connection, quick-fill connection with valve, drain piping with valves up to the nearest drain point, and overflow connection with siphon.

i) Double inlet double width Centrifugal fan units (2 X 50% capacity) with electric drive motor, drive pulleys, v-belt, belt guards, cushy foot mountings, removable drain plug and other accessories as required. Both inside and outside surfaces of all parts of the fans shall be spray galvanized. (Both the fans shall be placed inside the Air Washer casing).

j) Air washer chamber of 4mm thick sheet steel fabricated construction with adequate stiffeners, bracings etc. (duly painted with epoxy resin based paint from inside and outside) covering all components of the Air Washer Unit including Centrifugal Blowers, but excluding the water circulating pump sets.

k) Air Washer Sump of minimum 5mm thick MS construction duly painted with epoxy resin based paint both from inside and outside.

l) One (1) no. Relay based Local Starter-cum-Control Panel for each Air Washer Unit.

NOTE: Bidder will indicate make up water requirement for the equipment offered by them

2.02.05 Unitary Air Filtration (UAF) units, each consisting of:

a) Air Intake Louver with bird screen of GI construction.

b) A spray nozzle system consisting of single bank spray system connected to Header, flow regulating valves for controlling flow to spray header.

c) Two (2) nos. (one no. working and one no. stand-by) Centrifugal

monobloc pumps for circulation of water. Pump system shall be provided with pot strainer with by-pass valves; inlet and outlet pressure gauges and filter back wash arrangement.

d) Automatically cleanable type Stainless Steel mesh Filters complete with SS / Al. frame continuously flooded with water by one bank of spray header with stainless steel water spray nozzles spraying water over the filter in the direction of air flow.

e) Moisture eliminator sets of die-extruded PVC construction.

f) UAF chamber shall be of sheet metal (2mm MS) construction with 3mm thick MS tank etc. Both the casing and the water tank shall be of epoxy painted from inside and outside and shall be complete with all valves, pipes, nuts and bolts, pipe hangers, supports, internal fittings and supports, suction pipe connection with coarse strainer, make-up water connection with ball float valve, overflow connection with siphon, drain connection with valve, quick fill connection with valve etc.

g) Interconnecting G.I. piping between pump and UAF Spray Header / Sump complete with necessary supports and supporting structures etc.

h) Inspection door with ladder marine lights and catwalk in the spray chamber.

i) Single inlet single width Centrifugal fan (1 X 100%) complete with electric drive motor, drive pulleys, V-belt, belt guards, slide rails and other accessories etc. Both inside and outside surfaces of all parts of the fans shall be spray galvanized.

j) GI connection piece between the centrifugal fan and UAF casing.

k) Interconnecting G.I. piping between pump and UAF unit spray header / sump, with necessary supports and supporting structures etc.

l) One (1) no. Relay based Local Starter cum Control Panel for each Unitary Air Filtration Unit.

2.02.06 GI sheet steel fabricated ducting including the following:

a) GI sheet metal (180 Grade) duct as per IS 655.

b) Branch Duct Damper with control arrangement at each branch off and whatever necessary.

c) All supply air grilles and diffusers made of powder coated MS sheet (20 SWG) with volume control dampers and supporting frames as required at site.

d) Supports and hangers including anchor bolts as required.

e) Sealing compound and jointing gasket for ducts.

f) Flexible connections of rubberized canvas.

g) Thermal insulation with 25mm thick EPS covered with 500-gauge polythene sheet, chicken wire mesh and finally with12mm thick sand cement plaster on all over the ducting exposed to atmosphere.

h) Motorized Fire damper with supply as well as with exhaust air duct (wherever applicable).

i) Motorized fire dampers will be provided in the supply air ducts and supply air openings leading to all the electrical areas (MCC and Switchgear Rooms, cable spreader rooms of Power House as well as ESP building). Similar fire dampers will also be provided with the exhaust fans provided for the Oil rooms and Gas Rooms of Power House Building, as shown in the drawings.

2.02.07 Back draft dampers will be provided at the air outlet paths where pressurized ventilation has been envisaged.

2.02.08 All drive motors.

2.02.09 Local Starter Panel

2.02.10 Local Starter Cum Control Panel for air washer and unitary air filtration units.

2.02.11 Local push button stations (If Required)

2.02.12 Smoke detector/thermal sensor for operation of fire dampers for the buildings not having fire-fighting arrangement. The signal from smoke detectors / thermal sensors (to be provided by purchaser including potential free contact at the fire panel) shall be sent to operate the supply air fire damper. In case of fire / power failure, the damper actuator shall be de-energized to close the damper and respective fan motor shall be tripped in case of fire.

2.02.13 All Power and Control cabling details.

2.02.14 Grounding of all ventilation equipment and panels.

Note: Equipment sizing is to be done on the basis of heat load and number of air changes. The higher of the sizes arising out of these requirements should be considered. Selection of fan duty conditions is to be supported by back-up calculations, to be enclosed with bid.

2.03.00 Supply, Erection, Testing and Commissioning.

2.03.01 Supply, erection, testing and commissioning of all electrical drives and equipment mentioned hereinabove including supply erection, testing and

commissioning of cables, cable trays, grounding of all drives and equipments for each AC plant and system as required for efficient and trouble-free operation and successful commercial operation.

2.03.02 Erection, testing and commissioning of electrical drive motors and equipment shall be as per VOLUME: II-B of specification.

2.04.00 Erection, testing and commissioning of all the equipment and accessories mentioned hereinabove including supply of all grouting pieces, all matching flanges, connecting flanges, valves and other fittings bolts, nuts, gaskets and supporting arrangement as required.

2.05.00 Base plate and foundation plates including anchor bolts, nuts, loose fittings etc. for equipment and as would be necessary for erection and complete anchoring of steel materials for the pipes, hangers and supports for water chilling unit and other equipment.

2.06.00 At least 39 mm thick Aluminium foil faced Nitrile rubber / XLPE insulation on refrigerant piping as required for the Precision type PAC units and Duct-able units and 26 mm thick similar insulation for Non Duct-able Split units.

2.07.00 All consumables such as grease, lubricating oil for three years trouble free operation.

2.08.00 Supply of mandatory & recommended spare parts for three years trouble free operation and maintenance.

2.09.00 Supply of special tools and tackle including toolbox required for operation, maintenance and overhauling of the system.

2.10.00 Testing of equipment at manufacturer's works and performance testing of the AC and Ventilation system at site.

2.11.00 All Equipment sizing calculations, drawing, data, characteristic curves and instruction manuals for the equipment and system as detailed in aforementioned clauses of this specification.

2.12.00 Above clauses specify the equipment for general guidance only. Any other equipment and/or materials necessary to ensure safe and satisfactory erection, commissioning and operation of the plant shall be supplied.

3.00.00 CONTROL PHILOSOPHY

Air conditioning system

All controls shall be electrical/electronic type and shall be operated from the DDC panels located in the AC Plant room, local Push Button Stations located near each drive and equipment / Built-in Microprocessor based control panels of different equipment.

3.01.00 A stable room inside temperature as indicated in clause no. 4.00.00 (Design

Criteria) shall be maintained by controlling the flow of chilled water for chilled water system. This shall be effected by means of a motorized 3-way mixing valve provided with the cooling coils of AHU's. The operation of this control valve through the central DDC system, getting sense from the temperature sensor and associated transmitter placed in the return air path inside AHU room.

FCUS shall be provided with the motorized 3-way mixing valve with the cooling coil. Such 3-way valves will control the flow of chilled water getting sense from the temperature sensor and associated transmitter through DDC panels.

All Precision Air Conditioners will be controlled from their respective Microprocessor based control panels getting sense from temperature sensors and RHsensors placed in the RA paths.

All split air conditioners & window conditioners shall be provided with on/off thermostatic control.

3.02.00 The inside RH shall be controlled with the help of humidifiers (if required) & duct mounted re-heaters through the central DDC system getting sense from the RH & Temperature sensor and their associated transmitters placed in the return air path inside AHU room.

3.03.00 Other Controls

ON/OFF control of each drive and equipment will be possible from the work stations PCs as well as respective Local Push Button Stations. Provision of Start/Stop for drives and equipment along with their status (ON/OFF/TRIP) shall be kept in the central Workstations.

Following safety controls for the Air handling system shall be provided:

a) Overload trip of AHU/FCU fan motor.

b) High temperature and/or "no air flow cut out" with strip heaters.

3.04.00 The Chilled water plant shall have the following minimum operating and safety controls and interlocks, as applicable.

3.04.01 Operating Controls

The capacity control of the chiller compressor shall be automatically operated at the dictate of operating thermostat / temperature sensor provided with the chiller outlet, to maintain a constant chilled water temperature.

3.04.02 Safety Controls

Following safety controls shall be incorporated with the Screw chiller Unit, as applicable:

a) High pressure cut out (condensing pressure)

b) Low pressure cut out (evaporating pressure)

c) Low oil pressure cut out (if applicable)

d) Low condenser water flow cut out

e) Low chilled water flow cut out

f) Low chilled water temperature cut out

g) Overload trip of compressor motor

h) Overload trip of Condenser Cooling Water and chilled water pump motors

i) Overload trip of cooling tower fan motor

3.04.03 Interlocks

The chiller compressor will not start, if:

a) The cooling tower fans of cooling tower are not running

b) Condenser water pump is not running

c) Chilled water pump is not running

d) At least one AHU is not running.

The chilled water plant shall therefore be started in the following sequence:

a) Cooling tower fan
b) Condenser water pumps

c) Chilled water pumps

d) Air handling units

e) Compressors.

3.05.00 All the standby equipment will be put into operation manually after getting alarm of failure of normally running unit. All the units will be manually restarted after any trip off due to malfunctioning. Stand-by selection of drives shall be done through selector switch to be located at control panel.

3.06.00 One hooter for any kind of malfunctions shall be provided for audio effect of the complete system.

3.07.00 Audio-Visual annunciation shall be provided at central Work stations and common fault Hooter.

3.08.00 Following Audio-Visual Annunciations are to be provided for each air conditioning plant as applicable.

a) For the Central Plant

i) Low Oil Pressure of Compressor, if semi sealed

ii) Low Condenser Water Flow

iii) Low Suction Pressure Of Compressor

iv) High Discharge Pressure Of Compressor

v) Compressor Motor Overload

vi) Low Chilled Water Flow

vii) Low Chilled Water Temp.

viii) Chilled Water Pump Motor Overload

ix) Condenser Water Pump Motor Overload

x) Cooling Tower Fan motor Overload

xi) AHU Motor Overload For Each AHU

xii) Fresh Air Fan Motor Overload

NOTES:

1. Provision of one common audio annunciation for any kind of malfunctioning is provided in the AC Plant Control room. Duplication of this annunciation will also be provided in the central control room.

3.09.00 Motorized fire dampers (spring return type) shall be provided in the supply air duct which will close and stop the air flow in the event of fire. These dampers shall be operated through the DDC Panels getting signal from relevant duct mounted smoke detectors / fire alarm panel. The dampers will operate on “De-energized to close” mode. In the event of fire, the dampers will close automatically & AHU/FCU fan will also stop. Smoke detectors/thermal sensors and zonal fire panels will be procured through other packages.

Ventilation System

3.10.00 **Humidity Control (Air Washer System)**

To protect the equipment located in the ventilated space from effects of high humidity, control device using humidistat inter- locked with pump motor (for the fill deck arrangement) of the air washer unit shall be used in electrical areas. Humidity beyond 60% RH in these ventilated spaces shall

automatically trip the respective AWU pump. The pump may be restarted automatically at about 50% RH. At least two (2) nos. humidistats (RH High and Low) shall be provided per pump of each Air Washer Unit.

However, manual over-riding facility shall be provided for humidistat controlled spray pumps for the Air Washer Unit. Selection and starting of stand by pump shall be manual.

3.11.00 **Operation of Electrical Type Fire Damper**

Motorised type electrically operated fire dampers shall be provided in the ventilation supply air ducting/fans leading to Electrical Rooms like various MCC rooms, Switchgear rooms, cable spreader rooms and in the exhaust path of oil room and oil tank area. These dampers shall be operated with the help of signal from smoke detectors/thermal sensors. Motors shall remain energised in normal condition to effect opening of dampers. In the event of fire, the motors will be de-energised and the damper will close due to spring action. Smoke detector/thermal sensors will be supplied by the Bidder.

4.00.00DESIGN CRITERIA

4.01.00AIR CONDITIONING SYSTEM

4.01.01The following criteria shall be considered for determining the capacity of air conditioning system and selection of individual equipment.

A The bidder shall calculate independently based on following design parameters and satisfy himself regarding inside conditions and confirm the same.

Outdoor design condition:	Summer	42.2 Deg.C (DB), 25.6 Deg.C (WB)
	Monsoon:	32.2 Deg.C DB, 30.0 Deg.C WB
	Winter:	11.1 Deg.C DB, 6.7 Deg. C WB
Inside design condition:	24.0 Deg. C ± 1Deg. C DB & RH 55 % ± 5% and not exceeding 60% for the non-critical areas like offices, conference room, SWAS room, telephone exchange etc. and the areas served by Split / Window air conditioners.	

Any equipment/process demanding any other (less) temperature shall be provided with.

Floor area	:	As per actual layout
Roof area	:	As per actual layout

Glass area	:	As per actual layout
Lighting load	:	20 Watt/sq.m (or actual) for all areas except shift charge engineer's room & Service Building where 15 watt per sq.m (or actual) shall be considered.
Occupancy	:	One (1) person in 12 sq.m (or actual)
Equipment/Panel load	:	As actual.
Solar load	:	Solar and transmission load through walls, roofs, doors, windows, glazing, floors etc. should be considered.
Ventilation Air	:	Fresh air at the rate of 1.5 air changes per hour for the control rooms and 1 air change per hour for office areas or at least 34 Cu. M / Hr. per person, whichever is higher, should be considered to achieve pressurization of air conditioned space and to meet the ventilation requirement of occupants.
Other loads	:	Heat load due to AHU fan motor, duct friction etc. shall be considered while finding total heat load.
Plant sizing	:	Plant sizing is to be done by allowing 10% margin on total sensible and latent heat calculated on the basis of above design considerations.

All Condenser Cooling water Pumps and Chilled water Pumps, AHUS and FCUS shall have further, 10% margin on their flow capacities.

Insulation	:	Roof over AC space exposed to sun will be provided with 50 mm thick expanded polystyrene or equivalent. Roof over AC spaces not exposed to sun will be provided with similar insulation of 25mm thickness.

B Individual air handling equipment shall be provided for individual facilities. Chilled water flow control valve (3 way), strip heater and pan humidifier are provided for maintaining inside conditions.

C All water piping for the make-up at cooling tower sump, humidifiers, Expansion tank and Make-up water tank etc. shall be provided. Such make-up water piping shall be taken from the nearest clarified water header.

D Electric power supply will be 415V ± 10%, 3 phase, 50 Hz. ± 5% A C.

E The basic proposal by the bidder shall be for equipment strictly according to the technical specification. The location of air conditioning equipment, layout of ducting, piping etc. shall be designed by the bidder and approved by the Consultants/Owner.

F The bidder shall satisfy himself regarding the refrigerating capacity required for maintaining the end conditions inside AC spaces before submitting the offer. For this purpose, Clause 4.01.01 shall be referred to, where the basis of computing air-conditioning loads is furnished. The bidder shall have to guarantee the end conditions mentioned in Clause 4.01.01.

G Codes and Standards

Design, manufacture, inspection and testing of the equipment covered by the specification shall unless otherwise specified conform to the latest edition of the standards and codes including all addenda mentioned below:

IS-659	:	Safety code for air-conditioning
IS-660	:	Safety code for mechanical refrigeration
ASHRAE-23	:	Standard method of testing and rating [67 Standards] Air Conditioner.
AR1-450-6	:	Standards for Water cooled Refrigerant Condenser.
ASME Sec. VII	:	Unfired pressure vessels
IS-4503	:	Shell and tube type Heat Exchanger.
ASHRAE 22-72	:	Method of testing for rating Water cooled Refrigerant Condenser.
ANSI-8-31.5	:	Refrigeration Piping.
ANSI-8-9.1	:	Safety code for Mechanical Refrigeration.
AR1-410	:	Standard for Air cooling and Air heating coils.
AR1-210	:	Standard for Unitary air conditioning equipment.
IS-3588	:	Specification for Electrical axial flow fans.
AMCA-210	:	Methods of performance test for fans.
BS-2831	:	Methods of test for air filters used in AC and general ventilation.
IS-4671	:	Expanded polystyrene for thermal insulation

purpose.

IS-702	:	Industrial bitumen
IS-1239	:	Heavy class Pipes for sizes upto 150 mm dia.
IS-8188	:	For Water conditioning
IS-325	:	3 phase induction motors
IS-4029	:	Guide line for testing 3 phase induction motor
IS-210	:	Specification grey iron casting
IS-2062	:	Structural steel
AMCA -Bulletin No. 210	:	Standard code of testing centrifugal and axial flow fans
IS-2825	:	Code of practice for welding mild steel
IS-2676	:	Dimensions for wrought aluminum and aluminum alloy sheets and strips.
ASHRAE Code	:	for various filter
IS-655	:	Specification for metal air ducts
BS-4735	:	Horizontal Burning for XLPE insulation
BS- 4370 Part-1	:	Dimensional Stability for XLPE Insulation
ASTM D 1056	:	Water Absorption for XLPE Insulation

Pump design and testing should correspond to the procedure mentioned in IS-1520

H The refrigerant for Split units and Window Conditioners shall be refrigerant 22 as per ARI designation.

I For requirements of materials of construction, 5.00.00 of this section shall be referred to.

J Special Note

In case any discrepancy is found between requirements of this section and those mentioned in other sections, stipulations of this section shall prevail.

4.02.00VENTILATION SYSTEM

4.02.01 OUTDOOR
DESIGN CONDITIONS

Same as mentioned under clause no. 4.01.01 A

4.02.02 **INSIDE DESIGN**
CONDITIONS

The desired condition inside the ventilated space has to be maintained by selecting proper type of Ventilation System.

A In dry type forced (mechanical) Ventilation System where the ambient air is drawn and distributed inside the building/room and then exhausted, the average design condition inside the space to be ventilated is to be restricted about 3°C higher than the ambient (outside) dry-bulb temperature. Relative humidity will depend upon moisture content of ambient air.

B In the areas ventilated by evaporative cooling units, the inside dry bulb temperature will be restricted to 3ºC less than the summer ambient temperature (DB). This temperature will occur only for a few hours of some days in peak ambient condition and will prevail near the roof level where the hot air along with some solar heat load through roof will be exhausted out by roof exhausters wall exhaust fans/louvers/back draft dampers.

In Powerhouse building, where this type of ventilation has been used, actual temperature at the ground floor, mezzanine floor and operating floor level shall be less. The relative humidity should be kept within 50%-60% through proper control of Air Washer pump operation.

C Inside condition of TG hall and other electrical areas like switchgear room, MCC room of Power House building will be made reasonably dust free by adopting flooded type filter in the Air Washer Units. Moreover some amount of over pressure will be maintained inside the TG hall and electrical areas, and dust infiltration will be prevented thereby. For this system to work effectively, the rolling shutters should be kept closed. In some dry type mechanical ventilation, dry type washable HDPE filter shall be adopted where cleanliness requirement is of importance. Here also some amount of over pressure will be maintained by using back draft damper to prevent the ingress of dust.

D Auxiliary buildings should be ventilated generally in line with Clause No. 1.02.00. Areas not covered in these places but require ventilation should also be ventilated.

E The following minimum air change rates are to be maintained for the areas indicated below.

i) T.G. Hall and Cable Spreader Room - 6 Air Change / Hr. (min.)

ii) Electrical Room like M.C.C. Room, Switchgear room in T.G. Building - 15 Air Change / Hr. (min.)

iii)	Oil Room	-	20 Air Change / Hr.
iv)	Elevator Machine room	-	15 Air Change / Hr.
v)	Battery Room	-	20 Air Change / Hr.
vi)	Bunker Floor	-	30 Air Change / Hr.
vii)	AC Plant Room	-	Heat Load Basis
viii)	Pump Houses	-	10 Air Change/hr.
ix)	Electrical Rooms associated with the pump houses	-	15 Air Change/hr.
x)	Electrical Rooms for all Auxiliaries Buildings	-	15 Air Change/hr.
xi)	Non AC areas of ESP control building	-	15 Air Change/hr.
xiii)	Compressor House	-	10 Air Change/hr.
xiv)	CW Treatment Plant Building	-	15 Air Change/hr.
xv)	Store	-	2 Air change/hr.
xvi)	DG plant building	-	10 Air Change/hr.
xvii)	Toilet areas of all Building	-	20 Air Change/hr.

NB:

1. The fan capacities shall be decided on the basis of the actual heat load or specified minimum air change rate, whichever is higher.

2. All the Toilet areas of various buildings not mentioned above should have 20 Air change /hr.

3. All the Electrical areas should have 15 AC / Hr. (Min.)

5.00.00 DESIGN AND CONSTRUCTIONAL REQUIREMENT

5.01.00 GENERAL INSTRUCTION TO THE TENDERER

5.01.01 The Tenderer shall refer only to those of the following clauses, which are

applicable for this particular project. The clauses which are not applicable for this project shall be ignored.

5.02.00 GENERAL DESIGN AND CONSTRUCTIONAL REQUIREMENT

5.02.01 All the equipment shall be capable of with standing the stresses which may be experienced during normal operation and test.

5.02.02 All the equipment shall be designed to permit inter-changeability of parts and ease of access during inspection, maintenance, installation and repair of various parts.

5.02.03 All parts subject to substantial temperature changes shall be designed and supported such as to permit free expansion or contraction without resulting in leakages, harmful distortion misalignment or play.

5.02.04 Proposals for repair or any similar operations involving the plugging welding, boring or addition of metal to the original castings shall be submitted to the Purchaser/Consulting Engineer and approval shall be received before any such work is carried out. Drawing showing details and locations of such modifications shall be submitted to the Purchaser/Consulting Engineer for his records.

5.02.05 All equipment shall be heavy-duty type suitable for installation in heavy industries and for long period of uninterrupted service.

5.02.06 All materials used shall conform to the specification and shall new and first class in all respects.

5.02.07 Anchor bolts, nuts and seating steel work shall be supplied with the equipment. Only hexagonal nuts shall be used for holding down the equipment, with proper lock nuts. All boltholes shall be spot faced for nuts. In specific cases where not necessary, spot facing may be omitted.

5.02.08 Casting and welding shall conform to their respective specifications and shall be free from flaws and objectionable imperfections, machined true and in a workmanlike manner.

5.02.09 The separate pieces of equipment shall be marked with unit number The assembly drawings shall indicate part number of each equipment and unit number for easy correlation.

5.02.10 Coupling guards and belt guards shall be furnished as applicable.

5.03.00 **REFRIGERANT COMPRESSORS (TWIN SCREW TYPE)**

5.03.01 The refrigerant compressors shall be screw type as mentioned in previous sections of the specification.

5.03.02 The compressor may be hermetically/ semi hermetically sealed and shall be designed for direct drive.

5.03.03 The compressor assembly shall be adequately designed for minimum vibration and noise disturbances.

5.03.04 The shaft seal, if applicable for semi hermetic type shall be of proven design.

5.03.05 All safety devices against high pressure refrigerant, low pressure refrigerant and low oil pressure shall be provided. The compressor units must be provided with oil pressure regulator. All safety devices should be electronically controlled.

5.03.06 The compressor shall also be provided with an oil drain plug. This should be so located that the oil can be drained out without removing the compressor.

5.03.07 Capacity control must be achieved by use of slide valve, which provides fully modulating capacity control from 100% to 10% (20%, at least) of full load. The slide valve shall be actuated by oil pressure controlled by external solenoid valves.

5.03.08 The horse power of the compressor motor shall be sized for 115% of maximum rated power required for the unit including the drive loss.

5.03.09 The compressors shall be provided with built-in-unloaded starting device. The compressor shall have automatic capacity control device preferably built-in-type to match reduced refrigeration load.

5.03.10 The oil separator should be effective enough to incur gravity drop out of oil from the refrigerant gas before it enters the condenser.

5.04.00 **HEAT EXCHANGERS (CONDENSERS & CHILLERS)**

5.04.01 All condensers shell be of shell and tube type with water in the tubes and refrigerant in the shell.

5.04.02 All chillers for chilled water plant shall also be of shell and tube type.

5.04.03 The heat exchangers shall be designed for a minimum working pressure of 10.5 kg/Sq.cm gauge (about 150 psig) on the water side and 21.0 Kg/Sq.cm (27 Kg/Sq.cm. / 19 Kg/Sq.cm. for refrigerant R410A / R407C as applicable for Precision Air Conditioners) on the refrigerant side and shall conform to the latest ASME CODE for unfired pressure vessels SECTION-VIII.

The design pressure shall have a reasonable margin over the maximum working pressure.

5.04.04 The average velocity of water in tubes shall not be more than 2.5 M/Sec.

5.04.05 Water heads or refrigerant heads of the heat exchangers shall be designed such as not to allow leakage of fluid from one pass to the other.

5.04.06 Tube supports of adequate strength shall be provided to prevent the tubes from sagging and vibrating. The supports shall be as per TEMA Standard.

5.04.07 The overall fouling factor for the condensers and chillers shall be minimum 0.0002 and 0.00013 hr.Sq.m Deg. C/KCal respectively.

5.04.08 The condensers shall be designed to provide at least 2°C sub cooling of refrigerant under rated design condition. The water chillers also shall be designed to superheat the refrigerant by at least 3°C. under rated design condition.

5.04.09 Testing and other design feature of the beat exchangers shall meet the requirements of TEMA Class-C heat exchangers or approved equal.

5.04.10The heat exchangers shall have open able water boxes for ease in maintenance.

5.04.11 The tube for water chillers shall be of de-oxidized copper with or without integral fins. The tubes for the condensers shall also be of copper with integral fins. The tube wall thickness at any point shall not be less than 18 SWG.

5.04.12 The baffle plates and the tube sheets shall be made of steel. The shell shall be made up of seamless steel tube or shall be fabricated from flange quality steel plate (ASTM-A 285 Grade-C). The tube support plates shall be made of flange quality carbon steel plates and shall be as per TEMA Standard. (Class C).

5.04.13 The heat exchangers shall be provided with vent valve, relief valve, and or safety fusible plug on refrigerant side and vent valve and drain valve on water side (at every section of the baffled shell of heat exchanger).

5.04.14 The tenderer shall quote packaged unit having compressor, condenser and chiller assembly together in a single frame work and mounted on a common base plate.

5.04.15 Each heat exchanger shall be provided with water flow switch. This shall be interlocked with the control of the individual refrigeration system.

5.04.16 All the heat exchangers shall be provided with standard connections like thermo- wells, inspection valve, antifreeze thermostat for chillers and external equalizer connection for expansion valves for chillers.

5.05.00**REFRIGERANT PIPING**

5.05.01 Refrigerant piping shall be either of M.S. Seamless (as per IS- 1239), Part-I heavy grade) or copper tube (IS-5493) or ASA-B-31.5).

5.05.02 Pressure drop in hot gas, liquid and suction lines should not exceed the value corresponding to 1.11°C change in saturation temperature of the fluid.

5.05.03 Velocity in the discharge and suction pipe of the refrigerant shall not be so high as to create undue vibration and noise, velocity in the vertical length of discharge and suction pipe of the refrigerant shall be high enough to carry the entrained oil in the refrigerant, even in case of unit running at lowest partial capacity. An angle type drain valve with male flare outlet connection will be

installed at the bottom end of each vertical riser pipe to drain any accumulated oil.

5.05.04 Instrument piping for gauges, switches etc. shall be of copper only. Capillary tubes will be used wherever possible.

5.05.05 Spacing and location of pipe hangers shall conform to preferred engineering practice. Hangers and supports shall be made up of structural steel sections. The design of the hangers and supports shall provide for suitable protection to insulation on the pipes, wherever applicable. All materials for anchoring the hangers with reinforced concrete work or building structural beams and columns shall be furnished by the tenderer.

5.06.00 **WATER PIPING**

5.06.01 All condenser cooling water piping of diameter 150 mm NB or below shall conform to IS-1239, Part-I, heavy grade and IS-3589 for sizes above 150 mm NB with minimum pipe thickness of 6 mm.

5.06.02 The piping shall be so designed that the water velocity through the piping shall not exceed 3 m/Sec. and also the piping friction drop shall be limited to 4 m per hundred meter of pipe length.

5.06.03 The pipes shall be of plain end in case of M.S. Pipes (i.e. suitable for welded connections) as far as possible.

5.06.04 Counter-flanges for connecting to flanges on valves or equipment shall be made of IS-2062 or superior and shall preferably be slip on type, suitable for welding on the piping in case of M.S. Piping.

5.06.05 All bolts and nuts for flange connection shall be of hexagonal carbon steel type as per IS-1363 and with the material and other requirements as per IS-1367.

5.06.06 For piping of size above 100 mm bends and fittings, fabricated at site from straight length of piping, would be acceptable. If instead, the contractor uses the regular type fittings/bends that shall be as per IS-1239, Part-II. Welding of joints of fabricated fittings should be such that they do not obstruct in air the flow or increase the fluid resistance appreciably.

5.06.07 The flange joints for waterline will use canvas impregnated rubber gasket. The gasket material thickness shall be minimum 3 mm. The material shall have adequate strength in compression without damage. Pipe lines should be such installed that any equipment or valves can be removed by disconnecting flange bolts and nuts/union joints. If necessary a short piece joint to be installed for easy removal. All threads for screwed joints should be properly made. The threads will be covered to make a leak proof joint. Pipes passing through any building structure will pass through a pipe sleeve. The thickness of pipe sleeve will be not less than the thickness of the passing pipe itself.

Pipes entering any equipment will be protected by a rubber grommet or such other material.

All drainpipes will use "Tee" fitting instead of elbows or bends. "Tee" fitting should be such installed that the plug can be removed, and any section of pipe can be cleaned. Drain valves will be located at lowest point of pipelines. If necessary more than one drain valve will be installed to facilitate complete drainage from pipe.

Water filling valve and air vent shall be installed on the highest point of pipeline. If necessary more than one valve is to be installed for satisfactory operation or maintenance of the plant. In case of insulated pipes the connections for pressure gauge, thermometer, drain valve, purge valve, filling valve and any such other accessories, the connection should be long enough such that the requisite pipe insulation can be carried out on the main pipe. The connecting pipes or fittings will be insulated separately if necessary.

5.06.08 Spacing and location of pipe supports shall conform to preferred engineering practice. Hangers and supports shall be made up of structural steel sections. The design of hangers and supports shall be provided for suitable protection to insulation on the pipes, wherever required.

5.06.09 The insulation will be fixed as per manufacturer's recommendation.

5.07.00 AIR HANDLING UNIT

5.07.01 Fan

The fans shall be forward curve bladed centrifugal type. The number of fans per unit shall be as per standard of the manufacturer. The impeller and the scroll casing of the fans shall be made of steel and protected with suitable painting.

The fan shaft shall be of carbon steel. Bearing shall be heavy-duty self-aligning type having minimum working life of 40000 hours. The fans shall be dynamically balanced. The motor shall be mounted outside the AHU casing and shall be connected to the common fan shaft by a V-belt drive.

The motor shall be adequately designed to prevent overload and shall have minimum 20% margin over maximum BHP in working range.

5.07.02 Face and by-pass dampers (applicable for AHUs of D-X plant only)

a) The dampers shall be designed such that the pressure drop through each of the alternate path (face path or by-pass path) shall be equal.

b) Face and by-pass dampers of opposed blade type shall be provided. All face and by-pass dampers shall be designed for automatic control by modulating thermostat. Damper operating linkage and handle shall be located outside the casing. Damper bearing shall be of either oil impregnated bronze or gunmetal or nylon.

c) All dampers shall be reasonably tight shut-off type to avoid leakage of air.

5.07.03 Drive

Centrifugal fans shall be equipped with v-belt drive and belt tensioning equipped with removable guard to avoid accidental hazards. There shall be a minimum of two bolts per drive.

5.07.04 Dry Panel type HDPE filter

The filter media shall be as specified elsewhere designed to hold dust, sand and prevent it from being dislodged by vibration or other cause and passing through filter.

The filters shall be of cleanable type construction and held corrugated by aluminum spacers.

The filter shall have G.I. frames of adequate thickness but not less than 20 SWG suitable for long use in an industrial plant. The filters may be in panels of size about 600 x 600 for easy handling of the same. Such modules will be fixed with the ladder frame through Quick release mechanism.

The face velocity of air across the filters shall not exceed 2.5 m/Sec.

5.07.05 Cooling Coils

The cooling coils for either DX or chilled water shall consist of seamless copper tubes with aluminum fins. Each AHU shall be provided preferably with only one number cooling coil.

The Cooling coils for chilled water plant shall be equipped with motorized modulating 3-way mixing valve to control the chilled water flow. This cooling coil shall be designed for chilled water/air duty.
The cooling coil for DX plant shall be equipped with thermostatic expansion valve and modulating room thermostat operated liquid refrigerant regulating valve to control the refrigerant flow. The cooling coils for DX plant shall be designed for refrigerant/air duty.

Counter-flow process of heat transfer shall be considered in the design requirement.

The fouling factor of minimum 0.0002 Hr -Sq.m. Deg.C/Kcal shall be taken in the design of the cooling coil.

Even number of rows like 2,4,6 and 8 etc. shall be selected for any particular coil to facilitate connection of water/refrigerant only on one side of the unit.

Fin design shall be chosen for the duty to be performed with special attention to the possibility of lint accumulation. However, in any case, number of fins in the coils shall not exceed 5/Cm.

Velocity of air across the coils shall be limited to 2.5 m/Sec.

5.07.06 In case of chilled water-cooling coil, arrangement for air purging and water draining from the coil is to be provided. In case of D-X type coil an equalizer connection to be provided for each section of the refrigerant circuit.

5.07.07 Casing

a) The casing shall be of double skin type and shall be constructed of minimum 24 gauge GI sheets with Aluminum structure. The outer skin shall be powder coated.

b) Base frames shall be supplied for floor mounted type units. Drain pans shall be of SS construction and may be manufactured of double bottom type or otherwise sufficient insulation shall be pasted with bituminous compound to avoid condensation on the outside surface. The bidder/contractor shall guarantee against condensation of water on the outside of the unit.

c) Panels of the casing shall be reasonably air tight with suitable gaskets with cams or similar fastenings for easy opening.

d) Necessary arrangement shall be provided on the casing for measuring temperature and pressure in a cooling coil.

e) Waterproof, vermin proof, thermal insulation shall be provided in between two skins of the casing by injection method. The thickness of insulation shall be adequate to arrest condensation of moisture on the outside surface of the units. The insulation shall be securely fixed so that the same does not fall out during operation of the units.

f) The drain pan shall be extended to catch any free moisture carried over from the coils. The drain connection shall be readily accessible for cleaning and shall be generously sized.

5.07.08 Humidifying Section

Humidifying unit shall be Electrode type as per manufacturer's standard.

Electrode humidifier consists of high temperature Polypropylene water tank, electrodes, auto flash cycle activated on demand from the microprocessor based control system with humidity sensor, located in the AHU room. Such Humidifier shall be controlled by its own stand-alone microprocessor based control panel. Alarm indication will be provided for low water level in the water tank.

Whenever the relative humidity of the conditioned space reaches the minimum allowable percentage of humidity, the humidifier shall be energized to restore the relative humidity. The humidifier shall be such controlled that it shall not exceed the maximum allowable limit of relative humidity in the conditioned space. The humidifier shall be sized and designed accordingly.

5.07.09 Heating Equipment

Heating equipment wherever required shall be electrical type. All frame members, control box cover and associated sheet metal parts are to be heavy gauge steel with corrosion resistance treatment. Heating equipment may be required for winter heating as well as for reheating. Reheating heaters may be used for winter heating also.

Electric heaters will be of fin-tube type of required KW rating, with fins permanently brazed to metal sheath. The metal sheath and fins will be of G.I. sheet material.

Wherever electric heaters are installed in the ductwork, size of ducts should be suitably increased to effect the additional resistance created by the heaters. All heaters shall be mounted on such insulators that there shall be no leakage current under all weather condition including high humidity operation. The mounting frame shall be suitably grounded by earth wires/earth leads at two points.

An air stat is to be installed such that in case there is no circulation of air around the heater coils the heaters will be de-energized. Wherever the heaters are installed in the ductwork the terminal block will be such positioned in a junction box that it will be outside the ductwork in an accessible position. The junction box will be vermin proof, rat proof and provided with a hinged cover. A caution plate as per I.E.E. rules will also be provided. Access door will be provided in the duct near the heating coil for easy inspection and removal/replacement/fixing of individual strip heaters. The capacity of heaters will be distributed over three phases.

In case of re-heaters the controller will be humidistat and in case of winter heaters the controller will be thermostat.

5.08.00 **FAN COIL UNITS**

The fan coil units shall be of reputed make – horizontal type for ceiling suspension. The units shall be complete with chilled water coil, one or more centrifugal fans and motors, cleanable HDPE filters, double wall insulated condensate drain pan with 15 mm thick expanded polystyrene (self extinguishing quality) insulation sandwiched between top and bottom sheets of drain pan and 18 gauge sheet steel casing panels. Horizontal fan coil units shall be provided with auxiliary secondary condensate drain pans.

Access panels shall have positive locking fasteners for easy removals. The filters shall be mounted at the rear section of the cabinet with filter box.
All cooling coils shall be standard three row staggered seamless copper tube with aluminium plate fins mechanically bonded to copper tubes. Tubes shall be aluminium 10 mm 0.D. and wall thickness shall be minimum 0.5 mm. All bends and joints shall be enclosed within the insulated end sections of the base unit for protection against sweating. Each coil shall be provided with an air vent and drain plug. All coils shall be factory tested at 21 kg. Per Sq. cm. air pressure while submerged in water. Fin spacing shall not be less than 10 fins per inch. Tubes shall be mechanical / hydraulically expanded for thermal contact

resistance with fans.

Fans shall be centrifugal, forward-covered, and direct driven by shaded pole motor.

All fans coil units shall be equipped with copper piping connection and manual air vent at the cooling coil. 0ther accessories shall be wall mounted thermostat for individual unit, containing two speed and ON / Off control for fan speed, motorized there-way diverting/mixing valve for individual unit, Y-strainer, ball valve and globe valve, adjustable discharge air grilles.

The fan coil unit shall be selected for the lowest operating noise level. It should offer capacity at the lower speed.

5.09.00 **HIGH EFFICIENCY FILTER**

The filters shall be high efficiency of 99% down to 5 microns. The filters shall be of cleanable type construction of reinforced glass fibre or cotton fabric or fabric-like material sand witched in between two galvanized wire netting arrangement in an uniformly corrugated form to increase the surface area.

The filters shall have G.I. frames of adequate thickness suitable for long use in an industrial plant. The filters may be in panels of size about 600 x 600 for easy handling them.

The filter panels shall be mounted on the ladder type angle iron holding frames. The frames shall be designed strong enough to take the load of double the pressure drop in dirty condition of the filters. Face velocity of air across the filters shall not exceed 1.5 m/sec.

5.10.00**WATER PUMPS**

5.10.01 Each pump shall be of horizontally split casing, centrifugal type, directly coupled to electric drive motor and mounted on a common base plate. The pump shall be complete with casing, impeller, renewable type wearing rings, shaft, shaft sleeve, bearings, stuffing box, couplings, base plate etc.

5.10.02Pumps with motor of 6 KW capacity or below can be of mono-block construction. Pump head-capacity characteristics shall gradually rising from operating to shut off point without any zone of instability. The pump BHP-flow characteristics shall preferably be non-overloading type beyond rated capacity point.

5.10.03Operating speed of the Pump shall not preferably be more than 1500 rpm.

5.10.04Material of the pump shall preferably as follows (all material shall be of tested quality).

a)	Casing	:	Cast iron, grade 20 as per IS-210
b)	Impeller & Wear Ring	:	Bronze
c)	Shaft	:	Carbon steel C-45, IS 1570 or

Class- IV, IS 1875

d) Shaft sleeve : Bronze

5.10.05 Pumps shall be provided with suitable bearings sized adequately to take the maximum possible unbalance load occurring due to all mechanical and hydraulic reasons. The bearings should have a minimum working life of 40000 hours.

5.10.06 Pump and drives shall be directly coupled through a flexible coupling. Suitable coupling guard shall be provided for each pump.

5.10.07 Each Pump shall be complete with pressure gauge at the suction and discharge, isolating valves, all integral piping required for sealing and cooling, casing drain and vent connections etc. The pressure gauge of pump will be connected with a siphon and a two-position brass cock.

5.10.08 The rated BHP of the motor shall provide 15% margin over the rated BHP of the Pump. For other electrical particulars of the motor the standard specification of the motors furnished elsewhere shall be referred to.

5.10.09 The design of the pumps shall conform to the relevant IS Code, standards of hydraulic institution of U.S.A. or approved equivalent.

5.10.10 Major rotating components of the pumps like impellers, balancing drums etc. shall be balanced statically.

5.11.11 The critical speed of the pump motor shall be at least 25% above the operating speed.

5.10.12 All pumps and motors shall be aligned properly, and bolted and dowelled to a common base frame.

5.11.00 WATER COOLED PACKAGED AIR CONDITIONER (PRECISION TYPE)

5.11.01 Compressor

The compressor shall be hermetically sealed scroll type medium speed, single acting type designed for R-410A / 407C duty. The compressor shall be complete with crank case heater (to be energised when compressor is on off cycle.

The compressor shall have proper lubrication system. Safety devices viz. high-pressure switch, low-pressure switch, low oil pressure (if applicable) shall be provided and such devices shall be electronically operated. Manual reset on safety cut out shall be provided. The horsepower for the compressor motor shall be adequately sized or 110% of the rated power required for the unit including drive loss.

Capacity control shall be devised by providing at least two compressors.

5.11.02 Condenser

All condensers shall be of shell and tube type with water in the tubes and refrigerant in the shell.

Other specifications shall be as detailed in clause no.5.04.00 above.

5.11.03 Evaporator Cooling Coil

The cooling coil shall be direct expansion type with multi-row deoxidised copper tubes with aluminium fins. Air velocity across the coil shall be limited to 2.5 m/sec. The coils shall be pressure tested and thoroughly dehydrated before assembling.

The coil shall be placed to make the system draw through type. Refrigerant feed control shall be by electronic expansion valve. Temperature control shall be through microprocessor based control panel.

The cooling coil shall be to produce the capacity required under specified coil condition and air quantity. Heat load calculation to check the system selection shall be carried out and submitted by the tenderer.

5.11.04 Evaporator Fan

The fan shall be heavy duty DIDW centrifugal type statically and dynamically balanced with forward curve blade, indirect drive designed for high efficiency and quiet operation with automatic belt tension adjustment mechanism. Fan wheels and casing shall be constructed of steel and mounted on steel shaft. The bearings shall be ball bearing type mounted on vibration absorbing rubber mounts. The fan motor shall be mounted within the cabinet. Motor base shall be adjustable for alignment. Motor horsepower shall be sized for 120% of the rated power required including the drive loss.

The supply fan shall be sized to deliver the required air quantity against the total external static pressure required for the system application, after taking care of all internal static pressure requirements of the units.

5.11.05 High Efficiency Filter

A set of High efficiency filters will be located inside the PAC unit cabinet.
The filters shall be high efficiency of 99% down to 5 microns. The filters shall be of cleanable type construction of reinforced glass fibre or cotton fabric or fabric-like material sand witched in between two galvanized wire netting arrangement in an uniformly corrugated form to increase the surface area.

The filters shall have G.I. frames of adequate thickness suitable for long use in an industrial plant. The filters may be in panels of size about 600 x 600 for easy handling them.
The filter panels shall be mounted on the ladder type angle iron holding frames. The frames shall be designed strong enough to take the load of double the pressure drop in dirty condition of the filters. Face velocity of air across the filters shall not exceed 1.5 m/sec.

5.11.06**Humidifier**

The humidifier shall be of Electrode type and shall be placed inside the PAC unit cabinet. The humidifier shall be electronically controlled through the built-in microprocessor based control panel of the unit. A provision of make-up water connection with the humidifier shall be kept with the Unit cabinet.

5.11.07**Electric Strip Heater**

The PAC unit will be provided wit built-in electric strip heater electronically controlled through the built-in microprocessor based control panel of the unit. Such control includes both operating and safety controls with the sense of air temperature at the RA path and at the downstream side of the heater respectively.

