

THDC INDIA LIMITED

**4 X 111 MW VISHNUGAD PIPALKOTI
HYDRO ELECTRIC PROJECT**

TECHNICAL SPECIFICATION

FOR

HVAC SYSTEM

SPECIFICATION NO.: - PE-TS-413-571-11000-A-A001 (REV0)



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



TITLE:
4x111MW VISHNUGAD PIPALKOTI HEP
TECHNICAL SPECIFICATINS FOR
HVAC SYSTEM

SPECIFICATION No: PE-TS-413-571-11000A-A001

SECTION

REV. 00

DATE: JAN 2020

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SECTION - I



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SECTION-I

SUB-SECTION-A

INTENT OF SPECIFICATION



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1.0 INTENT OF SPECIFICATION

- 1.1 The specification covers design, engineering, manufacture, supply / procurement, inspection and testing at vendor's / sub vendor's / manufacturer's works, painting, forwarding, proper packing and shipment till storage area and delivery from storage area to site, unloading, handling & on-site transportation, storage, preservation , security / safety at site , Erection & Commissioning, minor civil & structural (as applicable) works as required on FOR site basis, Performance and guarantee testing / demonstration testing and handing over to BHEL's customer of **HVAC SYSTEM** as per details in different sections / volumes of this specification and various pre award agreements for **4X111 MW VISHNUGAD PIPALKOTI HYDRO ELECTRIC PROJECT**.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **HVAC SYSTEM**.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to highest standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.
- 1.5 The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL



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and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification **within 10 days of receipt of tender documents**. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Vol – III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.
- 1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, Section – C1 shall prevail over section – D, however more stringent requirement as per the interpretation of the owner shall apply.
- Further, In case of any discrepancy in section 'C1' and section 'C2', Section-C2 shall prevail (customer specification).
- 1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.11 For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser Employer, consultant, please refer relevant clause of GCC.



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PROJECT INFORMATION WITH WIND AND
SEISMIC DESIGN CRITERIA**

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**PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN
CRITERIA**

3. Site and Other Data

(Data is based on Joshimath observatory)

1. CLIMATIC CONDITIONS :

1.1 TEMPERATURE DATA

i)	Temperature of Air in shade	(Ever recorded)
	(a) Maximum temp	31 ⁰ C
	(b) Minimum temp	(-)2.9 ⁰ C
ii)	Maximum variation between day & night temperature during	
	(a) Winter	9.9 ⁰ C
	(b) Summer	11.6 ⁰ C
iii)	Maximum river water temperature (During June)	27 ⁰ C

1.2 RELATIVE HUMIDITY

Maximum	90%
---------	-----

1.3 RAINFALL DATA

i)	No. of months of tropical monsoon conditions	04
ii)	Average annual rainfall (at Joshimath)	1160 mm
iii)	Average Nos. of rainy days in a year	120
iv)	Occurrence of fog conditions	Nil

1.4 ALTITUDE

i)	Dam site(River Bed)	El 1225 m
ii)	Power House (Service bay level)	El 1041 m
iii)	Switchyard (Potyard over ground)	El 1130 m

2. SEISMICITY

The Project Area lies in the Himalayas which are known as a highly seismic belt.

Seismic data obtained from the Indian Meteorological Department to cover the area between latitude $28^{\circ} - 32^{\circ}$ N and longitude $76.5^{\circ} - 80.5^{\circ}$ E covers 1169 shocks recorded between the year 1720 to 2005 of magnitude 1.1 to 6.8 at Richter's Scale.

The Seismic Coefficient for the design of the equipment will be considered as specified in Bid Documents.

3. LOCATION AND ACCESS

The site is well connected with all weather roads and is connected to Ghaziabad-Haridwar-Rishikesh-Srinagar-Pipalkoti-Joshimath National Highway No. 58. The project site is about 225 km from Rishikesh.

4. HYDROLOGY

The river Alaknanda drains a catchment area of about 4672 Sq. km. at the proposed dam site. The water availability for the project i.e. the dependable flows for 90 % & 50% dependable year have been assessed as 3737Mcum and 5673 Mcum. The computed inflow series worked out has been adopted as 6700 m³/sec as SPF for design of spilling arrangement and the system has been checked for safe passage of PMF i.e. 10800 m³/sec.

5. POWER POTENTIAL STUDIES

The 33 years data of water flows on 10 daily basis has been analyzed. For determining 90 % & 50% dependable energy year, the power potential & energy generation for all the 33 years have been computed. An installation of 444 MW comprising generating units each of size 111MW have been proposed. The energy in 90 % dependable year has been summarized below.

Annual Energy Generation

Annual energy generation (GWh)	1812.90
Annual load factor (%)	46.61

Generation during lean flow season

Lean Period Avg. Power (MWc)	74.69
Load factor (%)	16.82

The design energy for tariff at 95% availability in 90 % dependable year has been worked out as 1797.12 GWh.

A pondage of 2.473 Mcum has been provided at diversion dam site, which would enable the station to operate **3.15hrs. per day**.

6. POWER EVACUATION ASPECTS

The 444 mw power generated at 13.8 kv at vishnugad pipalkoti hydro electric project, will be stepped upto 400 kv by unit step transformers. The power will be taken to pooling station near kuwari pass.