5.11.08 **Casing and Cabinet**

All components shall be housed in a welded sheet metal cabinet of double skin of not less than 22 G thick MS powder coated sheets. The gap between two skins is filled up with at least 25mmthick PUF/ EPS insulation. Different sections will be constructed with framework and connected with each other in an airtight manner through gaskets, thermal barriers and sealant.

Removable panels shall be constructed of framed 1.6 mm sheet steel with angle iron framing. Units shall be provided with 316 L.S.S. fasteners for easy removal and access for servicing. Air handling section of evaporator shall be provided with an acoustic lining of 25 mm thick fibreglass covered with fibre glass cloth and perforated aluminium sheet on the inside surface of the unit casing. Insulated condensate drain pan of SS construction shall be provided within the unit. The unit shall be factory assembled, wired, with inter connecting refrigerant piping and built-in microprocessor based control console and tested as per the relevant code.

The return air opening shall be on the front face with a matching grille of same colour finish.

5.12.00 **AIR COOLED DUCT-ABLE SPLIT AIR CONDITIONER**

5.12.01 **Compressor**

The compressor shall be Scroll type medium speed, designed for R-22 duty. The compressor shall have proper lubrication system. Safety devices viz. high-pressure switch, low-pressure switch, low oil pressure (if applicable) shall be provided. All such devices shall be electronically operated through the built-in microprocessor based control console of the unit. Manual reset on safety cut out shall be provided. The horsepower for the compressor motor shall be adequately sized or 115% of the rated power required for the unit including drive loss.

Capacity control device shall be provided by incorporating more than one compressor with individual refrigerant circuit.

5.12.02 **Condenser**

The Condenser shall be of Air Cooled type and shall be constructed of copper tube with aluminum fins. Tubes shall be designed for a minimum working pressure of 20.33 kg/sq.cm. The condenser shall be complete with fans with drive motors and shall be provided with charging connection, safety relief valve and standard accessories. Both the compressor and condenser along with interconnecting refrigerant piping shall be encased in a powder coated GI casing with built-in electrical items and supporting frame. The condenser shall have the matching capacity with the compressor. There shall be a provision of isolating switch for the fans and compressor drive

5.12.03 **Evaporator Cooling Coil**

The cooling coil shall be direct expansion type with multi-row deoxidised copper tubes with aluminium fins. Air velocity across the coil shall be limited to 2.5 m/sec. The coils shall be pressure tested and thoroughly dehydrated before assembling.

The coil shall be placed to make the system draw through type. Refrigerant feed control shall be by thermostatic expansion valve. Temperature control shall be by thermostat, solenoid valve. An insulated drain pan of mild sheet/aluminum construction, not less than 35 mm deep and 2 mm thick for collecting the condensate shall be provided with suitable drain connection.

The cooling coil shall be to produce the capacity required under specified coil condition and air quantity. Heat load calculation to check the system selection shall be carried out and submitted by the tenderer.

5.12.04 **Evaporator Fan**

The fan shall be heavy duty DIDW centrifugal type statically and dynamically balanced with forward curve blade, indirect drive designed for high efficiency and quiet operation. Fan wheels and casing shall be constructed of steel and mounted on steel shaft. The bearings shall be ball bearing type mounted on vibration absorbing rubber mounts. The fan motor shall be mounted within the cabinet. Motor base shall be adjustable for alignment. Motor horsepower shall be sized for 120% of the rated power required including the drive loss.

The supply fan shall be sized to deliver the required air quantity against the total external static pressure required for the system application, after taking care of all internal static pressure requirements of the units.

The filter shall be dry panel HDPE type of 50 mm thick. Face velocity through the filter shall not exceed 2.5 m/sec.

All the above items, namely, fan, cooling coil and filters are encased in a powder coated sheet metal casing complete with built-in microprocessor based control panel, supply air outlets with volume control damper and flexible connection, return air grille, insulated drain connection, acoustic lining supports and hangers.

Both the outdoor and indoor units for each Split Air Conditioner shall be connected with thermally insulated refrigerant piping. The insulation shall be at least 39 mm Aluminum foil faced Nitrile Rubber foam/XLPE or equivalent.

5.13.00**WINDOW TYPE AIR CONDITIONING UNITS**

5.13.01The room air conditioner will be complete with all components to perform filtering, cooling and dehumidifying air. The refrigerant condenser will be air-cooled. The Compressor shall be of rotary type. The unit will be suitable for window mounting and wall mounting.

5.13.02The unit shall have nominal rating capacity as required and at a room temperature as desired under the design outside ambient condition. The unit shall be suitable for the operating conditions as mentioned under site condition. The capacity variation should not be more than 5%.

5.13.03 The outer cabinet of the unit will be constructed of not less than 1.2 mm thick M.S. sheet and treated for anticorrosion or of anodized aluminum sheet not less than 1.25 mm thick.

5.13.04**The fan shall be of dual speed**

The unit should be operating free from any vibration and noise. The unit will be fitted with fully adjustable ventilation and exhaust dampers. The operation of damper shall be easy. The damper knob/lever should be easily accessible.

5.13.05The unit will be complete with an adjustable thermostat, overload relay and high winding temperature cutout. The bottom tray of the unit will be of mild steel sheet not less than 35 mm deep and 2 mm thick. The unit will be thermally insulated wherever required such that there is no condensation on the outside of the cabinet. The insulation will be of expanded polystyrene type. The evaporator and condenser fans shall be both statically and dynamically balanced.

5.14.00 **AIR COOLED NON-DUCT-ABLE SPLIT AIR CONDITIONER**

5.14.01 **Compressor**

The compressor shall be Rotary/ Reciprocating type medium speed, designed for R-22 duty.

The compressor shall have proper lubrication system. Safety devices viz. high pressure switch, low pressure switch, low oil pressure (if applicable) shall be provided. All such devices shall be electronically operated through the built-in microprocessor based control console of the unit. Manual reset on safety cut out shall be provided. The horsepower for the compressor motor shall be adequately sized or 115% of the rated power required for the unit including drive loss.

Capacity control device shall be provided by incorporating more than one

compressor with individual refrigerant circuit.

5.14.02 **Condenser**

The Condenser shall be of Air Cooled type and shall be constructed of copper tube with aluminum fins. Tubes shall be designed for a minimum working pressure of 20.33 kg/sq.cm. The condenser shall be complete with fans with drive motors and shall be provided with charging connection, safety relief valve and standard accessories. Both the compressor and condenser along with interconnecting refrigerant piping shall be encased in a powder coated GI casing with built-in electrical items and supporting frame. The condenser shall have the matching capacity with the compressor. There shall be a provision of isolating switch for the fans and compressor drive

5.14.03 **Evaporator Cooling Coil**

The cooling coil shall be direct expansion type with multi-row deoxidised copper tubes with aluminium fins. Air velocity across the coil shall be limited to 2.5 m/sec. The coils shall be pressure tested and thoroughly dehydrated before assembling.

The coil shall be placed to make the system draw through type. Refrigerant feed control shall be by thermostatic expansion valve. Temperature control shall be by thermostat, solenoid valve. An insulated drain pan of mild sheet/aluminum construction, not less than 35 mm deep and 2 mm thick for collecting the condensate shall be provided with suitable drain connection.

The cooling coil shall be to produce the capacity required under specified coil condition and air quantity. Heat load calculation to check the system selection shall be carried out and submitted by the tenderer.

5.14.04 **Evaporator Fan**

The fan shall be heavy-duty DIDW centrifugal type statically and dynamically balanced with forward curve blade, directly driven designed for high efficiency and quiet operation. Fan wheels and casing shall be constructed of steel and mounted on steel shaft. The bearings shall be ball bearing type mounted on vibration absorbing rubber mounts. The fan motor shall be mounted within the cabinet. Motor horsepower shall be sized for 120% of the rated power. The fan shall be of dual speed.

The supply fan shall be sized to deliver the required air quantity against the total external static pressure required for the system application, after taking care of all internal static pressure requirements of the units.

The filter shall be dry panel HDPE type of 50 mm thick. Face velocity through the filter shall not exceed 2.5 m/sec.

All the above items, namely, fan, cooling coil and filters are encased in a powder coated sheet metal casing complete with built-in electrical items, supply air outlets with automatic swivelling mechanism and decorative return air grille, insulated drain connection, acoustic lining, supports and hangers.

Both the outdoor and indoor units for each Split Air Conditioner shall be connected with thermally insulated refrigerant piping. The insulation shall be at least 26 mm Aluminum foil faced Nitrile Rubber foam/XLPE or equivalent.

Each Split unit shall be provided with a cordless hand operated control panel.

5.15.00**INDUCED DRAFT COOLING TOWER**

5.15.01Cooling tower shall be of cross flow induced draft two cell type with FRP casing and sump with air entry on all four sides and air discharge on top. The fan motor shall be easily accessible from outside and out of moist air steam.

5.15.02Cooling tower shall be of sufficient capacity to cool the rated amount of water through the specified range at the design W.B. temperature.

5.15.03The structural frame-work of the tower including all members and connections shall be designed for operating loads and prevailing wind pressure. Steel members shall be galvanized steel and be of sufficient size to safely withstand all imposed loads including maximum wind speed.

5.15.04FRP casing sheets shall be clamped on close centres to the structural steel members. Rubber neoprene gaskets must be used on all bolted joints as a seal against water leakage.

5.15.05The fan deck shall be of ample strength to support all loads normally encountered in operation and maintenance. Stiffeners shall be provided on the under side.

5.15.06Galvanized Steel/Aluminium ladder with safety cage and hand railing shall be provided in such a number and locations as necessary to give safe and complete access to all parts to tower requiring occasional inspection or adjustment. An access door shall be provided in the fan deck and in the cell for ready access to the interior parts of the tower.

5.15.07Honeycomb type fixed louvres shall be an integral part of PVC film type fill which also incorporates integral drift eliminators.

5.15.08Formed PVC fill sheets shall have a suitable shape to minimize resistance to airflow. The entire fill assembly shall be sufficiently durable construction in operating conditions and shall be supported by hot dip galvanized steel structural tubes/members. Fill sheets shall be suitable to withstand hot water temperature of 55 °C.

5.15.09PVC eliminators integral to the fill shall have adequate efficiency to reduce drift loss to 0.05% of the water circulated.

5.15.10The water distribution system shall be open basin type with gravity feed nozzles. The system shall be self draining and non-clogging and designed for flexible operation and ready accessibility. Suitable measuring orifices shall be provided. All main piping connections shall be brought out and end in flanges, to flexible connection.

5.15.11 The cold water basin shall be of FRP construction. The basin shall be complete with float valve for make up water control quick fill connection with valve, drain connection with valve and overflow connection. The make-up water supply pipe shall be positioned at least twice in diameter of pipe above maximum water level in the basin. The water basin shall be constructed such as to provide a coarse strainer of Brass wire mesh easily accessible from outside.

5.15.12 Fan shall be of the propeller type, cast aluminium and multibladed aerofoil construction with adjustable pitch. The entire fan assembly shall be statically balanced. Outlet velocity of air shall be not less than 610 metres per minutes and the fan tip speed shall not exceed 75 meter per second.

5.15.13 Each fan shall be either belt driven or gear driven. Where reduction gears are used, housing shall be of heavy cast iron construction with large oil reservoir and complete with supply of oil.

5.15.14 Fan motors shall be of the totally enclosed fan cooled type and of the required capacities. Motor shall be located outside the moist air stream.

5.15.15 Fan drive shaft using reduction gearing shall be dynamically balanced and connected through flexible couplings.

5.15.16 The mechanical equipment assembly shall be adequately supported on the fan deck.

5.15.17 Fan discharge batch shall be covered with galvanized wire mesh to prevent birds nesting during idle periods.

5.15.18 All nuts, bolts and fasteners used in the cooling tower shall be not dip galvanized.

5.16.00 NON CHEMICAL WATER TREATMENT EQUIPMENT

5.16.01 The water treatment equipment is a 1 M long pipeline, which once installed, stops the formation of scale in the heat exchange zones completely.

5.16.02 The water treatment equipment consists of Metal Cell and Core and is installed on line after the pumps and before the heat exchange zone. The distance of the heat exchange zone should not be more than 30 M and there should not be any static area between the water treatment equipment and heat exchange area.

5.17.00 CONTROL SYSTEM

All control shall be electrical/pneumatic type depending upon the requirement & as specified elsewhere of the specification.

5.17.01 Chilled Water System

All safety controls against high refrigerant pressure, low refrigerant pressure, low oil pressure, high and low voltage, compressor over-load and protection against freezing of the water in chilled water system low flow of condenser cooling water and chilled water shall be provided.

Operating thermostat sensing outlet water temperature of chiller shall be provided for each compressor. This thermostat shall control the magnetic shut off valve in the liquid line in conjunction with the capacity controller of the compressor. Automatically operated unloaded starting device shall be provided for compressor. Automatic capacity control with slide valve arrangement shall be provided.

5.17.02 **Direct Expansion System**

All devices for automatic refrigerant flow control by thermostatic/electronic expansion valve sensed by the superheat in suction line. Controlling the magnetic shut off valves in the liquid line to operate in conjunction with automatic capacity control of compressor by room thermostat sensing from the inside temperature of the conditioned space is to be provided. High pressure and low pressure cut out, oil pressure output, high and low voltage protection, and compressor motor over-load protection shall be provided. Automatic crank case heater and unloaded starting device shall be provided for the compressor.

5.17.03 **Air Handling Unit/Fan Coil Unit**

The temperature of all conditioned space shall be maintained/controlled by a motorized modulating type 3-way mixing valve for controlling chilled water flow in AHU/FCU with chilled water systems.

One humidistat shall be provided with the humidifier, wherever exists, in AHU, to maintain the desired relative humidity of the conditioned space.

Room humidistats will also control the reheaters.

5.18.00 **VALVES**

5.18.01 **Refrigerant Valves**

All refrigerant valves as may be applicable shall have steel body with flange connection or sweat connection for welding to pipe. For copper pipes size 5/8" and below flare connection will be acceptable. It is preferable to have the steam of rising stems inside screw type. The valve body and bonnet connection shall have bolted or welded connection.

It is preferable to have Teflon gland packing for the valves. The construction of the discs of the valves shall be either globe or angle type. The valve seat shall have white metal lining or any equivalent soft replaceable lining. The valves shall be of tested quality. Leak tightness of the valves shall be tested at minimum 1.5 times the design pressure for the system.

5.19.00 **MISCELLANEOUS INSTRUMENTS**

5.19.01 The space humidistat and thermostat shall be of reputed make. The humidistat and thermostat shall be complete with suitable metallic enclosures and shall be mounted in the walls of the handling unit space or conditioned

space. The instruments shall be complete with wiring encased in 3/4" dia. conduits, terminating in the suitable terminal box.

Digital Humidity Indicator in Control Room with 4-20 mA DC output from the meter to be hooked up with DDC Panel.

Digital Temperature indicator in Control Room with 4-20 mA DC output from the meter to be hooked up with DDC Panel.

5.19.02 The pressure indicators and temperature indicators shall have minimum 160 mm size dial. The pressure gauges shall be complete with isolating cocks/valves.

5.19.03 Apart from the thermostats, pressure switches, level switches and level indicators specified in this tender documents, the local instruments as required shall also be furnished as a part of the system.

5.19.04 The range of controls and instruments should be such that the operating range are preferably in the mid-scale or in line with the recommendation of the manufacturer. The accuracy should not be less than ± 1% of full-scale deflection. The differential in controls should be such that the equipment is able to operate at desired settings or maintain desired conditioned.

5.19.05 The scale of pressure indicators for refrigeration units will be in kg/Sq.cm. Saturation temperature of the refrigerant in use, at the corresponding pressure should also be indicated in the scale. The suction and oil gauge shall be compound gauge.

The scale of pressure indicator for pumps will be in meter. The temperature indicator's scale will be in Deg. C. The range should be such that even then the equipment is idle and the temperature of the medium is at such variance, the indicator will not be damaged.

5.19.06 All instruments should be such selected and installed that they are easily readable from the floor.

5.20.00 **DUCT WORK**

5.20.01 **General**

Velocity of air in any section of duct shall not exceed 7.5 m/sec. for air conditioning system.

5.20.02 All duct work for supply of air inclusive of accessories such as damper, vanes, access doors etc. shall be fabricated from G.I. sheet or aluminium sheet. The ductwork shall be properly reinforced to prevent sagging, buckling or vibration. Interior of all ducts shall be smooth and free from obstruction. All duct sections shall be cross broken.

5.20.03 Joints

a) All longitudinal joints for the ducts will be Pittsburgh Lock seam type.

b) Transverse joints of the low-pressure ducting shall be continuous around the four sides, the corner closures, we required. The type of transverse joints shall be follows:

Large side mm		Type of transverse joints
Up to 600	:	25 mm wide pocket, drive or S-slip
600 - 1000	:	85 mm wide, bar s-slip or pocket slip
1001-225	:	40 mm x 40 mm x 6 mm M.S. Angle connection

The low-pressure ducting work shall be provided with intermediate transverse bracings continuous around the four sides between the joints according to the following sizes:

Large side mm		Bracing
0 - 450	:	None
451 - 1500	:	40 mm x 40 mm x 6 mm angle 1200 mm from joints.
1501 and above	:	40 mm x 40 mm x 6 mm angle 600 mm from joints

All flat surfaces between bracing or joints having 900 mm or more crosswise dimension of the duct, shall be reinforced by a longitudinal internal standing seam located in the centre third of the duct width. All flat surfaces over 1500 mm wide shall be reinforced by the longitudinal internal standing seams located approximately on the third points or the width.

5.20.04 Hangers and Supports

a) All ductwork shall be provided with adequate hangers or supports to ensure rigid support and to prevent vibration. Spacing of duct supports shall not exceed 3 m centres.

b) Hangers shall be suspended from the building steel with provision for necessary auxiliaries, or special steel members, or by hooks fixed to the embedded plates provided in the ceiling.

c) Hangers for all ducts shall be trapeze type with the shelf construction from 35 mm x 35 mm x 5 mm angle iron and hung by two steel rods each of not less than 10 mm dia. for ducts, with larger side less than 2250 mm while for those greater than 2250 mm shall be with 50 x 50 x 5 angles and rods not less than 16 mm dia.

d) All hangers and supports shall be as per drawings / specifications. When

vertical ducts pass through floor slab, they shall be supported by means of collars, constructed of steel structural angles securely fastened about the girth of the duct and bitumastic compound between the horizontal leg of the supporting angle and the floor. The duct aspect ratio shall not be more than 4:1. Turning vanes are required to be provided with bend more than 45 Deg.

5.20.05 Access doors

All main ductwork shall be accessible throughout using tight fitted hinged access doors. Doors shall have to be cemented on sponge rubber gaskets. Angle joints shall be provided with felt or rubber gaskets for leak-tightness of the joints.

Access doors/panels are to be provided at following places:

Near each fire damper

Near each heater coil

Near each filter bank

In case access doors are to be installed in the insulated ducts, the access door panel should be suitably insulated, such that it can be operated without damaging the duct insulation and there should be no condensation either on the access doors or on the duct when the plant is running.

5.20.06 Flexible connection

Rubber impregnated canvas or equal flexible connections of at least 150 mm length shall be provided at each connection between ductwork and fan units.

5.20.07 Dampers

i) Splitter damper

Splitter dampers in branch take off shall be provided. Dampers blades shall be minimum 16 SWG thick. Alternatively catcher shall be provided in right angle tee of ducts.

ii) Fire damper

Fire dampers shall be provided as per the requirement mentioned elsewhere in the specification. The fire dampers shall be of motorized / solenoid/fusible link type operated by smoke detectors of the zone fire fighting system. The fire damper shall be smoke-tight type and shall have 90 min. fire rating. Provision shall be kept for manual operation of the damper.

Blade thickness : At least 16G CRCA

Frame : At least 40 x 40 x 3 mm Angle.

Motorised Fire Dampers shall be rated for 240 V, 50 Hz, 1 Ph., AC supply. Motor for Fire dampers shall be continuously rated. These Dampers shall

close on de-energisation and open on energisation of Motor. Provision shall be kept for manual operation of the Damper.

iii) Opposed multiple louvre damper

Opposed multiple louvers dampers shall be provided at the fan outlets and wherever mentioned in the drawings, specification and fan schedule. Each blade of the dampers shall be provided with bronze, gunmetal or nylon bearing at each end of its spindle. The spindle with bearing shall be mounted in a strong structural framework. Operating lever with fixing device for keeping the damper at the desired position shall be fitted for the manually operated dampers.

Operating level will be fixed on an indicator to show the percentage of opening of the damper in all cases except for the application with grilles and nozzles.

Velocity across the dampers shall not exceed 10 m/sec. Damper blades at fan outlet shall be made up of 16 gauge M.S.

5.20.08 Diffusers, Grilles, Registers

Design of grilles & diffusers shall be such as to create desired throw and spread of air and shall be approved by the purchaser/engineer.

All diffusers and grilles shall be made up of powder coated sheet steel with finish painting. Design of all diffusers and grilles shall be made by the Contractor matching with the lighting and other fittings and to be approved by the Engineer. Each supply air diffusers shall be fitted with opposed blade damper, built-in vanes and louvers arranged as per manufacturer's standard design.

Side throw type supply registers shall have two sets of adjustable louvers with opposed blade dampers. The front of louvers shall be horizontal to provide horizontal deflection and the rear set of vertical louvers shall adjust vertical deflection. The dampers shall have horizontal opposed blades regulated by an operating lever in the frame. All wall type exhaust / return air grilles shall have one set of louvers in the front. The louvers shall be fitted such as to remain in position by friction grip. All supply air grilles shall have one set of opposed multiple louver damper at the inlet. The dampers shall be gang operated and will have a device to keep the dampers fixed in one position.

The grille frame and louvers shall be manufactured of at least 20 SWG GI sheet and 22 SWG M.S. respectively. No grilles should by any chance make any rattling sound during continuous operation. All grilles shall match the decor of the space.

All grilles/diffusers shall be fitted with suitable gasket to prevent air leakage.

The air velocity through grilles/ diffusers shall not be exceed 2 m/sec.

5.21.00 **THERMAL INSULATION**

5.21.01 The following items are to be insulated:

a) Refrigerant suction piping from the evaporator coil outlet up to the compressor inlet shall be insulated with minimum 39 mm (26 mm for Non ductable Split Units) thick aluminium foil faced Nitrile rubber/ XLPE. For better efficiency of operation the liquid line running side by side with the suction line may be insulated together with the suction line already mentioned.

b) Double skin Casing of the cabinet type air handling unit with at least 25 mm thick Poly Urethane Foam (PUF) or equivalent.

c) Supply air duct and part of the return air duct passing through non conditioned space, if any, with at least 13 mm thick aluminium foil faced Nitrile Rubber / XLPE Insulation.

d) Entire chilled water-piping, valves, chilled water circulating pumps, and chillers with 39 mm thick aluminium foil faced Nitrile rubber/XLPE.

The portion of Chilled water piping exposed to atmosphere shall be insulated with 50 mm thick EPS (TF quality) finished with 500 gauge Polythene sheet, chicken wire mesh, 12 mm thick sand-cement plaster and an overall cladding of 30 gauge Al. sheet.

e) Chilled water Expansion tank drain piping with 6mm thick aluminium foil faced Nitrile Rubber/X LPE

f) Roof Ceiling of all AC spaces with 50mm thick aluminium foil faced Expanded Polystyrene (TF Quality).

5.21.02 Insulation shall be fixed as per manufacturer's recommendation. Due care shall be taken to avoid damage to vapour arresters and insulation. For EPS Insulation roll or slab shall be attached with equipment, piping or ducts with bitumen (85/40) or CPRX sticking compound. Insulation clips shall be used as necessary.

5.21.03 Extra insulation thickness shall be provided at duct pipe hangers and special care shall be taken to seal the insulation and hanger member penetrations and instruments and accessories tapings.

5.21.04 Special care shall be taken to provide satisfactory insulation for valves, flanges, vessel connections etc. with proper facility for maintenance and inspection.

5.21.05 Insulated ducts crossing the floors shall have to be normally protected from damage and water splashing by providing suitable cladding up to 300 mm from the floor level.

5.22.00 ACOUSTIC INSULATION

All supply air ducts in the air conditioning system shall be insulated acoustically up to a length of 6 meter from the blower mouth with 25 mm thick resin bonded fibreglass of density (48 Kg / Cu. M) insulation from inside of the

duct. For protection against erosion, the insulation mass shall be covered with fibreglass cloth and 30G perforated aluminium sheet provided with 30% perforation area. The protective covering shall be securely fixed to avoid dislodgement of the insulation.

5.23.00 CENTRIFUGAL AND AXIAL FLOW FANS

5.23.01 Centrifugal fans shall be SISW/DIDW as mentioned in the Specification. The designs shall be in general end suction and upward/downward/inclined/ horizontal discharge type as demanded by the system/installation need. All centrifugal fans are coupled to the drive motors with V-belts. Puller holes should be provided on fan impellers and pulleys for ease of extraction from fan/motor shaft. Fan/motor shafts should have threaded centre holes for fixing pushers and locking the impeller/pulley axially on fan/motor shaft.

5.23.02 All Roof exhausters / supply fans and wall exhausters/supply fans are of direct drive axial flow type. Roof exhausters/supply fans shall have multi-bladed impeller with a short duct casing while wall exhausters/supply fans shall have coned inlet suitable for free discharge of air.

5. 23.03 The centrifugal fans and axial flow fans shall be capable of withstanding the stresses which may be experienced during normal operation under the condition which it is required for and during over speed test.

5. 23.04 It is desirable that all centrifugal fans shall be designed to operate within 9% and 25% of system throttling line.

5. 23.05 All the fan units shall be reasonably noise and vibration free in operation and therefore of reasonably low speed. RPM of axial flow fans shall be restricted within 1000 to reduce their noise level excepting roof extractors for which RPM shall be restricted to 1500. Outlet air velocity of all fans shall be restricted within 12 m/s.

5. 23.06 Casing for centrifugal and axial flow fans shall be reasonably leak proof.

5. 23.07 The first critical speed of the rotating assembly shall be at least 25% above the operating speed.

5.23.08 Fan wheels shall be statically and dynamically balanced according to ISO 1940 Grade 6.3.

5.23.09 Impeller

a) The blades of the centrifugal fan impeller for all units shall be backward curved unless otherwise specifically mentioned. The blades of the impeller shall be die formed aerofoil or laminar type. They shall have self-cleaning and non-overloading characteristics, and shall be welded to the back plate and shroud, if any. The fan wheel shall be statically and dynamically balanced.

b) The axial flow fan impeller shall be cast in one piece, finished all over and are fully balanced both statically and dynamically. Finally the assembled rotor shall be dynamically balanced. All axial flow fan impeller shall consist of high

efficiency aerofoil section blades. Puller holes should be provided on fan impellers and pulleys for ease of extraction from fan/motor shaft. Fan/motor shafts should have threaded centre hole for fixing pushers and locking the impeller/pulley axially on fan/motor shaft.

5.23.10 Casing

a) Centrifugal fan casing shall be of welded construction and provided with flanges on inlet and outlet sides for duct connection. Mounting legs welded to the casing shall be provided. Plummer blocks should preferably be not supported on the bracings/stiffeners of casing sidewalls.

b) Axial flow fan casing for roof exhausters/supply fans and their components shall be suitable for outdoor installation. The casings will be provided with flanges at inlet and outlet. All nuts & bolts associated with it shall be of zinc or cadmium plated with proper baking to remove hydrogen.

Easily removable inspection cover having galvanised fly nut shall be provided. The inspection covers shall be located such that the grease nipple for all bearings, and also motor terminals are easily accessible through the cover. It is however, preferred that provisions will be there for greasing the fan bearings from outside the fan casing.

Suitable motor brackets as per manufacturer's standard for both roof and wall exhausters/supply fans shall be fitted. The brackets shall be designed to provide rigid mounting for motors.

5. 23.11 Bearing

Centrifugal fan shaft shall be mounted on self-aligning, heavy-duty spherical roller bearing of adequate capacity and life. In no case the life of the bearings shall be less than 40,000 hours. Centrifugal fans for air washers installed in the T.G. Building, should have minimum bearing life of 100,000 hours. Bearings shall be grease lubricated and provided with fittings for lubrication from outside. The bearings shall be located in an easily accessible location to facilitate maintenance.

5. 23.12 a) Roof exhausters/wall mounted fans (if located on the exposed wall) shall be provided with hood for protection against rain and other contingencies. It must ensure no dripping of rainwater under any circumstances and will have low-pressure drop of air. The hoods shall be provided with a heavy gauge expanded metal bird screen. Axial flow fans should be fitted with protective screens from inside of room.

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

c) A typical sketch enclosed herewith shows arrangements for both roof exhausters and rain protection cowl. Any other approved design for the hoods and cowls can be considered. Grouting frames for the cowls

if required shall be included in the supply along with nuts and bolts.

5.23.13 Coned Inlet

Wall exhausters shall be provided with coned inlet made of M.S.

5. 23.14 Inlet Screen

Inlet screen shall be manufactured of min. 14 SWG galvanised wire knitted in 1" square mesh. Suitable flanges to protect the edges of the screen shall be provided.

5.23.15 Vibration isolator

Double deflection rubber in shear or rubber in compression type vibration isolators shall be provided with each centrifugal fan. Rubber bushes, washers, wherever needed for the vibration isolators shall be included in the supply. Sufficient number of such isolators shall be provided to ensure isolation of foundation from vibration of the equipment.

5. 23.16 Fans for special application

Fans for battery room, oil rooms and fuel stores shall be of spark proof construction. These axial flow type fans, shall be bifurcated type construction with motor away from air stream. Motors for these fans shall be of flameproof construction.

All fans for special application shall have all accessories as mentioned in the Specification.

5. 23.17 Fan drive

a) Centrifugal fans shall be provided with V-belts and sheaves. All belts shall be sized with minimum 1.5 service factor. All V-belt drives shall be equipped with removable guards that do not impede the airflow to the fan inlet. There shall be a minimum of two belts per drive. All pulleys should have threaded puller holes for the ease of their extraction.

b) All direct drive axial flow fan impellers shall be directly mounted on extended motor shaft.

5. 23.18 MATERIALS OF CONSTRUCTION

The following materials shall be used for the construction of various parts:

a)	Centrifugal fan impeller	:	M.S. sheet/Plate (IS:2062)
b)	Axial flow fan impeller	:	Cast Aluminium Alloy A-6M. IS-617
c)	Fan shaft	:	C-45, IS-1570 or Class-IV.

			IS-1875 or its equivalent
d)	Fan Scrawl	:	Heavy gauge M.S. (IS-2062)
e)	Fan supports, frames and Structure.	:	M.S. of adequate thickness (IS-2062)
f)	Coned inlet for wall exhausters/Supply fans	:	M.S. (IS-2062)
g)	Dampers	:	M.S. of heavy gauge (IS-2062)
h)	Flexible connections for fan inlet and outlet	:	Fire resistant type plastic impregnated canvas with M.S. flange and cleats.
i)	"V" pulleys	:	G.I. multigrooves (IS-210, Gr.20)
j)	"V" belts(Matched sets)	:	Reinforced rubber of appropriate section.
k)	Slide rails	:	C.I. or M.S.
l)	Connection pieces	:	Galvanised iron according to supplier's design.
m)	Bolts and Nuts	:	M.S. unless otherwise specified.
n)	Rain protection cowls, hoods And casing for roof Exhausters/wall exhausters/ Supply fans	:	Aluminium or hot dipped galvanized after fabrication from M.S.
o)	Vibration isolating pad: washers & bushes, if any.		Hard synthetic rubber of Hardness 40° shore.

5.24.00 **AIR WASHER UNITS**

5.24.01 The air washer unit shall be designed as Cell type units. Air is sucked by the centrifugal fan unit / units successively through the air inlet louver, Stainless Steel Filters continuously flooded with water through spray nozzles, fill deck of cross fluted configuration assembled in self supporting pads made of cellulose paper duly impregnated with insoluble anti-rat salts, rigidifying saturants and wetting agents, Die-extruded PVC eliminators and delivered to the duct system with Supply air Grilles for distribution.

5.24.02 The fill section consists of a perforated Fiberglass Reinforced Plastic (FRP) trough over the fill deck covering the top surface of the fill section (Maximum allowable height of each Fill section will be 2000 mm) for proper distribution of water through cellulose fills. In case the height of the Fill Section exceeds

2000 mm, double deck arrangement with a separate water trough shall have to be provided. The required quantum of water will be taken to the trough with the help of a Monobloc Centrifugal Pump set and medium class internal GI piping. The air velocity through the Fill Section will be limited to of 2.25 M / Sec (maximum).

5.24.03 The Filter section consists of a set of Stainless Steel (SS-316) mesh filter modules mounted on a ladder type GI framework and quick release mechanism for easy dislodgement of the filter modules. The filter mat shall be weaved with SS wire of 0.16 mm diameter providing an aperture of max. 0.025 mm. Such filters are continuously flooded with water spray from a spray header bank. The water spray is in the direction of airflow. The Spray nozzles shall be made of brass / stainless steel and shall be of solid-cone type with an orifice dia. of 6 mm.

The filter module size shall not be more than 610 mm x 610 mm. The water spray will be generated with the help of a Horizontal Split Casing type Centrifugal Pump-Motor set and associated Medium Class GI piping with all fittings and supports. The water will be collected in a RCC (in case of masonry Air Washer) / MS tank (in case of sheet metal enclosure type) and will be re-circulated by means of the said pump. This tank shall be common for both the Filter section and Fill section and shall be complete with make-up connection with float valve, quick fill connection, drain connection with valve and overflow connection with siphon. The tank shall be RCC or made of min. 5 mm thick MS with epoxy painting, as applicable.

5.24.04 To protect the equipment located in the ventilated space from effects of high humidity, control device using Humidistat interlocked with the Pump Motor of the Fill Section shall be used in the electrical areas. Humidity beyond 60% RH in these ventilated spaces shall automatically trip the respective Pump set. The pump may be restarted automatically at about 50% RH. At least two (2) nos. Humidistat (RH High and Low) shall be provided for each Air Washer Unit. However, manual over riding facility shall be provided for humidistat controlled Pump sets of the air Washer Unit.

5.24.05 The equipment shall be located within the sheet metal casing. The masonry air washer chamber shall be associated with an air lock chamber with air pressure breaker valve at the doors. The overflow pipe connected with the water tank must be terminated with a siphon, to avoid leakage of air into the air washer chamber. All air washer internals coming in contact with moist air shall be spray galvanized. All in side and out side parts of the fans shall be spray galvanized whereas the shaft shall be epoxy painted. Provision of Marine lights shall be kept in both the Filter and Fill section.

5.24.06 The Air Washer Units shall be suitable for running with clarified water. Bidder shall refer to the water analysis sheet enclosed with this specification for necessary confirmation.

5.24.07 The air washer units shall be designed for a saturation efficiency of 90%.

5.24.08 **Sheet metal air washer chamber**

Air washer chamber housing filter, (SS mesh in SS/ Al frame), water headers, supports, moisture eliminators, water sump etc. shall be manufactured of sheet steel in sections to facilitate easy dismantling and erection. The unit shall be fabricated from minimum 4 mm M.S. sheet with adequate stiffeners, bracings etc. and shall have at least 90% saturation efficiency. The water sump shall be made of at least 5mm thick MS sheet.

The various sections of the unit shall be bolted with suitable gasket to avoid leakage of water. All the sections of the units shall be spray galvanised to prevent corrosion. The units and bolts used for jointing the sections shall also be galvanised. The connection pieces shall have at least 2 coats of rust inhibiting paint. All inside and outside parts of the fan shall be spray galvanised except the shaft which hall be epoxy painted. The casing front shall be provided with an air inlet louver.

The pressure drop across the spray chamber shall be kept around 15 mm - 20 mm WG.

5.25.00 **UNITARY AIR FILTRATION UNIT**

5.25.01 Unit shall have in general one set of filter of washable metallic filter (SS mesh in SS/ Al frame) with water spray arrangement over the surface of it continuously to clean the filter. One moisture eliminator screen made of GI/Aluminium shall be used after the water flooded filters to eliminate the carry over of moisture. Suitable galvanized iron grid shall, be used inside both the screens and eliminator for reinforcement. One backward curve centrifugal fan motor unit shall be used for conveying the air. The unit shall be self-enclosed by 2 mm galvanized casing. The casing front shall be provided with an air inlet louver. Water with the dirt will be collected in the drain pan of 3 mm thickness and bled off to the drain in small quantity. Water will be recirculated by means of one set of pump.

The drain pan shall be provided with overflow pipe terminating to the nearest drain point (provided by the Purchaser). Protection sheds of sheet metal construction shall be provided for the motors installed outdoor. All parts including fan of this system coming in contact with moist air shall be spray galvanized except the fan shaft, which shall be epoxy painted.

5.25.02 **WASHABLE METALLIC FILTER**

The filter media shall be designed to hold dust, sand and prevent it from being dislodged by vibration or other cause and passing through filter.

The filters shall be washable/cleanable type construction of SS wire netting with three or more layers of wire mesh of different mesh sizes stitched together & held in a SS/Al frame. The filter when flooded shall have a filtration efficiency of 90% down to 10 microns.

The filter shall have SS/AL frames of adequate thickness but not less than 18 SWG for Al & 20 SWG for SS suitable for long use in an industrial plant. The filters may be in panels of size about 600 x 600 for easy handling of the

same.

The face velocity of air across the filters shall not exceed 2.5 m/sec.

5.26.00. **MOISTURE ELIMINATOR SETS**

5.26.01 Moisture eliminator sets used for the air washer / UAF units shall be vertical and die-extruded PVC construction.

5.26.02 Face velocity of air for the PVC Eliminator sets shall not exceed 2.5 m / sec.

5.26.03. Eliminators shall be manufactured in suitable sizes for easy handling, erection and replacement whenever necessary.

5.26.04 Moisture Eliminator shall have bends at 300 with the direction of airflow and shall have 2 effectively hooked edges for trapping the carry over of water. The catcher should face the direction of airflow.

5.26.05 The Moisture Eliminators shall be fixed rigidly in their proper position and spacer shall be provided to maintain the proper gap.

5.26.06 Holding frame for the PVC Eliminators shall be of G.I. angles of adequate strength for support.

5.27.00 **SPRAY NOZZLE STREAM**

5.27.01 The arrangement of spray nozzle for all air washer systems shall be two bank type (one along the air flow & the other against the air flow) and single bank type (along the air flow) for unitary air filtration units. Supplier shall confirm the layout of the nozzles on the vertical face. The nozzle arrangement shall ensure good spray distribution and fine break-up of water across the air stream. The saturation efficiency of the spray system shall be at least 90% for air washers and 60% for unitary air filtration units with an inlet air condition as mentioned under Design Criteria of this specification. The spray nozzle shall be made of Stainless Steel.

The supplier shall include water spray headers and piping connected to the pumps. The water header and piping shall be of G.I. One pot strainer with very fine mesh brass screen shall be fitted preferably in the suction line of the pump. Bypass line with necessary valve arrangement shall be required for ease of maintenance of the pot strainer.

Provision for regulating the flow of water to the supply headers of the water spray nozzles shall be kept by providing globe valve as shown in the drawing. Water from the washer chamber tank shall be taken to pump through a primary water filter fitted in an accessible position in the tank. The filter screen shall be manufactured of G.I. netting in a G.I. Frame.

5.27.02 All accessories like valves, drain valves, fittings, pipe supports, hangers, etc. shall be included in the supply. These will be manufactured according to the supplier's standard.

5.27.03 Properly hinged air tight galvanized inspection doors of suitable size with ladder and catwalk shall have to be provided in each sheet metal air washer unit and unitary air filtration unit.

5.28.00 WATER PUMPS (FOR VENTILATION SYSTEM)

5.28.01 Each pump shall preferably be of horizontally split casing, centrifugal type, directly coupled to electric drive motor and mounted on a common base plate and located by dowel pins after proper alignment. However, mono bloc type may be acceptable below 5 HP.

5.28.02 The pumps will operate under flooded suction and shall have axial suction and radial discharge.

5.28.03 Pump head-capacity characteristics shall be gradually rising from operating to shut-off point without any zone of instability. The pump BHP flow characteristics shall preferably be non-over loading type beyond rated capacity point.

Pump shall be rated for continuous operation.

5.28.04 Operating speed of the pump shall not preferably be more than 1500 r.p.m.

5.28.05 Material of the pump shall preferably be as follows (all material shall be of tested quality)

a)	Casing	:	Cast iron, Grade-20, IS-210
b)	Impeller & wearing rings	:	Bronze
c)	Shaft	:	Carbon Steel C-45, IS-1570 or Class-IV, IS-1875
d)	Shaft sleeve	:	Bronze

5.28.06 The pump bearings and the shaft shall be sized adequately to take the maximum possible unbalance and hydraulic loads. Pump bearings shall have adequate life and in no case it shall be less than 40,000 hours.

5.28.07 Pump and drives shall be directly coupled through a flexible coupling. Suitable coupling guard shall be provided for each pump.

5.28.08 Each pump shall be complete with pressure gauge at the suction and delivery, isolating valves, all integral piping required for sealing, cooling, etc.

5.28.09 The design of the pumps shall conform to the relevant IS Code, Standards of Hydraulic Institute of U.S.A. or approved equivalent.

5.28.10 The pump suction strainer shall be of pot type having easily removable top cover for access to the filter cartridge. The filters shall be fitted with fine mesh

copper or brass wire strip.

5.28.11 The pump motor should be so selected that it is not overloaded at 50% of the flow.

5.29.00 DUCTING (FOR VENTILATION SYSTEM)

5.29.01 GENERAL

a) Velocity of air in any section of duct shall not normally exceed 12 m/sec.

b) All ductwork for supply for air shall be fabricated from G.I. sheet and all ductwork for exhaust system shall be fabricated of black M.S. sheet or whatever mentioned in the drawing. The ductwork shall be properly reinforced to prevent sagging, buckling or vibration. Interior of all ducts shall be smooth and free from obstruction. This specification is applicable for all ductwork except otherwise mentioned in the drawing.

c) All duct for ventilation supply or exhaust shall be manufactured of at least 1 mm thick G.I./M.S. sheet.

d) The duct conveying the battery room exhaust or any other corrosive fume shall be made of M.S. with epoxy painting on both sides.

5.29.02 CONSTRUCTION

a) All longitudinal joints for ventilation duct shall be Pittsburgh Lock seam type.

b) Transverse joints of the low-pressure ducting shall be continuous around the four sides. Corner closures are required. The type of transverse joints shall be as follows.

Larger side (mm)		Type of transverse Joints
Up to 600	:	25 mm wide pocket, drive or S-slip
601 - 1500	:	75 mm wide, bar-S-slip or pocket slip
1501 - 2250	:	40 mm x 40 mm x 60 mm M.S. Angle connection.

c) Low pressure ventilation ducts shall be provided with intermediate transverse bracings continuous around the four sides between the joints according to the following sizes:

Larger Side (mm)		Bracing
0 – 450	:	None
451 – 1500	:	40 mm x 40 mm x 6 mm angle, 1200 mm
from 1501 and above	:	40 mm x 40 mm x 6 mm angle, 600 mm from joints

All flat surface between bracing or joints shall be reinforced 900 mm crosswise of the duct and by a longitudinal internal standing seam located in the center third of the duct width. All flat surfaces over 1500 mm widths hall be reinforced by the longitudinal internal standing seams located approximately on the third points of the width.

d) **Riveting and Sealing**

All joints, slips and seams shall be made secure by riveting on centers not exceeding 150 mm. All transverse stiffeners and all reinforced bar slip joints shall cross at corners and be riveted. All bar slip joints and angle iron bracings shall be riveted on centers not exceeding 75 mm.

All construction joints and seams shall be reasonably sealed with suitable sealing compounds.

e) **Access Doors**

All main ductwork shall be accessible throughout using fitted hinged access doors. Doors shall have to be cemented on sponge rubber gaskets. Angle joints shall be provided with felt or rubber gaskets for leak-tightness of the joints.

f) Suitable drain point with water trap shall be provided for all washed air duct routing at suitable places, preferably just after air washing unit.

g) All duct sections shall be cross-broken.

h) Canvas or equal flexible connection shall be provided at each connection between ductwork and fan units to isolate vibration.

5.29.03 **HANGERS AND SUPPORTS**

a) All ductwork shall be provided with adequate hangers to ensure rigid support and to prevent vibration.

b) Hangers shall be suspended from the ceiling by cinch anchor/expansion bolts.

c) Hangers for all ducts shall be trapeze type with the shelf constructed from 35 mm x 35 mm x 5 mm angle iron and hung from two steel rods each of 10 mm dia at least.

d) All hangers and supports shall be approved by the Engineer. When vertical ducts pass through floor slab. They shall be supported by means of collars constructed of steel structural angles securely fastened about the girth of the duct and resting on the floor slab. The supporting angle shall be fastened to the floor slab with a filter or bitumastic compound between the horizontal leg of the supporting angle and the floor.

e) All ducts running on the floor/roof shall be adequately fixed in position by angles. The supporting and fixing arrangement shall be approved by the Engineer. The fixing and supports interval shall not exceed 3 meters.

5.29.04 GRILLES/NOZZLES

a) All supply air grilles shall have two sets of adjustable louvers for desired spread and throw requirement. The louvers shall be fitted such as to remain in position by friction grip. All supply air grilles shall have one set of opposed multiple louver damper at the inlet. The damper shall be gang operated and will have a device to keep the dampers fixed in one position.

The grills frame and louvers shall be manufactured of at least 20 SWG MS sheet.

All exhaust/return air grilles shall have one set of louvers in the front or thick rat-proof wire net guards. All grilles shall be fitted with adjustable gaskets to prevent air leakage.

No grille should by any chance make any rattling sound during continuous operation. All grilles shall match the decor of the space.

b) All air nozzles shall be provided with opposed blade type dampers and shall have thick rat-proof wire netting in the front. The dampers shall have a device to keep them locked at the desired position. Mouth of the supply air nozzles shall be inclined downwards to direct the air in the working zone.

c) Design of grilles/nozzles shall be such as to create desired throw and spread and shall be approved by the Purchaser/ Engineer.

5.29.05 DAMPERS

a) SPLITTER DAMPER

Splitter dampers in branch take off wherever needed shall be provided. Damper blades shall be minimum 16 SWG thick.

b) GRAVITY OPERATED DAMPER

Gravity operated back draft dampers are needed to ensure pressurization of rooms where specified. These dampers shall be designed such as not to allow infiltration of air from outside while forced exfiltration by the fan will be achieved through the above dampers. The louvers of the dampers shall be freely mounted on spindles to allow the damper to open with the pressure developed by the fan. The dampers shall be provided with flanges at inlet.

c) FIRE DAMPER

Fire dampers shall be provided at the supply/exhaust fan/duct in all electrical

areas and oil rooms. The fire dampers shall be of electrical type with damper actuated by motors and smoke detectors/heat sensors.

d) **OPPOSED MULTIPLE LOUVERS DAMPER**

Opposed multiple louver dampers shall be provided at the fan outlet as and where required by the system. Each blade of the damper shall be provided with bronze, gun-metal or nylon bearing at each end of its spindle. The spindle bearings shall be mounted in a strong structural frame work Operating lever with fixing device for keeping the damper at the desired position shall be fitted for the manually operated dampers. Operating lever will be fixed on an indicator to show the percentage of opening of the damper in all cases except for the application with grilles and nozzles. Velocity across the dampers shall not exceed 10 m/sec.

5.30.00 **DRY FILTER**

5.30.01 The filter media shall be of high density Polyethylene or equivalent, and shall have an efficiency not less than 90% down to particle size of 10 microns.

5.30.02 The filter media shall be sandwiched in between two galvanized wire netting arrangement in a uniformly corrugated form to increase the surface area.

5.30.03 The filter shall have G.I. frames of adequate thickness suitable for long use in an industrial plant.

5.30.04 The filters may be in panels of size about 600 x 600 for easy handling. The filter panels shall be mounted on angle iron holding frames with quick release mechanism.

5.30.05 The frames shall be designed strong enough to take the load of double the pressure drop in dirty condition of the filters.

5.30.06 The face velocity across the filter media shall not exceed 2.5 m/sec. Pressure drop across the filter shall be limited to 6 mm WG during clean and 12 mmWG during dirty condition.

5.31.00DRIVE MOTOR

a) All motors of all equipment shall be squirrel cage induction type of required BHP rating. The BHP rating of the motor for backward bladed centrifugal fans and also for axial flow fans shall provide at least 15% margin over their limit load power.

b) Motor Powers for other equipment shall have at least 15% margin over their driven equipment rated BHP including drive loss.

c) All motors shall be suitable for direct-on-line starting. The motors shall be rated to suit the following:

i) Supply voltage of 415 V +_ 10%, 3Ø, 50 +_ 5% Hz with a

combined voltage and frequency variation of± 10%.

ii) Ambient temperature 50 Deg. C for all equipment except roof/wall exhausters and 55 Deg. C for roof/wall exhausters.

iii) Class-F insulation with Class-B temperature rise.

iv) Enclosure TEFC, IP-55

v) All motors rated 250 W and below shall be suitable for single phase 240 V ± 10%, 50 ± 5% Hz. Motor rated above 250 W shall be 3 phase and suitable for 415 V ± 10%, 50 ± 5% Hz.

d) Each motor terminal box shall be provided with cable gland and lugs suitable for the size and type of cable of the respective motor – as specified.

e) All electric drive motors including flame proof motors shall be as specified in Main Plant Package, Technical specification, VOLUME: II-F/1, Electrical Work.

f) Starting time for large fan motors shall be mentioned.

g) All motor should have threaded centre holes in their shafts.

5.32.00Local Starter Panel

415 V Local Starter Panel (LSP)

- 415V, 3 phase, 4 wire, 50Hz Local Starter Panel shall be provided at each auxiliary building for feeding ventilation fan motors. For Turbine Building and Auxiliary buildings grouping of fan motor starter in each Local Starter Panel will depend on the number of ventilation fans, their motor ratings and locations.

- Local Starter Panel shall also house incoming SFU for incoming power supply, outgoing SFU with power contactors, auxiliary contactors, thermal overload relays, Start-Stop push buttons, and indication lamps for incoming power supply, ON/OFF/TRIP indication lamps, terminal block, wiring for fan motors, etc.

- Emergency Stop P.B. shall be pressed to latch and turn to release type and provided for each fan.

- The LSPs shall be suitable for cable entry from top and suitable mounting arrangement. The LSPs shall be front wired and front connected and their enclosure shall be dust and splash proof, conforming to degree of protection of IP-54.

- Rating of components and all other constructional details shall be as per Main Plant Package, Technical Specifications, VOLUME: II-F/1, Electrical Work.

5.33.00 Local Starter Cum Control Panels for AWUs and UAF Units

- Local Starter Cum Control Panel shall be provided for each Air-washer Units in and for each UAF unit.

- Each Air Washer / UAF system will have one LSCP located near each Air Washer / UAF Unit. These LSCPs shall house all electrical devices for power and control purposes of Air Washer/ UAF Unit loads, (Fan Motors, Pump Motors, Fire dampers etc. and other controls.)

- This LSCP shall house incoming SFU for incoming power supply, outgoing SFU with power contactors, auxiliary contactors, thermal overload relays, Start-Stop push buttons, and indication lamps for incoming power supply, ON/OFF/TRIP indication lamps, terminal block, wiring for fan and pump motors, motorized fire dampers, controls and interlocks for Humidistats etc.

- Stop P.B. shall be pressed to latch and turn to release type.

- Control Voltage at LSCP shall be 240V, 1Ph, 50HZ. Necessary control transformer shall be provided in LSCP.

- For Motors rated 30KW and above, Ammeters shall be provided in LSCP.

- For all motors having long starting time, the thermal overload relays shall be provided with saturable core current transformer to avoid spurious tripping during starting of the motor, The current transformer will have linear characteristics up to approximately twice the setting current.

- The panel shall be wall/floor mounted.

- Auto-manual selector switch, auxiliary relays/contactors as required for RH control shall be provided in each LSCP. However manual overriding facility shall be provided for Humidistat controlled spray pumps

- By-pass P.B. for manual testing of fire-dampers for Air washer system from remote shall be provided in this panel.

- Power supply to 240V motorised Fire Dampers shall be fed from respective LSCP through MCB and Contactors.

- Audio-visual Annunciations with common hooter, Accept, Reset PB for Trip of any motor & low water level in the sump shall be provided in LSCP.

- Potential free contact for ‘Air Washer/UAF Trouble’ Group Annunciation in each LSCP for AW / UAF system. Remote Group Annunciation in each LSCP shall be provided by the contractor for Purchaser’s use.

- 10% spare annunciation facia shall be provided over and above the

annunciations as listed and / or recommended by the bidder, spare facia shall be equipped with all devices as provided for the active facia.

- Lamps shall be LED type.
- 1 module of each type and rating as spare shall be provided in each LSCP.
- General construction and other details of LSCP shall be as per Main Plant Package, Technical Specifications, VOLUME: II-F/1, Electrical Work.

5.34.00 Local Push Button station (If Required)

- Local Push Button Station (LPBS) shall be used for controlling the drives from local. LPBS shall be of the following types:

a. LPBS TYPE-A shall be provided with one (1) Red STOP push button and one (1) Green START push button. STOP PB shall be lockable in pushed position (key less mechanism) and shrouded to prevent accidental operation. START PB shall be push to actuate and spring return type.

b. TYPE-B LPBS shall house transducer operated (4 –20mA) ammeter in addition to START-STOP push button and shall be provided for motors rated 30 KW and above.

c. Type-C LPBS shall be provided with bi-directional motors and shall house OPEN, CLOSE and OFF push button shall be provided.

- Local Push Button Stations shall be as per Main Plant Package, Specifications, VOLUME: II-F/1, Electrical Work.
- Total number of Local Push Button Stations shall be as required as per specification and as required for satisfactory operation of the plant.

5.35.00 All power and Control Cabling and Grounding will be provided for complete Ventilation system

5.36.00 All 240V, 1ph fans (below 0.25KW motor rating) will be operated by switches located near the individual fans. Power supply to the fans through their switches shall be arranged by the purchaser from their nearest Distribution board.

5.37.00 CODES AND STANDARDS (AS APPLICABLE FOR VENTILATION SYSTEM)

5.37.01 Design, manufacture, inspection and testing of the equipment covered by the specification shall unless otherwise specified conform to the latest edition of the standards and code including all addenda mentioned below:

IS : 325 -1978 - Three Phase Induction Motors

IS	: 4029 - 1967	-	Guide for Testing Three Phase Induction Motors.
IS	: 210 – 1978	-	Grey Iron Casting
IS	: 2062 - 1992	-	Structural Steel (standard quality)
IS	: 277 – 1992	-	Galvanized Steel Sheets
IS	: 2676 - 1981	-	Dimensions for Wrought Aluminium and Aluminium Alloys, Sheet and Strip.
IS	: 617 – 1975	-	Cast Aluminium Alloys , Reaffirmed 1991
IS	: 655 – 1963	-	Metal Air Ducts Reaffirmed 1991

Standard Code for Testing Centrifugal & Axial Flow Fans AMCA: Bulletin No. 210.

IS	: 4894 – 1987-		Centrifugal Fans
IS	: 3588 – 1987-		Electric Axial Flow Fans
IS	: 3963 – 1987-		Roof Extractor Units
IS	: 5120 – 1977	-	Technical Requirements for Roto dynamic Reaffirmed 1991 Special purpose Pumps
IS	: 1239 – 1992- (Part - I & II)		Mild Steel Tubes & Fittings
IS	: 780 - 1984 Reaffirmed 1990	-	Gate Valves
IS	: 5312 – 1984- (Part-I) Reaffirmed 1990		Check Valves
BS	: 6540 Part-I: 1985	-	Methods for Test Air Filter used in Air conditioning and General Ventilations.
BS	: 848 Part-1 : 1980, Part-2 : 1985 Part-5 : 1986, Part-6 : 1989	-	Method of Performance Test for Fans
AMCA Publication 99		-	Standard Hand Book
IS	: 737 – 1986	-	Wrought Aluminium & Aluminium Alloys,

Reaffirmed 1991 Sheet and Strip.

6.00.00 **TESTING AND INSPECTION**

Testing and inspection both at manufacturer's works and at site after erection shall be conducted on all equipment as per guidelines given in VOLUME II-A of this specification.

6.01.00 Following tests shall be carried out during and after completion of different component parts as applicable and in accordance with the requirements of the applicable codes.

- Material analysis and testing.
- Hydraulic test for pressure parts including pumps, compressors and its components, vessels etc.
- Dynamic balancing of all the rotating parts.
- Performance test on pump, compressors, condenser, chiller cooling towers and air handling units as per code procedure.
- Tests on motors as per Indian Standard IS-325 and IS-4029 and as stipulated in the specification VOLUME IIB.
- Other tests, as necessary and recommended by the manufacturer.
- Performance testing of fans is an essential requirement. Routine test certificates in case of all equipment except big size fan units (consuming more than 15 HP for centrifugal fans and consuming more than 5 HP for axial flow fans) may be acceptable. For big size fan units, performance testing of at least one fan of each type is to be shown in presence of Purchaser's representative. This testing may be carried out at reduced speed for minimizing power consumption during testing. All instruments used shall be supplied by the contractor and those shall be calibrated by an acceptable authority.
- Performance testing of pumps of each type is to be carried out at manufacturers works and the test certificates shall be made available to the purchaser for approval.

6.02.00 **Field Test**

6.02.01 Overall performance of the air conditioning system with peak summer outside conditions as well as individual equipment shall be tested after complete installation at site. This test shall be carried out to determine whether the plant meets the performance requirements specified here in and shall include measurements of all parameters under various outside conditions and establishment of correct supply of equipment. All testing and calibrating instruments required for this purpose shall be supplied by the contractor. Within one month from the date of equipment is placed in service, it shall be

tested by the Purchaser. A calibration chart showing water Flow VS. Differential pressure across cooling coil shall be supplied by the Contractor for each cooling coil to measure chilled water flow rate through the cooling coil.

6.02.02 Field test shall also indicate freedom from vibration, unbalance, leakage, etc. and establish the design performance of the equipment. The contractor shall also carry out the balancing of airflow in all duct branches to obtain the desired air quantities at all the points as mentioned in various tender drawings. All instruments used for the field test shall be supplied by the contractor. Manufacturer shall submit the procedure of field test for Purchaser's approval. Within six (6) months from the date of equipment is placed in service, it shall be tested by the Purchaser.

6.02.03 **Inspection and testing of duct work**

All component and duct work supplied shall be subjected to inspection and testing as per relevant codes and standard.

All ductwork shall be carefully examined to determine their performance with the specification with respect to dimensions, materials, marking, workmanship and other requirement.

The contractor shall give assistance for all site tests of the equipment according to prescribed procedure laid down by the Manufacturer/Engineer.

7.00.00 DOCUMENTS, DATA TO BE FURNISHED

7.01.00 **Documents, Data To Be Furnished With Tender Proposal**

Besides submitting the bid proposal exhibit sheets duly filled in, the proposal shall also include the following drawings, curves and information wherever applicable.

7.01.01 Preliminary equipment layout drawings of the air conditioning plant room, pump room, AHU room, preliminary ducting layout drawing.

7.01.02 Manufacturer's catalogues and literatures incorporating outline and sectional drawings and ducting data for the following equipment:

a) Packaged Chilling Unit

b) Screw Compressors

c) Condensers

d) Chillers

e) Air handling unit (Fan, Cooling Coil, and Filter)

f) Drive motors for various equipments as applicable

g) Condenser cooling water and chilled water pump

e) Cooling tower

f) Water cooled and Air cooled Precision Air Conditioners as applicable

g) Duct-able Split Air Conditioners

h) Non Duct-able Split and window conditioners

7.01.03 Manufacturer's catalogue and literatures on air conditioning system, instruments and controls.

7.01.04 Sectional drawing for air diffusers and grilles as applicable.

7.01.05 Manufacturer's data sheets for filters and refrigerant.

7.01.06 Design Calculation supporting sizing of Ventilation equipment.

7.01.07 Characteristic curves of each type of fans centrifugal and axial flow type.

7.01.08 Characteristic curve of each pump.

7.01.09 Characteristic curve of each motor.

7.01.10 Descriptive and illustrative literature/catalogues/leaflets on each of the equipment and components offered.

7.01.11 A detailed experience list about supply for system of similar type for similar application mentioning in each case the salient technical parameters, date of commissioning and name of customers.

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

7.01.13 Any other relevant data and particulars.

7.01.14 Heat load calculation, calculation for plant sizing and requirement of water, power and compressed air.

7.02.00 **Post Award Documents, Data To Be Furnished**

7.02.01 The Contractor shall submit the drawings submission schedule indicating the dates (counting from the date of issue of the Letter of Intent) for submission to the Purchaser or the Consulting Engineers for approval of various drawings, data and procedures as mentioned below:

7.02.02 **Equipment layout drawing for**

a) AC Plant room

b) AHU rooms

c) PAC Units and Split Units

d) Cooling Tower and CW pumps

e) Air Washer Units

f) UAF Units

7.02.03 Schematic flow and instrumentation diagram of the complete system indicating the limits of supply and erection.

7.02.04 Ducting layout drawing including the details of duct sizes, duct joints, duct insulation, duct supports, diffusers, grilles, dampers etc.

7.02.05 Layout drawings showing the route of refrigerant piping, chilled water piping and cooling water piping with details of insulation hangers, supports, etc.

7.02.06 Outline drawings incorporating all principal dimensions, foundation civil drawings and weight etc. and also sectional drawings incorporating data of material of construction when applicable for following equipment:

a) Water Cooled Screw Chillers

b) Chilled Water and Condenser Water Pumps

c) Air handling Units

d) Fan-Coil Units

e) Water Cooled and Air Cooled Precision Air Conditioners as applicable

f) Ductable/ Non Ductable Split Units & Window Conditioners

g) Cooling towers

h) Air Washer Units

i) UAF Units

j) Roof Extractors

k) Wall mounted Supply/ Exhaust Fans

l) Fan –Filter units

m) Drive motor for above equipment as applicable

n) Humidifiers

o) Fresh air units

p) Make-up water tank and Expansion Tank

q) Non chemical Water treatment Equipment

7.02.07 Mounting details of Axial Flow Fans, Split and Window Conditioners

7.02.08 Locational detail / Layout of Axial Flow fans, Split Units and Window Conditioners.

7.02.09 Drawings and data sheet of each of instruments.

7.02.10 Drawings and data sheets for air filter, fire damper, refrigerant/filter drier and moisture indicator.

7.02.11 Write up on system interlock and/or interlock block diagram.

7.02.12 Electrical schematic and wiring diagram for control panel and the system as applicable with back-up write-up.

7.02.13 DDC panel / MCC cum PDB / PDB/ Local Starter Panels / Local Starter cum Control Panels/ Push-Button Stations outline drawings, bill of instruments and drawings showing construction of control panel/MCC.

7.02.14 Layout drawings showing the route of cables including the detail of cable trays and supports.

7.02.15 Other drawings and data as required.

7.02.16 Material test certificates.

7.02.17 Shop test reports and certificates.

7.02.18 Flow Calibration charts (water flow VS. pressure difference between inlet and outlet of cooling coil) for all the chilled water type cooling coils.

7.02.18 Performance curves for all evaporator fans and ventilation fans.

7.02.19 Operation, maintenance and overhauling manuals.

22.00.00 (B) TECHNICAL SPECIFICATION FOR DIRECT DIGITAL CONTROLLER

1.00.00GENERAL

1.00.01 The Instrumentation and Control System envisaged under this specification shall be complete in all respect and adequate for safe, reliable, efficient and commercial operation of the Air Conditioning System under normal and worst service and environmental conditions specified.

1.00.02 Control & Instrumentation system shall include state-of-the-art Direct Digital Controllers (DDC) placed on a wall mounted structure having provisions for further extension of DDC panels, two nos. workstations (OWS) with graphical user interface & visual annunciation, sensors (temperature, Relative Humidity etc.), transmitters, transducers, final control elements (control valves / dampers & actuators) etc. as per the requirements of Tender P & ID and relays, a common hooter for audio annunciation of any malfunctions of the AC equipment and system, erection hardware and other accessories like Junction boxes, cable glands, instrumentation cables / wires etc. as required for complete system shall be supplied.

1.00.03 Bidder to follow the KKS Tag numbering philosophy while preparing all instrumentation & control related documents like P & ID, Instrument List, Drive List, Logic & Loop Diagrams, Junction Box Schedule, Cable Schedule & Interconnection Diagram etc.

1.00.04 Direct Digital Control (DDC) system shall consist of local controllers connected to a network with two personal computers (PC) based central station which will provide monitoring, reporting, data storage and programming capabilities. The controllers are optimized for economical AC system control, which generally does not require fast execution speeds. The hardware and control software will be proprietary, with either proprietary or open protocols used for network communication viz. standard BACnet (Building Automation and Control Networks).

1.00.05 DDCs shall be stand-alone, multi-tasking, multi-user, real-time digital processor complete with all hardware, software, and communications interfaces, power supplies.

1.00.06 The DDC system components will include a communication network, network controllers, application specific controllers, control components, an operator programming unit and software. The control system will be compatible with and integrated with the control components and controls furnished with other AC equipment.

1.00.07 Network Area Controllers (NACs) in the DDC systems shall be connected in a system local area network using protocol defined by ASHRAE Standard 135, BACnet protocol.

1.00.08 RS-232 port with DB-9 or RJ-11 or RJ-45 Ethernet connector port for communication with each controller shall be provided to allow direct connection of standard printers, operator terminals, modems.

1.00.09 Each DDC controller shall include its own microcomputer controller, power supply, input / output modules, termination modules, battery, and spare AC outlet. The battery shall be continuously charged and be capable of supporting all memory for a minimum of 72 hours. Upon restoration of system power, the control unit shall resume full operation without operator intervention.

1.00.10 Provisions shall be made to allow additional DDC controllers to be added at any point on the communication bus for future expansion.

1.00.11 Each DDC shall be capable of performing all specified control functions in a completely independent manner. Additionally, DDCs shall be capable of being

networked for single point programming and for sharing of information between panels, including, but not limited to, sensor values, calculated point values, control set-points, tuning parameters, and control instructions.

1.00.12 The Graphic displays in Workstations shall represent the mechanical systems and floor areas under control. Systems to be displayed include the air handlers, chillers, cooling towers, pumping systems, fire dampers, humidifiers, electric heaters and similar mechanical devices etc.. All displays shall show real time data to include temperatures and run status.

1.00.13 Each DDC shall have sufficient memory to support its operating system, database, and program requirements, including the following:

a) Device and network management.

b) Data sharing.

c) Alarm and event management including custom alarm messages for each level alarm for the points noted in the I/O Schedule.

d) Energy management.

e) Historical trend data for points specified.

f) Maintenance report.

g) Scheduling.

h) Dial up and network communications.

i) Manual override monitoring.

1.00.14 The DDC Panel, two workstations complete with respective CPU & Monitor Units shall be located in AC Plant Room separately mounted. All Logic will be built up in the DDC panel including the Logic of Fire Dampers.

1.00.15 Facility for clock synchronization and ability for remote communication have been envisaged for safe and reliable operation, supervision & control, alarm & event management, historical data collection, energy management and optimization, maintenance management of entire AC system.

1.00.16 Provision of one common audio annunciation for any kind of malfunctioning in each AC plant “Common Trouble-AC Plant” shall be kept in the DDC panel board located in the AC plant room.

1.00.17 One Local Starter Panel (LSP) shall be provided in each AHU room. Power supply to all drives located in each AHU room, 3-way Motorized valves, heaters, humidifiers and motorized fire dampers shall be arranged from LSP through starter switch fuse units and switch fuse units as applicable. One incoming power feeder will be terminated in the Incoming switch fuse unit of each LSP from AC MCC located in the AC Plant room. Room temperature and RH sensors and other such sensors with transmitters will also be located in each AHU room. Such sensors and transmitters located in each AHU room shall be suitably interfaced with the central DDC panel located in the AC plant room. The LSP shall also be suitably interfaced with the central DDC panel.

1.00.18 The general technical requirements given in this section supplements the requirements stated in other sections of this specification and the drawings enclosed. These shall be fully met by all equipment / systems and accessories furnished as per this specification. The entire Instrumentation & Control System for this package whether specified or not shall be in the scope of the Bidder. Bidder shall supply, erect and commission the complete C&I package on turnkey basis.

1.00.19 The instruments & control system design & construction shall be proven to meet all functional requirements and perform accurately and safely under the environmental and operating conditions without undue heating, vibration, wear, corrosion, aging, malfunction or other operating problems. All instruments shall be supplied from reputed manufacturer and shall conform to relevant national / international standard.

1.00.20 The technical details furnished in the accompanying documents with this specification are preliminary and subject to change in future within reasonable limit which the Bidder shall abide by.

1.00.21 The design of I&C system shall be such that isolation of any piece of defective equipment would be possible without shutting down the main equipment or disturbing the operation of associated instrument and accessories.

1.00.22 In general all transmitters & computing hardware shall be electronic, while control actuators for regulating duty shall be electric type.

1.00.23 All electronic signal transmission from field to central DDC panel shall be 4-20 mA DC.

1.00.24 All regulating duty control valves shall be equipped with 2-wire position transmitter giving 4-20 mA DC output linear with associated power supply unit.

1.00.25 All signal processing hardware like signal isolators, limit value monitors, computing modules transmitter power supply units shall be modular and 19” rack mounted type.

1.00.26 The electronic equipment and components shall operate satisfactorily from temperature range of 5 deg. C to 70 deg.C., 95% humidity under corrosive and polluted atmosphere prevailing in the plant.

1.00.27 Solid state UPS having capacity to supply power at Full load to CPU, Monitor & printer with 30-minute battery back up shall be provided for DDC system. The battery shall be of Ni-Cd SMF type.

1.00.28 Adequate numbers (to be decided during detailed engineering) isolated signals of analog variables for process parameters and that of isolated potential free contract for drives shall be arranged for interfacing with Owner’s main plant DDCMIS. Isolated analog signal will be desired by signal isolator card and potential free contact by interposing relays.

1.00.29 Interfacing signals will be grouped together inside centralized DDC panel located inside Air Conditioning Plant Room.

1.00.30 KKS Tag no., range, service, make, model no. etc. shall be engraved in stainless steel tag plate for all instruments and accessories.

1.00.31 Field Instruments shall be weatherproof, dust tight and corrosion resistant with Protection Class IP-65.

1.00.32 All junction boxes and field enclosures required for the cabling and tubing of complete Instrumentation & control equipment shall be IP-65 as minimum.

1.00.33 All cables from field instruments to field junction box shall be armored and laid on perforated galvanized tray.

2.00.00 CONTROL & MONITORING PHILOSOPHY

Refer VOLUME: IIA/1, SECTION-III, Clause No. 3.00.00.

3.00.00 SCOPE OF SUPPLY AND WORK

3.00.01 The **Scope of Supply** for Instrumentation & Control under this package shall include supply, installation and commissioning of all instruments, panels described in relevant specification clauses and to meet functional requirement of the plant. The items covered in the I & C system shall broadly include, but not limited to the following :

a) The control system for complete Air conditioning equipment / system including AHUs of Power House Building, Service Building and Main Control Building shall be based on DDC Controllers with necessary I/O Racks, Interposing Relays etc.

b) Field temperature and RH sensors & transmitters, final control elements (control valves / dampers & actuators), relays, etc. as per the specification and approved P & ID.

c) PC based Operator's workstations (2 Nos.) with necessary hardware & licensed version of all operating, HMI and engineering software.

d) One (1) A4 colour laser printer for alarm & report printing.

e) Graphical displays, operational parameters, alarms, trip set points will be decided during detailed engineering.

f) Network computer processing, data storage and communication equipment including Servers and digital data processors.

g) Routers, bridges, switches, hubs, modems, interfaces, media converters and the like communication equipment.

h) Central DDC Controller connected to field panels and controllers together with their power supplies and associated equipment.

i) Necessary battery back up for RAM for 24 hours continuous operation during power failure and necessary UPS and battery (Ni-Cd, SMF) charger with minimum 30 minutes back up.

j) All Local Panels, Transmitter Racks, canopy etc. required for mounting the field instruments. All electronic type field transmitters shall be enclosed in

closed type transmitter rack with minimum protection class of IP-65. The rack, enclosure, canopy drawings are subjected to approval of the Owner. The hookup diagram of field Instruments shall be subject to approval of Owner.

k) Complete erection hardware. All process connection & piping materials including impulse pipes of different grades with necessary fittings such as isolating valves, drain valves etc. as applicable for all field instruments like transmitters, process switches or any other local instruments etc. with the process shall be provided.

l) Junction boxes, cable glands, cable trays, conduits, brackets, nuts, bolts etc.

m) All I&C cables, communication / network cables, special cables including optical fibre cables (if applicable), from Air Conditioning System Proprietary Control Panels to other third-party systems, all cable glands etc.

n) Power supply with 240 V AC, 50 Hz to DDC panel from the AC MCC .

Power supply with 415V , 50 Hz to each drive located in the AC plant room and to the cooling towers, Make-up water booster pumps (if required) and to the LSPs from AC MCC.

Power supply with 415V , 50 Hz to each drive located in the AHU rooms, heaters and humidifiers from the respective LSP.

Power supply with 240 V AC, 50 Hz to control valves, fire dampers and motorized isolating dampers of smoke exhaust system, wherever applicable, from the respective LSPs.

Any other power supplies required for the Bidder supplied instruments and systems.

o) Terminal blocks, Internal wiring and gland plates with required holes for all the panels, consoles (including local & transmitter racks) shall be included in the scope of the Bidder.

p) Technical data sheets for all bought out and manufactured items shall be subject to approval from Owner.

3.00.02 The **Scope of Services** shall completely cover all the Control & Instrumentation equipments, functions, activities and documentation specified under the specifications. It shall include but not limited to the following:

a) Detailed design and engineering of the manufactured equipment; system integration and system engineering.

b) Complete manufacture including shop testing.

c) Specifying, procurement, quality inspection of bought-out items from sub-suppliers. Design co-ordination for and integration with bought-out items with sub-suppliers.

d) Site calibration of all field instruments shall be done by bidder in the

presence of Owner and end user's engineer. All the instruments shall be recalibrated before PG test.

e) Coordination, integration and interface between the various proprietary / sub-suppliers / other package suppliers for example Fire Protection System supplier.

f) Providing engineering drawings, documents, licensed copy of software and development tools, data, instruction, operation and maintenance manual etc. for Owner's review / approval / record.

g) Arranging for Owner's inspection and testing of manufactured as well as bought-out items at the respective works.

h) Packing and transportation of instruments, equipment, accessories and erection hardware from the manufacturer's works to the site, including transit insurance.

i) Opening of site office at location provided by Owner.

j) Receipt, storage, preservation and conservation of instruments, equipment, and erection at the site.

k) Fabrication of site constructed items.

l) Pre-assembly (if any), erection, testing and commissioning of all the equipment and instruments at totality (including erection hardware, accessories / devices etc.).

m) Performance availability tests and performance and Guarantee tests on completion of commissioning.

n) Prepare and submit all approved and as-built drawings both in hard and soft copies.

o) Furnishing of spares, tools and tackle.

p) Fulfilling post-commissioning liabilities.

q) Arrange for training of Owner's personnel of different categories.

Other activities detailed in the previous and subsequent sections of the Specification.

4.00.00 SPARES

List of spares shall be furnished along with the unit prices.

4.00.01 General requirement of Spares

a) All spares required for operation / maintenance by Owner shall be delivered in unused new condition.

b) Spares shall be interchangeable with the parts for which they are intended for replacement.

c) Supplier shall indicate the service expectancy period for spares under normal operating conditions after which replacement will be necessary.

d) Spares shall be properly packed for long storage under the prevailing site condition.

4.00.02 Recommended Spares

The supply of Spare parts as necessary and recommended by the manufacturer for three (3) years' reliable operation and maintenance of the equipment shall be under the scope of this specification.

4.00.03 Start-up and Commissioning Spares

Spares, which may be required during tests, trial and commissioning, shall be arranged separately. Supplier shall replace spares, which will be used for this purpose, within reasonable period of time.

5.00.00 TOOLS & TACKLE

The Bidder in his proposal shall indicate a list of tools & tackles, which may be required for maintenance, overhaul, and replacement of instrument / equipment / component to be supplied under this specification.

6.00.00 CODES & STANDARDS

Please refer **Attachment – F** for Codes & Standards to be generally followed for Instrumentation & Control items.

7.00.00 QUALITY ASSURANCE, INSPECTION & TESTING

Please refer **Attachment – G** for Quality procedures to be generally followed for Instrumentation & Control items.

8.00.00 SUBMISSION OF DRAWINGS AND DOCUMENTS

All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

8.01.00 DATA AND DOCUMENTS TO BE FURNISHED BY THE BIDDER

a) Technical Data Sheets of Instruments & Control Valves with Bill of Material and catalogues. Bidder to fill all information in **Volume-III B** of this specification.

b) Typical Measuring & control loops with Write-up

c) DDC Configuration / System Architecture Drawing with write-up

d) Technical Data Sheets of DDC with catalogue & Bill of materials

e) Technical Data Sheets of Instruments, Control Valves & Control Cables with Bill of materials

f) Cable Scope Diagram

g) Technical Data Sheets of Erection Hardware with Bill of materials

h) Power supply and Distribution arrangement.

i) Electrical Load List (UPS / Non UPS)

j) Technical Data sheet of UPS with Load List & Sizing calculation

k) Grounding Scheme for electronic equipment

l) DDCMIS I/O list (In Owner's format)

m) Set Point & Alarm list

n) Third party Interface details with both hardware & software signal list

o) Quantity & Type of Port Required to Interface with Owner's Plant GPS Master Clock System

p) Proposed general arrangement drawings of panels / cabinets / racks / JB

q) List of sub supplier **(for Owner's approval)**

r) List of Spares

s) List of Tools & Tackle

t) Schedule of type and routine tests

u) Details of post commissioning services

v) Proposed delivery schedule

w) Deviation sheet (if any) shall be furnished mentioning the specification clause number against which the deviation has been sought and the specific deviation taken against the clause. Any departure from the specification, not specifically mentioned in the deviation sheet, shall be ignored even though deviation may be mentioned, hinted or implied otherwise in any other section of the offer, it will be presumed that Bidder shall comply with the specification in totality in the event of award of contract.

8.02.00 DATA AND DOCUMENTS TO BE FURNISHED BY THE VENDOR (SELECTED BIDDER)

a) Final version of all drawings and data submitted along with the proposal

b) P & ID and Instrument list (In Owner's Format) with KKS Tag Nos.

c) DDC I/O List, Alarm List, DDCMIS I/O List and Drive List with KKS Tag No.

d) DDC Configuration / BOM / datasheets

e) Graphics / Logs / Reports

f) Control Valve and Flow element Sizing Calculation sheets

g) Control dampers and control valves schedule, including the size and pressure drop.

h) Detail dimensional drawings / GA of various equipment, components / sub assemblies with internal views

i) Complete Layout diagrams with Foundation details of all Control Desks / Panels / Racks / Cabinets etc.

j) Work Station, Printer, Ethernet Switch Details

k) Data sheet for UPS along with sizing calculations, UPS load list and Power supply distribution drawing

l) Grounding scheme

m) Cable Schedule / Routing & Interconnection Drawing

n) Panel / Rack / Cabinet / JB Wiring Drawings

o) Pneumatic / Process hookup Drawings for all Instruments & Control Valves

p) Cable Tray Installation Drawing

q) Fibre Optic Cable Laying Procedure

r) Installation instructions for smoke dampers and combination smoke / fire dampers.

s) All necessary calibration and Factory Acceptance Test certificates

t) Quality Assurance Plan

u) Final list of sub suppliers for Owner's approval

v) As built drawings

w) Operation / Maintenance / Instruction / User's Manual

x) Any other relevant data, drawings / documents and information necessary for review of items whether specifically mentioned or not, shall be furnished by the Bidder.

23.00.00 GASES

Suitable storage, distribution and control systems for gases which are necessary for the operation of the plant, shall be provided. This shall include connection of hydrogen to Generator.

CO_2 and Nitrogen storage, distribution and control systems (a) associated with hydrogen cooled Generator, for emergency and/or routine purging purpose and (b) for nitrogen blanketing of the boiler, mill fire protection and such other requirements as applicable, shall be provided.

24.00.00 OVERHEAD HANDLING FACILITIES

The Contractor shall provide all overhead traveling cranes, hoists, runway beams, etc. necessary for the safe and efficient operation and maintenance of the plant.

All parts of the plant shall be provided with a convenient arrangement for slinging or handling during erection and overhaul. Any item of plant, normally stripped or lifted during periods of maintenance, and which weighs 55 Kg. or more, shall be permanently marked with its weight.

TG Hall Cranes :

Two (2) nos. EOT cranes (to work in tandem when required) shall be provided in the turbine hall for handling all TG hall equipment including the Generator Stator.

Where permanent cranes, hoists, etc. are used for the construction of the plant, these shall be refurbished to "as new" condition before handing over to the Owner.

The Bidder shall include facilities for remote operation of main cranes (above 30 Te capacity) and pendant operation of all small cranes and electric hoists.

25.00.00 VALVES

Valves for vacuum service (continuous as well as occasional / intermittent) shall be provided with adequate gland sealing system. Extra deep gland packing instead of water sealing shall be used for sizes 50 mm & below.

All valves shall be located such that safe access for operation is provided, and such that the valve maintenance is possible in-situ. Extension spindle/ chain operator shall be provided, where required. Under no condition, valve actuator shall be installed in inclined position.

Valves essential for the power plant's operation and safety shall be fitted with a local position indicator, which clearly shows the open and shut positions.

SECTION – C

SPECIFIC TECHNICAL REQUIREMENT FOR ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER :

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".

b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.

c) Supply of mandatory spares as specified in the specifications of mechanical equipments.

d) Erection and Commissioning spares.

e) Erection & Maintenance tools & tackles.

f) Electrical load requirement for the Plant.

g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

h) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer /BHEL approval without any commercial and delivery implications to BHEL.

i) Various drawings, data sheet as per required format, quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer /BHEL approval without any commercial implications to BHEL.

2.0 **EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:**

Refer "Electrical Scope between BHEL and Vendor".

3.0 **DOCUMENTS TO BE SUBMITTED ALONG WITH BID**

3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, two signed and stamped copies of the following shall be furnished by the bidder as technical offer:

a) A copy of this sheet "Electrical Equipment Specification' and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.

b) List of Erection and Commissioning spares.

c) List of Erection & Maintenance tools & tackles.

d) Electrical load requirement in enclosed load data format.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 **LIST OF ENCLOSURES**

4.1 Electrical scope between BHEL & vendor.

4.2 Load data format.

4.3 Technical specification Motors.

4.4 MOTORS data sheet –A.

4.5 Quality Plan for motors.

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

1.0 INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement ofr rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechnical vibration of rotatinf electrical machines
IS: 12615	Energy efficient motors.

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable fro three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be sutable fro mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechnical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise statedin Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or V W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

	TITLE	SPECIFICATION NO.
	LV MOTORS **1X250 MW DURGAPUR PROJECT** **DATA SHEET-A**	VOLUME II B SECTION D REV NO. / DATE SHEET 1 OF 1

1.0	Design ambient temperature	:	50 °C
2.0	Maximum kW rating of LV motor	:	0.2 to 200 kW
3.0	Details of supply system		
	a) Rated voltage (with variation)	:	415 V ± 10 %
	b) Rated frequency (with variation)	:	50 Hz ± 5%
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec.
	e) Short time rating for terminal boxes		
	Above and 100 kW (Breaker controlled)	:	50 KA for 1 sec.
	Below 100 kW (Fuse/MCCB controlled)	:	50 KA for 0.25 sec.
4.0	Class of insulation	:	F (temp. rise limited to Class B only)
5.0	Space Heater Requirement	:	30 KW & Above
6.0	Minimum voltage for starting	:	80% of rated voltage
7.0	Maximum Locked Rotor Current	:	600% ± IS Tolerance
8.0	Method of starting		DOL
9.0	Type of duty		Continuous (S1)/Intermittent depending upon application.
10.0	No. of phase		3 phase
11.0	Acceptable Noise Level	:	85dB at 1.5m
12.0	Power cables data	:	Will be given during drawing approval
13.0	Earth Conductor Size & Material	:	As per spec.
14.0	Space heater supply	:	240 V, 1¢ , 50 Hz
15.0	Single phase motor	:	Acceptable 0.20 KW & below
16.0	Color shade of paint	:	D.D.E
17.0	Additional tests	:	As per QP

18.	Flame-proof motor		
	Enclosure suitable (As per IS:2148)	:	As per requirement
	Classification of Hazardous area (As per IS:5572 part-I)	:	As per requirement
19.	Valve Actuator & its motor		
20.	Application	:	Valves as per requirements.
21.	Degree of protection	: :	IP 55 for indoor IP67 for outdoor
22.	Special requirement of Motors	:	Motors are energy efficient as per: IS-12615-2004
23.	Makes	:	ABB/ Bharat Bijlee/ CGL / KEC/ NGEF/ Siemens ALSTOM

	TITLE	SPECIFICATION NO.
	LV MOTOR **1X250 MW DURGAPUR PROJECT** **DATA SHEET - C**	**VOLUME II B** **SECTION D** **REV NO. 00 DATE** **SHEET** 1 **OF** 2

S. No.	Description		Data to be filled by successful bidder
A.	**General**		
1	Manufacturer & country of origin		
2	Motor type		
3	Type of starting		
4	Name of the equipment driven by motor & Quantity		
5	Maximum Power requirement of driven equipment		
6	Rated speed of Driven Equipment		
7	Design ambient temperature		
B.	**Design and Performance Data**		
1	Frame size & type designation		
2	Type of duty		
3	Rated Voltage		
4	Permissible variation for		
5	a	Voltage	
6	b	Frequency	
7	c)	Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)		
9	Synchronous speed & Rated slip		
10	Minimum permissible starting voltage		
11	Starting time in sec with mechanism coupled		
12	a) At rated voltage		
13	b) At min starting voltage		
14	Locked rotor current as percentage of FLC (including IS tolerance)		
15	Torque		
	a) Starting		
	b) Maximum		
16	Permissible temp rise at rated output over ambient temp & method		
17	Noise level at 1.0 m (dB		
18	Amplitude of vibration		
19	Efficiency & P.F. at rated voltage & frequency		
	a) At 100% load		
	c) At 75% load		

NAME OF VENDOR				
			REV.	
NAME	SIGNATURE	DATE	SEAL	

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	**Constructional Features**	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	**Characteristic curves/ drawings** (To be enclosed for motors of rating ≥ 55KW)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006/0			SPECIFICATION TITLE			
		SHEET 1 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 75KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.O	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	3	-	-	
2.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	3	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	3	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	3	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	3	2,1	2,1	NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006/0			SPECIFICATION : TITLE :			
		SHEET 2 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 75KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	3	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
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		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
		SHEET 1 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	 W	 V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BROUGHT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	-	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	-	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	-	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
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		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
		SHEET 2 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	**W**	**V**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	-	
		4.INTERNAL FLOWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	-	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO BREAKAGE ON OTHER PHY. DESIGN	-DO-	3	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
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		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
		SHEET 3 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	-	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULA-TION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3	-	-	
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3/2	-	2	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

			CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
		QUALITY PLAN	BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
		SHEET 4 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG.	MANFR'S DRG.	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
1.11	SLIP RING	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC.	MANUF'S SPEC.	-DO-	3	-	-	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
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	DATE		BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
		SHEET 5 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	**W**	**V**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUFR'S SPEC./ BHEL SPEC./	-DO-	3	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	3	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	3	-	2	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	3	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	3	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
		SHEET 6 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	3	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	3	-	-	
		3.CORE LOSS & HOTOPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	3	-	2	(FOR MOTORS OF 2MW AND ABOVE)
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	3	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	3	-	-	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	2	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	2	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	2	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	3	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	3	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	2	THREE DIPS TO BE GIVEN

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
		SHEET 7 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	**W**	**V**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	2	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	3	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	3	-	-	
		2.SOUNDNESS	CR	MALLET TEST & MV TEST	-DO-	-DO-	-DO-	Log Book	3	-	-	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	3	-	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	3	2	1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	3	2	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	3	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	3	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	3	-	2	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	3	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	3	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
		SHEET 8 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	3	1	1,2	NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	3	1,2	1,2	NOTE - 2
		3.VIBRATION	MA	-DO-	100%	IS-12075	IS-12075	-DO-	3	1,2	-	
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	3	2,1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	3	-	2,1	TC FROM AN INDEPENDENT LABORATORY NOTE-3
		6.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	3	2,1	-	
		7.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	3	-	2,1	NOTE-3
		8.PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	3	2,1	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007/2			SPECIFICATION : TITLE			
		SHEET 9 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION WITH THE CUSTOMERS, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

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

NOTES:
1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

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

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE : VENTILATION / A-C / (CIVIL IN BHEL SCOPE)

PROJECT :

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	1. 415 V AC/240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract including power supply equipment (battery charger etc) required for the PLC/control panel (as applicable) for the system supplied by vendor. 2. Interposing relays (RE 302 of Jyoti make or equivalent), if required for PLC and microprocessor based systems, shall be provided by BHEL in MCCs. Requirement of these relays shall be furnished by vendor during detailed engineering stage.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL	 BHEL Vendor BHEL	1. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Laying of cables by BHEL except for local cabling in conduits supplied by vendor as part of scope. 3. Termination at BHEL equipment terminals by BHEL. 4. Termination at Vendor equipment terminals by Vendor.
4	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	
5	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
6	Cable glands and lugs for equipments supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
7	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer/ BHEL approval at contract stage.