7. ENVIRONMENTAL ASPECTS

The proposed project entails submergence of 24.5 ha of area. Mainly forest and partly private land are coming under reservoir submergence. The key impacts are given as below:

- Impacts due to acquisition of forestland.
- Impacts on wildlife, especially species categorized as Schedule-I species as per Wildlife Protection Act (1972)
- Increased potential for fisheries in the reservoir as a result of construction of dam.
- Proper stabilization of quarry sites
- Management of pollution from various sources for labour camps
- Resettlement and Rehabilitation plan for families losing private land and homesteads in project affected villages.

As a part of IEE various management measures including pollution control measures during construction phase, minimal acquisition of forest area, compensatory afforestation, resettlement & rehabilitation plans, area development activities, installation of cyclones /in crushers, etc.

The proposed project is recommended for environmental clearance, which will require approval from Ministry of Environment and Forests, Government of India.

4. Salient Features

I. LOCATION:	
State	Uttarakhand
Distt.	Chamoli
River	Alaknanda
Dam site	Near Village Helong (E – 79 ⁰ 29'30") (N - 30 ⁰ 30'50")
P H site (underground)	Near Village Hat (E – 79 ⁰ 24'56") (N - 30 ⁰ 25'31")
II. HYDROLOGY:	
Catchment Area at Dam Site	4672 km ²
Annual mean flow	5682.6 Mcum
Submergence area	24.5 ha
Design Flood	SPF 6700m ³ /sec (For Design) PMF 10840M ³ /SEC (FOR CHECKING)
Diversion Flood (1: 25 yr Non monsoon flood)	725 m ³ /sec
III. RESERVOIR:	
Full reservoir level	E L 1267 m
Maximum Water level	E L 1269 m (PMF)
Minimum Draw Down level	E L 1252.5 m
Gross storage at FRL	3.63 Mcum
Storage at MDDL	1.16 Mcum
Live storage	2.47 Mcum
Surface Area at FRL	24.5 ha
IV. DIVERSION ARRANGEMENT:	
A. Diversion Tunnel:	
Location	Left bank
Length	490m
Diameter	10m, Circular
Design Discharge	725m ³ /sec
Gates	10mx10m, Vertical lift fixed wheel
Invert level at Entry	1228m
B. U/S Cofferdam:	
Type	Colcrete
Length	60 m
Height	15 m
Top Elevation	EL 1242 m
C. D/S Cofferdam:	
Type	Rock fill
Length	46 m
Height	6 m

Top EL.	EL. 1229 m
V. DIVERSION DAM:	
Type of dam	Concrete, gravity dam
Height of dam above deepest foundation level	65 m
Top of dam	EL 1270 m
River bed level	EL 1225 m
Foundation level	EL 1205 m
Length	89.3 m (NOF 32.3 m, OF 57.0 m)

VI. SPILLING ARRANGEMENT:

A. Sluices:	
Nos.	4
Design Flood	8004 m ³ /sec
Size of sluice	6.6 m (W) x 15 m (H) (4 nos. 6.6 m x 15 m)
Type of gate	Radial Stoplog (1 no. 6.6 m x 22.5 m)
Crest level of sluice	1233 m
B. Diversion cum Spillway Tunnel:	
Invert level at Entry	Diameter 10 m (Φ) ,Circular 1249 m
Length	490 m
Design Discharge	1074 m ³ /sec
Gate	2+1 no., 4.1 m x 10 m (Vertical lift fixed wheel Gate)
C. Spill Tunnel (12m Φ):	
Size	12m Φ, Circular
Invert level at Entry	1245 m
Length	250 m
Design Discharge	1618 m ³ /sec
Gate	2+1 no., 4.8 m x 12 m (Vertical lift fixed wheel Gate)
D. Ogee spillway	
No.	1
Type of gate	vertical
Size	4 m x 3 m
Design flow	80 m ³ /sec
Crest EL	EL 1264 m

VII. POWER INTAKE:

Location	Right bank
Nos.	3
Type	Straight intake with bell mouth
Maximum discharge	277.9 m ³ /sec
Intake invert level	EL 1242.5 m
Size	6 m modified Horse shoe type
Gates	3 + 3 nos. 5.20 m x 6 m Vertical lift fixed wheel gate (service gate + emergency gate)
Silt Flushing Tunnel (Below Intake)	
Size of Intake	3 nos. of 3mx3m
Size of SFT ducts	3 nos. of 2mx5m
Gate	3+3 nos. of 3mx3m
Design Discharge capacity	380 cumec

VIII. DESILTING CHAMBER:

Nos.	3
Size	350 m (L) x 16 m (W) x 20.6 m (H)
Particle size to be removed	0.2 mm & above
Gates	3 nos. 5.24 m x 6 m (H), Vertical lift fixed wheel
Gate chamber	6 m (W) x 9 m (H) x 155 m (L)
Operation level	EL 1270 m
Silt Flushing Tunnel:	
Size	3.6 m x 4.0 m (D shaped)
Flushing discharge	47.6 m ³ /sec
Length	680 m
Gates	3 nos. 2.5 m x 2.85 m, (Vertical lift slide Gate)
Gate chamber	4.8m x 4.8m x 118 m
Operation level	EL 1233.5 m

IX. HEAD RACE TUNNEL:

Length	13.4 km
Diameter	8.8 m (Horse shoe)
Design discharge	228.86 m ³ /sec
Velocity	3.56 m/sec
Bed slope (average)	1:208
No. of adits	4