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE : VENTILATION / A-C / (CIVIL IN BHEL SCOPE)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
8	Lighting	BHEL	BHEL	
9	Equipment grounding & lightning protection	BHEL	BHEL	
10	Below grade grounding	BHEL	BHEL	
11	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
12	Mandatory spares	Vendor	-	Vendor to quote as per specification.
13	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle.	Vendor	-	
14	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
15	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for C & I systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
16	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Electrical equipment layout drawing shall be to BHEL approval.
17	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. For skid mounted system, 2 nos. (1W+1S) supply of 415 V, 3 phase AC shall be provided by BHEL. Complete electrical distribution for the skid including changeover between feeder/starters/LCP/inter-locks/protection devices / any other supply etc. shall be in bidder's scope.

SPECIFIC REQUIRMENTS: -

1. The Control for Ventilation system shall be realized in Relay based control system in vendor scope.
2. The valve actuator shall be without integral starter.
3. All instruments shall be terminated on JB/LCP in field and both Instrument and JB/LCP is in vendor scope.
4. For scope of cables, refer electrical section of specification.
5. Important signal shall be forwarded to DCS for monitoring purpose.

The list of these signals & process graphics for implementation in DCS shall be furnished by successful bidder. The cable between LCP to DCS is excluded from bidder scope.

1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site of Local Panels required for control and monitoring of the Auxiliary Plant & Equipment.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 As a minimum requirement, the following standards shall be complied with:

a)	IS-6005 : 1970	:	Code of practice for phosphating of iron and steel.
b)	IS-5 : 1978	:	Colours for ready mixed paints and enamels.
c)	IS-1248:1983	:	Direct Acting Indicating Instruments.
d)	IS-13947 (Part-III):1993	:	Rotary Cam Switches.
e)	IS-6875:1973	:	Auxiliary relays.
f)	IS-8828:1993	:	Circuit breaker for household and similar installations.
g)	IS-13947 (Part-I):1993	:	Low Voltage switchgear & control gear : Part-I (General Rules)
h)	NFPA-496:1974	:	Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and stiffners as necessary shall be provided.

3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel
Frame thickness: Not less than 3.0mm
Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments), 1.6 mm for doors and Not less than 2.0 mm for others
Panel Height: Not less than 2365 mm
Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at minimum three places.The door width shall not be more than 550mm.The doors shall be provided with suitable stiffners to prevent buckling. The handle shall be on the right side of the door. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings / documents.

3.1.6 Suitable neoprene gasket shall be provided on all doors and removable covers. Suitable ventilation louvers shall be provided at bottom and top of the doors covered with removable wire mesh.

3.1.7 The class of protection shall be in accordance with IP-42 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).

3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145-54A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.

3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145-54A-DS1-0) shall be supplied alongwith the Panel.

3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.
No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.

3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145-54A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.

3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm2 size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.

3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm2 to 2.5mm2 external cables. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (10) percent spare terminal.

3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.

3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.

3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm2 size.

3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte Sheet / 2 mm Anodised Aluminium Plate. The inscription shall be with white letters on black background on traffolyte sheet. The labels shall be fixed by self tapping non-rusting screws.

3.2 Hazardous Area Panel Requirement

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.

3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.

3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring devices

3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.

3.3.2 Alarm Annunciator System

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.

3.3.3 Relays

The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

3.3.4 Timers

The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.

3.3.5 Control / Selector Switches

Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position / functions.

3.3.6 Push Buttons / Indicating Lights

The push buttons shall be momentary action self-resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate / inscription plate. Colour coding of push buttons shall be as under:

RED	Motor OFF / Valve CLOSE	YELLOW	Alarm acknowledge.
GREEN	Motor ON / Valve OPEN	BLACK	Lamp test

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with LED cluster type lamp replaceable from front.

GREEN	Motor OFF / Valve CLOSED condition	AMBER	Motor tripped condition.
RED	Motor ON / Valve OPEN condition	WHITE	Normal / healthy condition

3.3.7 Ammeters

Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type as called for in the data sheet-A (No. PES-145-54A-DS1-0). Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication.

3.3.8 Miniature Circuit Breaker (MCB)

These shall be instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal trip feature for over current protection. The housing of MCB shall be made of non-ignitable, high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

3.3.9 Makes of various instruments / devices shall be as given below

1.	Alarm Annunciators	:	Procon / IIC
2.	Ammeters	:	AEP / IMP
3.	Control / Selector Switches	:	Alsthom / Kaycee / Siemens / L&T
4.	Push Buttons / Indicating Lamps	:	Siemens / L&T / Teknic / Alsthom
5.	Auxiliary Relays	:	Jyoti / Siemens / L&T / OEN
6.	Timers	:	L&T / Alsthom / Bhartiya Cutler Hammer
7.	MCBs	:	S&S Power Engg. / Indo Asian / MDS
8.	Terminal Blocks	:	Jyoti / Elmex

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 BHEL's standard Quality Plan for LCP is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.

4.3 The vendor shall conduct the following tests as a minimum requirement:

4.3.1 Routine Tests

1. High Voltage (H.V.)
2. Insulation Resistance (I.R.)
3. Functional

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

5.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

1. Data Sheet no. PES-145-54A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract:

1. Data Shee No. PES-145-54A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs.

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrossion, incidental damage due to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Local Panels : Data sheet no. PES-145-54A-DS1-0
- Data sheet C for Local Panels : Data sheet no. PES-145-54A-DS2-0

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR LOCAL PANELS**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 2

TAG No. …… Qty..... Data Sheet No.: **PE-DC-999-145-I054A**

Data Sheet A & B

	DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER			
	CONSTRUCTION		■ FOLDED ☐ WELDED (As per requirement)	
	ENCLOSURE SHEET THICKNESS	FRONT	☐ 2.5 mm	
		OTHER	☐ 2.0 mm	
		DOOR	☐ 1.6 mm	
TECHNICAL	INPUT POWER SUPPLY		☐ 240V 50 Hz AC ☐ 220V DC ■ 415V 3 PHASE ☐	
	NO. OF FEEDERS		☐ ONE ☐ TWO	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____NOS. (AS REQUIRED)	
	PAINT TYPE		■ EPOXY ENAMEL ☐ EPOXY POWDER COATED	
	PANEL COLOUR (EXTERNAL)		■ LIGHT GREY (Shade 631 IS-5) ☐ OPALINE GREEN (Shade 275) ☐	
	FINISH		☐ MATT ☐ GLOSSY ■ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL)		☐ WHITE ☐ CREAM ☐ OFF WHITE	
	FINISH		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	CLASS OF PROTECTION		☐ IP-42 ☐	
	CONTROL HARDWARE		■ RELAY BASED	
	FOUNDATION ARRANGEMENT		■ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)			
	PANEL TYPE		☐ PRESSURISED ■ UNPRESSURISED As per Requirement	
	CABLE GLAND		☐ SINGLE COMPRESSION ■ DOUBLE COMPRESSION	
	AAMETER (TYPE OF INPUT)		☐ 1 Amp CT ☐ 4-20 mA	

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

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR LOCAL PANELS**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 2

TAG No. …… Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER		
	CONSTRUCTION		
	ENCLOSURE SHEET THICKNESS	FRONT	
		OTHER	
		DOOR	
TECHNICAL	INPUT POWER SUPPLY		
	NO. OF FEEDERS		
	CONTROL SUPPLY		
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		
	PAINT TYPE		
	PANEL COLOUR (EXTERNAL)		
	FINISH		
	PANEL COLOUR (INTERNAL)		
	FINISH		
	CLASS OF PROTECTION		
	CONTROL HARDWARE		
	FOUNDATION ARRANGEMENT		
	WEIGHT OF PANEL (Kg.)		
	PANEL TYPE		
	CABLE GLAND		
	AAMETER (TYPE OF INPUT)		

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

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
	INCOMING											
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	

LEGEND:
* CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		3. Conductor a) Resistance b) Size c) Sheet colour	 MA MA MA	 Electrical Measurement Visual	 100% 100% 100%	 BHEL Spec. and IS:1554 or IS:694	 BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type	CR	Visual	Sample	BHEL Spec. and BOM	BHEL Spec. and BOM	Log Book	2	---	---	
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	Relevant IS	Relevant IS	Log Book	2	---	---	
		3. Operation / Functional check	CR	Electrical	Sample+ 100%@	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	+ for relay & contactors only
		4. I.R.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	
		6. Calibration	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	1	
		7. Pick up / Drop off Voltage	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	3 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
	IN PROCESS											
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
	ASSEMBLY											
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	4 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	5 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
	FINAL											
12.	Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	6 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1	
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1	
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1	

At Random by BHEL, based on 100 % internal test reports by Mfr.

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	7 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibratio	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	

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(page no. 148 to 152 deleted)

LIST OF MAKES
(ANNEXURE-I)

	Description	Makes
1.	Air Washer*	ABB / C.Doctor / Blue Star / Voltas / Hyderabad Pollution Controls / SK System / Advance Ventilation / Draft Air / Ventech systems India / Iklim ltd. turkey / meytek Turkey
2.	Centrifugal Fan	ALSTOM / Flakt / CB Doctor / Hyderabad Pollution / Krugger / SK System / Advance Ventilation / Patel Air Flow/ Draft Air / Nicotra / Ventech systems India / Iklim ltd. turkey / meytek Turkey
3.	Induction Motors (LT)	Siemens / ABB / Kirloskar / Bharat Bijlee/CGL/KEC/ Marathon
4.	Centrifugal Water pump	Kirloskar / Best & Crompton / Jyoti / KSB / Worthington / Mather & Platt / Beacon Weir/ Beacon-Weir / Kirloskar Bros. Ltd. / Flowmore PVT. Ltd. / B.D.K. Marketing Services Pvt. Ltd. / Sulzer Pumps India Ltd. / Voltas Ltd./ WPIL Limited.
5.	Air Filters	Purolator / Ucomech / John Fowler / FMI / Anfilco / Spectrum / Puromatic
6.	Axial Flows Fans	ALSTOM / Flakt / CB Doctor/ Hyderabad Pollution/ SK System / Advance Ventilation / Patel Air Flow / Kruger / Nicotra
7.	Insulation Material	FGP / Lloyds / Basf / Mettur-Beardshell / UP Twiga / Owens Corning
8.	Non Return Valves	Fluid line//Hi-tech Valves/ Cresent/Leader/AV Valves
9.	Gate/Globe Valves	Cresent/Leader/AV Valves/Kirloskar/ Shivadurga/Fouress
10.	Gate/Globe Valves (forged Steel/Cast Steel)	Cresent/Leader/AV Valves/BDK/Audco
11.	Piping	Tata / Jindal / SAIL/BST.
12.	GI Sheets for Ducting	SAIL / TISCO/Jindal/Bhushan.
13.	Pressure Gauges	Bells / General Instrument / AN Instruments/Manometer, Mumbai.
14.	Temperature Gauges	Bells / General Instruments / AN Instruments
15.	Level Gauge	Sigma / Levcon / Toshniwal / Technomatic / GeneralInstruments / Chemtrols / SBEM, Pune/V, Automat Mumbai.
16.	Pressure Switches	Bells / Switzer / Danfoss / Indfoss / General Instruments.
17.	Level Switch	Levcon / SBEM, Pune/V, Automat Mumbai.
18.	Fire Damper	Carryaire/TSC / Ravistar
19.	Butterfly Valve	Audco / Fouress / Inter Valve / Keystone / BDK
20.	Pot Strainer	Multitex / Greaves Cotton / Otoklin / Grand Prix / Jaypee / Gujarat Otofilt / Sant
21.	Control Panel	Industrial Control & Appliance / Control & Switchgear / Siemens / L&T / Pyrotech / GE-Power / Positronics
22.	Humidistat	Honeywell/Penn.

Note: Designed by ABB / C.Doctor / Blue Star / Voltas / Hyderabad Pollution Controls / SK System / Advance Ventilation / Draft Air / Ventech systems India / Iklim ltd. turkey / meytek Turkey and fabricated by their approved fabricators.

DCPL-K9A01
ANNEXURE-III

A. DAMODAR RIVER WATER ANALYSIS (TENTATIVE)

Sl. No.	CHEMICAL COMPOSITION	UNIT	AVERAGE VALUE
1.	Total Alkalinity as $CaCO_3$	ppm	100
2.	Chlorides as $CaCO_3$	ppm	30
3.	Sulphates as CaCO3	ppm	120
4.	Mg Hardness as $CaCO_3$	ppm	60
5.	Ca Hardness as $CaCO_3$	ppm	115
6.	Total Hardness as $CaCO_3$	ppm	175
7.	Turbidity	NTU	50 - 2500
8.	Suspended matters	ms/L	25
9.	pH value	No.	7.2 – 9.1
10.	Silica as SiO_2	ppm	25
11.	Iron as Fe	ppm	0.4 – 0.6
12.	Organic matter	ppm	4.0 – 10.0

B. CLARIFIED WATER ANALYSIS (TENTATIVE)

Sl.No	Constituents	As	Analysis

1.	Calcium	$CaCO_3$	169 ppm
2.	Magnesium	$CaCO_3$	60 ppm
3.	Sodium & Potassium	$CaCO_3$	75 ppm
	Total Cations	**$CaCO_3$**	**304 ppm**
4.	Bicarbonates	$CaCO_3$	111 ppm
5.	Carbonates	$CaCO_3$	-
6.	Chloride	$CaCO_3$	37 ppm
7.	Sulphate	$CaCO_3$	156 ppm
	Total Anions	**$CaCO_3$**	**304 ppm**
8.	Dissolved Silica	SiO_2	25 ppm
9.	Total Iron	Fe	0.1ppm
10.	Turbidity	NTU	20
11.	Free Chlorine	Cl_2	Less than 1
12.	pH		7.5

ANNEXURE- III

DURGAPUR PROJECTS POWER STATION - 1 X 250 MW UNIT # 8

LIST AND QUANTITY OF MANDATORY SPARES

ITEM	DESCRIPTION	QTY.REQUIRED				
2	**Ventilation System**					
2.1	Centrifugal fans					
2.1.1	Set of bearings for Air Washer fans	1	Set for each Type of Fan			
2.1.2	Set of Bearings for U.A.F fans	1	Set for each Type of Fan			
2.1.3	Impeller for the fan	1	Set for each Type of Fan			
2.2	Centrifugal Pumps					
2.2.1	Set of bearings for Air Washer fans	1	Set for each Type and rating of Pump			
2.2.2	Set of Bearings for U.A.F fans	1	Set for each Type and rating of Pump			
2.2.3	Gland Packing ,shaft sleeve & casing wearing ring	1	Set for each Type and rating of Pump			
2.2.4	Impeller for the Pump	1	Set for each Type and rating of Pump			
2.3	Spray Nozzles					
2.3.1	Spray nozzles for air washer unit	1	5% of total quantity used in the system			
2.3.2	Spray Nozzles for U.A.F unit	1	5% of total quantity used in the system			
2.4	SS Filters					
2.4.1	SS Filters for Air Washer	1	5% of total quantity used in the system			
2.4.2	SS Filter for Unitary air filtration unit	1	5% of total quantity used in the system			
2.5	Flow Regulating Valve					
2.5.1	For Air Washer	1	10% of total quantity used in the system orMinimum 1 No. whichever is higher			
2.5.2	For Unitary Air Filtration Unit	1	10% of total quantity used in the system orMinimum 1 No. whichever is higher			
2.6	Basket for POT Strainer					
2.6.1	Strainer Basket for Air Washer	1	No. for each type and size			
2.6.2	Strainer Basket for Unitary Air Filtration Unit	1	No. for each type and size			
2.7	Valves					
2.7.1	Gate valve for Air Washer	1	10% of total quantity used in the system orMinimum 1 No. whichever is higher			
2.7.2	NR Valve for Air Washer	1	10% of total quantity used in the system orMinimum 1 No. whichever is higher			
2.7.3	Gate valve for Unitary Air Filtration Unit	1	10% of total quantity used in the system orMinimum 1 No. whichever is higher			
2.7.4	NR valve for Unitary Air Filtration Unit	1	10% of total quantity used in the system orMinimum 1 No. whichever is higher			
2.7.5	Gate Valve for Make-up Drain of Air Washer	1	10% of total quantity used in the system orMinimum 1 No. whichever is higher			
2.7.6	Gate valve for UAF	2	20% or Minimum 2 Nos. whichever is higher			
2.8	Electrical spares as applicable as per the Electrical List		Applicable Item & Quantity same as indicated in Electrical list 'B' Sl.No. 11 & 19			
2.9	Field Instruments & Others as applicable as per the C&I List		Applicable Item & Quantity same as indicated in C&I list 'C' Sl.No. 4,7 & 10			
B.	**ELECTRICAL PACKAGES**					
	Electrical Items					
11	**Control Panel/Desk Mounted Items**					
11.1	Push Button					
11.1.1	Complete assembly	5	Nos. for each colour			
11.1.2	Contact Element (1 NO + 1NC) Block	20	Nos. for each colour			
11.2	Selector Switch	10	Nos. for type and rating			
11.3	Meter(Analog or Digital)					
11.3.1	Ammeter	1	No. for each type and range			
11.3.2	Voltmeter	1	No. for each type and range			
11.3.3	Frequency	1	No. for each type and range			
11.3.4	MW	1	No. for each type and range			
11.3.5	MVAR	1	No. for each type and range			
11.3.6	Power Factor	1	No. for each type and range			
11.3.7	Synchroscope	1	No. for each type and range			
11.4	Indicating Lamps complete assembly	10	Nos. for each colour and type			
11.5	Mimic Lamps	10	Nos. for each colour and type			
11.6	MCB	2	Nos. for each type and range			
11.7	Door Limit Switch	2	Nos.			
11.8	Annunication system					
11.8.1	Lamp Box with Facia & Lamps (LED type)	25	Nos.			
11.8.2	Hooter	1	No.			
11.8.3	Each type of PCS(for non-PLC driven system)	1	No.			
19	**Motor**					
19.1	HT Motor(other than BFP Motor)					
19.1.1	Driving End Bearing	1	No. (or 1 set as applicable) for each type and rating of Motor			
19.1.2	Non-Driving Bearing	1	No. (or 1 set as applicable) for each type and rating of Motor			
19.1.3	Cooling Fan Internal & External	1	Set for each type and rating of Motor			
19.1.4	Bearing Temperature Gauge Driving & Non Driving End	1	Set for each type and rating of Motor			
19.1.5	Phase-Segregated Terminal Box	1	Set for each type and rating of Motor			
19.1.6	Neutral End Terminal Bushing with Fasteners	1	Set for each type and rating of Motor			
19.1.7	RTD for Bearing Temperature	1	Set for each type and rating of Motor			
19.1.8	Motor Space Heater	1	Set for each type and rating of Motor			
19.1.9	Complete set of Coupling	1	Set for each application			
19.2	BFP Motor					
19.2.1	HT Bushing	1	Set			
19.2.2	Elastomould Jointing Kit	1	Set			
19.2.3	Driving End & Non Driving End Bearing	1	Set			
19.2.4	ON Seal Ring	1	Set			
19.2.5	Bearing Temperature Gauge Driving & Non Driving End	1	Set			
19.2.6	RTD for Bearing Temperature	1	Set			

ITEM	DESCRIPTION	QTY.REQUIRED				
19.2.7	Motor Space Heater	1	Set			
19.3	415 Volt Motor(above 30 KW Rating)	1				
19.3.1	End Shield Cover Driving & Non Driving End	1	Set for each type and rating of Motor			
19.3.2	Driving End & Non Driving End Bearing	1	Set for each type and rating of Motor			
19.3.3	Cooling Fan	1	Set for each type and rating of Motor			
19.3.4	Motor Space Heater	1	Set for each type and rating of Motor			
19.3.5	Motor Terminal Block	1	No. for each type & rating of Motor			
19.3.6	Complete set of Coupling	1	Set for each Application			
19.4	415 Volt Motor(Upto 30 KW Rating)					
19.4.1	Driving End & Non Driving End Bearing	1	Set for each type and rating of Motor			
19.4.2	Cooling Fan	1	No. for each type & rating of Motor			
19.4.3	Motor Terminal Block	1	No. for each type & rating of Motor			
19.4.4	Complete set of Coupling	1	Set for each Application			
C.	**CONTROL & INSTRUMENTATION PACKAGES**					
4	Field Instrument					
4.1	Electronic Transmitters (Pressure, Differential Pressure, Level, Speed etc.) all types	1	1 (One) no. complete set for each type and model/range used in the system			
4.2	Switch (Pressure, Differential Pressure, Level, Flow, Temperature etc.)	1	1 (One) no. of each type & model/range used in the system			
4.3	Thermocouple	2	10% of each type and length of the total nos. used in the system or minimum 2{two) nos. whichever is more.			
4.4	RTD	2	10% of each type and length of the total nos. used in the system or minimum 2 (two) nos. whichever is more.			
4.5	Thermo-well for both TC and RTD	1	One no. for each type and rating/length used in the system			
4.6	Solenoid Valve					
4.6.1	Complete Solenoid Valve Assembly	2	2Nos. for each type and rating used in the system.			
4.6.2	CoB (single or double coil type)	5	10% of total nos. used in the system or minimum 5 (five) Nos. whichever is more for each type and rating.			
4.7	Gauge (Pressure, Differential Pressure, Temperature, Level)	1	10% of total nos. used in the system or minimum 1(one) no. whichever is more for each type and range.			
4.8	Air Filter Regulator complete set with pressure gauges	10	10Nos.			
4.9	Rotameter	2	10% of total nos. used in the system or minimum 2 (Two) nos. whichever is more for each type, rating,/model and size used in the system.			
4.10.	Gauge Glass	1	1 No. for each type and size			
4.11	Erection Hardware					
4.11.1	Transmitter's Manifold	2	10% of. total nos. used in the system or minimum. 2 (Two) nos. whichever is more for each type, rating/model and size used in the system.			
4.11.2	Impulse Line Root valve	4	10% of total nos. used in the system or minimum 4 (four) nos. whichever is more foreach type, rating./model and size used in the system.			
4.11.3	Impulse Line fittings		Each type/size 25Nos.			
4.11.4	Impulse Pipe		Each type/size 50Mtrs.			
4.11.5	Copper/SS Tube		Each type/size 100Mtrs.			
4.11.6	Fittings for Copper/SS Tube		Each type/size 100Nos.			
4.12	Electronic Water Level Indicator					
4.12.1	Drum Level					
4.12.1.1	Conductivity Probes	6	Nos.			
4.12.1.2	Complete Electronics unit	1	No.			
4.12.1.3	Remote Indicator	1	No.			
4.12.1.4	Special Tool Kit for attending valves & Probes	1	Set			

ITEM	DESCRIPTION	QTY.REQUIRED				
4.12.1.5	Isolating/Root Valve	2	Nos.			
4.12.2	Other Application (HP Heaters)					
4.12.2.1	Conductivity Probes	6	Nos.			
4.12.2.2	Complete Electronics unit	1	No.			
4.12.2.3	Remote Indicator	1	No.			
4.12.2.4	Special Tool Kit for attending valves & Probes	1	Set			
4.12.2.5	Isolating/Root Valve	2	Nos.			
4.13	Conductivity Type Level Switch					
4.13.1	Conductivity Type level Probes	4	10% of total nos. used in the system or minimum nos. 4 (four) nos. whichever is more.			
4.13.2	Complete Electronics unit	1	Set			
4.13.3	Isolating/Root Valve	2	Nos.			
4.14	Cable					
4.14.1	Thermocouple Cable		2 (two) Km. of each type, size & rating of Cables			
4.14.2	Control & Instrumentation Cable		2 (two) Km. of each type, size & rating of Cables			
4.15	Current/Voltage Transducers	1	No. each type/rating used in the system			
4.16	MWatt/MVAR Transducer	1	no. each type/rating used in the system			
4.17	Chlorine Leak Detector System					
4.17.1	Sensor unit (complete)	2	Nos.			
4.17.2	Transmitter/Processing Unit (complete)	2	Nos.			
7	Pneumatic Control Valve & Power Cylinder (Applicable for all Modulating Type & On-Off/Isolating Type)					
7.1	Control Valve					
7.1.1	Pneumatic Diaghragm for Diaghragm actuated valve	2	nos. for each type of Actuator			
7.1.2	Actuator Seal Kit for Pneumatic Cylinder actuated valve	2	nos. for each type of Actuator			
7.1.3	Gland Packing	1	set for each type of Control Valve			
7.1.4	Plug, Seat, Cage, Stem etc.	1	set for each type of Control Valve			
7.1.5	Retainer Ring, Seal Ring etc.	1	set for each type of Control Valve			
7.1.6	Gasket	2	Sets, for each type of Control Valve			
7.2	Power Cylinder					
7.2.1	Actuator Seal Kit	2	nos. for each type of Power Cylinder			
7.2.2	Gasket	2	Sets, for each type of Power Cylinder			
7.2.3	Complete Set of Power Cylinder	1	no. each type for all application			
7.3	Common Items for Control Valve & Power Cylinder					
7.3.1	Position Transmitter complete set	2	10% of total quantity used in the system or minimum 2 (two) nos. whichever is more for each type and model.			
7.3.2	Control Valve/Power Cylinder Positioner complete Set	2	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.			
7.3.3	I/P Converter for Control Valve & Power Cylinder	5	10% of total quantity used in the system or minimum 5(five) nos. whichever is more for each type and model.			
7.3.4	Complete Set of Solenoid Valve for Pneumatic type On/Off Valve/Power Cylinder	2	Nos. for each type and ratings			
7.3.5	Solenoid Coy for Pneumatic type On/Off Valve/Power Cylinder	5	Nos. for each type and ratings			
7.3.6	Position Limit Switch for Pneumatic type	10	Nos. for each type and ratings			
	On/Off Valve/Power Cylinder					
7.3.7	Air Lock Relay	10	Nos. for each type			
7.3.8	Signal Air Booster Unit	2	Nos. for each type			
10	Control Panel And Local/Remote Control Desk					
10.1	Recorder	1	No. each type and model			
10.2	Bar graph indicator	1	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.			
10.3	Digital indicator	1	1 0% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.			
10.4	Digital Integrator	1	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.			
10.5	Mosaic/Conventional Type Push button Station	2	1 0% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.			
10.6	Mosaic Type Push button Station with LED Indication	2	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.			
10.7	Mosaic Type LED Indication Station	2	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.			
10.8	Semaphore Indicator		2 (two) Nos. each type			
10.9	Annunciation System					
10.9.1	Each type of PCB (for non-PLC driven system)		1 (one) No. each			
10.9.2	Lamp Box with Facia & Lamps (LED type)	10	Nos.			
10.9.3	Hooter	1	No.			

SECTION D

STANDARD TECHNICAL SPECIFICATION

1.0 GENERAL

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

2.0 CODES AND STANDARDS

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

i/ IS:277 = Galvanised steel sheets

ii/ IS:1239 = Mild steel tubes

3.0 DESIGN/CONSTRUCTION FEATURES

3.1 GENERAL

The air washer shall be designed for max. air velocity of 2.8M/sec. Circultating water quantity shall be 1.3 CMH for every 1000 CMH of air flow, unless otherwise stated in data sheet A. The minimum saturating efficiency of air washer shall not be less than 90% Minimum length of airwasher shall be 2500 mm.

3.2 TANK (SUMP)

The airwasher tank shall either be masonry or metallic construction as specified in data sheet A. Masonry tank shall be provided by purchaser whereas metallic tank shall be of welded construction, fabricated from not less than 6mm thick MS plates, and inside, outside surfaces shall be provided with anti corrosive paint

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

3.3 DISTRIBUTION PLATE

The distribution plate shall be fabricated from minimum 18 gauge thick GSS and shall have minimum 50% free area. The angles used for supports shall be galvanized.
The distribution plate shall be built up of number of sections for easy handling.

3.4 HEADERS AND STAND PIPE

The airwasher shall be of two bank construction (one cross flow and other unit flow). The piping upto and including 100mm dia meter shall be of galvanized steel and above 100mm dia shall be black steel. All piping shall be adequately supported.

3.5 SPRAY NOZZLES

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

3.6 ELIMINATOR PLATE

Eliminator plate shall be fabricated from 22 gauge thick GSS.The eliminator section shall have minimum 6 bends. Spacer bars, tie rods and supports shall be of galvanised steel construction. Eliminator box shall be complete with suitable drop tray and drain pipe.

3.7 **SUCTION SCREENS**

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

3.8 **INSPECTION DOOR AND MARINE LIGHT**

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

3.9 **MAKE UP DRAIN AND QUICK FILL CONNECTION**

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

	TITLE	SPECIFICATION NO. PE-TS-360-554-A001
BHEL	**AIR WASHER**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 | DATE
		SHEET 1 OF 2

S.No.	DESCRIPTION	DETAILS
	GENERAL	
1.	Designation	Air washers for power house building.
2.	Nos. required	Four (4) Nos. of 1, 30,000 M^3/hr capacity of Sheet Metal type for power house bldg.
3.	Service	Evaporative Cooling of TG Hall & electrical bay
4.	Location	As per section-C/ Tender Layout Drg.
DESIGN DATA		
5.	Type	Sheet metal type, as per schedule of Ventilation system.
6.	Capacity M3/hr	1,30,000 M^3/hr at 75 mm WC each.
7.	Inlet air temperature	(Refer design data.)
8.	Saturation Efficiency	To achieve saturation efficiency of 90% (min).
9.	Allowable Pressure drop through Spray nozzle	2.4 Kg/cm2 (g) max.
9.	Pressure drop across Spray chamber	15 to 20 mm WG.
MATERIALS		
11.	Moisture Eliminators plates	24 SWG Galvanized Sheet (Vertical and brake type)./ 100% Virgin PVC of minimum finished thickness of 2 mm.
12.	Moisture Eliminators Frame	22 SWG G.I. Sheets.
13.	Distribution plates	18 G GSS to have 50% free area.
14.	Tank	MS
15.	Casing	Black M.S. (10 SWG min.)
16.	Louvers	20 G GSS sheet & frame of 18 G galvanized steel angle. Louvers with Bird screen of galvanized wire mesh of 10 mm square.
17.	Piping	MS Heavy Class Galvanized to IS: 1239 Part I, OR IS –3589 depending upon size.
18.	Suction Screen Water	Brass (40 mesh size 2 nos for each air washer)
19.	Spray nozzles	Brass/Bronze with chrome plating or suitable plastic material (Nylon/Polymer) and shall be self cleaning type.
20.	Flooding Nozzles	Nylon/Polymer.

21.	Banks	Two spray banks each connected to individual header

EQUIPMENT SELECTION CRITERIA

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

NOTE:

1) All parts coming in contact with moisture for air washer shall be spray galvanized/epoxy painted (2 coat of rust preventing epoxy primer & 2 coat of finished paint from both sides.)
2) Moisture eliminator shall have bends at 30 Degree with the direction of air flow & shall have effectively hooked edges for traping the water.

	TITLE	SPECIFICATION NO. PE-TS-374-554-A001
BHEL	**UNITARY AIR FILTERATION UNIT**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 | DATE
		SHEET 1 OF 2

S.No.	DESCRIPTION	DETAILS
	GENERAL	
1.	Designation	Unitary air filtration Unit for Blower room.
2.	Nos. required	1 no. 50,000 M^3/Hr capacity of sheet Metal type for ESP/VFD control room.
3.	Service	Evaporative Cooling of electrical area of ESP/vfd control room
4.	Location	As per section-C/ Tender Layout Drg.
DESIGN DATA :		
5.	Type	Sheet metal type, as per schedule of ventilation system.
6.	Capacity M3/hr	50,000 M^3/Hr at 60 mm WC
7.	Inlet air temperature	(Refer Design data)
8.	Saturation Efficiency	To achieve saturation efficiency of 60% (min).
MATERIALS :		
11.	Moisture Eliminators plates	24 SWG Galvanized Sheet or 20 G Al (Vertical and 3 brake type)./ 100% Virgin PVC of minimum finished thickness of 2 mm.
12.	Moisture Eliminators Frame	18 SWG Al or 20 SWG G.I. Sheets.
13.	Distribution plates	18 G GSS to have 50% free area.
14.	Tank	Black M.S. (3mm) for sheet metal Air Washer with catwalk (600 mm depth)
15.	Casing	Black M.S. 2 mm thick.
16.	Louvres	20 G GSS sheet & frame of 18 G galvanized steel angle. Bird screen of galvanized wire mesh of 10 mm square.
17.	Piping	Heavy Class Galvanized to IS: 1239 Part I
18.	Suction Screen Water	Brass (40 mesh size 2 nos for each air washer)
19.	Spray nozzles	Nylon/Polymer
20.	Flooding Nozzles	Nylon/Polymer.
21.	Banks	Single bank type (along the air flow).
EQUIPMENT SELECTION CRITERIA		
22.	Face Velocity through louver.	Not to exceed 2.5 m/s
23.	Max. Pressure drop	Not to exceed 6.5 mm Wg when clean

24.	Saturation efficiency	Not less than 60%.
25.	Face velocity of air through spray chamber.	Not to exceed 2.5 m/s.
26.	Allowable pressure drop for washing chamber.	15 to 20 mm Wg.

NOTE:

1) All parts coming in contact with moisture for UAF unit shall be spray galvanized/epoxy painted (2 coat of rust preventing epoxy primer & 2 coat of finished paint from both sides.)
2) Moisture eliminator shall have bends at 30 Degree with the direction of air flow & shall have Effectively hooked edges for traping the water.

DATA SHEET -C

DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

1. Performance curve for air washer
2. GA drg.
3. Foundation drag. weight, dynamic loading etc.
4. O&M manual

FANS CENTRIFUGAL/AXIAL

1.0 GENERAL

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

2.0 Code and Standards

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

i) IS:4894 -Centrifugal fans
ii) IS:3588 -Electric Axial Flow fans
iii) IS:2312 -Propeller type A.C. ventilation fans
iv) IS-3963 -Roof extractor units
v) BS:848 -Method of performance test for fans.
vi) AMCA publication 99 standards handbook
vii) AMCA standard 210, Test code for air moving devices.

3.0 Design and Construction

3.1 The enclosed data sheet A gives the necessary details for centrifugal/Axial/Roof extractor units etc.

3.2 Casing

a) The centrifugal fans casing shall be of welded construction fabricated with heavy gauge material with flanges on inlet and out let side for direct connection and shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed airtight. Split casings shall be provided on large size fans. Casing drain with valve shall be provided, as required.

b) The axial flow casing for supply fans/roof extractors shall be of heavy gauge construction properly reinforced for rigidity and shall be complete with suitable supports. Access doors with suitable locking arrangement shall be provided in the casing for easy access to the motor and impeller.

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

3.3 **Impeller**

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

b) The axial fan impeller shall be of high effeciency aerofoil design. The blades shall be mounted on a streamlined hub and the impeller shall be mounted directly on the motor shaft. Impeller shall be in one piece however,fabricated blades will be acceptable up to 450 mm impeller diameter. Final assembled fan motor shall be statically and dynamically balanced.

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

3.4 **Bearings:**

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

3.5 I**nlet cones and Guards**

a) Centrifugal fans inlet shall be spun to have a smooth contour. Inlet screen, if provided, shall be galvanised wire mesh of 25 mm square.
b) Inlet cone , outlet bell and suitably designed guards shall be provided.

3.6 **Guide Vanes** : In case of vane axial fans guide vanes shall be provided on discharge side.

3.7 **Base plate and Vibration Isolators**

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

3.8 **Hood and Cowl**

Roof exhaustors shall be provided with hinge type hood providing easy access to motor and impeller. Weather proof lockable type disconnect switch shall be provided such that hood can open only when the disconnect switch is in'off' position. On larger size of roof ventilators hoods may be of split construction. 15 mm mesh galvanised bird screen shall be provided.

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

3.9 **Speed**

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

4.0 **Motors**

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

5.0 **Accessories**

Accessories as specified in Data sheet-A and as required for satisfactory trouble free & safe operation of fans shall be provided.
Data to be furnished by vendor after award of contract

1.0 GA drawing, wall opening, fixing arrangement etc.

2.0 Operation and maintenance manual.

3.0 Motor data as per data sheet C of motor specification.

4.0 Performance curves for approval.

5.0 Sound level data for approval including directivity patterns.

6.0 Instructions for bearing lubrication.

TITLE	SPECIFICATION NO. PE-TS-374-554-A001
CENTRIFUGAL FAN	VOLUME II-B
DATA SHEET - A	SECTION D
	REV 00 | DATE
	SHEET 1 OF 3

No.	Particulars	Data
1	**General Information**	
1.1	Fan Designation/application.	Refer schedule of Ventilation system/ Air washers & UAF Units.
1.2	Nos. required/capacity	a) Total 8 Nos. fans for 8 nos. Air Washer having 1, 30,000 CMH capacity and 70 mmwc st. pr.for each Air-washer unit. For (TG- area) b) One (1) nos. Cent. Fans having 50,000 CMH capacity and 60 mmwc st. pr. for 1 no. UAF unit for ESP Bldg. vent. System.
1.3	Location	Refer layout drg. Attached.
2.0	**Design Data**	
2.1	Type	DIDW for Air Washer and SISW for UAF
2.2	Type of blades	backward curved
2.3	Arrangement	To suit application as per layout.
2.4	Discharge direction	To suit application as per layout.
2.5	Duty	Continuous
2.6	Capacity at site (Cubic Meter/hr) & static pressure.	1,30,000 M^3/Hr at 70 mmWC. 50, 000 M^3/Hr at60 mmWC.
2.7	Suction pressure (mm Wg)	As per system requirement.
2.8	Fluid	Atmospheric Air.
2.9	Suction Temperature	Refer weather data attached.
2.10	Suction humidity	Refer weather data attached.
3.0	**Materials**	
3.1	Fan Scroll	Heavy Gauge Mild Steet to IS: 2062 with galvanised
3.2	Fan Casing (side plates & stiffeners)	Heavy Gauge Mild Steet to IS: 2062 / IS: 1079 / Eq. Minimum 3 mm thick casing.
3.3	Impeller	Mild Steel/plate to IS: 2062
3.4	Impeller hub	Mild Steet/plate to IS: 2062

3.5	Impeller back plate blade & shroud	Mild Steet to IS: 2062 / IS: 1079 / Eq.
3.6	a) Shaft b) Shaft sleeve	EN-8 or eqv. -do-
3.7	Support frame and structure.	Mild Steet to IS: 2062
3.8	Flexible connection at outlet canvas with MS Flanges and cleats (3mm thick).	Fire resistant type plastic impregnated
3.9	V Belt	ISI marked (Reinforced rubber section to IS: 4776)
3.10	V Pulley	Cast Iron multi groove to grade FG 20 as per IS: 210. Having taper lock type
3.11	Slide rails	M.S./C.I.
3.12	Connection pieces	G.I. according to supplier's design
3.13	Bolts & nuts	M.S. Galvanized / Epoxy painted.
3.14	Vibration isolating pads, washers and spring if any.	Hard synthetic rubber
4.0	**ACCESSORIES**	
4.1	Common base plate	Required.
4.2	Anchor bolts	-do-
4.3	Vibration Isolators	Hard synthetic rubber
4.4	V-belt pulleys	-do-
4.5	V-belts	Reinforced rubber of appropriate section
4.6	Belt guard	Required.
4.7	Outlet damper	Required(M.S. Heavy Gauge)
4.8	Inlet guard	Required.
4.9	Inlet Vane (variable)	Not required.
4.10	Drain valve	Required.
4.11	Acoustic silencers	Not required.
5.0	**Motor**	
5.1	Motor by	Bidder
5.2	Starter by	BHEL
6.0	Painting of fans including base frame	Galvanized / epoxy painting (as per Section-C & painting specifications)

	TITLE	SPECIFICATION NO. PE-TS-374-554-A001
BHEL	**CENTRIFUGAL FAN**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 | DATE
		SHEET 3 OF 3

NOTE:

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

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

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

	TITLE	SPECIFICATION NO. PE-TS-374-554-A001
BHEL	**Ventilation Fan (R.E.Unit)**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 / DATE :
		SHEET 1 OF 2

General Information

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

Design Data

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

Materials

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

ACCESSORIES

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

Motor

20)	Motor by	Bidder
21)	Starter by	Bidder

22)	Type of motor	Conforming to IS: 325 latest/as per specification.
23)	Free delivery test	Yes.
24)	Performance test at specified duty point.	Yes
25)	Speed	Not more than 1500 RPM

NOTE:

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

DATA SHEET - C

Data to be furnished by vendor after the award of contract as applicable.

A. **CENTRI FUGAL / AXIAL FANS**

1. GA drawing, wall opening, fixing arrangement etc.
2. Operation and maintenance manual.
3. Motor data as per data sheet C of motor specification.
4. Performance curve for approval.
5. Instruction for bearing lubrication.

DATA SHEET - C

Data to be furnished by vendor after the award of contract as applicable.

A. **AXIAL FANS**

1. GA drawing, wall opening, fixing arrangement etc.
2. Operation and maintenance manual.
3. Motor data as per data sheet C of motor specification.
4. Performance curve for approval.
5. Instruction for bearing lubrication.

1.0 GENERAL

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

2.0 CODES AND STANDARDS

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

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

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

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

3.0 DESIGN REQUIREMENTS

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

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

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

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

4.0 CONSTRUCTIONAL FEATURES

4.1 Pump Casing

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

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

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

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

4.2 **Impeller**

Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity.

4.3 **Wearing Ring**

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

4.4 **Shaft**

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

4.5 **Bearings**

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

4.6 **Stuffing Boxes**

Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer.

4.7 **Shaft Couplings**

The pumps shall be directly coupled to their drives through heavy duty flexible coupling. Suitable coupling guards shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.

4.8 **Base Plate and sole Plate**

Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided.

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

4.9 **Prime Mover**

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

4.10 **Lifting arrangement**

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

5.0 **Performance Requirements**

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

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

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

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

6.0 **Drive Rating**

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

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

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

7.0 **SCOPE OF INSPECTION AND TESTING**

7.1 **Castings**

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

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

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

7.1.4 Verification of neat treatment charts (as applicable)

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

7.2 **Forgings and**

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

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

7.3 **Fabricated items**

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

7.3.2 Approval of welding procedure specifications and qualifications of weld procedures and personnel.

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

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

7.3.5 Hydro test as per para 7.5.1 below.

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

7.4 **In process Inspection and Testing**

7.4.1 Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. No defect shall be permitted on moving parts. On static parts acceptance norms are as per ASME Sec.III NB 2546.

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

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

a) Cracks, flakes, seams and laps

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

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

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

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

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

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

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

7.5 **Performance Test**

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

Capacity V/s Head

Capacity V/s Power absorbed by pump

Capacity V/s pump efficiency

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

7.5.2 NPSH test in case specifically mentioned elsewhere

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

7.5.4 Overall dimensions as per GA drawings

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

7.5.6 Painting and packing as per technical specification.

7.6 **Test at site**

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

7.7 **Performance Guarantee**

The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification.

The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head.