X. UPSTREAM SURGESHAFT:	
Type	Restricted Orifice type
Diameter	22/15 m Φ (22m Φ from EL.1185m to EL. 1240m) (15m Φ from EL.1240m to EL. 1305m)
Height (from HRT invert)	130 m
Top EL	1305 m
Orifice level	1185 m
Orifice diameter	1.5m
Tunnel invert	EL 1175 m
Pressure shaft gates	2 nos., 4.2 m x 5.2 m
XI. BUTTERFLY VALVE CHAMBER:	
Size	50 m (L) x 9.8 m (W) x 19 m (H)
Butterfly Valve	2 nos., 5.2 m dia
XII. PRESSURE SHAFT:	
Nos.	2 / 4
Type	Circular
Diameter	5.2 m / 3.65 m
Length of each PS	351 m / 36.7 m
Design velocity	5.39 m/sec
XIII. POWER HOUSE:	
Type	Underground
Size of P/H cavern	127 m x 20.3 m x 50 m
Size of Transformer cavern	112 m x 16 m x 24.5 m
Nos. of units	4
Rated unit capacity	111 MW
Installed capacity	4 x 111 MW = 444 MW
Gross Head	237.0 m
Rated Head	212.46 m
Centre line of unit	EL 1022.0 m
Service bay level	EL 1038 m
Main Inlet Valve (Spherical valve)	3.0m dia, Design Pressure 28.2 Kg/cm ²
Maximum flow through each unit	57.22 m ³ /sec
Generator:	
Synchronous speed of Generator	250 rpm
Power factor, Generator voltage	0.9, 13.8kV
Excitation system	Quick response static
Transformers- Type, Nos, No. of Phases,	OWF, 4, 3, single phase, 46MVA, 13.8/ 420/ $\sqrt{3}$ kV.
Step-up voltage, Capacity	400kV

Energy generation
(on 90% dependability basis) 1813.03 GWh

XIV. D/S SURGE TANK:

Type Underground
Size 120 m (L) x 12 m (W) x 27 m (H)
Maximum Surge level 1040 m
Minimum Surge level 1026.5 m

XV. TAIL RACE TUNNEL:

a) Size 8.8 m ϕ (Horse shoe)
b) Length 3.07 km
c) Max. TWL 1030.0 m (with all M/C running)
d) Min. TWL 1027.2 m (with 10% load)
e) TRT invert level EL 1025.0 m

XVI. SWITCHYARD:

a) Type of Switchyard GIS
b) No. of bays in the switchyard 7 bays
c) Voltage level 420 kV
d) Size of potyard 40m x 60 m

XVII. POWER GENERATION:

a) Firm power 74.69 MW
b) Annual Energy 1813.03 GWh
c) Load factor (lean flow) 16.82%
d) Design Energy 1797.24 GWh

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**4x111MW VISHNUGAD PIPALKOTI HEP
HVAC SYSTEM
TECHNICAL SPECIFICATION**

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TECHNICAL SPECIFICATION



**4x111MW VISHNUGAD PIPALKOTI HEP
HVAC
SPECIFIC TECHNICAL
REQUIREMENT**

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SPECIFIC TECHNICAL REQUIREMENT



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1.0 FUNCTION

The purpose of the system is to provide HVAC (Air conditioning and ventilation) for different areas of 4x111 MW Vishnugad Pipalkoti HEP under the scope of this tender.

2.0 SYSTEM DESCRIPTION

2.1 AIR CONDITIONING

Ductable / Non Ductable type Split air conditioning plant shall be provided to cater to the air conditioning requirements of the following areas of unit 1&2:

- a) Control room floor at EL 1046m.
- b) Conference room at EL 1042m.
- c) PLCC room at EL 1046m.
- d) GIS Protection Panel room at EL 1048m.
- e) Elect. Lab at EL 1038m.
- f) Shift engineer room at EL 1038m.
- g) Communication room at EL 1038m.

The configuration of the equipment (Ductable Split AC) shall be 2 x 100% or 4x50%.

2.2 VENTILATION SYSTEM

I) Once Through type ventilation system shall be provided for following areas:

For this system cooling water shall be taken from the sump / upstream through pump and discharged to down stream. Supply air from once through AHU shall be fed to various areas as detailed below through duct.

- a) Operating Floor at El. 1036.00Mtr.
- b) Generator Floor at El. 1030.50Mtr.
- c) Turbine Floor at El. 1025.70Mtr.
- d) MIV Floor at El. 1017.00Mtr.
- e) Transformer cavern Floor at El. 1036.00Mtr.
- f) GIS Floor at El. 1046.00Mtr.
- g) Bus duct area

II) DRY TYPE MECHANICAL VENTILATION SYSTEM

Dry Mechanical type Ventilation System shall be provided for following areas:

- a) DG sets Room.
- b) Butterfly Valve House area
- c) Workshop
- d) Electrical workshop
- e) Stairs
- f) Toilets
- g) Locker etc.



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However, exhaust air of these areas shall be routed through separate ducting/ connected with main exhaust air duct to release the same to atmosphere outside power station.

3.0 DESIGN CRITERIA

3.1 AIR CONDITIONING SYSTEM

- a) The outside design conditions considered shall be under:-

	Summer	Monsoon	Winter
DBT (°C)	31	30	20
WBT (°C)	25.5	29.9	0

- b) The inside design conditions to be maintained shall be as under:-
23°C ± 1C & RH 50% ± 5% for control room etc.
- c) Fresh air requirement shall be minimum 1.0 air change per hour for control room areas or 16 CFM per person whichever is higher. For other areas like office, Fresh air shall be considered as per ISHRAE.
- d) A design margin of 10% on total sensible and latent heat shall be considered while designing the AC Plant capacity for each area.
- e) Lighting load considered shall be 2 W/sqft.
- f) The Occupancy considered shall be 1 person in 25SQM or (actual) whichever is more.
- g) Necessary Heater and Humidifier shall be provided (if required) to maintain inside design conditions as mentioned above.

3.2 VENTILATION SYSTEM

- a) The outside design conditions shall be same as for AC system clause no. 3.1(a).
- b) The inside design conditions to be maintained shall be as under:-
25-28°C & RH 65% for Power House & Transformer Cavern etc.
- c) Ventilation system shall be designed as per the following:

S.No.	Area	Type of Ventilation	ACPH (Air changes per hour)
1	Power House	Once Through System	3
2	Battery Room	Wall mounted exhaust fans (spark proof with flame proof moto, Wall mounted exhaust fans with ducting (if required) Fresh air supply through of Louvers	6
3	Workshop Room (Electrical & Mechanical)	Exhaust by means of wall mounted axial flow fans. Fresh air supply through of Louvers	6
4	D.G set Room	Exhaust by means of wall mounted axial flow	20



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		exhaust fans. Fresh air supply through of Louvers	
5.	Toilets & pantries for Power House	Exhaust by means of propeller type exhaust fan. Supply through door undercuts / door louvers	8
6.	Locker Room	Exhaust by means of wall mounted axial flow fans.	6

4.0 LAYOUT CONSIDERATIONS:

4.1 AIR CONDITIONING SYSTEM

I) DUCTABLE SPLIT AC UNIT

Air Cooled Ductable type AC for control room in Power House Building.

II) NON DUCTABLE SPLIT AC UNIT

Non- ductable Split AC shall be provided following areas:

- a) Conference room in Power House Building.
- b) PLCC room in Power House Building.
- c) GIS protection panel room in Power House Building.
- d) Elect. Lab room in Power House Building.
- e) Shift engineer room in Power House Building.
- f) Communication room in Power House Building.

4.2 VENTILATION SYSTEM

Once through type Ventilation AHU shall be located in AHU Room for Power House at El. 1052.0Mtr. & AHU for Transformer Cavern at El. 1046.00 GIS Floor.

5.0 EQUIPMENTS TO BE PROVIDED

5.1 AIR CONDITIONING SYSTEM

- a) Air Cooled Ductable type (2x100% or 4x50% configuration) with R-22/ R-134a / R-407c/ 410a refrigerants complete with all accessories as described hereinafter.
- b) 1 (one) Pan type humidifier (If required).
- c) 1 lot strip type duct heaters.
- d) Fresh air arrangement complete with louvers, filters fan and motor shall be provided.



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- e) Lot- Refrigerant piping with insulation interconnecting Ductable Split AC and fittings such as elbows, tees, reducers, flanges etc.
- f) Lot-Drain water piping out of GI pipes conforming to IS-1239, Part I, heavy grade and galvanised as per IS:4736, from various equipments like Ductable Split AC etc. up to the nearest drain point.
- g) The supply air duct shall be provided with motor operated fire damper at locations where duct pass through walls & floors for ease of isolation, maintenance and as well as for emergency operation. The operation of these automatic dampers shall be interlocked with the fire alarm system. Fire dampers shall be of rating 90 minutes.
- h) Lot – GSS Ducting (as per IS-277) with 275 g/sq.m. of zinc coating sheet metal work, complete with volume control dampers, Extruded aluminium supply air (with VCD) and return air grills, hangers, supports, flexible connections, including thermal insulation on complete supply air duct & return air duct(if required) with 25mm thick resin bonded mineral conforming to IS: 8183 and covered with insulation wrapped with wire mesh etc.
- i) Lot- Acoustic insulation 25 mm thick of fibre glass with 48kg/m³ of first 5 M of ducting after Ductable Split AC.

j) SPLIT TYPE AIR CONDITIONERS

Split type air conditioners (air cooled) shall be provided to cater to the air conditioning requirements as per clause no. 4.1(ii). For areas requiring multiple working split ACs, One (1) No. standby (of same capacity) shall be provided. Local isolator / MCB shall be provided with split units.

Hand operated remote and other accessories as specified. Local Distribution Boards containing Switch / MCB shall be provided for Split Air Conditioners, and FCUs. Each split unit shall also be provided with suitable rating stabiliser.

Single phase electrical feeders of following ratings shall be provided for split units. Bidder to ensure the suitability as per these feeder requirement.

Capacity of Split AC	Single phase feeder
2TR	3.0 KW

5.2 VENTILATION SYSTEM

a. CIRCULATION WATER PUMP SETS

Each water circulating pump set shall comprise of the following:-

- i. One No. for taking water from upstream/ sump to AHU's, Horizontal split casing type centrifugal pump of adequate capacity to match the system requirement.