8.0 **CLEANING, PROTECTION & PAINTING**

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

9.0 DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL

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

i) Foundation base plate and sole plate details as applicable

ii) Civil foundation and anchor bolts details and loading data

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

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

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

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

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

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

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

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

10.0 DRAWINGS AND DATA AFTER AWARD OF CONTRACT

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

10.1 MANUFACTURERS NAME AND TAG. PLATES

Each pump shall have a permanently attached brass/metal tag on the body indicating the following information both in Hindi and English.

a) Manufacturer's name and trade mark
b) Design Capacity and Head
c) Design
d) Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

TITLE	SPECIFICATION NO. PE-TS-360-554-A001
Centrifugal Pumps	VOLUME II-B
DATA SHEET - A	SECTION D
	REV 00 | DATE
	SHEET 1 OF 2

S.No.	DESCRIPTION	DETAILS
1)	Designation	Air washer Pumps.
2)	Type	Horizontal Centrifugal Type.
3)	Quantity	a) 2X100 % duty for circulating water pump in Each air washer unit. (total nos. of pumps – 8) b) 2X100 % mono block pump (total nos. of pumps – 8)
4)	Installation	On floating type foundation inside Air Washer Room
5)	Fluid to be handled	Filtered Water.
6)	Temperature of Fluid	To suit.
7)	Capacity Cum/Hr TDH at	To suit system requirements however head shall Not be less than 35 MWC.
8)	Duty	————Continuous (24Hr./day)————-
9)	Suction condition	————Flooded————-
10)	Type of drive	Direct (flexible coupling)
11)	Type of prime mover	LV Ac Motor.
12)	Maximum speed	Not more than 1500 RPM
13)	Type of lubrication	Grease Lubrication

MATERIALS OF CONSTRUCTION

S.No.	DESCRIPTION	DETAILS
a)	Impeller	Bronze
b)	Pump Shaft	Carbon Steel C-45, IS-1570 or class-IV, IS-1875
c)	Casing	Cast Iron, grade-20, IS- 210
d)	Wearing ring	Bronze
e)	Shaft Sleeve	Bronze
f)	Base Plate/frame	Cast Iron to Grade FG-200 IS-210/fabricated Mild steel
g)	Counter Flanges	Mild Steel
h)	Stuffing box bush	Deep Bronze packing to be renewable with Case.
i)	Stuffing box gland	Flexible graphite or PTFE (Asbestos shall not be used)

j)	Pump Motor Coupling	Pin & Bush type (Flexible)
k)	Bolt and Nuts	MS

15) **ACCESSORIES REQUIRED**

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

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

DATA SHEET - C

DRAWINGS/DOCUMENTS TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT.

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

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.

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

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

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

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

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.

8. Installation , operation and maintenance manual.

9. Other drawings and data, if necessary.

1.0 GENERAL

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

2.0 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.

3.0 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 not be less than 450 gms/m^2,class - 3 as per IS-277 latest.

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.

4.0 CONSTRUCTION/FABRICATION

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

4.1 Rectangular ducts

4.1.1

S.No.	Max side	Sheet (mm) GI	Thk (mm) Al	Type of transverse Joint connections	Bracings
a)	Up to 600	0.63 (24G)	0.80	S-drive, pocket or bar slips or flanged joints on 2.5m centres	None
b)	601 to 750	0.63 (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 joint.
d)	1001 to1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or 40mm bar slips with 35x3mm bar reinforcing on 2.5m centres.	40x40x3mm MS angles, 1.2m from joints.
e)	1501 to2250	1.00 (20G)	1.50	40x40x3mm MS angles, flanged connections or 40mm pocket or 40mm bar slips, 1M maximum centres, with 35x3mm MS bar reinforcing.	40x40x3mm diagonal angles or 40x40x3mm angles, 600mm from joints
f)	2251 & above	1.25	1.80	50x50x3mm MS angles,connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.	50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints.

g) No bracing is required if transverse joints are less than 600mm apart

.

h) For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser.

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

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

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

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

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

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

4.2.0 **<u>Round ducts</u>**

4.2.1	Duct dia-mm	Thickness of sheet mm GI	mm Al	Reinforcing
a/	Upto 150	.63	.80	None
b/	151 to 600	0.80	1.00	None
c/	601 to 1000	1.00	1.50	40x40x3mm girth MS at 2.5M centres
d/	601 to 1000	1.00	1.50	40x40x3mm girth MS angles at 2.0 meter centres
e/	1251 and above	1.25	1.80	40x40x3mm girth MS angles at 1.2m centres

4.2.2 The seams on round ducts may be continuously welded or grooved longitudinal seam.

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

4.3.0 **Duct supports**

Unless secified 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 shall be used in between.

4.4.0 **Flexible connections**

Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of atleast 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 collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.

4.5.0 **Transformations and breaches**

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

4.6.0 **Caulking**

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

4.7.0 **Easement**

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

4.8.0 **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 atleast two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.

4.9.0 **Dampers and splitters**

a) 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.

b) **Fire Dampers**

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

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

d) **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.

e) **Flashing**

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

4.10 **Diffusers and grilles**

The type and quantity of diffusers and grilles is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers grilles indicated in the drawing/data sheet is indicative and is for vendor's reference purpose only. Vendor shall ensure that the diffusers/grilles 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/grilles shall be approved by purchaser.

Unless specified otherwise the diffusers/grilles shall be of mild steel land painted with two coats of primer paint. Supply air grilles shall be complete with volume control dampers. Supply air grilles shall be double diflection type while RA grilles 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 grilles/diffusers.

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

4.11 **Plenums and RA boxing**

All plenum chambers and/or connections to fans, dampers etc. Shall be constructed in 18 gauge GSS. 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 AC sheets shall be insulated with 25mm thick fibre-glass or engineer acceptable equivalent insulation.

4.12 **Accoustic lining**

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

4.13 **Painting**

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

4.14 **Thermal insulation**

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

5.0 **INSPECTION AND TESTING**

5.1 **Inspection & testing at manufacturers works**

5.1.1 Identification of raw material & verification against mill test certificate.

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

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

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

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

5.2 **Inspection & testing at site**.

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

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

6.0 BALANCING

6.1 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 grille/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

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

	TITLE	SPECIFICATION NO. PE-TS-317-554-A001
BHEL	**Low Pressure Air Distribution System**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 | DATE
		SHEET 1 OF 1

1)	General (List of areas)	As per schedule/tender drgs of Ventilation system.
2)	i) GSS Duct Work	
	a) Type	GSS (Zinc coating 180 gm/sq.m)
	d) 1.25 mm thk ducting	Bidder to estimate as per Drawings/sketch
	e) 1.0 mm thk ducting	Separately for Ventilation system.
	f) Any other size	(area wise)
	ii) Battery Room ducting.	MS with epoxy painting on both sides.
3)	Special painting	MS Ducts in Battery Room to be epoxy painted. Both interior & exterior)
4)	Thermal Insulation	Required in duct for vent. System exposed to Sun only (furnished by Cement sand plaster)
5)	SA grilles (for each size) (SQ.M)	To suit airflow as per schedule/tender drgs.
6)	Exhaust Gravity/Manual relief dampers (for each size & to maintain a slight positive pressure inside.)	-do-
	a) Frame	1.6mm M.S.
	b) Louver	0.8mm Al.

NOTE:

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

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

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

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

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

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

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

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

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

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

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

DATA SHEET - C

Data to be furnished by vendor after the award of contract.

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

2. Test certificates in line with scope of inspection.

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

1.0 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:

2.0 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.

3.0 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 geaned 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 3M/sec.

3.5 **ABSOLUTE FILTERS**

Filters shall be constructed by pleating a continuous sheet of filter medium into closely spaced pleates 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 repellant 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 filteration system only.

4.0 **Inspection & Testing**

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

1) Dimensional inspection of frame & filter media.

ii) 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) condition.

c) Efficiency as per BS EN - 779.

iii) Vertification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable).

	TITLE	SPECIFICATION NO. PE-TS-266-554-A001
	AIR FILTER	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 / DATE 23.02.2007
		SHEET 1 OF 1

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

Note:-

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

	TITLE	SPECIFICATION NO. PES-554-04	
	STANDARD TECHNICAL SPECIFICATION	VOLUME II-B	
	AIR FILTERS	SECTION D	
		REV 01	DATE 15-03-2011
		SHEET 1 OF 1	

DATA SHEET - C

Data to be furnished by vendor after award of contract

1. GA Drawing
2. Drawing showing material/construction detail
3. Installation and\service manual
4. Rating curves/charts
5. Test certificates
6. Elect. diagrams (when automatic cleaning type)

1.0 **SCOPE**

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

2.0 **CODES & STANDARDS**

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

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

b/ IS:4671 : Expanded polystyrene for thermal insulation purposes.

c/ IS:3677 : Mineral wool for thermal insulation

d/ IS:8183 : Resin bonded mineral wool

e/ IS:702 :

3.0 **DESIGN REQUIREMENTS**

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

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

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

4.0 **APPLICATION DETAILS**

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

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

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

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

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

5.0 **VAPOR SEALING & INSULATION FINISH**

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

5.1 **Finishing System I: External insulation with plaster finish**

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

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

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

5.2 Finish system II: External insulation with plaster finish over polythene.

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

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

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

5.3 **Finish III:External insulation with sheet metal finish**

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

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

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

5.4 **Finish IV: External insulation with plaster & water proofing compound**

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

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

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

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

5.4.43mm (1/8") thick coat of water proofing compound shall be applied & wrapped with fibre glass RP tissue. A final coat of 3mm thick water proofing compound shall then be applied over the fibre glass RP tissue & allowed to dry. Alternatively, in place of water proofing as desired above, tar felt type 3 grade 1 of IS 1322 with joints overlapped by 75mm shall be fixed & sealed with bitumen & over this 24 SWG. 25mm hexagonal GI mesh shall be fixed with 22 SWG. GI lacing wire & finally bitumen paint shall be applied over wire netting.

6.0 **INSULATION OF PUMPS & VALVES**

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

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

8.0. **INSPECTION & TESTING** (Refer Spec. No - PES-553.00)

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

9.0 **PAINTING**

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

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

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

	TITLE	SPECIFICATION NO. PE-TS-317-554-A001.
BHEL	**INSULATION**	VOLUME II-B
	DATA SHEET - A	SECTION D
		REV 00 | DATE :
		SHEET 1 OF 1

INSULATION MATERIAL :

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

TYPE OF INSULATION :

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

DATA SHEET - C

Data to be furnished after award of contract

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

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

i/ Thermal conductivity test

ii/ Sound absorption coefficient test

iii/ Corrosion test

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

v/ Compressive strength & cross breaking strength test

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

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

5.0 Instructions on maintenance of insulation work.

SECTION – E

INSPECTION & TESTING

1.00.00 INSPECTION AND TESTING

1.01.00 Inspection and Tests during Manufacture.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1.02.00 **Performance Tests at Site**

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

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

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

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

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

DOC. NO. PE-VO-360-554-QP/

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT : 1X250 MW DURGAPUR TPS UNIT - 8 SYSTEM : VENTILATION SYSTEM

VENDOR : ITEM : AIR WASHER UNIT

MANUFACTURING QUALITY PLAN

S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	-10			(11)
1.0	**MATERIAL**											
1.1	Air washer tank & casing Material : MS	Visual, Chemical & Physical	Major	Visual / Physical & Chemical	Sample / Heat	Mfg's drawing / Appd Data sheet/IS 1079/ IS 2062	Mfg's drawing / Appd Data sheet/IS 1079 Gr.O/ IS 2062 Gr.A	TC/Inspection report	3	-	2,1	Material testing is carried out pediodically at random by c. doctor at autorised test lab.
1.2	Elimanator & Air Distribution Sheet Mat. - G.I.	Visual, dimension (Including thickness)	Major	TC Varification	One / Lot	Appd data sheet / Drg./ IS 277	Appd data sheet / Drg./ IS 277Grade. 275 gms./sq.m	Inspection Report	3	-	2,1	
		Bend Test & Zn coating grade	Major	TC review	One / Heat	- do -	- do -	- do -	3	-	2,1	
1.3	Pipes for header, branch for spray set, external piping for air washer .	Mech. Dimension, hydro test	Major	TC Varification	100%	IS:3589/1239	IS:3589/1239 Heavy Grade	Test Certificate	3	-	2,1	
1.4	Nozzle	Dimension, Visual & Material	Major	Visual	At random	Mfg's drawing	Mfg's drawing	Inspection Report & TC	3	-	2,1	

		SIGNATURE	DATE				DATE					
REV. NO. 0		NAME										
PAGE NO. 1 OF 2		PARTY		CUSTOMER/CONSULTANT		BHEL		VENDOR				
LEGEND.	CR: CRITICAL CHARECTERISTIC				P : PERFORMING		1:BHEL					
	MA: MAJOR CHARECTERISTIC				W: WITNESSING		2: VENDOR					
	MI : MINOR CHARECTERISTIC.				V: VERIFYING		3: SUB VENDOR					

DOC. NO. PE-VO-360-554-QP/

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT : 1X250 MW DURGAPUR TPS UNIT - 8 SYSTEM : VENTILATION SYSTEM

VENDOR : ITEM : AIR WASHER UNIT

MANUFACTURING QUALITY PLAN

S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	-10			(11)
2.0	**IN PROCESS INSPECTION**											
2.1	Fabrication of Casing & Tank, marking, cutting, forming & pipe fabrication,eliminator,distributionplate	Visual, dimensional	Major	Visual & Measurement	100%	CDC Mfg's drawing	CDC Mfg's drawing	Inspection report	3	-	-	CDC approved WPS to be used
2.2	Welding	DPT of weld	Major	NDT	20%	ASTME 165	No relevant indication	Inspection Report	3	-	2,1	
3.0	**FINAL INSPECTION**											
3.1	Water fill test of TANK	Leakage test	Major	Fill test for 4 hrs.	100%	Appd. Drawing	No leakage	Inspection Report	3	2,1	-	CHP
3.2	Assembly of tank & casing Trial assly.Procedure Of A/W UNIT	Visual, final dimension	Major	Visual & Measurement	1 of each type & size	Appd. Drawing/trial assly. Procedure.	Appd. Drawing	Inspection Report	3	2,1	-	CHP-All air washers are of field errected type. One no. of air washer will be offered to BHEL/BVQI in assembled condition in shop.
3.3	Spray galvanising / painting	Visual, dft/galvanising thk	Major	Visual & Measurement	100%	Appd. Drawing	Appd. Drawing	Inspection Report	3	2,1	-	
3.4	Review of QA document					Appd Q Plan	Appd Q Plan		-	-	2,1	CHP

		SIGNATURE	DATE				DATE					
REV. NO. 0		NAME										
PAGE NO. 2 OF 2		PARTY		CUSTOMER/CONSULTANT			BHEL		VENDOR			
LEGEND.	CR: CRITICAL CHARECTERISTIC				P : PERFORMING		1:BHEL					
	MA: MAJOR CHARECTERISTIC				W: WITNESSING		2: VENDOR					
	MI : MINOR CHARECTERISTIC.				V: VERIFYING		3: SUB VENDOR					

	MANUFACTURE'S NAME & ADDRESS	STANDARD QUALITY PLAN						PROJECT : 1X250 DURGAPUR TPS, UNIT # 8			
		ITEM : CENTRIFUGAL PUMP					QP. NO. :	PACKAGE : VENTILATION SYSTEM			
							REV. : 0	CONTRACT NO. : PE-TS-360-554-A001,			
		SYSTEM : VENTILATION SYSTEM					DATE :	MAIN CONTRACTOR : BHEL LIMITED			
							PAGE 1 OF 3	SUB CONTRACTOR :			

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	**MATERIAL,CONTROLS**											
1.1	CASING(UPPER&LOWER/VOLUTE)/BOWLS DIFFUSER,STAGE BODIES,DISCHARGE HEAD (IF CAST) ETC.	Physical & Chemical Props.	Critical	Physical & Chemical Analysis.	ONE/HEAT/BATCH	Apprd. Data Sht/ Apprd G.A. Drg.	Apprd. Data Sht/ Apprd G.A. Drg.	LAB. REPORT	3,2			
1.2	IMPELLERS	Physical & Chemical Props.	Critical	Physical & Chemical Analysis.	ONE/HEAT/BATCH	Apprd. Data Sht/ Apprd G.A. Drg.	Apprd. Data Sht/ Apprd G.A. Drg.	LAB. REPORT	3,2	2,1		
1.3	STUFFING BOX,SUCTION HOUSING,SUCTION BELL,WEARING RINGS,NECK RINGS,SHAFT SLEEVES,GLAND	Physical & Chemical Props.	MA	Physical & Chemical Analysis.	ONE/HEAT/BATCH	Apprd. Data Sht/ Apprd G.A. Drg.	Apprd. Data Sht/ Apprd G.A. Drg.	LAB. REPORT	3,2		2,1	
	STRESS RELIEVING/HEAT TREATMENT OF CASTING, AS ABOVE(IF APPLICABLE)	HEAT CYCLE	MA	VARIFICATION OF SR/HT CHARTS	ALL BATCHES	Apprd. Data sht / Apprd G.A. Drg.	Apprd. Data sht / Apprd G.A. Drg.	SR/HT CHARTS	3,2		2,1	
1.4												
1.5	BARS/FORGINGS FOR SHAFTS,LINE SHAFTS	1.Physical & Chemical Props. 2.DIMENSIONS 3.SUB-SURFACE DEFECTS FROM 50 MM AND ABOVE DIA SHAFTS	Critical	1.Physical & Chemical Analysis. 2.Measurement 3. ULTRASONIC TEST	1/CAST OR 1/BAR 100%	MFR DRAWING ASTMA:388,BACK WALL ECHOE 100%	MFR DRAWING DEFECT ECHOE MAX.20% OF B.W.E.LOSS OF BACK WALL ECHOE 20% MAX.	MILL T.C. OR LAB. REPORT INSPN. REPORT	3,2		2,1	
1.3	Shaft (Above 50 mm dia)	Ultrasonic Testing	Critical	Non Destructive Testing	1005	ASTM-E-114	KBL Procedure QAE 10002-35	NDT Certificate	3		2,1	

	Q.P No :		DESIGNATION		DATE		DATE			DATE
	REV. No / DATE		NAME							
	PAGE No	1 OF 3	PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR		

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 DURGAPUR TPS, UNIT # 8
		ITEM : CENTRIFUGAL PUMP QP. NO. : REV. : 0 SUB-SYSTEM : VENTILATION DATE : PAGE 2 OF 3	PACKAGE : VENTILATION SYSTEM CONTRACT NO. : PE-TS-360-554-A001, MAIN CONTRACTOR : BHEL LIMITED SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.0	**INPROCESS INSPECTION**											
2.1	Various Components Mentioned in 1.0	Dimensional Inspection	Major	Dimensional Check	100% for Critical & 10% for others	KBL Drawing	KBL Drawing		3			
2.2	Impeller	Cleaning & de burning	Major	Visual	100%	KBL Drawing	KBL Drawing	Assm report	3			
2.3	Rotating Unit	Balancing	Major	Balancing	100%	ISO 1940 Gr.6.3 at reduced speed	ISO 1940 Gr.6.3 at reduced speed	Balancing Certificate	3		2,1	
2.4	Impeller	D.P. Testing	Critical	D.P. Test on Machined surface and Accessible	100%	ASTM-E-165	KBL Procedure QAE 10002-28	NDT Certificate	3		2,1	
2.5	Shaft & Shaft sleeve	D.P. Testing	Critical	D.P. test	100%	ASTM-E-165	KBL Procedure QAE 10002-22	NDT Certificate	3		2,1	
3.0	**ASSEMBLY & TESTING**											
3.1	Hydro Test	Leak Tightness	Major	Visual	100%	Appd. Data sheet	No leak for test duration of 30 min.	Hydrostatic Pressure Test Certificate	3	2,1		Refer Note 4
	Dimension	Overall dimension	Major	Measurement	100%	Appd drawing	Appd drawing	IR	3	2,1		

	Q.P No :			DESIGNATION		DATE		DATE		DATE
	REV. No / DATE			NAME						
	PAGE No	2 OF 3		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR	

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 DURGAPUR TPS, UNIT # 8
BHEL		ITEM : CENTRIFUGAL PUMP QP. NO. : REV. : 0 SUB-SYSTEM : VENTILATION DATE : PAGE 3 OF 3	PACKAGE : VENTILATION SYSTEM CONTRACT NO. : PE-TS-360-554-A001, MAIN CONTRACTOR : BHEL LIMITED SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
3.2	Performance test with calibrated shop motor / Job Motor	Q Vs H,Q Vs n, Q Vs P, Vibration, noise level and brg. Temp rise	Critical	Performance test	100%	Appd. Data sheet & HIS	Appd. Data sheet & HIS	Test Report	3	2,1		CHP refer note 5
3.3	Strip test	Check for wear and rubbing	Major	Visual	100%	No undue wear & rubbing	No undue wear & rubbing	I.R.	3	2,1		CHP refer note 6
4.0	**FINAL INSPECTION**											
4.1	Pump	Record checking and crediting / review of QA documentation	Major	Record Checking / Verification	100%	All assembly record & test certificates as per appd. QAP	Appd. QAP	Crediting Slip	3		2,1	
		Painting, Packing & Despatch	Major	Visual	100%	KBL Std./ Relevant Spec.	KBL Std./ Relevant Spec.	Crditing slip	3			

NOTES :

A) Chemical composition of grey cast iron, Ni = as applicable, S = 0.1% Max, P = 0.15% Max., As cast heat mark shall be provided on CI castings.

B) In case of co-relation TC's are not available then quantum of check will be each bar.

1. **This QAP is also applicable for spares if ordered.**
2. **No weld repairs permissible on CI castings.**
3. **Materials shall be as per approved C.S. Drawings.**
4. **Test Pressure shall be 1.5 times the Shut off Head or twice the Duty Point Head whichever is higher.**
5. **Vibration level shall be recorded during shop test but shall not form acceptance criteria, However values as per HIS are quaranteed at site only.**
6. **Strip Test : - Only in case of abnormal performance, pump shall be dismantled followed by re-assembly & testing. Otherwise it is limited to bearing inspection only by removing bearing cover. Bearing shall not be removed from shaft.**

	Q.P No : 10		DESIGNATION		DATE		DATE		DATE
	REV. No / DATE		NAME						
	PAGE No	3 OF 3	PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR	

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 DURGAPUR TPS, UNIT # 8
		ITEM : CENTRIFUGAL FAN QP. NO. : 7 REV. : SUB-SYSTEM : VENTILATION DATE : PAGE 1 OF 4	PACKAGE : VENTILATION SYSTEM CONTRACT NO. : MAIN CONTRACTOR : BHEL SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	**MATERIAL**											
1.1	Casing, Impeller Pedestal & Hub - M.S sheets & plates	Visual, Chemicals & Physical	Major	Visual Measurement Physical & Chemical test	Sample / heat	Appr. drg./ Appr. Data sheet	Appr. drg./ Appr. Data sheet	Arrival note & test certificate	3		2,1	Material testing is carried out periodically at random by sub-vender authorised testing lab & test report is kept. Sample are drawn & tested from each lot.
1.2	SHAFT (EN-8)	Visual, Chemicals & Physical	Critical	- do -	100%	- do -	- do -	- do -	3		2,1	
		UT if DIA > 50mm (in proof machined condition)	Critical	NDT	100%	ASTMA 388	When back wall echo set to 100% of FSH in sound area of material, defects echo shall not exceed 20% of FSH and or back wall echo shall not fall to less than 80% of FSH. Max. no of acceptable defects indication as scanned above shall be 5 in 1 mtr length of	IR	3		2,1	Report will be submitted to BHEL / CUSTOMER for verification
1.3	BEARING	Visual	-----do-----	Check for make & no	100%	Mfg. Drg.	Mfg. Drg.	Arrival note	3			
1.4	PULLEYS - C.I.	Visual & dimension	Major	Visual & Measurement	100%	Appr. drg./ Appr. Data sheet	Manufacturer catalogue / drg	Arrival note	3			

	Q.P No :			DESIGNATION		DATE		DATE			DATE
	REV. No / DATE			NAME							
	PAGE No	1 OF 4		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR		

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 DURGAPUR TPS, UNIT # 8
BHEL		ITEM : CENTRIFUGAL FAN QP. NO. : 7 REV. : SUB-SYSTEM : VENTILATION DATE : PAGE 2 OF 4	PACKAGE : VENTILATION SYSTEM CONTRACT NO. : MAIN CONTRACTOR : BHEL SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.5	V-BELT	Visual	Minor	Visual & check for make	10%	------do-----	Dimension as per P.O.	Arrival note	3			
1.6	Base frame-MS channel & Angle	Visual	Minor	Visual & measurement	100%	Mfg. Drg	Mfg. Drg	Inspection report	3			
1.7	Outlet damper	Visual & dimensional	Major	-----do-----	100%	-----do-----	-----do-----	-----do-----	3			
2.0	**IN PROGRESS INSPECTION**											
2.1	Casing /impeller fabrication	DPT of welding	Major	NDT	20%	ASTME 165	No relevant indication	-----do-----	3		2,1	
2.2	Shaft machining	DPT	----do-----	----do-----	100%	-----do-----	-----do-----	-----do-----	3		2,1	
2.3	Impeller balancing (Static & Dynamic)	Balancing level	Critical	Balancing	100%	VDI-2060 / ISO 1940 Gr. 6.3	VDI-2060 / ISO 1940 Gr. 6.3	Balancing register	3	2,1		20% of each type and size to be witnesed by BHEL
3.0	**ASSEMBLY**											
3.1	Overall dimension	Visual & measurement	Major	Measurement	100%	Approved drg	Approved drg	Inspection report	3	2,1	2,1	At random by BHEL / CUSTOMER
3.2	Final painting	Visual & dimensional	Major	Visual	100%	Approved drg	Approved drg	-----do-----	3			

	Q.P No :			DESIGNATION		DATE		DATE		DATE
	REV. No / DATE			NAME						
	PAGE No	2 OF 4		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR	

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 DURGAPUR TPS, UNIT # 8

				ITEM : CENTRIFUGAL FAN			QP. NO. : 7	PACKAGE : VENTILATION SYSTEM				
							REV. :	CONTRACT NO. :				
				SUB-SYSTEM : VENTILATION			DATE :	MAIN CONTRACTOR : BHEL				
							PAGE 3 OF 4	SUB CONTRACTOR :				

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	**2**	3	4	5	6	7	8	9	10			11
4.0	**FINAL ACCEPTANCE**											
4.1	Motors					**REFER QP FOR MOTORS**						
4.2	Run test of fan for 4 hours or till stabilisation or temp. rise which ever is earlier	Visual & measurement	Critical	Measurement a) Speed b) Vibration c) Temperature rise d) Power input to motor e)Noise	100%	IS-4894 & VDI-2056 / ISO-10816-1	Approved data sheet. Vibration-acceptable zone as per VDI-2056 / ISO-10816-1 Temperarure Temp. rise; 40 deg C. Maximum above ambient	Runtest report	3	2,1		One of each type & size to be run tested and witnesed by BHEL / CUSTOMER. Noise & vibration value at shop for reference only
4.3	Performance test of Fan	Measurement	Critical	Measurement a) Flow b) Pressure c) Speed d) Power consumption	One of each type & size	AMCA-210 / IS-4894/ appvd data sheet	Performance IS-4894	PT report	3	2,1		P.T. will be conducted for D.I.D.W fan as per AMCA-210 providing test duct piece at fan outlet. P.T. for S.I.S.W fan will be conducted providing test duct piece at fan inlet as per IS-4894. However In both the cases testing will be conducted with available test bed motor with 55KW rating, may be at reduced / increased RPM depending on availability of drive set.

	Q.P No :			DESIGNATION		DATE		DATE				DATE
	REV. No / DATE			NAME								
	PAGE No	3 OF 4		PARTY	CUSTOMER/		BHEL		VENDOR			

				CONSULTANT					

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 DURGAPUR TPS, UNIT # 8
BHEL		ITEM : CENTRIFUGAL FAN QP. NO. : 7 REV. : SUB-SYSTEM : VENTILATION DATE : PAGE 4 OF 4	PACKAGE : VENTILATION SYSTEM CONTRACT NO. : MAIN CONTRACTOR : BHEL SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
				e) Efficiency f) Noise			Noise - 85dBA at 1.0mtr					Results thus obtained will be interpoleteed / extrapolatted
				g) Vibration			Vibration acceptance zone as per VDI-2056 / ISO-10816-1					to check the fan performance at rated RPM. Based on the above guaranteed power consumption will be arrived.
				h) Temp. rise			Temp rise -40 deg C max above ambient					Tolerance will be as per IS-4894 noise & vibration value at shop is for reference only.
4.4	Painting	Visual / Dft	Major	Visual & Measurement	100%	Appvd. Drg.	Appvd. Drg.	Insp. Report	3	2	1	
5	Review of Q.A documentation					Appvd. Q.P.	Appvd. Q.P.				2,1	CHP

	Q.P No :			DESIGNATION		DATE		DATE	DATE
	REV. No / DATE			NAME					
	PAGE No	4 OF 4		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR

DOC. NO. PE-VO-360-554-QP/

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8 — SYSTEM : VENTILATION SYSTEM

VENDOR : — ITEM : ROOF EXTRACTOR UNIT

MANUFACTURING QUALITY PLAN

S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATE-GORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)			(11)
1.0	FANS (AXIAL OR PROPELLER TYPE - REFER QUALITY OF RESPECTIVE FAN, AS APPLICABLE.											
2.0	MATL. OF HOOD & CONNECTION PIECE	PHYSICAL PROF., DIMENSIONS	MA	BEND TEST, MEAS.	1/PLATE 100%	APPD. DATA SHEET, MFRS. DRG.	APPD. DATA SHEET, MFRS. DRG.	LAB. REPORT	3	-	2,1	
3.0	COMPLETE R.E. UNITS WITH FANS	COMPLETENESS, CORRECTNESS, CLEANLINESS, CLEARANCES, OVERALL DIMENSIONS	MA	VISUAL EXAM., MEASUREMENT	100%	- DO -	- DO -	INSPN. REPORT	3/2	2,1	-	
4.0	- DO -	TYPE TESTS	CR	TYPE TESTS	ONE/TYPE/ SIZE	APPD. DATA SHEET	APPD. DATA SHEET,	TEST REPORT	3/2	2,1	-	
		ACCEPTANCE TESTS	MA	ACCEPTANCE TEST	100%	- DO -	- DO -	- DO -	3/2	2,1	-	
		ROUTINE TEST	MA	ACCEPTANCE TEST	100%	- DO -	- DO -	- DO -	3/2	2,1	-	
5.0	PAINTING & PACKING	SURFACE, PREPN. FILM THICKNESS, FINISH & SHADE, SOUNDNESS, WEATHER PROOFNESS OF PACKING	MI	VISUAL EXAM.	100%	TECHNICAL SPEC./ MFG. STANDARD	TECHNICAL SPEC./ MFG. STANDARD	INSPN. REPORT/ CHECK SHEET	3/2	-	2,1	
	NOTE 1 : ROUTINE TEST CERTIFICATE OF FANS CONSUMING LESS THAN 5 HP MAY BE ACCEPTABLE.											

Q.P. NO.CQS/SQP/46	SIGNATURE	DATE			DATE				DATE
REV. NO. 0	NAME								
PAGE NO. 1 OF 1	PARTY		CUSTOMER/CONSULTANT		BHEL		VENDOR		

	LEGEND.	CR: CRITICAL CHARECTERISTIC				P : PERFORMING		1:BHEL				
		MA: MAJOR CHARECTERISTIC				W: WITNESSING		2: VENDOR				
		MI : MINOR CHARECTERISTIC.				V: VERIFYING		3: SUB VENDOR				

DOC. NO. PE-VO-360-554-QP/

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8 — SYSTEM : VENTILATION

VENDOR : — ITEM : AXIAL FLOW FAN

MANUFACTURING QUALITY PLAN

S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATE-GORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)			(11)
1.0	RAW MATERIAL AND BOUGHT OUT CONTROL											
1.1	IMPELLER & HUB	1. PHYSICAL, CHEM. PROPERTIES	MA	PHY., CHEM. TEST	1/HEAT	APPD. DATA SHEET	APPD. DATA SHEET	FOUNDRY REPORT	3	-	2,1	
		2. - DO -	MA	- DO -	ONE/LOT	- DO -	- DO -	LAB. REPORT	3	-	2,1	
1.2	CASING	DIMENSIONS	MA	MEASUREMENT	100%	- DO -	- DO -	- DO -	3	-	2,1	
2.0	IN PROCESS CONTROL											
2.1	IMPELLER, HUB & CASING AFTER MACHINING/ FABRICATION	WORKMANSHIP AND FINISH DIMENSIONS	MA	VISUAL, MEAS.	100%	MFG. DRAWING	MFG. DRAWING	INSPN. REPORT/ LOG BOOK	3/2	-	2,1	
2.2	IMPELLER & HUB	STATIC, DYNAMIC, RESIDUAL BALANCE	CR	STATIC, DYNAMIC BALANCING	100%	IS0:1940	ISO:1940 G.6.3	INSPN. REPORT	3/2	-	2,1	
2.3	MOTOR	ROUTINE TESTS, TYPE TESTS, DRG. OF PROTECTION	MA	ELECTRICAL TESTS	100%	APPD. DATA SHEET	APPD. DATA SHEET	IIR/LOG BOOK	3/2	-	2,1	REFER NOTE-1
3.0	ASSY. CONTROL, FINAL INSPECTION & TESTS											
3.1	COMPLETE FAN ASSY. WITH UNIT MOTOR	COMPLETENESS, CORRECTNESS, CLEANLINESS, FREE RUN BY HAND, CLEARANCES	MA	VISUAL, MEAS.	100%	MFG. DRG./ APPD. DRG.	MFG. DRG./ APPD. DRG.	INSPN. REPORT	3/2	-	2,1	
3.2	COMPLETE FAN ASSY. WITH UNIT MOTOR	TYPE TESTS	CR	PERFORMANCE TEST	ONE/TYPE/ SIZE	APPD. DATA SHEET	APPD. DATA SHEET,	TYPE TEST REPORT	3/2	2,1	-	

Q.P. NO.CQS/SQP/44		SIGNATURE	DATE				DATE					DATE
REV. NO./DATE		NAME										
PAGE NO. 1 OF 2		PARTY		CUSTOMER/CONSULTANT		BHEL		VENDOR				
	LEGEND.	CR: CRITICAL CHARECTERISTIC				P :PERFORMING		1:BHEL				
		MA: MAJOR CHARECTERISTIC				W: WITNESSING		2: VENDOR				
		MI : MINOR CHARECTERISTIC.				V: VERIFYING		3: SUB VENDOR				

DOC. NO. PE-VO-360-554-QP/

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8 SYSTEM : VENTILATION

VENDOR : ITEM : AXIAL FLOW FAN

MANUFACTURING QUALITY PLAN

S.NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECKED	CATE-GORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)			(11)
3.3	COMPLETE FAN ASSY. WITH UNIT MOTOR	ACCEPTANCE TESTS	MA	ACCEPTANCE TEST	100%	APPD. DATA SHEET	APPD. DATA SHEET,	TEST REPORT	3/2	-	2,1	
3.4	COMPLETE FAN ASSY. WITH MOTOR	AIR DELIVERY	CR	AIR DELIVERY TEST	APPD. DATA SHEET	APPD. DATA SHEET	APPD. DATA SHEET,	- DO -	3/2	-	2,1	
3.5	COMPLETE FAN ASSY. WITH MOTOR	ROUTINE TESTS	MA	ROUTINE TESTS	100%	- DO -	- DO -	- DO -	3/2	-	2,1	
3.6	COMPLETE FAN ASSY. WITH MOTOR	DIMENSIONS, WORKMANSHIP, FINISH, COMPLETENESS	MI	MEAS., VISUAL	100%	APPD. DATA SHEET, MFRS. DRG.	APPD. DATA SHEET, MFRS. DRG.	INSPN. REPORT	3/2	-	2,1	
3.7	PAINTING & PACKING	SURFACE, PREPN. FILM THICKNESS, FINISH & SHADE, SOUNDNESS, WEATHER PROOFNESS OF PACKING	MI	VISUAL EXAM.	100%	TECHNICAL SPEC./ MFG. DRG.	TECHNICAL SPEC./ MFG. DRG.	- DO -	3/2	-	2,1	

NOTE 1 : MANUFACTURER'S ROUTINE TEST CERTIFICATE OF MOTORS VELOW 1.5 KW FOR ABOVE FANS WILL BE VERIFIED BY BHEL.
REFER QUALITY PLAN FOR MOTOR BELOW 75 KW.

Q.P. NO.CQS/SQP/44	SIGNATURE	DATE		DATE		DATE
REV. NO./DATE	NAME					
PAGE NO. 2 OF 2	PARTY		CUSTOMER/CONSULTANT	BHEL	VENDOR	

	LEGEND.	CR: CRITICAL CHARECTERISTIC				P : PERFORMING		1:BHEL				
		MA: MAJOR CHARECTERISTIC				W: WITNESSING		2: VENDOR				
		MI : MINOR CHARECTERISTIC.				V: VERIFYING		3: SUB VENDOR				

	MANUFACTURE'S NAME & ADDRESS FILTER MANUFACTURING INDUSTRIES	MANUFACTURING QUALITY PLAN ITEM : FILTER SUB-SYSTEM : VENTILATION	QP. NO. : 5 REV. : 0 DATE : PAGE 1 OF 1	PROJECT : 1 X250 MW DURGAPUR TPS, UNIT # 8 PACKAGE : VENTILATION SYSTEM CONTRACT NO. : PE-TS-360-554-A001, MAIN CONTRACTOR : BHEL LIMITED SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1		3	4	5	6	7	8	9	10			11
1	**MATERIALS**											
1.1	Filter Frame	Thickness of sheet	Major	Measure	Random	App. Drg/Data Sheet	App. Drg/Data Sheet	Inspection Report	3		2,1	
1.2	Spacer	Thickness of sheet	Major	Measure	Random	App. Drg/Data Sheet	App. Drg/Data Sheet	Inspection Report	3		2,1	
1.3	Filter Media	Gram / Sq.M	Major	Weight	Random	-----do-----	-----do-----	-----do-----	3		2,1	
1.4	Wirenet	Mesh Count	Minor	Measure	Random	-----do-----	-----do-----	-----do-----	3		2,1	
2.0	**IN PROCESS INSPECTION**											
2.1	Filter Frame	Dimensional	Major	Visual	Randomk	Appd. Data Sheet/ Drg	Appd. Data Sheet/ Drg	Inspection Report	3		2,1	
2.2	Media Stitching	Dimensional	Major	Visual	Randomk	-----do-----	Tech. Spec.	-----do-----	3		2,1	
3.0	**FINAL INSPECTION**											
3.1	Assembly	Dimensional	Major	Measure	Randomk	-----do-----	-----do-----	-----do-----	3	2,1		CHP at Random 5% (min 2 per visit for each size)
3.2	End Seal	Tightness	Major	Physical	100%	-----do-----	-----do-----	-----do-----	3	2,1		
3.3	Aesthetics	Visual	Major	Visual	100%	-----do-----	-----do-----	-----do-----	3	2,1		
4.0	**PERFORMANCE (DESTRUCTIVE TEST)**											
4.1	Initial and final pressure drop	Pressure drop Vs flow	Critical	Test	1 / Lot *	(As per BS : 6540 Part-I / Ashare 52-latest)	Appd. Data Sheet/ Drg	Inspection Report	3	2,1		CHP
4.2	Av. Synth. Dust weight arrestance	Efficiency	Critical	Test	1 / Lot *	-----do-----	-----do-----	-----do-----	3	2,1		CHP
4.3	Review of TC / IR as per approved QAP										2,1	CHP

	Q.P No :			DESIGNATION		DATE		DATE			DATE
	REV. No / DATE			NAME							
	PAGE No	1 OF 1		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR		

LEGEND : P - PERFORMER, W - WITNESS, V - VERIFICATION, 1 - BHEL, 2 - Vendor, 3 - FMI

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8
		ITEM : PIPES, FITTINGS, PIPE WORK QP. NO. : 8 REV. : 0	PACKAGE : VENTILATION SYSTEM
		SUB-SYSTEM : VENTILATION DATE : PAGE 1 OF 2	CONTRACT NO. : PE-TS-360-554A001, MAIN CONTRACTOR : BHEL LIMITED SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	**MATERIAL CONTROL**											
1.1	Pipes (Mill made)	Physical, chemical properties, dimensions surface finish, heat treatment (If applicable), leak tightness	Major	Physical, chemical, tests, measurement, visual exam., ver. Of HT chart, Hydro test	Technical specification IS : 4711	Appd. Data sheet/tech. Specification	Appd. Data sheet/tech. Specification	Mfg. TC/Lab report	3		2,1	
1.2	Fittings	Physical, chemical properties, dimensions surface finish, heat treatment (If applicable)	Major	-----do-----	1/heat, 100%	-----do-----	-----do-----	-----do-----	3		2,1	
1.3	Plate for flanges, fabricated piping & forgings for flanges	Physical, chemical properties, dimensions surface finish, heat treatment	Major	-----do-----	1/cast	-----do-----	-----do-----	-----do-----	3		2,1	
2.0	**IN-PROCESS CONTROL**											
2.1	Pipes, fittings, flanges-machining, bending	Dimensions including thinning, ovality, finish, wrinkles etc	Major	Measurement, visual exam	100%	Manufacturing drawing	Manufacturing drawing	I.I.R	3		2,1	
2.2	Welding procedure specification	Correctness	Major	Exam	100%	IS : 7307/ASTME IX	IS : 7307/ASTME IX	Format of IS : 7307 ASME	3		2,1	

	Q.P No :	CQS / SQP / 81		DESIGNATION		DATE		DATE			DATE
	REV. No / DATE			NAME							
	PAGE No	1 OF 2		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR		

LEGEND : P - PERFORMER, W - WITNESS, V - VERIFICATION, 1 - BHEL, 2 - VENDOR 3 -

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8
		ITEM : PIPES, FITTINGS, PIPE WORK QP. NO. : REV. : 0	PACKAGE : VENTILATION SYSTEM
		SUB-SYSTEM : VENTILATION DATE : PAGE 2 OF 2	CONTRACT NO. : PE-TS-360-554A001, MAIN CONTRACTOR : BHEL LIMITED SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.3	Procedure qualification & welder's qualification	Weld soundness	Major	Physical tests	ASME IX/IS : 7310 / IS : 7307	IS : 7310 / ASME IX	IS : 7310 / ASME IX	Format of IS : 7310 ASME	3	2	1	
2.4	Weld Fit - UPS	Dimensions, alignment orientation	Major	Measurement visual	100%	W.P.S, Approved drawings	W.P.S approved drawings	I.R	3,2	2	1	
2.5	Welds A) Butt welds with joint efficiency											
	i) Root run	Weld defects	Major	Penetrant test	100%	IS : 3658/ASME 165	ASME VIII DIV/ANSIB 31.1	Inspection report	3,2	2	1	
	ii) Final run	Weld defects	Major	Penetrant test	100%	-----do-----	-----do-----	-----do-----	3,2		2,1	
				RT	100% for JT. Eff 1.0 & 10% for 0.9	ANSI B 31.1	ANSIB 31.1	-----do-----	3,2		2,1	
	B) Butt welds with joint efficiency less thatn 0.9	-----do-----	Major	Penetrant test	100% for 100NB & above, 10% for other	IS : 3658/ASTME 165	-----do-----	-----do-----	3,2		2,1	
		-----do-----	Major	RT	10% for THK>/20mm & Spot for other							
3.0	Complete pipe work & pipes	Workmanship & finish dimensions, orientation, leak tightness	Critical	Measurement, visual hydro test at 1.5 x design pressure	100%	Appd. Drawing	Appd. Drawing No leakage	I.R BHEL Format	3	2,1		

	Q.P No :	CQS / SQP / 81		DESIGNATION		DATE		DATE				DATE
	REV. No / DATE			NAME								
	PAGE No	2 OF 2		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR			

LEGEND : P - PERFORMER, W - WITNESS, V - VERIFICATION, 1 - BHEL, 2 - Vendor, 3 -

	MANUFACTURE'S NAME & ADDRESS	STANDARD QUALITY PLAN		PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8
		ITEM : NON RETURN VALVE	QP. NO. :	PACKAGE : VENTILATION SYSTEM
			REV. : 0	CONTRACT NO. : PE-TS-360-554-A001
		SUB-SYSTEM : VENTILATION	DATE :	MAIN CONTRACTOR : BHEL
			PAGE 1 OF 1	SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	**MATERIAL**											
1.1	Body, cover, disc, hinge	1.Physical, chemical properties	Major	Physical, chemical, tests	1/Heat	Appd. Drawing/technical specification	Appd. Drawing/technical specification	TC	3,2	2	1	
2.0	**TESTING**											
2.1	Body	1.Leak tightness	Critical	Hydraulic test	100	Appd. Drawing/technical specification	No leakage	TC/IBR certificate (If required)	3,2	2	1	
2.2	Seat	Leal tightness	Critical	Hydraulic test : 1) At specified pressure 2.)At ATM Pressure	100%	-----do-----	-----do-----	-----do-----	3,2	2	1	
3.0	End connection details	1.Dimensions	Major	Measurement	100%	Appd. Drawing/relevant standard	Appd. Drawing/relevant standard	Inspection report	3,2		2,1	
		2.Surface defects for BW end	Critical	Pentrant test	100%	ASTME-165	ASTME-165	TC	3,2	2	1	
4.0	Final Inspection	1.Cleanliness & completeness	Major	Visual	100%	Appd. Drawing/technical spec.	Appd. Drawing/technical spec.	Inspection report	3,2	2	1	