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- ii. One No. adequately sized TEFC sq. cage induction motor suitable for 415 V, 3 phase, 50 Hz AC supply.
- iii. One set of base plate, coupling guard, anti-vibration pads, foundation bolts etc.
- iv. Valves, Instruments other fittings etc along with chilled water pumps.
- v. One No. Duplex Filter at inlet complete with all accessories, drain arrangement, etc.
- vi. 150 mm dia dial type pressure gauges one each at suction & discharge side of the pump set.
- vii. 150 mm dia dial type temperature gauges at suction side of each of the pump set.
- viii. Gate valves, one each at suction and discharge side of the pump set.
- ix. One No. non-return (check) valve at discharge side of pump set.
- x. One No. Pressure Switch at discharge side of pump set.
- xi. Drain Piping from pump to nearest drain.
- xii. Mechanical seals and all accessories as specified shall be provided.
- xiii. MOC of Pump

- Pump Casing Ductile cast iron
- Pump Shaft SS410
- Impeller Cast Stainless Steel Gr-CF8M
- Pump Bearings Anti friction
- Impeller wear rings Stainless Steel
- Casing wear rings Stainless Steel
- Shaft sleeve Stainless Steel Gr. 410 H
- Base Plate MS Plate to IS 2062
- Stuffing box seal Gland Packing/ Mechanical seal (C vs SiC & C vs TC) to suit silty water
- Companion Flange IS 2062 Gr.B



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b. AIR HANDLING UNIT (DOUBLE SKIN TYPE)

Each air handling unit shall comprise of the following:-

- i. Double skin panels (inside and outside) shall be fabricated using minimum **0.6 mm (24 G)** galvanized steel, with 25 mm thick polyurethane insulation of minimum 40 kg/m³ density in between, GSS channels shall be used as reinforcing to give structural strength. Insulated SS drain pan, and all accessories as specified are to be provided.
- ii. Fan section complete with forward / backward curved multi-bladed centrifugal fan mounted on a shaft with adjustable motor base. For Details, please refer clause no. 25.6.1 of customer specification.
- iii. One No. adequately sized TEFC sq. cage induction motor suitable for 415 V, 3 phase, 50 Hz AC supply with drive package comprising fan pulley, motor pulley, V-belt and belt guard. For Details, please refer clause no. 25.6.2 of customer specification.
- iv. Coil section (integral with filter section) with suitably sized circulation water coil made of as per manufacturer standard and aluminium fins along with valves for isolation.
- v. Filter sections complete with 50 mm thick dry panel type filter having efficiency 80% down to 20 micron.
- vi. Drain piping from the AHUs up to nearest drain point.
- vii. Lot – Controls comprising:
 - 150 mm dia dial type temperature gauges one each at suction & discharge side of the coil of AHU.
 - 150 mm dia dial type pressure gauges one each at suction & discharge side of the coil of AHU.
- viii. Lot – Serrated rubber pads for vibration isolation.

c. DUPLEX FILTER & CYCLONE SEPARATOR

- (I) Filters element shall be of SS-316 or superior for Duplex Filters
- (II) Internals shall be of SS-316 or superior for Cyclone separator.



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d. WALL MOUNTED AXIAL FLOW FAN/ TUBE AXIAL FAN / PROPELLER FANS

Each wall mounted axial flow fan shall be complete with

(i) Fan impeller with aerofoil section of cast aluminium alloy & casing/short duct as required.

(ii) Electric drive motor with coupling if any, including motor brackets.

(iii) Inlet cone and grouting framework, if any.

(iv) Rain protection cowl with bird-screen adjustable damper, vibration isolators, back draft dampers etc. shall be provided.

(v) Axial fans will be of propeller type, for fans with 5 mm of wc fan static pressure and Tube Axial type for fans with static pressure above 5 mm of wc.

(vi) Each Axial fan comprises of fan, fan motor, inlet and outlet cone (for Tube axial), Louvered shutter (exhaust fans), bird screen and supporting arrangement.

5.3 ITEMS COMMON TO AC AND VENTILATION

a) INSULATION

Insulation shall be provided as under:

S.No	Surface	Insulation Material	Insulation Form	Thickness (mm)	Finish
i)	AC Duct	Mineral wool	Roll / Slab	50	Aluminum Cladding
ii)	Ventilation Duct	Mineral wool	Roll / Slab	50	Aluminum Cladding
iii)	Acoustic insulation of first 5M of ducting after discharge	Mineral wool (48 Kg density)	Roll / Slab	12	Perforated Al sheet
iii)	Refrigerant Piping	Al foil faced Nitrile rubber / Eqt	Roll / Slab	39	Al cladding
iv)	Drain pipe	-do-	Roll / Slab	26	Al cladding
v)	Circulation water piping, valves & specialties	-do-	Roll / Slab	39	Al cladding



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S.No	Surface	Insulation Material	Insulation Form	Thickness (mm)	Finish
vi)	Circulation water piping, valves (Exposed to atmosphere)	S (TF Quality 16 Kg Density)	pipe section	50	Sand cement plaster and Al cladding
vii)	Circulation Water Pumps	-do-	Roll / Slab	39	Al cladding

b) CONTROLS

Local control panel with annunciation panel shall be provided for AC & Ventilation System as per clause no. 25.16 & 25.17 of section C2-A of customer specification.

6.0 POWER SUPPLY ARRANGEMENT

The power supply (rated voltage, frequency, phase) of the equipments will be 415V +/- 10%, 3ph, 50 Hz +/- 5% or 240V +/- 10%, 1ph, 50 Hz +/- 5% as the case may be. Also refer clause no. 25.15 of section C2-A of customer specification.

7.0 DEMONSTRATION TEST

Room condition test shall consist of taking the reading of dry bulb and wet bulb temp at different locations points to be mutually decided at site in the areas which are air-conditioned by the respective system/plant. Room condition test shall be done after stabilization of the system. The dry and wet bulb temp shall be measured by measured by sling psychrometer which will have accuracy of +/-0.5% with atleast count of 0.5 degC. This will be carried out for 24 hrs continuously and readings will be taken every two hours. Standby equipment should be changed over during these 24 hours. This test shall be carried out during summer during month April to June when the dry bulb temp is generally high and during. The format for recording the readings is enclosed at Annexure V. Relative humidity shall be determined from psychometric chart.