	Q.P No :	CQS / SQP / 81		DESIGNATION		DATE		DATE				DATE
	REV. No / DATE:-			NAME								
	PAGE No	1 OF 1		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR			

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8
BHEL		ITEM : BUTTERFLY VALVES QP. NO. : REV. : 0 SUB-SYSTEM : VENTILATION DATE : PAGE 1 OF 2	PACKAGE : VENTILATION SYSTEM CONTRACT NO. : PE-TS-360-554-A001 MAIN CONTRACTOR : BHEL LIMITED SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.	**RAW MATERIAL INSPECTION BOUGHT OUT ITEMS**											
1.1	Body / Disc	a) Dimensions	Major	Measurement	100%	Appd. Data Sheet / Relevant Std.	Appd. Data Sheet / Relevant Std.	GRN	3		2,1	
		b) Mechanical Properties	Major	Lab Analysis	1 per Heat	Appd. Data Sheet / Relevant Std.	Appd. Data Sheet / Relevant Std.	MTC	3		2,1	
1.2	Shaft	c) Chemical Properties	Major	Lab Analysis	1 Per Lot	Appd. Drg / Data Sheet	Appd. Drg / Data Sheet	TC	3		2,1	
1.3	Operating Hand Lever	a) Dimensions	Major	Measurement	10%	Drawing	Drawing	IR	3		2,1	
		b) Surface Quality	Major	Visual	100%	Drawing	Drawing	IR	3		2,1	

	Q.P No :	CQS / SQP /		DESIGNATION		DATE		DATE				DATE
	REV. No / DATE			NAME								
	PAGE No	1 OF 2		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR			

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8
BHEL		ITEM : BUTTERFLY VALVES QP. NO. : REV. : 0 SUB-SYSTEM : VENTILATION DATE : PAGE 2 OF 2	PACKAGE : VENTILATION SYSTEM CONTRACT NO. : PE-TS-360-554-A001 MAIN CONTRACTOR : BHEL LIMITED SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.	**IN PROCESS INSPECTION**											
2.1	Machining of Body / Disc / Shaft	a) Dimensions	Major	Measurement	100%	Mfg. Drg	Mfg. Drg	Insp. Report	3		2,1	
		b) Finish	Major	Visual	100%	Mfg. Drg	Mfg. Drg	Insp. Report	3		2,1	
3.	**FINAL INSPECTION**											
3.1	Assembled Valves	a) Dimensions	Major	Measurement	100%	Appd. Drg/Data Sheet	Appd. Drg/Data Sheet	Insp. Report	3	2,1*		*At random
		b) Seat Hydro Test	Major	Leakage Test	100%	-----DO-----	-----DO-----	Insp. Report	3	2,1*		* 10% will bw offered for witteness
		c) Operation Gear Lever	Major	Manual	100%	90° Opening	Smooth Operation	Insp. Report	3	2,1		
4.	**PAINTING & PACKING**	Surface Preparation, packing marking	Minor	Visual	100%	A.I.S.I.L Plant Standard	A.I.S.I.L Plant Standard	Insp. Report / Check List	3		2,1	

	Q.P No :	CQS / SQP / 81		DESIGNATION		DATE		DATE				DATE
	REV. No / DATE			NAME								
	PAGE No	2 OF 2		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR			

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8
		ITEM : C I CHECK VALVE QP. NO. : REV. : 0	PACKAGE : VENTILATION SYSTEM
		SUB-SYSTEM : VENTILATION DATE : PAGE 1 OF 1	CONTRACT NO. : PE-TS-360-554-A001 MAIN CONTRACTOR : BHEL SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1		3	4	5	6	7	8	9	10			11
1.1	Body, cover, door, hinge bracket	Tensile & Hardness	Major	Physical analysis	One / Heat	Appd. Drawing / Data Sheet / P.O	Relevant material STD. As per Col-7	T/C of testing laboratory				
1.2	Hinge Pin	Tensile & Chemical	Major	Mechanical, chemical, analysis	One / size	Appd. Drawing / Data Sheet / P.O	Relevant material STD. As per Col-7					
1.3	Seat rings	Chemical	Major	Chemical analysis	One / Heat	Appd. Drawing / Data Sheet / P.O	Relevant material STD. As per Col-7					
1.4	Assembly of valves	Overall diaminsion	Major	Measurement	100%	Approved Drg	Design.STD,Apd drg	Inspection				
		Flange drilling	Major	Measurement	100%	Approved Drg	Col-7	Inspection				
		Visual examination	Major	Visual	100%	Approved Drg	Re;evamt desig.std	Inspection				
1.5	Operation	Open / Close	Major	Smooth movement full travel	100%	Relevant design standard	Col-7	Inspection				
1.6	Testing	Body Leakage	Major	Hydrostatic	100%	Approved drawing	Col-7	Inspection report				CHP
		Seat leakage	Major	Hydrostatic	100%	Approved drawing	Col-7	Inspection report				CHP

	Q.P No :	CQS / SQP /		DESIGNATION		DATE		DATE				DATE
	REV. No / DATE			NAME								
	PAGE No	1 OF 1		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR			

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8
		ITEM : C I GLOBE VALVE QP. NO. : REV. : 0	PACKAGE : VENTILATION SYSTEM
		SUB-SYSTEM : VENTILATION DATE : PAGE 1 OF 1	CONTRACT NO. : PE-TS-360-554-A001 MAIN CONTRACTOR : BHEL SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1		3	4	5	6	7	8	9	10			11
1.1	Body, cover, door, hinge bracket	Tensile & Hardness	Major	Physical analysis	One / Heat	Appd. Drawing / Data Sheet / P.O	Relevant material STD. As per Col-7	T/C of testing laboratory				
1.2	Hinge Pin	Tensile & Chemical	Major	Mechanical, chemical, analysis	One / size	Appd. Drawing / Data Sheet / P.O	Relevant material STD. As per Col-7					
1.3	Seat rings	Chemical	Major	Chemical analysis	One / Heat	Appd. Drawing / Data Sheet / P.O	Relevant material STD. As per Col-7					
1.4	Assembly of valves	Overall diaminsion	Major	Measurement	100%	Approved Drg	Design.STD,Apd drg	Inspection				
		Flange drilling	Major	Measurement	100%	Approved Drg	Col-7	Inspection				
		Visual examination	Major	Visual	100%	Approved Drg	Re;evamt desig.std	Inspection				
1.5	Operation	Open / Close	Major	Smooth movement full travel	100%	Relevant design standard	Col-7	Inspection				
1.6	Testing	Body Leakage	Major	Hydrostatic	100%	Approved drawing	Col-7	Inspection report				CHP
		Seat leakage	Major	Hydrostatic	100%	Approved drawing	Col-7	Inspection report				CHP

	Q.P No :	CQS / SQP / 81		DESIGNATION		DATE		DATE		DATE
	REV. No / DATE			NAME						
	PAGE No	1 OF 1		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR	

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8
BHEL		QP. NO. : ITEM : INSULATION MATERIALS (THERMAL & ACCOUSTIC) REV. : 0 SUB-SYSTEM : VENTILATION DATE : PAGE 1 OF 1	PACKAGE : VENTILATION SYSTEM CONTRACT NO. : PE-TS-360-554-A001 MAIN CONTRACTOR : BHEL SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10	10	10	11
1	**MATERIAL**											
	Resinbonded & Glasswood	Bulk density	Major	Physical	Sample as per IS 8183	Approved Data Sheet / IS	Approved Data Sheet / IS	Inspection Report	3	2,1		Review of Certificate for k-value test done at Laboratory on sample from insulation material manufactured within 12 months period
		Compression	Major	-----do-----	-----do-----	-----do-----	------do-----	----do-----	3	2,1		
		Shot content	-----do-----	-----do-----	-----do-----	-----do-----	------do-----	----do-----	3	2,1		
		Moisture apsorption & Moisture content	-----do-----	-----do-----	-----do-----	-----do-----	------do-----	----do-----	3	2,1		
		Sulphur content	-----do-----	Chemical	-----do-----	-----do-----	------do-----	----do-----	3	2,1		
		Dimensional & Visual	-----do-----	Physical	-----do-----	-----do-----	------do-----	----do-----	3	2,1		
		Incombustibility	-----do-----	Physical	-----do-----	-----do-----	------do-----	----do-----	3	2,1		
		Recovedry after compression	-----do-----	Physical	-----do-----	-----do-----	------do-----	----do-----	3	2,1		
		Thermal conductivity	Critical	Physical	Once in 12 months per density & type	IS 3346	Appd. Data sheet	Lab Report	3		2,1	
		Final Inspection for making & packing	Major	Visual	100%	IS : 8183	IS : 8183	----do-----			2,1	
	Review of QA documentation						As per Appvd QP				2,1	

	Q.P No :	CQS / SQP /		DESIGNATION		DATE		DATE		DATE
	REV. No / DATE			NAME						
	PAGE No	1 OF 1		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR	

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8
		QP. NO. :	
		ITEM : MOTORISED OPERATED FIRE DAMPER	REV. : 0
		SUB-SYSTEM : VENTILATION	DATE :
		PAGE 1 OF 1	MAIN CONTRACTOR : BHEL
			SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
I.	**RAW MATERIALS**											
1	Damper - Casing	Bend Test &	Major	Lab Test	Sample	IS 277-1992	IS 2771992	Testing Lab				
2	Damper - Louver	Chemical Analysis			From Lot	ZN coating-120	ZN coating-120	Report	3		2,1	
3	Damper - Shaft	Chemical & Mechanical	Major	Lab Test	-----DO-----	IS 9550-1980	IS 9550-1980	-----DO-----				
4	Bearings	Visual & Operation	Major	Visual	100%	Mfg Standard	Mfg Standard	Internal Inspection Report	3		2,1	
5	Electric Solenoid	Operation characteristic	Major	Functional	100%	Appd. Drg/Data Sheet	Appd. Drg/Data Sheet	Mfg Test Certificate	3		2,1	
6	Limit Switch	Visual & Operation	Major	Visual	100%	Mfg Standard	Mfg Standard	Internal Inspection Report	3		2,1	
II	**FINISHED DAMPER**											
1	Visual Inspection	Surface Defects	Minor	Visual	100%	Mfg Standard	Mfg Standard	Internal Inspection Report	3		2,1	
		Tag Details	Minor	Visual	100%	Appd. Drg	Appd. Drg	Internal Inspection Report	3		2,1	
2	Dimensional Check	Measurement	Major	Dimentional	100%	Appd. Drg	Appd. Drg	Dimm. Report	3	2,1	2,1	
3	Damper operation with solenoid functioning	Functional/performance	Major	Functional	100%	Appd. Drg	Appd. Drg/Smooth & proper operation	Internal Inspection Report	3	2,1	2,1	
4	Limit Switch operation	Functional	Major	Functional	100%	-----do-----	-----do-----	Internal Inspection Report	3	2,1	2,1	
5	Review of QA documents					Appd. QAP	Appd. QAP				2,1	
6	Painting	Visual	Minor	Finish	100%	Appd. Drg	Appd. Drg	Internal Inspection Report	3		2,1	
	Note : Test Report of fInspection Reporte test as per UL-555 for similar type of fInspection Reporte damper shall be furnished at the time of inspection											

	Q.P No :	CQS / SQP /		DESIGNATION		DATE		DATE		DATE
	REV. No / DATE			NAME						
	PAGE No	1 OF 1		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR	

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8
BHEL		ITEM : G.I SHEET QP. NO. : REV. : 0 SUB-SYSTEM : VENTILATION DATE : PAGE 1 OF 1	PACKAGE : VENTILATION SYSTEM CONTRACT NO. : PE-TS-360-554-A001 MAIN CONTRACTOR : BHEL SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1		3	4	5	6	7	8	9	10			11
1.0	**MATERIAL**											
1.1	G.I Sheet	A) Chemical	Major	Chemical	One per Heat	IS-277 Gr-200	IS-277 Gr-200	Mfg TC	3		2/1	
		B) Bend	Major	Physical	One per Heat	IS-277 Gr-200	IS-277 Gr-200	Mfg TC	3		2/1	Co-related Mfg's T.C will be submittted for verification
		C) Sheet Thickness	Major	Dimension	One per Sheet	IS-277 Gr-200	IS-277 Gr-200	Mfg TC	3		2/1	
		D) Zinc Coating	Major	Grade	One per Sheet	IS-277 Gr-200	IS-277 Gr-200	Mfg TC	3		2/1	
2.0	**FINAL ACCEPTANCE**											
2.1	Jacketted Sheet/Coil	Identification	Major	Visual verification	100%	Mfg standard	Mfg standard	Inspection report	3	2	1	* Witness by AC Vendor

	Q.P No	CQS / SQP / 81		DESIGNATION		DATE		DATE			DATE
	REV. No / DATE			NAME							
	PAGE No	1 OF 1		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR		

	MANUFACTURE'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 1X250 MW DURGAPUR TPS, UNIT # 8
BHEL		ITEM : G.I SHEET QP. NO. : REV. : 0 SUB-SYSTEM : VENTILATION DATE : PAGE 1 OF 1	PACKAGE : VENTILATION SYSTEM CONTRACT NO. : PE-TS-360-554-A001 MAIN CONTRACTOR : BHEL SUB CONTRACTOR :

SL No.	COMPONENT & OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1		3	4	5	6	7	8	9	10			11
1.0	**MATERIAL**											
1.1	G.I Sheet	A) Chemical	Major	Chemical	One per Heat	IS-277 Gr-200	IS-277 Gr-200	Mfg TC	3		2/1	
		B) Bend	Major	Physical	One per Heat	IS-277 Gr-200	IS-277 Gr-200	Mfg TC	3		2/1	Co-related Mfg's T.C will be submittted for verification
		C) Sheet Thickness	Major	Dimension	One per Sheet	IS-277 Gr-200	IS-277 Gr-200	Mfg TC	3		2/1	
		D) Zinc Coating	Major	Grade	One per Sheet	IS-277 Gr-200	IS-277 Gr-200	Mfg TC	3		2/1	
2.0	**FINAL ACCEPTANCE**											
2.1	Jacketted Sheet/Coil	Identification	Major	Visual verification	100%	Mfg standard	Mfg standard	Inspection report	3	2	1	* Witness by AC Vendor

	Q.P No	CQS / SQP / 81		DESIGNATION		DATE		DATE			DATE
	REV. No / DATE			NAME							
	PAGE No	1 OF 1		PARTY	CUSTOMER/ CONSULTANT		BHEL		VENDOR		

SECTION -F

LIST OF DRGS. ENCLOSED:

1.	**TYPICAL SCHEME OF AIR-WASHER SYSTEM**	**PE-DG-360-554-A001. REV. 1**
2.	**TYPICAL SCHEME OF UAF**	**PE-DG-360-554-A002. REV. 1**
3.	**SCHEME OF AIR DISTRIBUTION FOR POWER HOUSE**	**PE-DG-360-554-A003. REV. 1**
4.	**SCHEMATIC DIAGRAM FOR HVAC MAKE-UP**	**PE-DG-360-553-A005 REV. 0**
5.	**PLOT PLAN**	**PE-DG-360-100-M001. REV. 5**
6.	**MAIN EQUIPMENT LAYOUT**	**PE-DG-360-100-M002. REV. 1**
7.	**CROSS SECTION OF MAIN PLANT**	**PE-DG-360-100-M008. REV. 1**
8.	**TG HALL EQPT. LAYOUT PLAN AT 0.0 M**	**PE-DG-360-100-M003. REV. 1**
9.	**TG HALL EQPT. LAYOUT PLAN AT 4.5 M,**	**PE-DG-360-100-M004. REV.1**
10.	**TG HALL EQPT. LAYOUT PLAN AT 8.5 M**	**PE-DG-360-100-M005. REV. 1**
11.	**TG HALL EQPT. LAYOUT PLAN AT 13.5 M**	**PE-DG-360-100-M006. REV. 1**
12.	**EQPT. LAYOUT PLAN AT MISC. FLOORS IN BC BAY**	**PE-DG-360-100-M007. REV. 1**

DRAWING NO. PE-DG-360-554-A002.
FIRST ANGLE PROJECTION
ALL DIMENSIONS ARE IN MM
CUSTOMER'S DRAWING NO.
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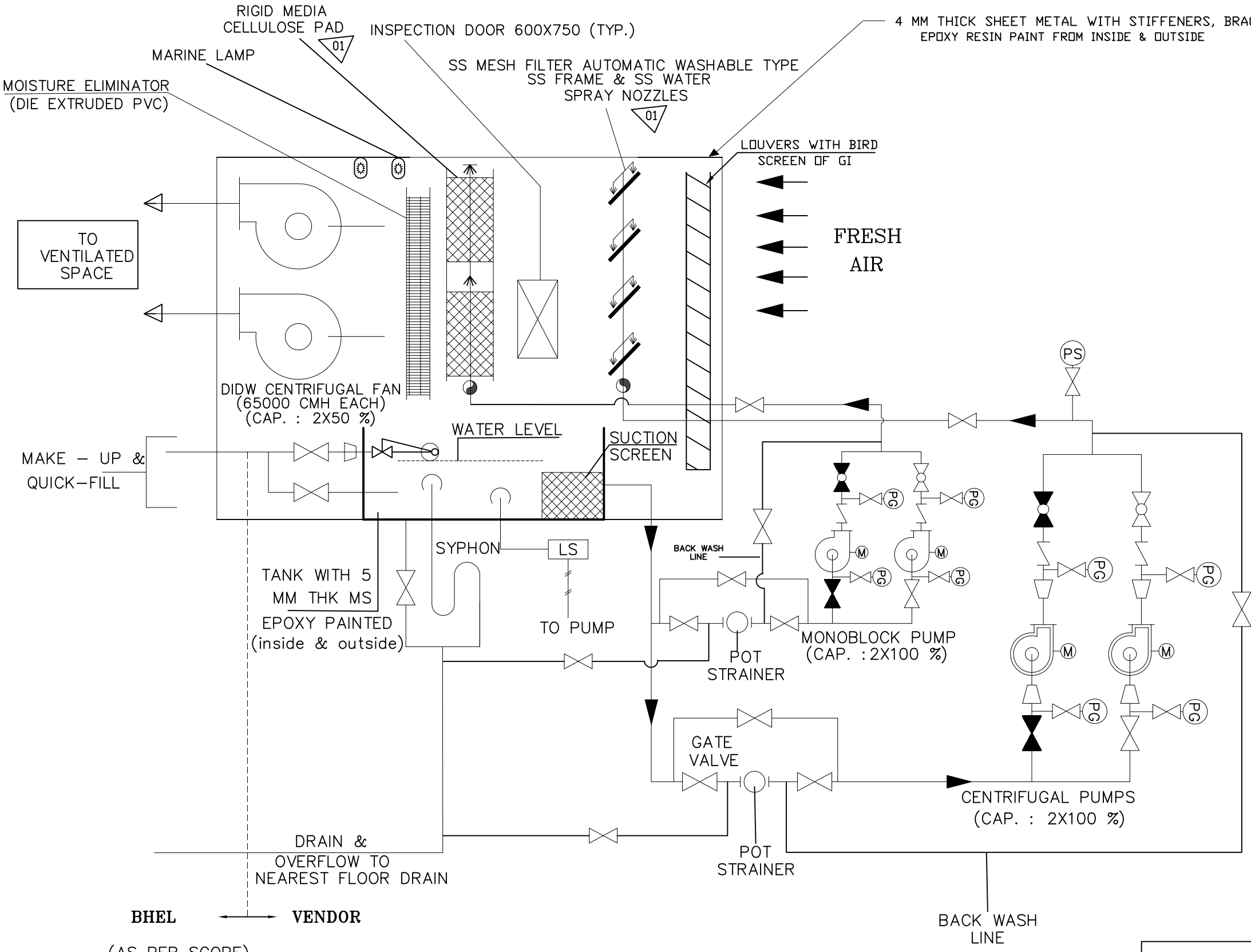
COMPUTER FILE NAME: G:\MAUX\SKC\FARIDA\CONTRACT\VENT\AWUFDRF



LEGEND :

	GATE VALVE
	REDUCER / EXPLANDER
	GLOBE VALVE
	CHECK VALVE
	FLOAT VALVE
	MARINE LIGHT
	HORIZONTAL SPLITCASING PUMP
	MONOBLOCK PUMP
M	MOTOR
PG	PRESSURE GAUGE
LS	LEVEL SWITCH
	POT STRAINER
PS	PRESSURE SWITCH

NOTES:–

1. SATURATION EFFICIENCY OF AIR WASHER SHALL BE 90% MINIMUM.
2. CENTRIFUGAL FAN SHALL BE BACKWARD CURVED BLADE HEAVY DUTY TYPE.
3. GI PIPES HEAVY CLASS FOR AIR WASHER SHALL BE PROVIDED FOR SPRAY SYSTEM.
4. METALIC FILTERS(SS–316MESH FILTER WASHABLE TYPE) SHALL BE PROVIDED.
5. GI LOUVERS (FIXED BLADE TYPE) SHALL BE PROVIDED, COMPLETE WITH GI BIRD SCREEN ETC.
6. ALL EQUIPMENTS DRAIN SHALL BE TERMINATED TO NEAREST FLOOR DRAIN.
7. IN THE AIRWASHER TANK LEVEL INDICATOR / GUAGE & LEVEL SWITCH SHALL BE PROVIDED FOR ALARM / TRIP.

FOR TENDER PURPOSE

TYPICAL ARRANGEMENT OF AIR WASHER UNIT FOR CAPACITY :1,30,000 CMH STATIC PR. 75 mmwc 01

CUSTOMER	DURGAPUR PROJECT LTD – WEST BENGAL
CONSULTANT	DCPL KOLKATA
	1X250 MW DURGAPUR TPS UNIT # 8
JOB NO. 360	BHARAT HEAVY ELECTRICALS LTD, POWER GROUP, PROJECTS ENGINEERING MANAGEMENT, NEW DELHI
STATUS CONTRACT	
DISTRIBUTION	
TD	
No.OFF	
CUSTOMER DRG. NO.:–	————

DEPT CODE		NAME	SIGN	DATE
MAX.	DRN	MKS	sd/–	15.01.11
	DESN	MKS	sd/–	15.01.11
	CHD	SKC/ SAK	sd/–	15.01.11
	APPD	P. K. DAS	sd/–	15.01.11

REV	DATE	ALTD	CHD	APPD
01	09.03.11	M.K.S	S.A.K	P.K.D

TITLE: TYPICAL SCHEME OF AIRWASHER SYSTEM

DEPT. | SCALE ~ | BHEL DRAWING NO. PE–DG–360–554–A001.
SIGN
DATE
SHEET 1 OF 1 | REV 01
SIZE–A1

DRAWING NO. PE-DG-360-554-A002.
FIRST ANGLE PROJECTION
ALL DIMENSIONS ARE IN MM
CUSTOMER'S DRAWING NO.
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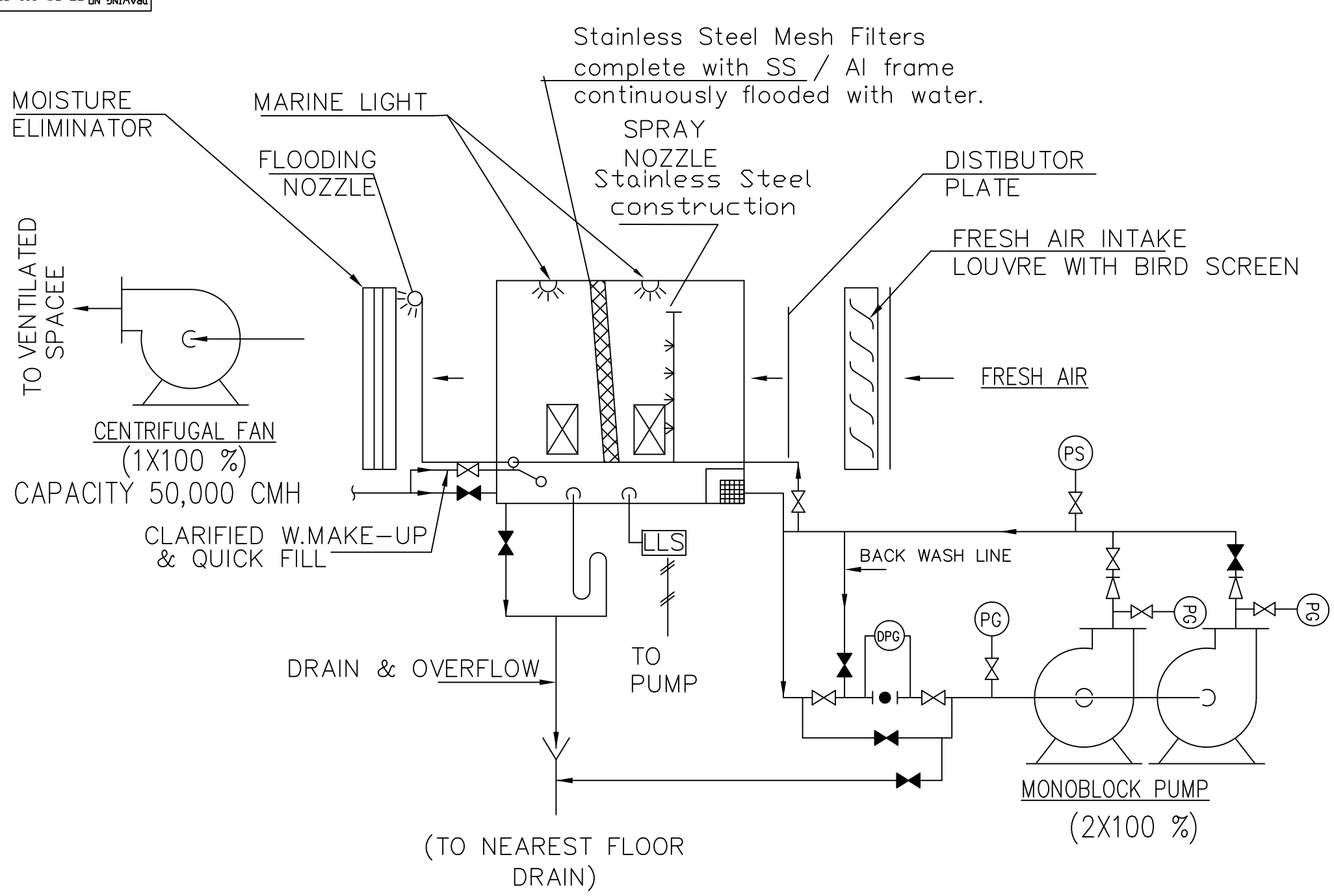
COMPUTER FILE NAME: G:\MAUX\SKC\FARIDA\CONTRAC\VENT\AWUFDRF



LEGEND:

GATE VALVE	
CHECK VALVE	
GLOBE VALVE	
GATE VALVE (NORMALLY CLOSED)	A
POT STRAINER	
SYPHON	
DRAIN	
PRESSURE GAUGE	PG
LOW LEVEL SWITCH	LLS
COARSE STRAINER	
DIFF. PRESURE GUAGE	DPG
PRESSURE SWITCH	PS

NOTES:

1) Sheet Metal Casing of UAF Unit shall be 2mm thick
2) The MS Tank for the UAF Unit shall be 3mm thick.
3) Both inside and outside surface of UAF Casing and Sump shall be of epoxy painted.
4) Saturation Efficiency of the UAF Unit shall be 60%.

TYPICAL SCHEME FOR UAF UNIT FOR CAPACITY: 50,000 CMH STATIC PR. 60 mmwc

FOR TENDER PURPOSE

261

REV	DATE	ALTD	CHD	APPD
01	09.03.11	M.K.S	S.A.K	P.K.D
03	01.06.11	M.K.S	S.A.K	P.K.D
04	29.06.11	M.K.S	S.A.K	P.K.D

CUSTOMER	DURGAPUR PROJECT LTD – WEST BENGAL
CONSULTANT	DCPL KOLKATA
STATUS CONTRACT	1X250 MW DURGAPUR TPS UNIT # 8
JOB NO. 360	
VENTILATION SYSTEM	

BHARAT HEAVY ELECTRICALS LTD
POWER GROUP
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE		NAME	SIGN	DATE
MAX.	DRN	MKS	sd/-	18.01.2011
	DESN	MKS	sd/-	18.01.2011
	CHD	SKC/ SAK	sd/-	18.01.2011
	APPD	P. K. DAS	sd/-	18.01.2011

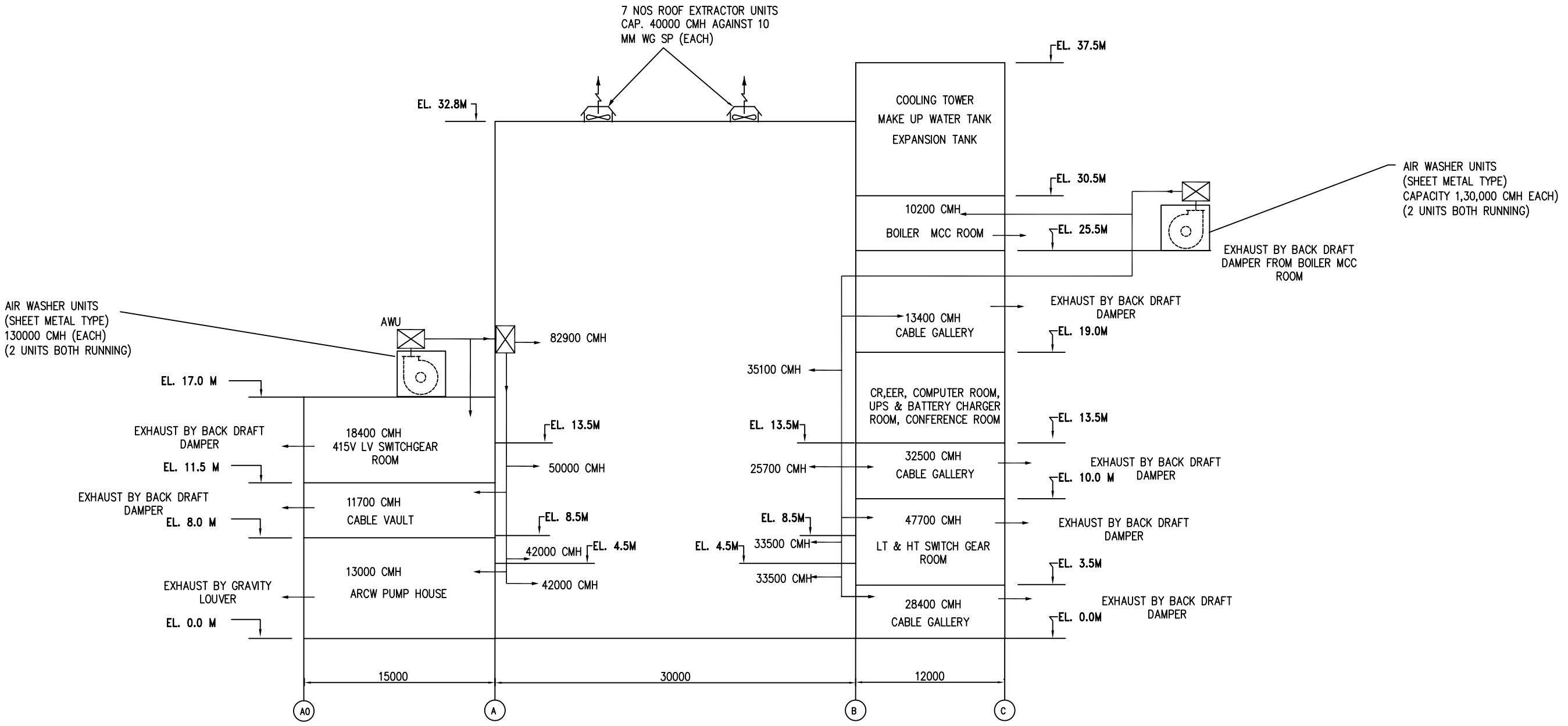
TITLE: TYPICAL SCHEME OF UAF
(SHEET METAL TYPE, CAPACITY: 50,000 CMH 60 mmwc ST.Pr.)

DEPT. SCALE ~
SIGN
DATE

BHEL DRAWING NO. PE-DG-360-554-A002.

SHEET 1 OF 1 REV 04

SIZE-A1



REV	DATE	AL.TD	CHD	APPD
01	09.03.11	M.K.S	S.A.K	P.K.D
02	09.03.11	M.K.S	S.A.K	P.K.D

REV	DATE	ALTD	CHD	APPD
–	–	–	–	–

CUSTOMER: DURGAPUR PROJECTS LIMITED (DPL)

CUSTOMER'S CONSULTANT: DCPL KOLKATA

VENTILATION SYSTEM

JOB No. 360

DISTRIBUTION

TO

No.OFT

1X250 MW DURGAPUR TPS
UNIT # 8

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE: MAX

	NAME	SIGN	DATE
DRN	MKS	sd/–	15.01.11
DESN	MKS	sd/–	15.01.11
CHD	SKC/ SAK	sd/–	15.01.11
APPD	P. K. DAS	sd/–	15.01.11

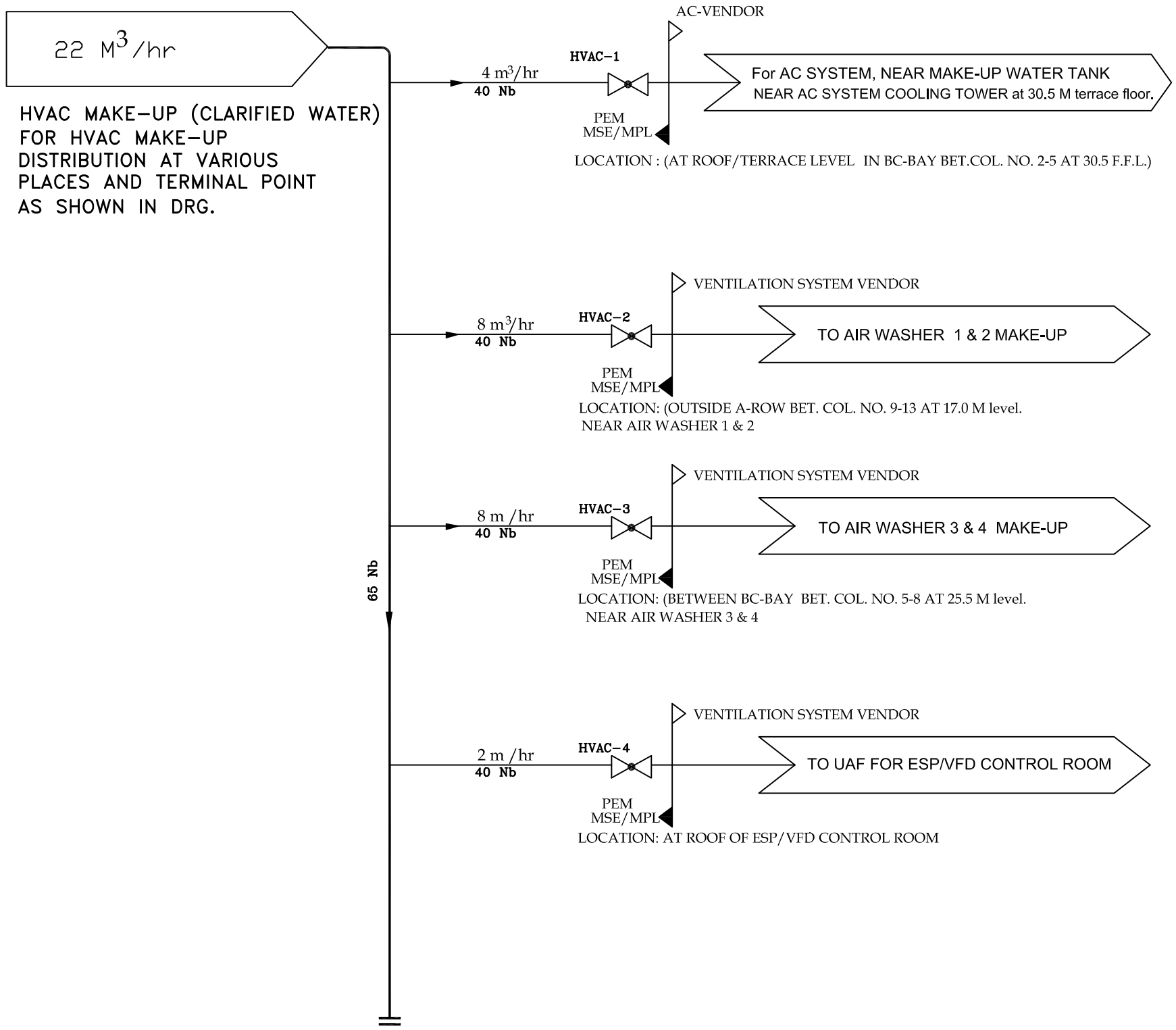
TITLE: SCHEME OF AIR DISTRIBUTION SYSTEM OF POWER HOUSE BUILDING

MPL	C	MSE	I	MAX	E	DEPT.	SCALE
						SIGN	
						DATE	

BHEL DRAWING No. PE-DG-360-554-A003

SHEET 1 OF 1 REV 2

SIZE-A1



NOTE:–

1. MPL TO PROVIDE HVAC MAKE-UP WATER PIPING/FITTINGS UP TO THE TERMINAL POINT AS SHOWN IN DRG.
2. 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 MPL (LP PIPING VENDOR'S SCOPE) FURTHER PIPING SHALL BE DONE BY RESPECTIVE PLANT SUPPLIER AS MARKED IN THIS DRG.
3. FOR HVAC MAKE-UP WATER ISOLATING VALVES PRCUREMENT ETC. PL. REFER VALVE SCHEDULE DOC. NO. PE-DC-360-553-A050.
4. THE HVAC MAKE-UP WATER ISOLATING VALVES AS PER VALVE SCHEDULE SHALL BE ARRANGED BY MPL (VALVE GROUP) AS PER THE SCHEME AS MARKED IN TGHE DRG.
5. HVAC MAKE-UP WATER PRESSURE at EACH TERMINAL POINT SHALL BE MAINTAINED 0.5 kg/cm2.
6. AC - SYSTEM MAKE-UP WATER PIPING FROM TERMINAL POINT TO MAKE-UP WATER TANK, COOLING TOWER, EXPANSION TANK & PAN HUMIDIFIER SHALL BE IN BIDDER'S SCOPE.
7. MAKE-UP WATER REQUIREMENT IS CONTINUOUS.

TENDER PURPOSE ONLY

CUSTOMER	DURGAPUR PROJECT LTD – WEST BENGAL
CONSULTANT	DCPL KOLKATA
JOB No. : 360	1x250 MW DURGAPUR TPS, UNIT # 8
STATUS: CONTRACT DISTRIBUTION: TO: NOTE: REV. / DATE / DRAWN / CHD / APPD 0 / 14.03.11 / MKS / RKC/NAK / RLR/VKD ENG. GENERALLY REVISED IN LINE WITH FINAL WATER QTY. REVIEW WITH MBE.	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI
	TITLE: SCHEMATIC DAIAGRAM FOR HVAC MAKE UP
MPL / C / MSE / I / MAX / K / DEPT. SCALE–N.T.S	DOCUMENT NO. PE–DC–360–553–A055.
SIGN	
DATE	SHEET 1 OF 1 REV. 0

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DRAWING No. PE-DG-360-100-M001

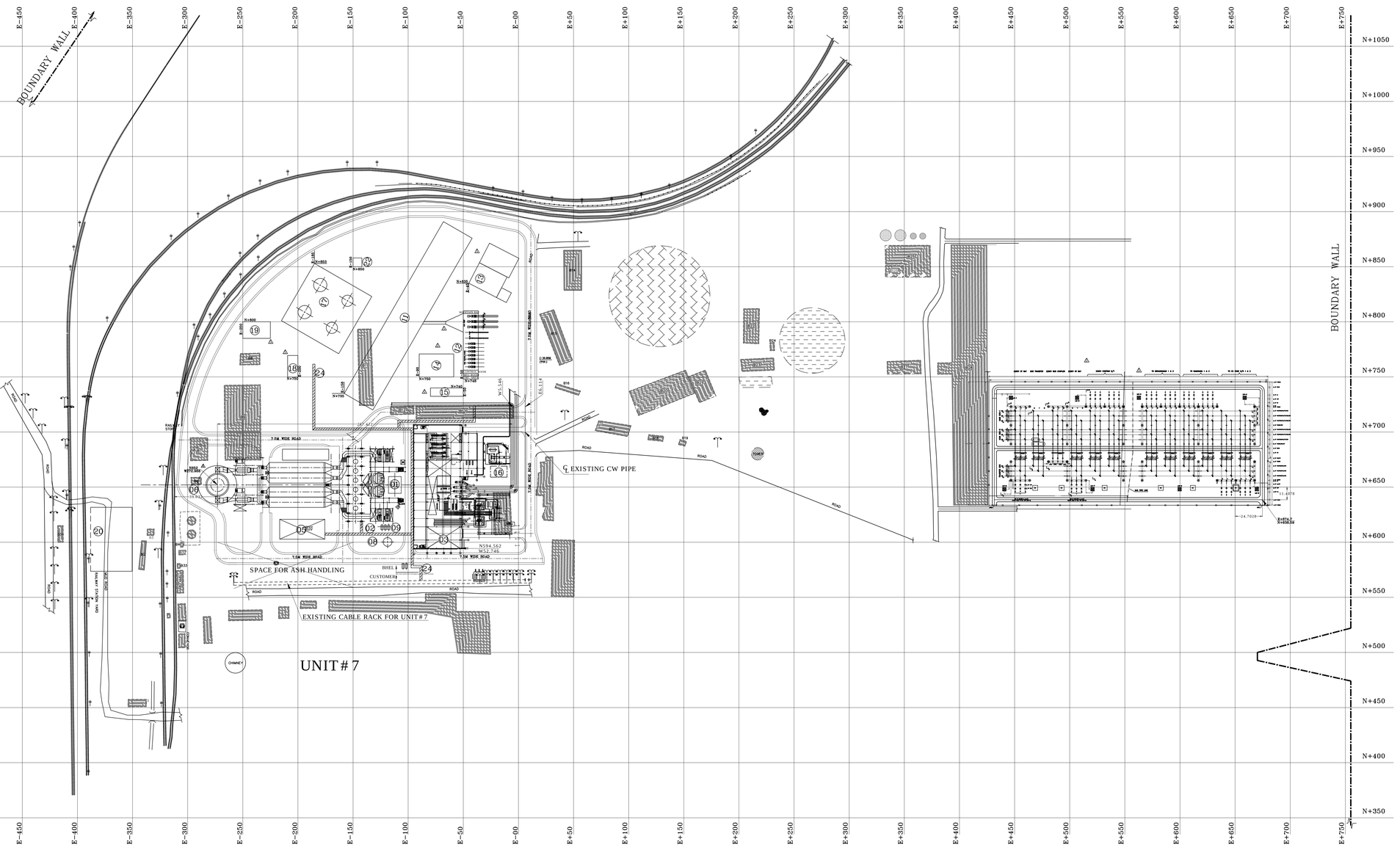
CUSTOMER'S DRAWING No.

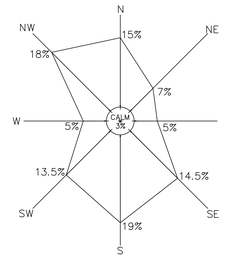
REFERENCE DRGS: –

1. SURVEY DRAWING	ACTPL/BHE/TOPO/50658 Rev05
2. PLOT PLAN	PE-DG-360-100-M001
3. GA OF BOILER SECTIONAL SIDE ELEVATION	0-00-022-75515
4. GA OF BOILER SECTIONAL PLAN	0-00-022-75516
5. LAYOUT OF ID SYSTEM	0-00-020-75522
6. SURVEY DRAWING	M/s DPL(M/s CYBER SWIFT INFO PVT.LTD.)
7. SURVEY DRAWING	M/s BHEL(M/s ARKITECHNO)
8. PLAN ROAD LAYOUT	PE-DG-360-603-C002

NOTES

1. ACCESS ROADS UNDER BHEL BATTERY LIMITS SHALL BE UNDER BHEL SCOPE.
2. BHEL SCOPE OF WORK HAS BEEN SHADDED.
3. EQUIPMENTS DIMENSIONS INDICATED ARE TENTATIVE ONLY. FINAL DIMENSIONS ARE TO BE GIVEN AFTER SUBSTATION OF EQUIPMENTS FROM RESPECTIVE BHEL'S UNIT.
4. SCOPE SHALL BE AS PER CONTRACT.
5. UNIT 8 POWER HOUSE FINISHED FLOOR LEVEL EL(+)0.0M WILL BE RL82.0M ABOVE M.S.L.





WIND ROSE DIAGRAM

LEGEND

1. BOILERS
2. MILL BAY
3. TURBO GENERATORS
4. TRANSFORMER YARD
5. ESP CONTROL ROOM
6. CHIMNEY
7. ELECTROSTATIC PRECIPITATOR
8. CONDENSATE STORAGE TANKS
9. BOILER FILL PUMPS/DM MAKE UP PUMPS
10. CHEMICAL HOUSE
11. COOLING TOWERS
12. CW /ACW/FIRE FIGHTING PUMP HOUSE(62Mx12M)
13. CHLORINATION BUILDING
14. SIDE STREAM FILTRATION PLANT
15. COMPRESSOR HOUSE(30MX10MX7M)
16. EMERGENCY D.G. ROOM
17. LDO/LVFO STORAGE TANKS DYKE AREA (60MX60M)
18. OIL UNLOADING PUMP HOUSE(25NX25M)
19. OIL HEATING & PUMPING UNIT
20. FGD
24. PIPE CUM CABLE RACK
25. FOAM P/H (8MX8MX5M)

LEGEND: –

AREA BOUNDARY LINE
BOUNDARY WALL
FENCE LINE
ROAD
RAILWAY LINE
DRAIN
EXISTING BUILDING
COOLING TOWER
AC FILTER
TANK
OIL STORAGE AREA
POND
TRANSFORMER
ELECTRIC POLE
CABLE LINE
LAMP POST
TOWER
COOLING TOWER
TREE
COLUMN

BUILDINGS TO DEMOLISHED: –

1.	B6	STORE
3.	B7	
2.	B9	PERMANENT STORE
4.	B11	STORE
5.	B12	STORE
6.	B13	POWER PLANT STORE
7.	B29	
8.	B30	

REV	DATE	ALTD	CHD	APPD
05	13.01.11	NRJ	PKK	PKK
01	DRAWING REVISED BASED ON SWITCH YARD AREA DRAWING RECEIVED ON DATED 20/12/2010.			
02	DRAWING REVISED BASED ON CUSTOMER COMMENTS RECEIVED ON DATED 19/12/2010.			

REV	DATE	ALTD	CHD	APPD
04	10.11.10	NRJ	PKK	GPA
01	DRAWING REVISED BASED ON MEETING-SITE SURVEY HELD AT DPL OFFICE(DURGAPUR) BETWEEN DPL,DCPL & BHEL ON DATED 02/11/10.			

REV	DATE	ALTD	CHD	APPD
03	11.10.10	NRJ	PKK	GPA
01	DRAWING REVISED BASED ON DISCUSSION HELD WITH CUSTOMER ON 06/10/10 AT PEM OFFICE.			

REV	DATE	ALTD	CHD	APPD
02	28.09.10	NRJ	PKK	GPA
01	DRAWING REVISED BASED ON DRAWING RECEIVED FROM BHEL(TRICHY).			

REV	DATE	ALTD	CHD	APPD
01	20.09.10	NRJ	PKK	GPA
01	DRAWING REVISED BASED ON THE COMMENTS DATED 20.08.10			
02	DRAWING REVISED BASED ON INPUT RECEIVED FROM CIVIL.			

CUSTOMER	DURGAPUR PROJECTS LTD– WEST BENGAL
CUSTOMER'S CONSULTANT	DCPL KOLKATA
JOB No.	360
STATUS	CONTRACT
DISTRIBUTION	
TO	
No.OFF	

1x250 MW DURGAPUR TPS
UNIT # 8

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	NRJ	-SD-	02.06.10
	DESN	PKK	-SD-	02.06.10
	CHD	GPA	-SD-	02.06.10
	APPD	D.PILLAI	-SD-	02.06.10

TITLE

PLOT PLAN

MPL	C	MSE	I	MAX	E	DEPT.
						SIGN
						DATE

SCALE 1:1500

DRAWING No. PE-DG-360-100-M001

SHEET 01 OF 01 REV 05

SIZE-A0

COMPUTER FILE NAME:

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FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

NORTH

718.035 N
124.810 W

718.035 N
98.995 W

718.035 N
11.250 E

692.749 N
301.840 W

692.749 N
150.000 W

692.749 N
228.968 W

692.749 N
159.413 W

(−)0.25M
(TYP.)

1.5M. WIDE SHOULDER (TYP.)

R17250

R22400

R17265

7.5M WIDE ROAD

W5.546
E6.114

N685.13
W217.135

702.250 N
11.250 E

654.310 N
304.850 W
N652
W272.968

646.650 N
304.850 W

625.215 N
270.420 W

608.000 N
11.250 E

N620.796
W606.000

594.5
W52.746

585.213 N
270.420 W

585.213 N
228.968 W

585.213 N
159.413 W

585.213 N
98.995 W

585.213 N
18.200 E

R8400

42000

VACUUM PUMP HOUSE

PASSAGE WAY

ELECTROSTATIC PRECIPITATOR

ELECTROSTATIC PRECIPITATOR

ELECTROSTATIC PRECIPITATOR

ELECTROSTATIC PRECIPITATOR

ID FAN A

ID FAN B

SPACE FOR ID FAN HANDLING

CL.OF CHIMNEY

CHIMNEY DIA Ø21000

CHIMNEY PART

BOILER AXIS

ESP CONTROL ROOM

3.0M WIDE PIPE RACK

BOILER FILL PUMP

CONDENSATE STORAGE TANK
Ø31600

C/L OF MILLS

C/L OF FURNACE

INERT GAS ROOM (7.5MX12M)

CABLE GALLERY

UNLOADING BAY

ROLLING SHUTTER (4.0mX5.5mnt.)

DMCW PUMPS

OIL ROOM

PHES

SCF

UFT

SPACE FOR CRITICAL PIPING

D.G. SET

C COND.

E T G SET

GAS ROOM

UNLOADING BAY & MAINTENANCE AREA

ROLLING SHUTTER (4.0mX6.5mnt.)

OIL WATER SEPARATOR PIT

BHEL

TP FOR SERVICES, POTABLE & CLARIFIED WATER

CUSTOMER

NOTES

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.
2. ALL ELEVATIONS ARE REFERRED TO POWER HOUSE GROUND FLOOR ELEVATION ± 0.00M.
3. BOILER AREA FINISHED GRADED LEVEL IS 200MM BELOW 0.0M
4. TRANSFORMER YARD AREA FINISHED GRADED LEVEL IS 100MM BELOW 0.0M
5. LAYOUT OF TRANSFORMER YARD AREA HAS BEEN SHOWN INDICATIVE ONLY.
6. ARRANGEMENT SHOWN FROM FIRST ROW OF BOILER COLUMN UP TO CHIMNEY IS INDICATED AS TYPICAL. HOWEVER DETAIL ARRANGEMENT SHALL BE AS PER RESPECTIVE TRICHY/CIVIL DRAWINGS.
7. ALL PLANT ROAD LEVELS SHALL BE 250MM ABOVE GRADED LEVEL.
8. THIS IS A CONCEPTUAL DWG NOT TO BE REFERRED FOR SCOPE.

REFERENCE DRGS:−

1. GENERAL LAYOUT PLAN (CUST.)	K9A01−DWG−P−001A
2. PLOT PLAN	PE−DG−360−100−M001
3. GA OF BOILER SECTIONAL SIDE ELEVATION	0−00−022−75515
4. GA OF BOILER SECTIONAL PLAN	0−00−022−75516
5. PLANT ROAD LAYOUT	PE−DG−360−603−C002

REV	DATE	ALTD	CHD	APPD

REV	DATE	ALTD	CHD	APPD
01	13/01/11	NRJ	PKK	PKK

01. DRAWING REVISED BASED ON THE CUSTOMER COMMENTS RECEIVED ON DATED 20/09/10.
02. DRAWING REVISED BASED ON THE DRAWING RECEIVED FROM BHEL(TRY).
03. DRAWING REVISED BASED ON PLOT PLAN (R5) SUBMITTED TO CUSTOMER ON DATED 13/01/11.

CUSTOMER	DURGAPUR PROJECT LTD−WEST BENGAL
CUSTOMER'S CONSULTANT	DCPL KOLKATA
JOB No.	1X250 MW DURGAPUR TPS UNIT#8
STATUS	
DISTRIBUTION	
TD	
NoOFT	

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN.	NRJ	−SD−	09/07/10
	DES'N	PKK	−SD−	09/07/10
	CHD	PKK	−SD−	09/07/10
	APP'D	GPA	−SD−	09/07/10

TITLE: MAIN EQUIPMENT LAYOUT

MPL	C	MSE	I	MAX	E	DEPT.
						SIGN
						DATE

SCALE

DRAWING No. PE−DG−360−100−M002

SHEET 01 OF 01 REV 01

SIZE−A0

COMPUTER FILE NAME:

DRAWING No. PE-DG-360-100-M008

CUSTOMER'S DRAWING No.

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

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COMPUTER FILE NAME

COLUMN NO. 6,7,8,9,10 SHALL BE ELEVATED UPTO AN ELEVATION OF 40.0M.

POTABLE WATER TANK

3000

EL.40.0M

FIRST ROW OF BOILER COLUMNS

STRUCTURE TO SUPPORT CRITICAL PIPING

WEATHER PROTECTION CLADDING

EL.37.5M

SPACE FOR BOILER MCC & AWR

CLADDING

5000

SLOPE

EL.32.8M

CLADDING

℄ DEAERATOR

INTERCONNECTION FLOOR

EL.25.75M

EL.25.50M

750

125

750

3000 (APPROX)

750

22.5M

EL.23.7M

TOP OF RAIL

TOP RAIL EL.25.0M

CABIN

MAIN HOOK EL23.5M (2X125T)

AUX. HOOK EL24.5M (25T)

EL.23.55M

TOP OF GANTRY GIRDER

SPACE FOR AHU, BATTERY ROOM BATTERY CHARGER ROOM & FOR CRITICAL PIPING

SPACE FOR FEED CONTROL STATION

SPACE FORSH,RH ATTEMPRATOR CONTROL STATION

EL.19.80M

19.0M

SPACE FOR AWR

LADDER FOR CRANE WALKWAY AND CRANE CABIN

1650 1400

1400 1400 750

VENTILATION DUCT

2000

17.0M

415 V LT SWITCH GEAR ROOM

℄ OF LPBP

℄ EL.14.42M

SPACE FOR COMPUTER ROOM, EER, CONTROL ROOM, SWAS ROOM, UPS & 24V DC CHARGER ROOM, UPS & 24V DC BATTERY ROOM, CONFERENCE ROOM.

1500

EL.13.50M

INTERCONNECTION FLOOR

EL.13.50M

13.5M

3100

750

OIL CANEL

1054

LPH 2

LPH 3

1988

VENTILATION DUCT

VENTILATION DUCT

CABLE GALLERY

3500

2300

EL.8.50M

EL.10.00M

EL.10.00M

11.0M

EL.9.92M

8.5M

11.0M

8.0M

CABLE GALLERY

℄ OF T.G.SET

8665

14000

HPH5,6

VENTILATION DUCT

VENTILATION DUCT

ARCW PUMP HOUSE & CENTRAL LUBE OIL PURIFICATION

(FOR LAY OUT DETAILS REFER DRG NO. PE-DG-360-100-M003)

20000

EL.5.815M

CONDENSER TUBE WITHDRAWL SPACE

13000

℄ OF CONDENSER EL.3.620M.

EL.4.50M

5000

HT & LT SWITCH GEAR ROOM

EL.3.50M

SPACE FOR WATER BOX OPENING

EL.0.965M

EL.(+)0.115M.

CABLE GALLERY

FREE MOMENT SPACE

0.00M

EL.0.00M

12000

8000

RE JOINT

℄ EL.(-)1.99M.

EL.(-)2.0M.

EL.(-)4.0M.

5500

EL.(-)4.4M.

1206

1990

7985

17000

℄ CEP

15000

13000

A0

A

B

C

NOTES

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.
2. ALL ELEVATIONS ARE REFERRED TO POWER HOUSE FINISHED GROUND FLOOR ELEVATION ±0.0M

REFERENCE DRGS:-

1. CRANE CLEARANCE DIAGRAM OF TG HALL DIAGRAM PE-DG-360-500-A001

REV	DATE	ALTD	CHD	APPD
01	15/12/10	NRJ	PKK	

01. DRAWING REVISED BASED ON THE CUSTOMER COMMENTS RECEIVED ON DATED 20/08/10.
02. DRAWING REVISED BASED ON THE DRAWING RECEIVED FROM UNITS.
03. COMMENTS RECEIVED FROM BHEL(HRD) INCORPORATED.

CUSTOMER	DURGAPUR PROJECT LTD-WEST BENGAL
CUSTOMER'S CONSULTANT	DCPL KOLKATA
JOB No.	1X250 MW DURGAPUR TPS UNIT#8
STATUS	
DISTRIBUTION	
TD	
NoOFF	

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	NRJ	-SD-	09/07/10
	DESN	PKK	-SD-	09/07/10
	CHD	PKK	-SD-	09/07/10
	APPD	GPA	-SD-	09/07/10

TITLE: MAIN PLANT CROSS-SECTION

MPL	C	MSE	I	MAX	E	DEPT.	SCALE1:100
						SIGN	
						DATE	

DRAWING No. PE-DG-360-100-M008

SHEET 01 OF 01 REV 01

SIZE-A0

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DRAWING No. PE-DG-360-100-M003

CUSTOMER'S DRAWING No.

FIRST ANGLE PROJECTION — ALL DIMENSIONS ARE IN MM

NORTH

NOTES

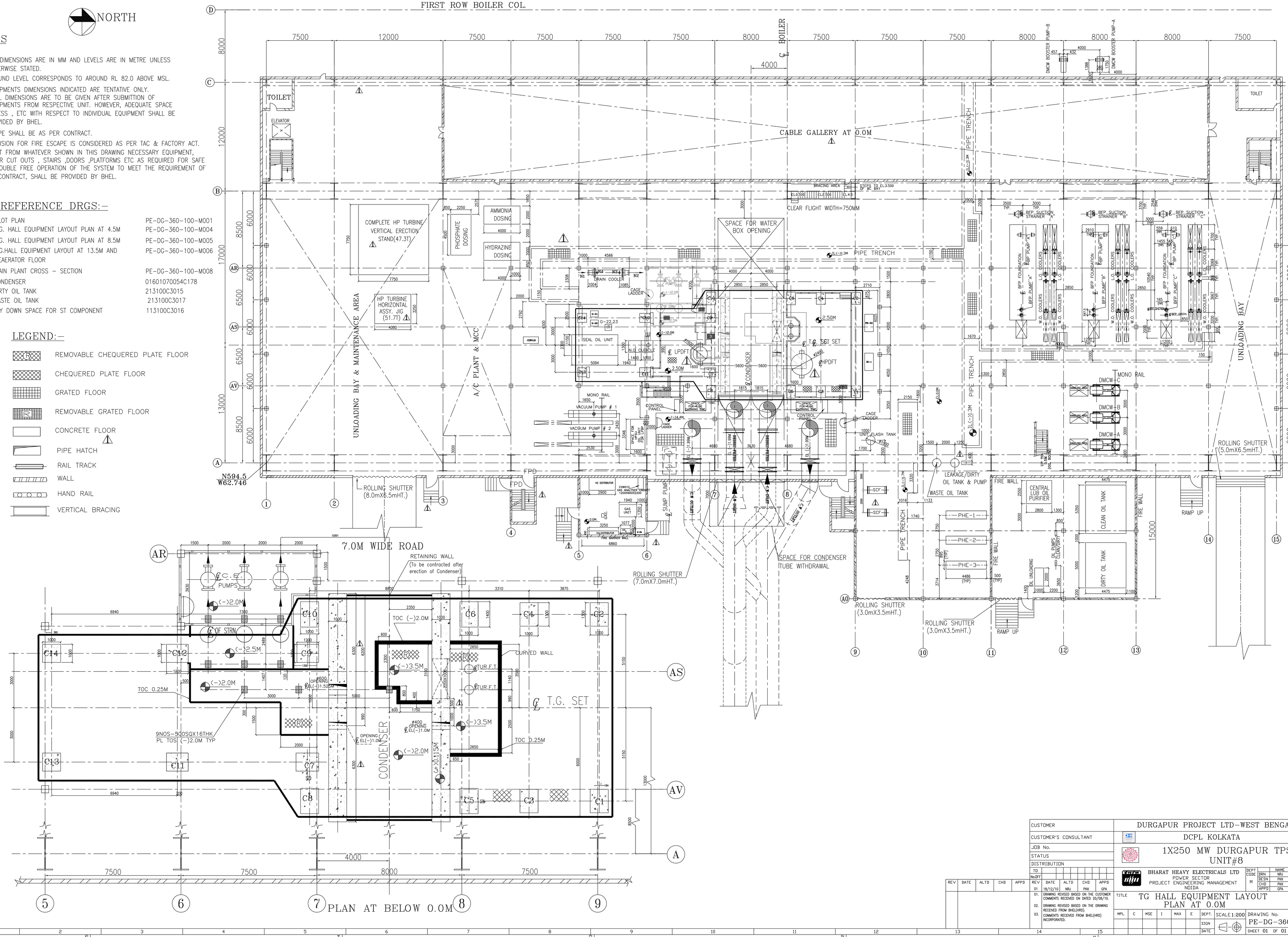
1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.
2. GROUND LEVEL CORRESPONDS TO AROUND RL 82.0 ABOVE MSL.
3. EQUIPMENTS DIMENSIONS INDICATED ARE TENTATIVE ONLY. FINAL DIMENSIONS ARE TO BE GIVEN AFTER SUBMITTION OF EQUIPMENTS FROM RESPECTIVE UNIT. HOWEVER, ADEQUATE SPACE ACCESS , ETC WITH RESPECT TO INDIVIDUAL EQUIPMENT SHALL BE PROVIDED BY BHEL.
4. SCOPE SHALL BE AS PER CONTRACT.
5. PROVISION FOR FIRE ESCAPE IS CONSIDERED AS PER TAC & FACTORY ACT.
6. APART FROM WHATEVER SHOWN IN THIS DRAWING NECESSARY EQUIPMENT, FLOOR CUT OUTS , STAIRS ,DOORS ,PLATFORMS ETC AS REQUIRED FOR SAFE & TROUBLE FREE OPERATION OF THE SYSTEM TO MEET THE REQUIREMENT OF THE CONTRACT, SHALL BE PROVIDED BY BHEL.

REFERENCE DRGS:–

1. PLOT PLAN	PE–DG–360–100–M001
2. T.G. HALL EQUIPMENT LAYOUT PLAN AT 4.5M	PE–DG–360–100–M004
3. T.G. HALL EQUIPMENT LAYOUT AT 8.5M	PE–DG–360–100–M005
4. T.G.HALL EQUIPMENT LAYOUT AT 13.5M AND DEAERATOR FLOOR	PE–DG–360–100–M006
5. MAIN PLANT CROSS – SECTION	PE–DG–360–100–M008
6. CONDENSER	01601070054C178
7. DIRTY OIL TANK	213100C3015
8. WASTE OIL TANK	213100C3017
9. LAY DOWN SPACE FOR ST COMPONENT	113100C3016

LEGEND:–

- REMOVABLE CHEQUERED PLATE FLOOR
- CHEQUERED PLATE FLOOR
- GRATED FLOOR
- REMOVABLE GRATED FLOOR
- CONCRETE FLOOR
- PIPE HATCH
- RAIL TRACK
- WALL
- HAND RAIL
- VERTICAL BRACING



REV	DATE	ALTD	CHD	APPD

CUSTOMER	DURGAPUR PROJECT LTD–WEST BENGAL
CUSTOMER'S CONSULTANT	DCPL KOLKATA
JOB No.	1X250 MW DURGAPUR TPS UNIT#8
STATUS	
DISTRIBUTION	
TO	
No.OF'T	

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	NRJ	–SD–	09/07/10
	DESN	PKK	–SD–	09/07/10
	CHD	PKK	–SD–	09/07/10
	APPD	GPA	–SD–	09/07/10

REV	DATE	ALTD	CHD	APPD
01	18/12/10	NRJ	PKK	GPA

01. DRAWING REVISED BASED ON THE CUSTOMER COMMENTS RECEIVED ON DATED 20/08/10.
02. DRAWING REVISED BASED ON THE DRAWING RECEIVED FROM BHEL(HRO).
03. COMMENTS RECEIVED FROM BHEL(HRO) INCORPORATED.

TITLE: TG HALL EQUIPMENT LAYOUT PLAN AT 0.0M

MPL	C	MSE	I	MAX	E

DEPT. | SCALE 1:200 | DRAWING No. PE–DG–360–100–M003
SIGN | DATE
SHEET 01 OF 01 | REV 01
SIZE–A0

COMPUTER FILE NAME:

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DRAWING No. PE-DG-360-100-M004

CUSTOMER'S DRAWING No.

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

NORTH

FIRST ROW BOILER COL.

TOILET

ELEVATOR

ERECTION WELL

ROLLING SHUTTER (6.0mX3.0mHT.)

MONO RAIL AT EL10.0M (CAPACITY:-7.0T)

HT & LT SWITCH GEAR ROOM (UNIT PCC & STATION PCC)

TOILET

PIPE HATCH

PIPE HATCH

PIPE HATCH

FOR DETAILS AT 0.0M REFER DRG NO. PE-DG-360-100-M003

MAINTENANCE AREA

UNLOADING BAY & MAINTENANCE AREA

UNLOADING BAY

ROLLING SHUTTER (8.0mX6.5mHT.)

ROLLING SHUTTER (5.0mX6.5mHT.)

ROLLING SHUTTER (7.0mX7.0mHT.)

SWELL WITHDRAWL

OPENING FOR HEATER MAINTENANCE

℄ H.P.H. # 5

℄ H.P.H. # 6

CONDENSER WATER BOX OPENING

GLAND STEAM CONDENSER

℄ CONDENSER

OPENING FOR SEAL OIL & GAS PIPING

℄ LPDFT

℄ HPDFT

ø450 OPENING

HP/MS Alt. Drain opening

ø850 OPENING

℄ T.G. SET

℄ T.G.SET

TANK

MOTOR

UNIT OIL PURIFIER

OIL COOLERS

UNIT FLASH TANK

℄ OF MAIN OIL TANK

HOLD

CW INLET

CW INLET

(CONDENSER TUBE WITHDRAWAL)

EMBEDDED PIPE MS50 FOR OIL MIST FLOW DRAIN

CENTRAL LUBE OIL PURIFICATION ROOM AT 0.0M

ARCW PUMP HOUSE AT 0.0M

REFERENCE DRG:-

1.	PLOT PLAN	PE-DG-360-100-M001
2.	T.G. HALL EQUIPMENT LAYOUT PLAN AT 0.0M	PE-DG-360-100-M003
3.	T.G. HALL EQUIPMENT LAYOUT PLAN AT 8.5M	PE-DG-360-100-M005
4.	T.G.HALL EQUIPMENT LAYOUT AT 13.5M AND DEAERATOR FLOOR	PE-DG-360-100-M006
5.	MAIN PLANT CROSS – SECTION	PE-DG-360-100-M008
6.	OIL ROOM ARRANGEMENT	013100C3004
7.	CONDENSER	01601070054C178

REV	DATE	ALTD	CHD	APPD
01	18/12/10	NRJ	PKK	PKK
01.	DRAWING REVISED BASED ON THE CUSTOMER COMMENTS RECEIVED ON DATED 20/08/10.			
02.	DRAWING REVISED BASED ON THE DRAWING RECEIVED FROM BHEL(HRO).			
03.	COMMENTS RECEIVED FROM BHEL(HRO) INCORPORATED.			

CUSTOMER	DURGAPUR PROJECT LTD-WEST BENGAL
CUSTOMER'S CONSULTANT	DCPL KOLKATA
JOB No.	1X250 MW DURGAPUR TPS UNIT#8
STATUS	
DISTRIBUTION	
TO	
NoDFT	

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	NRJ	-SD-	09/07/10
	DESN	PKK	-SD-	09/07/10
	CHD	PKK	-SD-	09/07/10
	APPD	GPA	-SD-	09/07/10

TITLE: TG HALL EQUIPMENT LAYOUT PLAN AT 4.5M

MPL	C	MSE	I	MAX	E	DEPT.	SCALE1:150	DRAWING No.
						SIGN		PE-DG-360-100-M004
						DATE		SHEET 01 OF 01 REV 01

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DRAWING No. PE-DG-360-100-M005

FIRST ANGLE PROJECTION | ALL DIMENSIONS ARE IN MM

CUSTOMER'S DRAWING No.

NORTH

FIRST ROW BOILER COL.

TOILET | ELEVATOR | CABLE GALLERY AT 10.0M | TOILET

PIPE HATCH | SPACE FOR SHELL REMOVAL | SPACE FOR SHELL REMOVAL | PIPE HATCH | PIPE HATCH | PIPE HATCH

MONKEY LADDER FROM 8.5M TO 10.5M | TURBINE JB MOUNTING FRAME | SPACE FOR HPSU OF ESV & IV

OPENING FOR BFP | OPENING FOR BFP | OPENING FOR BFP | ERECTION SPACE

UNLOADING BAY & MAINTENANCE AREA

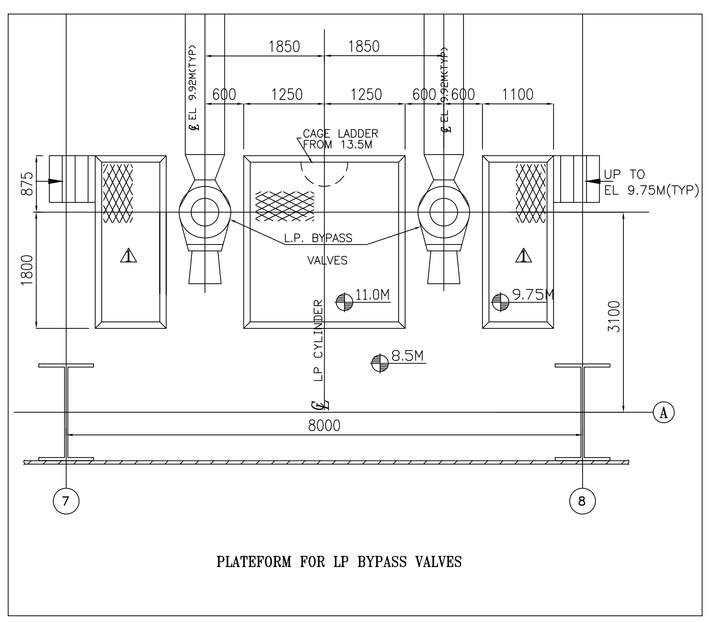
ø450 OPENING | T.G. SET | C of GENERATOR | OPENING FOR SEAL AND GAS PIPING (TYP) | BEARING EXHAUST BLOWER CHAMBER 150 x 150 | LIQUID DETECTOR RACK AT 8.5 | GENERATOR CONDITION MONITORING CABIN | AIR RECEIVER MOTER CONTROL STATION PANEL AIR COOLED AFTER COOLER | AIR DRYER | AIR COMP. AND MOTOR | PRESSURE STATION PANEL | LP BYPASS VALVES | TURBINE JB MOUNTING FRAME | OPENING FOR OIL PUMP | OPENING FOR OIL COOLER

BUS DUCT | 6.6KV BUSDUCT | S.P. CUBICLE

CABLE VAULT AT 8.0M

FR23 | FR24 | FR35 | FR36 | IR-5 | G20

EL.9.5M | EL.12.0M | EL.10.3M | EL.11.0M | EL.8.5M | EL.11.34



PLATEFORM FOR LP BYPASS VALVES

REFERENCE DRG:-

1.	T.G. HALL EQUIPMENT LAYOUT PLAN AT 0.0M	PE-DG-360-100-M003
2.	T.G. HALL EQUIPMENT LAYOUT PLAN AT 4.5M	PE-DG-360-100-M004
3.	T.G.HALL EQUIPMENT LAYOUT AT 13.5M AND DEAERATOR FLOOR	PE-DG-360-100-M006
4.	MAIN PLANT CROSS – SECTION	PE-DG-360-100-M008
5.	LP HEATER NO.01	01621870072C178
6.	LP HEATER NO. 2 & 3	01622270053C178

FOR GENRAL NOTES / LEGENDS REFRENCE DWG NO. PE-DG-360-100-M003

CUSTOMER	DURGAPUR PROJECT LTD–WEST BENGAL
CUSTOMER'S CONSULTANT	DCPL KOLKATA
JOB No.	1X250 MW DURGAPUR TPS UNIT#8
STATUS	
DISTRIBUTION	
TO	
No.OFT	

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

CODE		NAME	SIGN	DATE
DEPT	DRN	NRJ	-SD-	09/07/10
M	DESN	PKK	-SD-	09/07/10
	CHD	PKK	-SD-	09/07/10
	APPD	GPA	-SD-	09/07/10

REV	DATE	ALTD	CHD	APPD
01	18/12/10	NRJ	PKK	GPA

01. DRAWING REVISED BASED ON THE CUSTOMER COMMENTS RECEIVED ON DATED 20/08/10.
02. DRAWING REVISED BASED ON THE DRAWING RECEIVED FROM BHEL(HRD).
03. COMMENTS RECEIVED FROM BHEL(HRD) INCORPORATED.

TITLE: TG HALL EQUIPMENT LAYOUT PLAN AT 8.5M

MPL	C	MSE	I	MAX	E

DEPT. | SCALE 1:150 | DRAWING No. PE-DG-360-100-M005
SIGN
DATE
SHEET 01 OF 01 | REV 01

SIZE-A0

COMPUTER FILE NAME:

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DRAWING NO. PE-DG-360-100-M006

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

CUSTOMER'S DRAWING NO.

NORTH

FIRST ROW BOILER COL.

S1L S6L S6R S1R

TOILET
ELEVATOR
SPACE FOR CONFERANCE ROOM
UPS & 24V DC BATTERY ROOM
UPS & 24V DC CHARGER ROOM
PASSAGE
SHIFT IN-CHARGE ROOM
SWAS ROOM
CONTROL ROOM
EER
COMPUTER ROOM
TOILET
13.0M
PIPE HATCH
CRANE AUX. HOOK
CRANE MAIN HOOK
BRACING AREA
CLEAR FLIGHT WIDTH = 750MM

UNLOADING BAY & MAINTENANCE AREA

OPENING FOR HP/LP HEATER MAINTENANCE
OPENING FOR CE PUMPS
OPENING FOR BFP
UNLOADING BAY

CONDENSER
GENERATOR
ROTOR WITHDRAWAL SPACE
T.G. SET
TURBO-GENERATOR EL14.42M
E.S.V
OPENING 1300X1300
G8&G12
11.34M
11.02M
RACK FOR CONDENSER INSTRUMENTS
L.P.BP VALVE CUTOUT
OPENING FOR OIL PUMPS
OPENING FOR OIL COOLER
13.50 M

415 V LV SWITCH ROOM & AC MCC AT 11.5M
AND SPACE FOR AIR WASHER ROOM AT 17.0M

DETAIL OF LAY-DOWN SPACE FOR TG COMPONENTS

S.No	DESCRIPTION	WT.IN Kg.	AREA M x M
1	LP OUTER CASING UPPER HALF	23000	7.1 x 6.1
2	LP INNER OUTER CASING UPPER HALF (WITH DIFUSER)	21400	4.3 x 6.7
3	LP INNER CASING UPPER HALF	8500	1.3 x 3.5
4	IP TURBINE INNER CASING UPPER HALF	11500	2.1 x 2.5
5	IP TURBINE OUTER CASING UPPER HALF	14900	3.6 x3.6
6	PEDESTAL COVER	1030	1.6 x 1.5
7	PEDESTAL COVER	982	2.0 x 1.5
8	PEDESTAL COVER	680	1.0 x 1.8
9	PEDESTAL COVER	730	2.1 x 1.3
11	HP SHAFT	8100	4.2 x 0.9
12	IP SHAFT	17200	4.1 x 1.5
13	LP SHAFT	53000	7.1 x 3.0
14	END SHIELD UPPER HALF(TE)	4700	3.32X0.95
15	EXCITER	22000	4.735X3.410
16	END SHIELD UPPER HALF(EE)	4700	3.32X0.95
17	EXCITER HOUSING	2000	4.945X3.81
18	H2 COOLERS	2X4000	1.5X8.1
19	GEN.ROTOR	43300	9.585

PLAN AT 13.5M

REFERENCE DRG:-

1. T.G. HALL EQUIPMENT LAYOUT PLAN AT 0.0M — PE-DG-360-100-M003
2. T.G. HALL EQUIPMENT LAYOUT PLAN AT 4.5M — PE-DG-360-100-M004
3. T.G.HALL EQUIPMENT LAYOUT AT 8.5M — PE-DG-360-100-M006
4. MAIN PLANT CROSS - SECTION — PE-DG-360-100-M008
5. LAY DOWN SPACE FOR ST COMPONENT — 113100C3016
6. OIL CANAL DETAILS — 013100C3001

FOR GENRAL NOTES / LEGENDS REFRENCE DWG NO. PE-DG-360-100-M003

REV	DATE	ALTD	CHD	APPD
01	18/12/10	NRJ	PKK	PKK
01.	DRAWING REVISED BASED ON THE CUSTOMER COMMENTS RECEIVED ON DATED 20/08/10.			
02.	DRAWING REVISED BASED ON THE DRAWING RECEIVED FROM BHEL(HRD).			
03.	COMMENTS RECEIVED FROM BHEL(HRD) INCORPORATED.			

CUSTOMER	DURGAPUR PROJECT LTD-WEST BENGAL
CUSTOMER'S CONSULTANT	DCPL KOLKATA
JOB No.	1X250 MW DURGAPUR TPS UNIT#8
STATUS	
DISTRIBUTION	
TO	
No.OF	

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT		NAME	SIGN	DATE
CDDE	DRN	NRJ	-SD-	09/07/10
	DESN	PKK	-SD-	09/07/10
M	CHD	PKK	-SD-	09/07/10
	APPD	GPA	-SD-	09/07/10

TITLE: TG HALL EQUIPMENT LAYOUT PLAN AT 13.5M

MPL	C	MSE	I	MAX	E	DEPT.	SCALE
						SIGN	
						DATE	

DRAWING No. PE-DG-360-100-M006

SHEET 01 OF 01 REV 01

SIZE-A0

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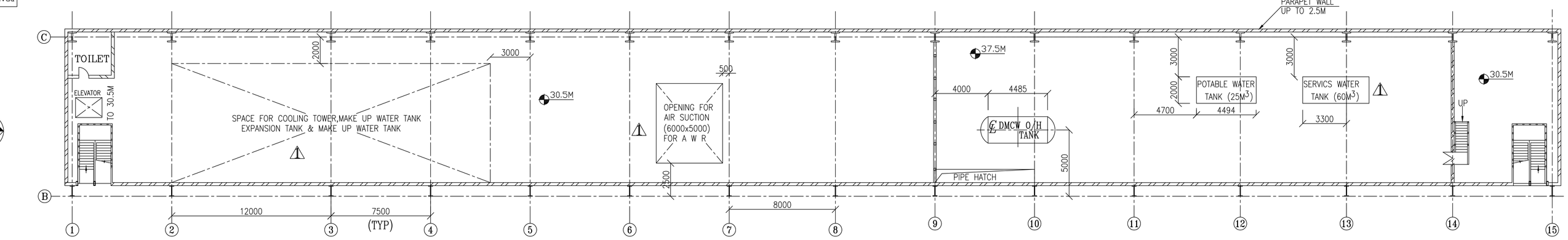
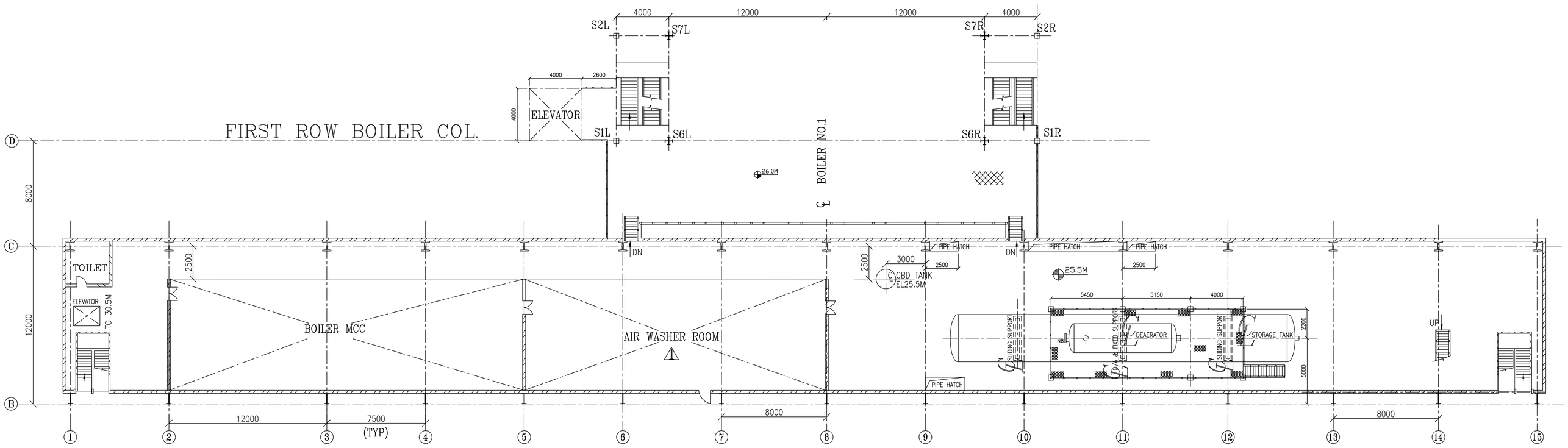
DRAWING No. PE-DG-360-100-M007

CUSTOMER'S DRAWING No.

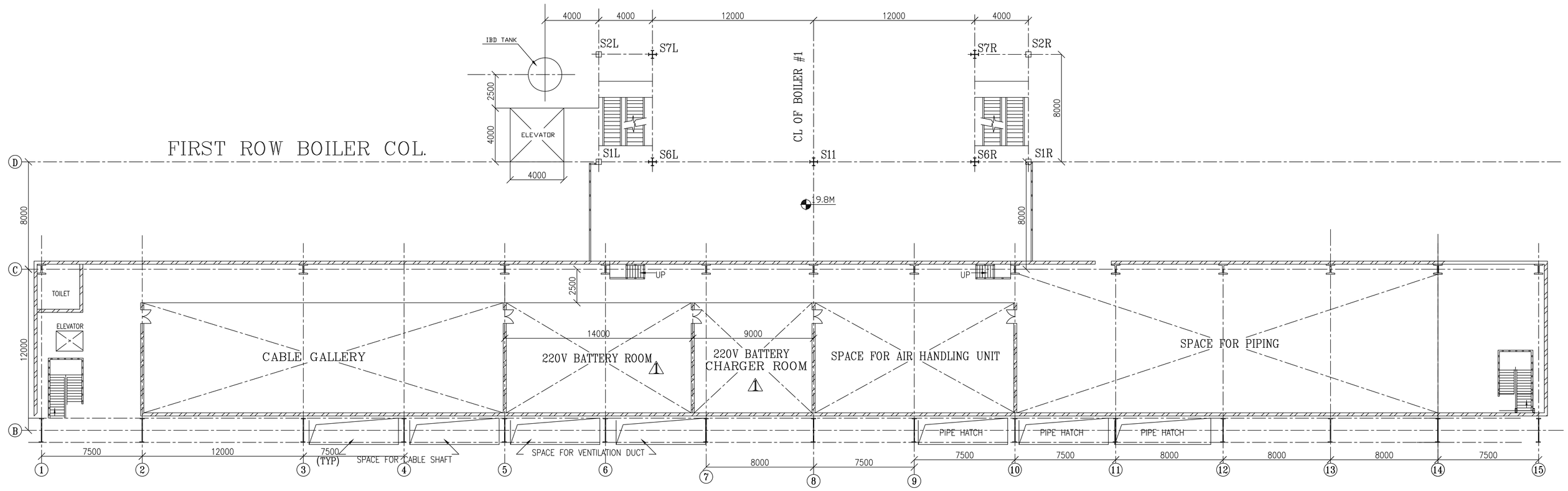
NORTH



PLAN AT 37.50M



PLAN AT 25.5M



PLAN AT 19.0M

LEGEND:–

- REMOVABLE CHEQUERED PLATE FLOOR
- CHEQUERED PLATE FLOOR
- GRATED FLOOR
- REMOVABLE GRATED FLOOR
- CONCRETE FLOOR
- PIPE HATCH/ CABLE SHAFT/ VENTILATION DUCT
- RAIL TRACK
- WALL

REFERENCE DRGS:–

1.	PLOT PLAN	PE–DG–360–100–M001
2.	T.G. HALL EQUIPMENT LAYOUT PLAN AT 0.0M	PE–DG–360–100–M003
3.	T.G. HALL EQUIPMENT LAYOUT PLAN AT 4.5M	PE–DG–360–100–M004
4.	T.G.HALL EQUIPMENT LAYOUT AT 13.5M AND DEAERATOR FLOOR	PE–DG–360–100–M006
5.	MAIN PLANT CROSS – SECTION	PE–DG–360–100–M008

NOTES

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.

REV	DATE	ALTD	CHD	APPD

REV	DATE	ALTD	CHD	APPD
01	18/12/10	NRJ	PKK	PKK

01. DRAWING REVISED BASED ON THE CUSTOMER COMMENTS RECEIVED ON DATED 20/08/10.
02. DRAWING REVISED BASED ON THE DRAWING RECEIVED FROM UNITS.
03. COMMENTS RECEIVED FROM BHEL(HRD) INCORPORATED.