All shop testing and test at site as specified shall be carried out.

Also refer clause no. 25.42 & 25.43 of section C2-A of customer specification.



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8.0 GENERAL

- 1) Basis of design, all calculations including heat load calculations for summer seasons, equipment selection criterion, layout drawings/ schemes/G.A. dwg and documents like data sheet/ technical particulars etc are subject to Customer approval during detail engineering stage.
- 2) Vendor to furnish characteristic curves for all major equipment offered indicating duty point during detailed engineering.
- 3) All drawings and documents shall be computer based.
- 4) All commissioning spares & consumables for trouble free operation shall be provided by Vendor to include alarm & trip of the pumps. Also include one no. Pressure transmitter for each pump
- 5) Quality Requirements in the Technical Specification are indicating minimum requirements for inspection and testing. Vendor shall note that quality plan is subject to Customer & BHEL-approval during detail engineering stage. Standard QP format is enclosed in the technical specification.
- 6) Indicative list of makes is enclosed elsewhere in the specifications, however these equipments / items shall be subject to Customer & BHEL approval during detail engineering Stage.
- 7) Inserts or any support arrangement for fixing ducting, fans, piping etc. shall be in bidder's scope. Necessary supports may be taken from nearest structure / walls / roofs / floors etc. by Vendor subject to customer/BHEL acceptance during detail engineering.
- 8) Fixing frame works for diffusers and grilles in the scope of Vendor.
- 9) Anchor fastener shall be used by vendor for fixing duct pipes etc. wherever applicable.
- 10) Necessary supports and structures / frames etc. as required for supporting the duct / piping / equipments etc. as lump-sum basis is in the scope of Vendor and no unit rates shall be applicable for these items.
- 11) Drain piping within room and up to the drain point to be provided by the Vendor.
- 12) The tools and machine required for erection of equipment shall be arranged by Vendor.
- 13) Tools & tackles as required for regular maintenance shall be supplied by Vendor.
- 14) Instruments required for performance testing of various equipment / system of the package shall be arranged by Vendor at site.
- 15) Only calibrated instruments shall be used by HVAC supplier for testing of various equipment.
- 16) Temperature gauges shall be provided with thermo wells and fixing arrangement.



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- 17) Pressure gauges shall have provision for air venting. Three way valves shall be used which shall have air venting provision.
- 18) Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied.
- 19) Bidders shall guarantee to maintain specified inside design conditions during summer, monsoon and winter and also even if the internal equipment load varies from 100% to 25%.
- 20) Besides the system performance as above, bidder shall guarantee major technical parameters of various equipments as per design basis / details furnished.
- 21) The guarantee tests shall cover but not limited to the following rated parameters for smooth operation of HVAC system.
 - Design dry bulb temperature and relative humidity of conditioned air, Vibration and noise level etc.
 - All calibrated instruments to be used for the tests at manufacturer's works/site shall be arranged by the bidder. Any Electrical/C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope. Only those items shall be provide free of cost which are categorically listed in the Electrical scope sheet of technical specification.
- 23) For motorized fire damper / 3 Way valve actuators / motorised valves, power supply shall be derived by vendor from respective control panels. BHEL shall not provide any feeder for them. Suitable transformer shall be provided by bidder (if required) to derive the power input. Further distribution through junction box / distribution board shall be in vendor scope and shall have provision for isolation of individual fire damper/ valves.
- 24) Tender drawings enclosed form the part of specification and the bidder shall check the space requirements for installing the equipment as per the specification and layout requirements given in the specifications.
- 25) Bidder should suitably group the signals coming from various instruments etc. & the same shall terminate in local JB, from Local JB common cable to PLC / panel / MCC shall be selected. Any Electrical / C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope. Only those items shall be provided free of cost which are categorically listed in the Electrical scope sheet of technical specification.
- 26) 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.
- 27) Bidder to note that BHEL reserve the right for drg/doc submission through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Bidder to ensure proper net connectivity at their end.
- 28) The drawings/ documents submitted by vendor shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non- submission with delays attributable to vendor's account. For any clarification/discussion required to complete the drawings, the bidder



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shall himself depute his personal to BHEL / Customer's place any number of time as per the requirement for across the table discussions/ finalizations/ submissions of drawings.

- 29) Sealing of duct opening, grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of HVAC system vendor.
- 31) Flat, platform type RCC / PCC foundation shall be provided for installing PUMP, AHU and FAN etc. Vendor shall fix the equipment using anchor fasteners to secure the equipment obtain parameters related to vibration and noise.
- 32) Bidder to note that the P&ID shows only the bare minimum requirement of valves and instruments. Any instrumentation & valves as required for the completion of the system in line with technical specification shall be provided by bidder during detailed engineering without any commercial implication.
- 33) HVAC plant supplier to furnish drawings/ documents as per the dwg. / documents distribution as per project requirement.
- 34) Each motor terminal box shall be provided with cable gland and lugs for the size and type of power and control cable of respective motor.
- 35) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.
- 36) The bidder's proposal shall be for equipment in accordance with the tech. Specification.
- 37) The bidder shall furnish complete tech. Particulars in data sheet and schedules as specified elsewhere in the specification.
- 38) The bidder shall arrange to provide training on complete HVAC system including operation & Maintenance for Employer Personnel.
- 39) Construction of openings in brick-walls, as required, for routing the ventilation and Air conditioning ducts, shall be in bidder's scope of works. Floor openings, as available at site, for duct routing can be used by bidder during erection of duct.

Further, sealing of duct opening, grouting of foundation bolts including special type of grouting like GPX2 etc. are in the scope of HVAC system vendor.

9.0 EXCLUSIONS

Items of works listed below are excluded from scope of the HVAC plant supplier.

- a) Construction of HVAC plant room, air handling unit room, foundations for HVAC equipments.
- b) False ceiling, drop ceiling.
- c) Provision of drain traps / points,

10.0 Codes and Standards

Design, manufacture, inspection and testing of the equipment covered by the specification shall conform to the latest edition of the standards and codes.



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CUSTOMER SPECIFICATION**

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**SECTION: I
SUB-SECTION: C2-A
CUSTOMER SPECIFICATION**

SECTION - 25

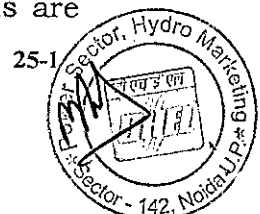
VENTILATION SYSTEM

25.1 SCOPE

25.1.1 This technical specification covers design, manufacture, assembly, inspection and testing at manufacturer's or his sub-contractor's works before dispatch, transportation, insurance & delivery FOR project site in Uttarakhand, unloading / handling, storage and preservation at site, complete work of site assembly erection, testing, commissioning and remedial action, if any, upto defects liability period of equipment for Ventilation systems for Vishnugad Pipalkoti HEP covering areas such as Power house cavern, Transformer cavern, GIS floor, Main Access Tunnel, Cable Tunnel, Service Building, Dam galleries etc. including 0.415 kV Motor Control Centers (MCC), central control and annunciation panel, control boxes for local / remote control of ventilation systems, Butterfly Valve House etc. The ventilation system shall comprise of supply air & exhaust air fans, back draft dampers, air filters and air washers to effect cooling, Aluminium grilles / diffusers, fitted with volume control dampers, motorised dampers, galvanised sheet metal ducts, acoustic lining insulations and supporting steel frame work structure for air supply & exhaust ducting system of the complete power house complex including supplying fresh air to air conditioned area. The scope of work also includes:

- a) Additional tunnels other than shown in Layout Plan of the project area and Minor civil works such as fixing of anchor bolts, hangers and air ducts, sealing of wall openings after air ducts are put in position, erection of panels, motors and hardware's required for the civil works.
- b) All the works which are required to install the ventilation system but not included in the specifications are also deemed to be in the scope of the supply. The bidder shall mention these items in the bid.
- c) The bidder shall co-ordinate with concerned agencies of the power house for erection and commissioning of ventilation system.
- d) All power cables from MCC to electric motors and control cables to the devices stipulated by this technical specification, as well as cables to the common control and annunciation panel envisaged in the computerised control room, cable trays, conduits, supports and all accessories for cables including laying of power and control cables on cable trays and their termination on MCC and panels are

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covered in the scope of supplies of this technical specifications.

- 25.1.2 The scope of supply shall include special tools and tackles, spare parts, all relevant drawings, data and instruction manuals.

25.2 DESIGN CONDITIONS**25.2.1 Outdoor Temperature & Humidity Conditions**

Maximum temperature = 31°C
 Minimum temperature = 0°C
 Maximum Relative Humidity = 95%

25.2.2 Indoor Temperature & Humidity Conditions Desired

For areas of power house served by ventilation system

Maximum temperature = (25-28°C)
 Maximum Relative Humidity: - 65 %

Bidder must refer to General Technical conditions specification for the actual site conditions. Those conditions would prevail for design of all systems.

25.3 STANDARDS

- 25.3.1 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian / International Standards, Indian Electricity Rules / Act and other applicable statutory provisions. The equipments shall comply in all respects with the latest issues of the following standards except wherein specified otherwise.

- i) IS: 4720 Code of practice for ventilation of surface hydel power stations
- ii) IS: 3103 Installation, operation, testing and maintenance of ventilation system
- iii) IS: 4894 Centrifugal fans
- iv) IS: 2312 Propeller type AC ventilating fans
- v) IS: 1822 AC motor starters of voltage not exceeding 1000 volts
- vi) IS: 655 Specification for metal air ducts
- vii) IS: 4029 Guide for testing of three phase induction motor
- viii) IS: 900 Induction motor installation and maintenance
- ix) IS: 277 code of practice
- x) IS: 325 Specification for galvanised steel sheets
- xi) IS: 3589 Induction motors
- Electrically welded steel pipes



- xii) IS: 3588 Specification for electric axial flow fans
- xiii) IS: 7613 Air filters for air conditioners and ventilation-tests
- xiv) IS: 737 Specification for wrought aluminium or aluminium alloys sheet and strip
- xv) IS: 661 Code of practice for insulation.
- xvi) BS: 2831 Methods of test for air filters used in air Conditioning and general ventilation
- xvii) BS: 3928 Sodium flame test for air filters (other than for air supply to I.C. Engines and Compressors
- xviii) IS: 3069 Glossary of terms, symbols and units relating to thermal insulation material.
- xix) IS: 4671 Expanded polystyrene for thermal insulation purpose.

25.3.2 Equipment meeting with any other authoritative standards which ensure an equal or better quality than the standards mentioned above is also acceptable. However, the salient points of differences between the standards opted and the standards specified shall be clearly brought out in the bid. The bidder will submit copies of the applicable standards after the award of work. Standards and codes being followed may be listed.