CUSTOMER	DURGAPUR PROJECT LTD–WEST BENGAL
CUSTOMER'S CONSULTANT	DCPL KOLKATA
JOB No.	1X250 MW DURGAPUR TPS UNIT#8
STATUS	
DISTRIBUTION	
TO	
No.OFT	

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	NRJ	–SD–	09/07/10
	DESN	PKK	–SD–	09/07/10
	CHD	PKK	–SD–	09/07/10
	APPD	GPA	–SD–	09/07/10

TITLE: EQUIPMENT LAYOUT PLAN AT MISC. FLOORS IN BC BAY

MPL	C	MSE	I	MAX	E	DEPT.	SCALE	DRAWING No.
						SIGN		PE–DG–360–100–M007
						DATE		SHEET 01 OF 01 REV 01

SIZE–A0

COMPUTER FILE NAME:

VOLUME – III

DATA SHEET- B & SCHEDULES
TO BE FURNISHED BY EACH BIDDER

PRICE FORMAT

DPL DURGAPUR THERMAL POWER PLANT 1x250 MW

VENTILATION SYSTEM

SUGGESTIVE PRICE FORMAT

				SUPPLY						ERECTION & COMMISSIONING				TOTAL
Sl.No	**DESCRIPTION OF EQUIPMENT / ITEM**	**Qty.**	**Unit**	**Unit Price (Rs)**	**Total Ex works Price (Rs)**	**ED including CESS (Rs)**	**CST/VAT (Rs)**	**Freight including service tax, if applicable and insurance (Rs)**	**Total FOR site price (Rs)**	**Unit Price (Rs)**	**Total Price (Rs)**	**Service Tax (Rs)**	**Total Price Including service tax (Rs)**	**Total Price Supply and E&C (Rs)**
					1	**2**	**3**	**4**	**5 (1+2+3+4)**		**6**	**7**	**8 (6+7)**	**5+8**
1.0	Total lumpsum firm prices for Equipment & Services as Specified, Comprising design, manufacture, inspection & Testing at manufacturers works, Painting at manufactures works, duly packed for transportation, delivery to site, unloading storage & handling at site, erection & commissioning, carrying out acceptance tests at site **& final painting of complete Ventilation System on turnkey basis** as per ***Specification PE-TS-360-554-A001*** including maintenance tools & tackles, and recommended spares etc.													
2.0	Break up prices for items covered in clause 1.0 above.In case, price indicated above does not match with item wise break-up given at 2.0, the highest price so calculated shall be considered for evaluation but in case of order, the same shall be placed at the lowest price.													
	VENTILATION SYSTEM													
2.1	Sheet Metal containerised type air washer unit with centrifugal fan with motor, pumps with motors, dry panel type pre-filter, spray header with water piping, valves & all fittings complete with fixing frame,valves for auto start of standby equipment, air washer internals, inlet air louvers, Bird sceen, nozzles,strainers, makeup water piping with isolating valves at battery limit, piping as per IS: 1239 pt I (heavy class galvanised), valves, nozzles, level switch, pressure switches, Temp. Indicators, back wash arrangement, galvanised drain piping, vibration isolators for fans **with control panels** etc. as per spec. (Each Air Waher shall have 2X65,000 CMH capacity fan at 75 mmwc. static pressure) as specified.	4	Sets											
2.1.1	Unitary air filtration unit with centrifugal fan (SISW) with motor, pumps with motors, SS metalic filter, spray header with water piping, valves & all fittings complete with fixing frame,valves for auto start of standby equipment, inlet air louvers, Bird sceen, nozzles,strainers, makeup water piping with isolating valves at battery limit, piping as per IS: 1239 pt I (heavy class galvanised), valves, level switch, pressure switches, Temp. Indicators, back wash arrangement, galvanised drain piping, vibration isolators for fans **with control panels** etc. as per spec. (Fan capacity 50,000 CMH at 60 mmwc. static pressure) as specified.	1	Sets											

DPL DURGAPUR THERMAL POWER PLANT 1x250 MW

VENTILATION SYSTEM

SUGGESTIVE PRICE FORMAT

				SUPPLY						ERECTION & COMMISSIONING				TOTAL
Sl.No	DESCRIPTION OF EQUIPMENT / ITEM	Qty.	Unit	Unit Price (Rs)	Total Ex works Price (Rs)	ED including CESS (Rs)	CST/VAT (Rs)	Freight including service tax, if applicable and insurance (Rs)	Total FOR site price (Rs)	Unit Price (Rs)	Total Price (Rs)	Service Tax (Rs)	Total Price Including service tax (Rs)	Total Price Supply and E&C (Rs)
					1	2	3	4	5 (1+2+3+4)		6	7	8 (6+7)	5+8
2.2 *	DUCTING, DIFFUSER/GRILL, THERMAL INSULATION FOR DUCT													
2.2.1 *	***Finished GSS*** (zinc coating 275 gms/sq.m) Ducting with hangers, supprts, volume control dampers, splitters,access doors, supporting structure etc.													
2.2.1 (a)	18 G	1000	SQM*											
2.2.1 (b)	20 G	1250	SQM*											
2.2.1 (c)	22 G	1250	SQM*											
2.2.1 (d)	24 G	1000	SQM*											
2.2.2 *	MS Duct With Epoxy paint for Battery room.	50	SQM*											
2.2.3*	MS Grilles with VCD	60	SQM*											
2.2.4*	MS Grilles without VCD	10	SQM*											
2.2.5*	Finished Thermal insulation 25 mm thick fiber glass wool 24 kg /m3 density confirming to IS : 8183 and finished with sand cement plaster as specified for supply air duct (This is applicable for the ducting which is Exposed to Sun).	600	SQM*											
2.2.6*	Wall mounted dampers (gravity operated) for aux. bldg. only.	20	SQM*											
2.2.7*	Inlet Louvres for Aux. Bldgs. only.	10	SQM*											
2.3*	**Fire damper**													
2.3.1 *	Fire damper with auto resetting, limit switches, indication lamps etc.	8	SQM*											
2.3.2 *	Motorized actuator with single phase power supply for the above fire damper.	10	Nos*											
2.4*	Roof extractor units (Axial flow type) with hood, disconnect switch, bird screen and all accessories as specified													
2.4.1*	40,000 CMH at 15 mm WC	8	Nos*											
2.4.2 *	20,000 CMH at 15 mm WC	2	Nos*											

DPL DURGAPUR THERMAL POWER PLANT 1x250 MW

VENTILATION SYSTEM

SUGGESTIVE PRICE FORMAT

				SUPPLY						ERECTION & COMMISSIONING				TOTAL
Sl.No	DESCRIPTION OF EQUIPMENT / ITEM	Qty.	Unit	Unit Price (Rs)	Total Ex works Price (Rs)	ED including CESS (Rs)	CST/VAT (Rs)	Freight including service tax, if applicable and insurance (Rs)	Total FOR site price (Rs)	Unit Price (Rs)	Total Price (Rs)	Service Tax (Rs)	Total Price Including service tax (Rs)	Total Price Supply and E&C (Rs)
					1	2	3	4	5 (1+2+3+4)		6	7	8 (6+7)	5+8
2.5*	Axial flow supply fans with pre filter & fine filter (Wall mounted) complete with casing, TEFC Squirrel Cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories as specified													
2.5.1*	15,000 CMH at 30 mmWC	1	Nos*											
2.5.2*	10,000 CMH at 30 mmWC	4	Nos*											
2.5.3*	8,000 CMH at 30 mmWC	5	Nos*											
2.5.4*	6000 CMH at 30 mmWC	4	Nos*											
2.5.5*	4000 CMH at 30 mmWC	2	Nos*											
2.6*	Axial flow exhaust fans Wall mounted complete with casing, flame proof motors, mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted as specified.													
2.6.1*	15,000 CMH at 15 mmWC	2	Nos*											
2.6.2*	7500 CMH at 15 mmWC	1	Nos*											
2.6.3*	6000 CMH at 15 mmWC	2	Nos*											
2.7*	Axial flow exhaust fans Spark proof construction, Wall mounted complete with casing, flame proof motors, mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted as specified, for Battery room.													
2.7.1*	15000 CMH at 20 mmWC	2	Nos*											
2.7.2*	10000 CMH at 20 mmWC	2	Nos*											
2.7.3*	7500 CMH at 20 mmWC	2	Nos*											
2.7.4*	5000 CMH at 20 mmWC	2	Nos*											
2.8*	Axial flow exhaust fans (Wall mounted) complete with casing, TEFC Squirrel Cage induction motors & mounting frame, MS rain protection cowl with bird screen, wire guard at inlet and all other accessories as specified													

DPL DURGAPUR THERMAL POWER PLANT 1x250 MW

VENTILATION SYSTEM

SUGGESTIVE PRICE FORMAT

				SUPPLY						ERECTION & COMMISSIONING				TOTAL
Sl.No	**DESCRIPTION OF EQUIPMENT / ITEM**	**Qty.**	**Unit**	**Unit Price (Rs)**	**Total Ex works Price (Rs)**	**ED including CESS (Rs)**	**CST/VAT (Rs)**	**Freight including service tax, if applicable and insurance (Rs)**	**Total FOR site price (Rs)**	**Unit Price (Rs)**	**Total Price (Rs)**	**Service Tax (Rs)**	**Total Price Including service tax (Rs)**	**Total Price Supply and E&C (Rs)**
					1	**2**	**3**	**4**	**5 (1+2+3+4)**		**6**	**7**	**8 (6+7)**	**5+8**
2.8.1*	10000 CMH at 7 mmWC	2	Nos*											
2.8.2*	6300 CMH at 7 mmWC	6	Nos*											
2.8.3*	2000 CMH at 7 mmWC (with Grease Filter) for pentry room.	2	Nos*											
2.9*	Exhaust fan (Propeller type) completes with induction motor & mounting frame MS rain protection cowl, bird screen and all other accessories as specified. (suitable for 220V/1 Phase) for Toilets.													
2.9.1*	1200 CMH at 5 mmWC	20	Nos*											
2.10	Field instruments/ Switches and interface to the control system for the system completeness to achieve monitoring and control functions specified.	1	Lot											
2.11	Local push button stations	1	Lot											
2.12	PRICES FOR TOTAL SYSTEM DESIGN & ENGINEERING.	1	Lot											
2.13	Any other item not indicated above, but required to complete Ventilation package as per system requirements.	1	Lot											
2.14	Total lump sum prices for Maintenance Tool & Tackles inclusive of packing, forwarding, transportation upto site, taxes, duties, insurance etc	1	Lot											
2.15	Bidder's lump sum prices for commissioning spares inclusive of packing forwarding, transportation up to site, taxes, duties, etc. (bidder to furnish lists of spares with item wise prices separately).	1	Lot											
3	**OPTIONAL PRICES**													
3.10	Bidder's total lump sum prices for mandatory spares as per list attaches elsewhere in the specifications.	1	Lot											
NOTES :														

1	The bidder shall furnish unit rates for variable item (marked *) i.e., Finished ducting, supply grilles (with and without VCD), fire damper, Finished thermal insulation for ducting, gravity damper, Louvers for Aux. Bldg. only, RE Units, Axial Flow fans (Supply/Exhaust), Propellor Fans etc 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 this 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 in any case since that may lead to cancellation of bidder's offer.
4	At any stage during the contract execution, for any variation in the BOQ of variable items, the L-1 bidder on whom the order is placed, will maintain the overall L1 status by restricting the total contract price accordingly.
5	Lot, shall be quantified during detailed engineering stage by the ventilation plant supplier.

VOLUME-III
REV-0

DESIGN, MANUFACTURING, SUPPLY, ERECTION, TESTING & COMMISSIONING OF VENTILATION SYSTEM FOR 1X250 MW DURGAPUR TPS AT DURGAPUR, WEST BENGAL

GUARANTEED POWER CONSUMPTION

SL NO	DESCRIPTION	QUANTITY (WORKING)	POWER CONSUMPTION AS GUARANTEED (KW) AT MOTOR INPUT TERMINAL	TOTAL POWER CONSUMPTION AS GUARANTEED (KW)
(1)	(2)	(3)	(4)	(5)=(3)x(4)
1.0	Centrifugal fans for air-washer units, 65,000 cumh at 75 mmwc.	8		
2.0	Cent. Pump Backpullout type for above air washer.	4		
3.0	Centrifugal fans for UAF unit, 50,000 cumh at 60 mmwc.	1		
4.0	pump for above UAF	1		
5.0	**RE units.**			
5.1	40,000 cmh at 15 mmwc.	7		
TOTAL CONSUMPTION (KW)				**339**

Notes: 1. Estimated power consumption figure for the Ventilation System (for MAIN POWER HOUSE BLDG. AREAS AND ESP/VFD CONTROL ROOM) has been considered is 339 kw.

2. Bidder's guaranteed power consumption at motor input terminals (not shaft power) as furnished in guaranteed schedule shall be demonstrated by the successful bidder during performance testing at works/site.

3. In case the power consumption is noted higher than estimated power consumption figure (kW) during the inspection /PG test, the penalty @ Rs 1,87,400 for each one (1) kw excess power consumption shall be levied on the supplier.

SIGNATURE WITH SEAL
OF BIDDER

FORMAT FOR NO DEVIATION CERTIFICATE
(To be submitted in the bidder's letter head)

BHARAT HEAVY ELECTRICALS LIMITED,
Power Sector - Northern Region,
Plot no 25, Sector – 16A,
NOIDA – 201301

Sub	No Deviation Certificate.	
Job	Design, engineering, manufacturing, supply, erection, commissioning etc of Ventilation System for 1X250 MW DURGAPUR TPS UNIT # 8 at Durgapur, West Bengal.	
Ref	01	Tender no
	02	BHEL's NIT, vide reference no
	03	Our offer, vide reference no _____, dated _____.
	04	Other references (if any).

Dear Sirs,

With reference to above, this is to confirm that as per tender conditions, we have visited site before submission of our offer and noted the job content & site conditions etc. We also confirm that we have not changed / modified the tender documents as appeared in the website/ issued by you and in case of such observance at any stage, it shall be treated as null and void.

We hereby confirm that we have not taken any deviation from tender clauses together with other references as enumerated in the above referred NIT. We hereby confirm our unqualified acceptance to all terms & conditions and unqualified compliance to technical specification.

In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null & void.

We confirm to have submitted offer in accordance with tender instructions and as per aforesaid references.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized representative of the bidder)

	TITLE : 1X250 MW DURGAPUR TPS, UNIT # 8	Spec. No.: PE-TS-360-554-A001.
	VENTILATION FANS (AXIAL FLOW)	Volume III Part
	DATA SHEET 'B'	Sheet 1 of 2

SL.NO.	ITEM	UNIT	PARTICULARS
1.	Manufacturer	--	
2.	Model No.	--	
3.	Nos. offered	--	
4.	Area	--	
5.	Specific weight of air at temp.	Kg/M^3	
6.	Static pressure at rated speed	MMWG	
7.	Total pressure at rated speed	MMWG	
8.	Outlet velocity of air	M/sec	
9.	Rated speed	RPM	
10.	Critical speed of fan shaft & impeller assembly	RPM	
11.	Tip speed	M/sec	
12.	Impeller dia	MM	
13.	No. of blades	--	
14.	Pitch angle	Degree	
15.	Efficiency at rated speed	%	
16.	Fan power at rated speed	KW	
17.	Recommended/selected motor	KW	
18.	Material of impeller & thickness and code conference	MM	
19.	Material of casing & thickness and code conference	MM	
20.	Material of casing & shaft and diameter code conference	MM	
21.	Type of bearing & material		
22.	Type of drive & manufacturer		
23.	Percentage reduction in capacity of fan when any of the following are added a) Inlet cone or bell		

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	b) Outlet cone c) Louver shutter d) Wall cowl e) Wire mesh guard	% % % % %	
24.	Motor data a) Voltage, phase, frequency b) Rated KW c) Type of enclosure d) Type of insulation e) Motor design ambient of temp.	 V/ph/HZ KW -- -- °C	
25.	Motor data sheet B as per spec. PES-5-6-02 furnished		Yes / No
26.	Fan statically & dynamically balanced		Yes / No
27.	Weight of fan/motor/base drive	Kg	
28.	Fan sound pressure level at 3 impeller dia from center of fan inlet/outlet (with ref. To $10^5 N/M^2$)	Db (A)	
29.	Performance curves enclosed		Yes / No

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

1	**TITLE : 1X250 MW DURGAPUR TPS, UNIT # 8** **LOW PRESSURE AIR DISTRIBUTION SYSTEM**	Spec. No.: PE-TS-360-554-A001. Volume - III Part
	DATA SHEET 'B'	Sheet 1 of 2

S.NO	ITEM	UNIT	PARTICULARS
1.0	Material & code conformance of duct sheets	--	
2.0	Zinc coating/class as per IS-277	gms/m^2	
3.0	Any deviation from specification requirements for construction & fabrication		Yes/No
4.0	Following accessories included		Yes/No
4.1	Branch dampers		Yes/No
4.2	Fire dampers		Yes/No
4.3	Guide vanes		Yes/No
4.4	Duct supports		Yes/No
5.0	Qty. of duct sheets included 18G sheet 20G sheet Any other size	 M^2 M^2 M^2	
6.0	Qty. of supply air grilles & diffusers included	M^2	
7.0	Qty. of return air duct work, if any	M^2	
8.0	Thermal insulation		
8.1	Type/make/thickness	mm	
8.2	Qty.included		
9.0	Acoustics insulation	M^2	
9.1	Type/make/thickness	MM	
9.2	Qty.included	M^2	
10.0	Any deviation from inspection & testing requirements		Yes/No
11.0	Pressure drop across i. Supply air diffusers ii. Supply air grilles	 Mm WG Mm WG	
12.0	Velocity at outlet i. Grilles ii. Diffusers	 M / sec M / sec	
13.0	Throw of i. Grilles ii. Diffusers	 M M	

Name of Bidder / Vendor						
PROJECT NAME						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	TITLE: 1X250 MW DURGAPUR TPS, UNIT # 8	Spec. No.: PE-TS-360-554-A001
	AIR FILTER	Volume III Part
	DATA SHEET 'B'	Sheet 1 of 1

S.NO	ITEM	UNIT	PARTICULARS
1.	Manufacture	--	
2.	Model No.	--	
3.	Type	--	
4.	Size	mm xmmxmm	
5.	Rating	M^3/hr	
6.	Nos.	--	
7.	Efficiency	Microns	
8.	Test method	--	
9.	Press drop at clean conditions	Mm wg	
10.	Press drop at dirty conditions	Mm wg	
11.	Filter media	--	
12.	Whether cleanable	--	
13.	Material of frame	--	
14.	Weight of filter	Kg	
15.	Mounting frame work	--	

Name of Bidder / Vendor						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	TITLE: 1X250 MW DURGAPUR TPS, UNIT # 8	Spec. No.: PE-TS-360-554-A001
	CENTRIFUGAL PUMP	Volume III Part
	DATA SHEET 'B'	Sheet 1 of 3

SL.NO.	ITEM	UNIT	PARTICULARS
1.	Manufacturer's name		
2.	Designation of pump		
3.	Model No.		
4.	Type of pump		
5.	Nos. provided		
6.	Capacity	M^3/hr	
7.	TDH at rated capacity	MWC	
8.	No. of stages	--	
9.	Shut off head with discharge valve fully closed	MWC	
10.	Pump rated speed	RPM	
11.	NBSH required	MWC	
12.	Pump efficiency at duty point	%	
13.	Power required at pump Shaft at duty point	KW	
14.	Maximum power required at any operating point	KW	
15.	Motor rated capacity	KW	
16.	Material of construction & code conformance		
	i. Casing		
	ii. Shaft		
	iii. Impeller		
	iv. Bearings		
	v. Wearing ring		
	vi. Shaft sleeve		
	vii. Stuffing box packing		
	viii. Base plate	--	
	ix. Pump motor coupling	--	
	x. Counter flanges	--	
	xi. Bolts &nuts	--	
	xii. Stuffing box bush	--	
	xiii. Stuffing box gland		
17.	Drilling standard for flanges/ counter flanges	--	
18.	Bearing (type & nos. provided per set)	--	
19.	Method of lubrication of bearings	--	

Name of Bidder / Vendor						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

20.	Type of shaft sealing arrangement	--	
21.	Coupling (type)		
22.	Coupling guard provided?	--	Yes/No
23.	Method of fastening impeller to shaft	--	
24.	Base plates, foundation bolts and hardwares Provided?	--	Yes/No
25.	Lifting lugs, eye bolts etc. provided for each pump drive set.	--	Yes/No
26.	Counter flanges with nuts, bolts and gaskets provided?	--	Yes/No
27.	Direction of rotation	--	
28.	Maximum allowable particle size	--	
29.	Dimension		
29.1	Pump/motor Length Width Height	 mm mm mm	
29.2	Length and width of base plate	mmxmm	
29.3	Suction dia	mm	
29.4	Discharge dia	mm	
30.	Weights		
30.1.	Completely assembled pump and drive motor	Kg	
30.2	Weight of pump only	Kg	
30.3	Weight of motor	Kg	
30.4	Maximum weight to be handled during erection and maintenance	Kg	
30.5	Total shipping weight	Kg	
31.	Testing		
31.1	Hydrostatic test pressure	Kg/cm^2 (g)	

Name of Bidder / Vendor						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

31.2	Duration of test	Hr	
31.3	Testing and inspection provided as per purchaser's requirement	--	Yes/no
32.	Painting details Painting details would be furnished to the successful bidder during contract stage.		

Name of Bidder / Vendor						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

DEVIATION SHEET: PART-B
(TECHNICAL)

If the proposal has got any deviation from the stipulations of “General Specification and Technical Specification”, (Volume-II) the Bidder shall tabulate the same with full particulars quoting the relevant clause/clauses. Vague references such as “See Covering letter”, etc. are not acceptable. Compliance with the specification will be taken for granted in absence of any departure from any of the clauses of the “General Specification and Technical Specification” if it is not mentioned in this Schedule. The price implications for the deviations shall be indicated in Deviation sheet part C. Add more sheets, if necessary.

Clause No.	**Deviation, if any**

SEAL OF COMPANY

Signature : .....

Name : .....

Designation

DEVIATION SHEET PART - C

Against each and every deviation from the Technical Specification as enumerated in the Deviation Sheet (Part - B), the amount by which the bid price will thereby be increased or decreased be intimated clause by clause in this Schedule. In case the amount is not mentioned in the Schedule against any of the deviations mentioned in Deviation Sheet (Part - B), it will be taken for granted that the same does not involve any change in the Bid Price.

Clause No.	Deviation, if any	Amount by which the Bid Price will change	
		Increase (Rs.)	Decrease (Rs.)

SEAL OF COMPANY

Signature : .....

Name : .....

Designation : .....

TITLE	SPECIFICATION NO.: PE-TS-360-554-A-001
SCHEDULE OF WEIGHTS AND DIMENSIONS 1X250 MW DURGAPUR TPS UNIT # 8	VOLUME III PART A
	SHEET OF

The bidder shall state below the weights and dimensions of various packages for shipment covering the complete scope.

Description of package(s)	Dimensions in (meter)	Weight (in tones)

PARICULARS OF BIDDER / AUTHORISED REPRESENTATIVE			
NAME	DESIGNATION	SIGN DATE	COMPANY SEAL

TITLE SCHEDULE OF EQUIPMENT MANUFACTURE DESPATCH TO SITE	SPECIFICATION NO.: PE-TS-360-554-A-001
	VOLUME III PART 'A'
	SHEET OF

S.N.	Equipment / Major Bought out Items	Time for manufacture/procurement from date of issue of letter of intent (weeks)	Time for test, dismantling, packing & ready for dispatch (weeks)	Time required for shipment to site (weeks)	Total time from date of issue of letter of intent to shipment to site (weeks)

Particulars of Bidders / Authorized Representative			
Name	Designation	Sign Date	Company seal

	Title: SCHEDULE OF DEVIATION **1X250 MW DURGAPUR TPS** **UNIT # 8** **VENTILATION SYSTEM**	SPECIFICATION NO.: PE-TS-360-554-A-001 VOLUME III PART A SHEET OF

( ) From general terms and conditions of contract and special condition of contract (Vol. I)
( ) From technical specifications (Vol. II B)
( ) From general terms and conditions of contract for erection (vol. I)
( ) From general technical conditions (Vol. IIC)

Note: Each type of deviation shall be listed on a separate sheet.

We the undersigned hereby certify that the above-mentioned information's are the ONLY deviations.

NAME	DESIGNATION	SIGN DATE	COMPANY SEAL

1X250 MW DURGAPUR TPS
UNIT # 8
Deviation /clarification list - Technical & Commercial

Sl. No.	Vol No / Sec No.	Clause No.	Page No.	Specification requirement	Comments / Clarifications / Deviations	Remarks

VOLUME-III
PRICE SCHEDULE, REV-01

Design, engineering, manufacturing, supply/ delivery, storage & handling, erection, commissioning, trial run, handing over to customer etc of Ventilation System for 1x250 MW unit at DPL, Durgapur, WB.

TENDER NO - PSER:SCT:DPL-M1275:11

PREAMBLE

01	This preamble forms part of tender document and schedule of items. The tenderer should read this preamble carefully in rates for various items. Clauses under this preamble shall be read in conjunction with Volume-IA, Volume-IB, Volume-IC, Volume-ID, Volume–II together with subsequent changes/ modifications etc thereto as applicable as on date of submission of price offer.
02	The work shall be carried out strictly as per specifications, description of the items in these schedule and/ or engineer's instructions.
03	Items of work provided in this schedule but not covered in this specification shall be executed strictly as per instruction of the engineer.
04	Unless specifically mentioned otherwise in the tender document, the tenderer shall quote for the finished items and shall provide for the complete cost towards power, fuel, tools, tackles, equipment, constructional plants, temporary works, labour, dismantling of all temporary piping, structures, valves, pumps, tanks & other misc equipment, strengthening of roads/ culverts/ bridges etc including arranging all clearances etc required for carrying out different activities & tests, materials, levies, taxes, transport, layout, repairs, rectification, maintenance till handing over, supervisions, colonies, shops, establishments, overheads, profits and all incidental items not specifically mentioned but reasonably implied and necessary to complete the work according to the tender document and this schedule.
05	The rates quoted shall be inclusive of cleaning of site of any vegetation, dressing and leveling etc including fixing of grid pillars, benchmarks etc required for commencement of site activities. No separate payment will be made towards the same.
06	Rates shall be quoted in figures and in words in clear legible writing. No overwriting is allowed. All scoring and cancellations should be countersigned and in case of illegibility the interpretation of engineer shall be final. All entries shall be in English.
07	The tender shall be deemed to have visited site and made himself aware of all the site conditions, studied the specifications and details of work to the done within the time schedule attached and to have acquainted himself of the conditions prevailing at site.
08	Engineer's decision shall be final and binding on the contractor regarding clarification of items in the schedule with respect to the other sections/volumes of the contract.
09	Unless otherwise specified & except for tender on lumpsum basis, for all item rate based tenders, the quantities of the various items mentioned in price schedule are approximate, based on very preliminary information and may vary to any extent or to be deleted altogether. The quoted/ accepted rates shall remain firm and valid as long as variation in total value of work executed under this contract including extra items, but excluding any price escalation, remains within +/- 30% (thirty percent) of the contract price given in the LOI/ WO.

VOLUME-III
PRICE SCHEDULE, REV-01

Design, engineering, manufacturing, supply/ delivery, storage & handling, erection, commissioning, trial run, handing over to customer etc of Ventilation System for 1x250 MW unit at DPL, Durgapur, WB.

TENDER NO - PSER:SCT:DPL-M1275:11

SCH-1 - MAIN PRICE

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	TOTAL QUOTED PRICE (`)
1.0	Total price for supply part & service part together for design, engineering, manufacturing, inspection and testing, painting, supply/ delivery duly packed at project site including freight, receipt, unloading, storage & handling at site, erection, commissioning, trial run, handing over to customer, operation & maintenance (O&M), etc in line with drawings/ documents/ test procedures approved by BHEL/ customer, including supply of consumables, start-up & commissioning spares, special tools & tackles for maintenance, for the total scope defined in technical specification and terms & conditions of tender, taking into account all clarifications, confirmations and agreements till date for Ventilation System.	

Note

1.0	Bidder to note that total price indicated above at 1.0 shall be considered for evaluation and hence should be complete in all respect for the full scope defined and considering all terms and conditions.
2.0	While total price at sl no 1.0 as per above will be considered for evaluation, bidder shall furnish further break-up of price in the following schedules.
2.1	SCH-2 - Main price break-up.
2.2	SCH-3 - Supply price break-up.
2.3	SCH-4 - Service price break-up.
3.0	Any item as per scope of work if not included in the price quoted above and shown separately will not be taken into cognizance and the offer shall be liable for rejection.
4.0	Total price of 1.1 & 1.2 should match with 1.0.
5.0	Total price of supply price break up should match with 1.1.
6.0	Total price of service price break up should match with 1.2.
7.0	Bidder shall note that VAT & Service Tax (On service part) shall be paid extra at actual as per tender provision. As such, bidder's price shall be exclusive of these 2 components and evaluation of bidders total price will be done on this basis.
8.0	There will be no technical loading for evaluation of bids on power consumption. However, in case power consumption is noted higher than estimated total power consumption figure specified in relevant portion schedule during the inspection/ PG test, penalty @ Rs 1.87 lac per additional KW shall be levied on vendor.
9.0	If freight component is not specifically indicated, 2 % of total amount will be considered as freight component against each item for further processing.
10.0	The bidder shall furnish unit rates for variable item (marked *) for necessary adjustment (plus or minus) variation during detailed engineering stage. The quantity of variable items is likely to vary during detailed design & engineering stage mainly due to changes in building layouts/ dimensions etc necessitating change in quantities of variable items as above. The unit rates quoted & accepted by BHEL shall be considered and no separate unit rates shall be quoted. Unit rates shall be valid throughout the contract. Bidder to note that BHEL reserve the right to rationalize the rates quoted by L-1 bidder against variable items and with respect to item-wise lowest rates (amongst the participating bidders), before placement of order.
11.0	Price format shall not be changed by bidder in any case, since it may lead to cancellation of bidder's offer.

VOLUME-III
PRICE SCHEDULE, REV-01

Design, engineering, manufacturing, supply/ delivery, storage & handling, erection, commissioning, trial run, handing over to customer etc of Ventilation System for 1x250 MW unit at DPL, Durgapur, WB.

TENDER NO - PSER:SCT:DPL-M1275:11

SCH-2 - MAIN PRICE BREAK-UP

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	QUOTED PRICE (`)				
		BASIC PRICE	ED (As per tender)	CST (As per tender)	FREIGHT	TOTAL
(1)	(2)	(3)	(4)	(5)	(6)	(7)=(3) ~ (6)
1.1	Total price for supply part for design, engineering, manufacturing, inspection and testing, painting, supply/ delivery duly packed at project site including freight, in line with drawings/ documents/ test procedures approved by BHEL/ customer, including supply of consumables, start-up & commissioning spares, special tools & tackles for maintenance, for the total scope defined in technical specification and terms & conditions of tender, taking into account all clarifications, confirmations and agreements till date for Ventilation System.					
1.2	Total price for service part for receipt, unloading, storage & handling at site, erection, commissioning, trial run, handing over to customer, operation & maintenance (O&M), etc in line with drawings/ documents/ test procedures approved by BHEL/ customer, for the total scope defined in technical specification and terms & conditions of tender, taking into account all clarifications, confirmations and agreements till date for Ventilation System.		NA			
TOTAL						

VOLUME-III
PRICE SCHEDULE, REV-01

Design, engineering, manufacturing, supply/ delivery, storage & handling, erection, commissioning, trial run, handing over to customer etc of Ventilation System for 1x250 MW unit at DPL, Durgapur, WB.

TENDER NO - PSER:SCT:DPL-M1275:11

SCH-3 - SUPPLY PRICE BREAK-UP

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY		QUOTED UNIT RATE (`)					QUOTED AMOUNT (`)				
				BASIC	ED (As per tender)	CST (As per tender)	FREIGHT	TOTAL	**BASIC**	**ED** (As per tender)	**CST** (As per tender)	**FREIGHT**	**TOTAL**
(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)=(4) ~ (7)	(9)	(10)	(11)	(12)	(13)=(9) ~ (12)
Price break-up of 1.1 of SCH-2.													
1.1.1	Sheet metal containerised type air washer unit with centrifugal fan with motor, pumps with motors, dry panel type pre-filter, spray header with water piping, valves & all fittings complete with fixing frame, valves for auto start of standby equipment, air washer internals, inlet air louvers, bird sceen, nozzles,strainers, makeup water piping with isolating valves at battery limit, piping as per IS:1239, P-I (heavy class galvanised), valves, nozzles, level switch, pressure switches, temp indicators, back wash arrangement, galvanised drain piping, vibration isolators for fans etc as per specification (Each air waher shall have 2x65,000 CMH capacity fan at 75 mmwc static pressure) as specified.	4	SET										

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY		QUOTED UNIT RATE (`)					QUOTED AMOUNT (`)				
				BASIC	ED (As per tender)	CST (As per tender)	FREIGHT	TOTAL	**BASIC**	**ED** (As per tender)	**CST** (As per tender)	**FREIGHT**	**TOTAL**
(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)=(4) ~ (7)	(9)	(10)	(11)	(12)	(13)=(9) ~ (12)
1.1.2	Unitary air filtration unit with centrifugal fan (SISW) with motor, pumps with motors, SS metalic filter, spray header with water piping, valves & all fittings complete with fixing frame, valves for auto start of standby equipment, inlet air louvers, bird sceen, nozzles,strainers, makeup water piping with isolating valves at battery limit, piping as per IS:1239, P-I (heavy class galvanised), valves, level switch, pressure switches, temp indicators, back wash arrangement, galvanised drain piping, vibration isolators for fans etc as per specification (Fan capacity 50,000 CMH at 60 mmwc static pressure) as specified.	1	SET										
1.1.3*	Ducting, diffuser/ grill, thermal insulation for duct.												
1.1.3.1*	Finished GSS (zinc coating 275 gms/sqm) ducting with hangers, supprts, volume control dampers, splitters, access doors, supporting structure etc.												
1.1.3.1.1*	18 G	1000	SQM										
1.1.3.1.2*	20 G	1250	SQM										
1.1.3.1.3*	22 G	1250	SQM										
1.1.3.1.4*	24 G	1000	SQM										
1.1.3.2*	MS duct with epoxy paint for battery room.	50	SQM										
1.1.3.3*	MS grilles with VCD.	60	SQM										
1.1.3.4*	MS grilles without VCD.	10	SQM										
1.1.3.5*	Finished thermal insulation 25 mm thick fiber glass wool 24 kg/ m3 density confirming to IS:8183 and finished with sand cement plaster as specified for supply air duct (This is applicable for the ducting which is exposed to the Sun).	600	SQM										
1.1.3.6*	Wall mounted dampers (gravity operated) for aux bldg only.	20	SQM										

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY		QUOTED UNIT RATE (`)					QUOTED AMOUNT (`)				
				BASIC	ED (As per tender)	CST (As per tender)	FREIGHT	TOTAL	**BASIC**	**ED** (As per tender)	**CST** (As per tender)	**FREIGHT**	**TOTAL**
(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)=(4) ~ (7)	(9)	(10)	(11)	(12)	(13)=(9) ~ (12)
1.1.3.7*	Inlet louvres for aux buildings only.	10	SQM										
1.1.4*	Fire damper												
1.1.4.1*	Fire damper with auto resetting, limit switches, indication lamps etc.	8	SQM										
1.1.4.2*	Motorized actuator with single phase power supply for the above fire damper.	10	NO										
1.1.5*	Roof extractor units (Axial flow type) with hood, disconnect switch, bird screen and all accessories as specified.												
1.1.5.1*	40,000 CMH at 15 mm WC.	8	NO										
1.1.5.2*	20,000 CMH at 15 mm WC.	2	NO										
1.1.6*	Axial flow supply fans with pre filter & fine filter (Wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories as specified.												
1.1.6.1*	15,000 CMH at 30 mm WC.	1	NO										
1.1.6.2*	10,000 CMH at 30 mm WC.	4	NO										
1.1.6.3*	8,000 CMH at 30 mm WC.	5	NO										
1.1.6.4*	6000 CMH at 30 mm WC.	4	NO										
1.1.6.5*	4000 CMH at 30 mm WC.	2	NO										
1.1.7*	Axial flow exhaust fans wall mounted complete with casing, flame proof motors, mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted as specified.												
1.1.7.1*	15,000 CMH at 15 mm WC.	2	NO										
1.1.7.2*	7500 CMH at 15 mm WC.	1	NO										
1.1.7.3*	6000 CMH at 15 mm WC.	2	NO										
1.1.8*	Axial flow exhaust fans spark proof construction, wall mounted complete with casing, flame proof motors, mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted as specified, for battery room.												
1.1.8.1*	15000 CMH at 20 mm WC.	2	NO										

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY		QUOTED UNIT RATE (`)					QUOTED AMOUNT (`)				
				BASIC	ED (As per tender)	CST (As per tender)	FREIGHT	TOTAL	**BASIC**	**ED** (As per tender)	**CST** (As per tender)	**FREIGHT**	**TOTAL**
(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)=(4) ~ (7)	(9)	(10)	(11)	(12)	(13)=(9) ~ (12)
1.1.8.2*	10000 CMH at 20 mm WC.	2	NO										
1.1.8.3*	7500 CMH at 20 mm WC.	2	NO										
1.1.8.4*	5000 CMH at 20 mm WC.	2	NO										
1.1.9*	Axial flow exhaust fans (Wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl with bird screen, wire guard at inlet and all other accessories as specified.												
1.1.9.1*	10000 CMH at 7 mm WC.	2	NO										
1.1.9.2*	6300 CMH at 7 mm WC.	6	NO										
1.1.9.3*	2000 CMH at 7 mm WC (with grease filter) for pentry room.	2	NO										
1.1.10*	Exhaust fan (Propeller type) completes with induction motor & mounting frame MS rain protection cowl, bird screen and all other accessories as specified (suitable for 220V/1 phase) for toilets.												
1.1.10.1*	1200 CMH at 5 mm WC.	20	NO										
1.1.11	Field instruments/ Switches and interface to the control system for the system completeness to achieve monitoring and control functions specified.	1	LOT										
1.1.12	Local push button stations	1	LOT										
1.1.13	Any other item not indicated above, but required to complete air-conditioning package as per system requirements	1	LOT										
1.1.14	Total price for special tools & tackles for maintenance. (Bidder to submit item-wise un-priced break-up in techno-commercial offer and price offer)	1	LOT										
1.1.15	Total price for start-up and commissioning spares. (Bidder to submit item-wise un-priced break-up in techno-commercial offer and price offer)	1	LOT										
TOTAL													

VOLUME-III
PRICE SCHEDULE, REV-01

Design, engineering, manufacturing, supply/ delivery, storage & handling, erection, commissioning, trial run, handing over to customer etc of Ventilation System for 1x250 MW unit at DPL, Durgapur, WB.

TENDER NO - PSER:SCT:DPL-M1275:11

SCH-4 - SERVICE PRICE BREAK-UP

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY		UNIT RATE (`)	AMOUNT (`)
Price break-up of 1.2 of SCH-2.					
1.2.1	Sheet metal containerised type air washer unit with centrifugal fan with motor, pumps with motors, dry panel type pre-filter, spray header with water piping, valves & all fittings complete with fixing frame, valves for auto start of standby equipment, air washer internals, inlet air louvers, bird sceen, nozzles,strainers, makeup water piping with isolating valves at battery limit, piping as per IS:1239, P-I (heavy class galvanised), valves, nozzles, level switch, pressure switches, temp indicators, back wash arrangement, galvanised drain piping, vibration isolators for fans etc as per specification (Each air waher shall have 2x65000 CMH capacity fan at 75 mmwc static pressure) as specified.	4	SET		
1.2.2	Unitary air filtration unit with centrifugal fan (SISW) with motor, pumps with motors, SS metalic filter, spray header with water piping, valves & all fittings complete with fixing frame, valves for auto start of standby equipment, inlet air louvers, bird sceen, nozzles,strainers, makeup water piping with isolating valves at battery limit, piping as per IS:1239, P-I (heavy class galvanised), valves, level switch, pressure switches, temp indicators, back wash arrangement, galvanised drain piping, vibration isolators for fans etc as per specification (Fan capacity 50,000 CMH at 60 mmwc static pressure) as specified.	1	SET		
1.2.3*	Ducting, diffuser/ grill, thermal insulation for duct.				
1.2.3.1*	Finished GSS (zinc coating 275 gms/sqm) ducting with hangers, supprts, volume control dampers, splitters, access doors, supporting structure etc.				
1.2.3.1.1*	18 G	1000	SQM		
1.2.3.1.2*	20 G	1250	SQM		
1.2.3.1.3*	22 G	1250	SQM		
1.2.3.1.4*	24 G	1000	SQM		
1.2.3.2*	MS duct with epoxy paint for battery room.	50	SQM		
1.2.3.3*	MS grilles with VCD.	60	SQM		
1.2.3.4*	MS grilles without VCD.	10	SQM		
1.2.3.5*	Finished thermal insulation 25 mm thick fiber glass wool 24 kg/ m3 density confirming to IS:8183 and finished with sand cement plaster as specified for supply air duct (This is applicable for the ducting which is exposed to the Sun).	600	SQM		
1.2.3.6*	Wall mounted dampers (gravity operated) for aux bldg only.	20	SQM		

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY		UNIT RATE (`)	AMOUNT (`)
1.2.3.7*	Inlet louvres for aux buildings only.	10	SQM		
1.2.4*	Fire damper				
1.2.4.1*	Fire damper with auto resetting, limit switches, indication lamps etc.	8	SQM		
1.2.4.2*	Motorized actuator with single phase power supply for the above fire damper.	10	NO		
1.2.5*	Roof extractor units (Axial flow type) with hood, disconnect switch, bird screen and all accessories as specified.				
1.2.5.1*	40,000 CMH at 15 mm WC.	8	NO		
1.2.5.2*	20,000 CMH at 15 mm WC.	2	NO		
1.2.6*	Axial flow supply fans with pre filter & fine filter (Wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories as specified.				
1.2.6.1*	15,000 CMH at 30 mm WC.	1	NO		
1.2.6.2*	10,000 CMH at 30 mm WC.	4	NO		
1.2.6.3*	8,000 CMH at 30 mm WC.	5	NO		
1.2.6.4*	6000 CMH at 30 mm WC.	4	NO		
1.2.6.5*	4000 CMH at 30 mm WC.	2	NO		
1.2.7*	Axial flow exhaust fans wall mounted complete with casing, flame proof motors, mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted as specified.				
1.2.7.1*	15,000 CMH at 15 mm WC.	2	NO		
1.2.7.2*	7500 CMH at 15 mm WC.	1	NO		
1.2.7.3*	6000 CMH at 15 mm WC.	2	NO		
1.2.8*	Axial flow exhaust fans spark proof construction, wall mounted complete with casing, flame proof motors, mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted as specified, for battery room.				
1.2.8.1*	15000 CMH at 20 mm WC.	2	NO		
1.2.8.2*	10000 CMH at 20 mm WC.	2	NO		
1.2.8.3*	7500 CMH at 20 mm WC.	2	NO		
1.2.8.4*	5000 CMH at 20 mm WC.	2	NO		
1.2.9*	Axial flow exhaust fans (Wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl with bird screen, wire guard at inlet and all other accessories as specified.				
1.2.9.1*	10000 CMH at 7 mm WC.	2	NO		
1.2.9.2*	6300 CMH at 7 mm WC.	6	NO		
1.2.9.3*	2000 CMH at 7 mm WC (with grease filter) for pentry room.	2	NO		
1.2.10*	Exhaust fan (Propeller type) completes with induction motor & mounting frame MS rain protection cowl, bird screen and all other accessories as specified (suitable for 220V/1 phase) for toilets.				
1.2.10.1*	1200 CMH at 5 mm WC.	20	NO		

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	QUANTITY		UNIT RATE (`)	AMOUNT (`)
1.2.11	Field instruments/ Switches and interface to the control system for the system completeness to achieve monitoring and control functions specified.	1	LOT		
1.2.12	Local push button stations	1	LOT		
1.2.13	Any other item not indicated above, but required to complete air-conditioning package as per system requirements.	1	LOT		
TOTAL					

VOLUME-III
PRICE SCHEDULE, REV-01

Design, engineering, manufacturing, supply/ delivery, storage & handling, erection, commissioning, trial run, handing over to customer etc of Ventilation System for 1x250 MW unit at DPL, Durgapur, WB.

TENDER NO - PSER:SCT:DPL-M1275:11

SCH-5 - GUARANTEED POWER CONSUMPTION

SL NO	DESCRIPTION	QUANTITY (WORKING)		POWER CONSUMPTION AS GUARANTEED (KW) AT MOTOR INPUT TERMINAL	TOTAL POWER CONSUMPTION AS GUARANTEED (KW)
1.0	Centrifugal fans for air-washer units, 65,000 cumh at 75 mmwc.	8	NO		
2.0	Centrifugal pump backpullout type for above air washer.	4	NO		
3.0	Centrifugal fans for UAF unit, 50,000 cumh at 60 mmwc	1	NO		
4.0	pump for above UAF	1	NO		
5.0	RE units.				
5.1	40,000 cmh at 15 mmwc.	7	NO		
TOTAL					
1.0	Estimated power consumption figure for the system (for working drives only) considered is 339 KW.				
2.0	Bidder's guaranteed power consumption at motor input terminals (not shaft power) including power for control panel as furnished in guaranteed schedule shall be demonstrated by the successful bidder during performance testing at works/ site.				

ANNEXURE - 2

FORMAT FOR NO DEVIATION CERTIFICATE
(To be submitted in the bidder's letter head)

BHARAT HEAVY ELECTRICALS LIMITED,
Power Sector - Eastern Region,
Plot no 9/1, DJ Block, Sector – II, Salt Lake City,
Kolkata – 700 091

Sub	No Deviation Certificate.	
Job	Design, engineering, manufacturing, supply/ delivery, storage & handling, erection, commissioning, trial run, handing over to customer etc of Ventilation System for 1x250 MW unit at DPL, Durgapur, WB.	
Ref	01	TENDER NO. PSER: SCT: DPL:M1275:11.
	02	BHEL's NIT, vide reference no PSER: SCT: DPL:M1275:11, Date:19-11-2011.
	03	BHEL's TCN-01, vide reference no PSER:SCT:DPL:M1275:TCN-01, Date: 07-12-2011.
	04	BHEL's TCN-02, vide reference no PSER:SCT:DPL:M1275:TCN-02, Date: 14-12-2011.
	05	BHEL's TCN-03, vide reference no PSER:SCT:DPL:M1275:TCN-03, Date: 17-12-2011.
	06	All other pertinent issues till date.

Dear Sirs,

With reference to above, this is to confirm that as per tender conditions, we have visited site before submission of our offer and noted the job content & site conditions etc. We also confirm that we have not changed/ modified the tender documents as appeared in the website/ issued by you and in case of such observance at any stage, it shall be treated as null and void.

We hereby confirm that we have not taken any deviation from tender clauses together with other references as enumerated in the above referred NIT. We hereby confirm our unqualified acceptance to all terms & conditions, unqualified compliance to technical specification, integrity pact (if applicable) and acceptance to reverse auctioning process.

In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null & void.

We confirm to have submitted offer in accordance with tender instructions and as per aforesaid references.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized representative of the bidder)