25.4 **DRAWINGS ENCLOSED WITH THE SPECIFICATIONS**

25.4.1 The proposed Power house layout, cross section & various plans are enclosed in Section-30: "Tender Drawings" of Part-2: Section VI: "Employer's Requirement".

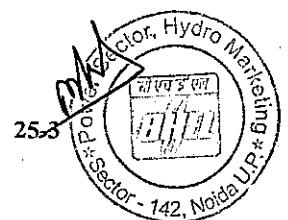
25.4.2 The bidder shall examine the scheme & requirements given in the specifications/drawings and may furnish his proposals meeting the requirements of this specification for the consideration of the purchaser. Deviations, if any, from the specifications /drawings shall be communicated by the Bidder.

25.5 **DESIGNING OF VENTILATION SYSTEMS AND ELIGIBILITY CRITERIA OF THE BIDDER**

25.5.1 These specifications and drawings for the ventilation systems define the design criteria and main requirements to be met by the offered equipment.

25.5.2 The bidder shall design the ventilation systems based on requirements of the specifications and shall select the respective equipment for the ventilation systems best suited for the operation in tropical and humid conditions.

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25.5.3 After the award of the contract, the supplier shall submit computations and drawings according to the conditions laid in the contract. The finalized technical data shall include appraisal of heat losses, dimensions of air ducts, as well as type and performance characteristics of the equipment.

25.5.4 The bidder shall submit to the purchaser for his approval catalogues and booklets with description of material and equipment, as well as design reports on operation of the systems and schedule of supplies and services including assembly and commissioning alongwith bid.

25.6 EQUIPMENT AND MATERIALS

25.6.1 Centrifugal Fan

25.6.1.1 General

The fans shall be supplied complete with electric motors, drives, starters, controls, protection measuring instruments, ammeter and voltmeter and accessories complete in all respect. The impellers shall be shop-balanced. The fans shall be provided with vibration absorbers. The fans shall be fabricated from carbon steel.

25.6.1.2 Design

Refer Clarification No. 1 Sl. No. 420

ENCLOSED
BELOW

The fans shall be provided with anti vibration pads for ensuring a reasonable degree of silence. Maximum speed of the fan preferably shall not be more than 500 rpm so that maximum noise level generated by fans is not more than 60 decibels inside the blower rooms. Necessary means shall be provided to prevent the entry of moisture inside the fans. The fans shall be designed for optimum performance at a given duty. However, it should be capable of working reasonably over a range of pressure and volume. The fans shall be designed for the static pressures suitable for site conditions.

25.6.1.3 Scroll

The casing shall be of welded construction, fabricated with heavy gauge material. It shall be rigidly reinforced and supported by structural angles and seams shall be permanently sealed air tight. Casing shall be provided with drain valve, if required.

Impeller

Refer Clarification No. 1 Sl. No. 420

The impeller shall have die-formed blades welded to a rim and back-plate. Inlet shall be spun to have a smooth contour. Shaft



sleeves shall be provided, if required. The impeller, pulley and shaft sleeves shall be fastened to the shaft by keys & nuts. The impeller shall be statically and dynamically balanced.

25.6.1.5 Bearings

The bearings may be ball, roller or sleeve type and shall be adequately supported. They shall be easily accessible and lubricated properly.

25.6.1.6 Inlet, Inlet Guard

Inlet shall be spun to have a smooth contour. Inlet screen, if provided, shall be of galvanised wire of 25 square mm.

25.6.1.7 Base Plate

Base plate with necessary number of spring type anti vibration pads shall be provided.

25.6.1.8 List of accessories to the fans as provided shall be furnished with the bid with item-wise prices.

25.6.1.9 Fan Motor Drives

When belt drives are used, they shall be of the multiple V-belt type. Each drive shall consist of a cast iron fan pulley, cast iron motor pulley, endless rubber and fibre 'V' belt of suitable thickness. Pulleys shall be accurately proportioned so that the fan will be driven at the correct speed. The pulleys shall have proper number of grooves for V-belts, statically and dynamically balanced and bored, fitted and keyed to their respective shafts.

Where direct drives are employed with flexible coupling, the same shall be rugged in construction and suitable for its application. It shall be carefully fitted and secured to the fan and motor shaft. A removable metal guard of substantial construction shall be provided for each flexible coupling. The guard shall adequately protect the operator and others from contacts with the coupling. Suitable drive guard shall be fitted to fans. These guards shall be designed to allow adequate ventilation and to permit the measurement of shaft speeds without its removal.

25.6.2 Induction Motors

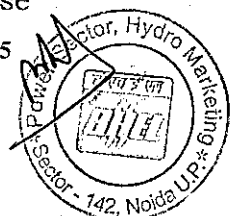
25.6.2.1 Performance and characteristics

- a. Fan motors shall be of totally enclosed type and shall conform to latest version of IS-325. The motors shall be suitable for operation at 415 V and 50 Hz, three phase

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supply with variation as given below. Motors shall be capable of giving rated torque and output without reduction in the expected life span when operated continuously under the following supply condition.

i)	Variation of supply voltage from rated motor voltage	$\pm 10\%$
ii)	Variation in supply frequency from rated frequency.	$\pm 3\%$
iii)	Combined voltage and frequency variation	$\pm 10\%$

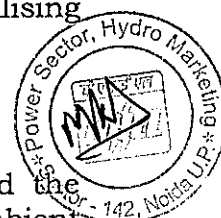
- b. Motors shall be suitable for full voltage direct on-line starting upto 50KW output and beyond 50KW it will be suitable for reduced voltage starting. The necessary starting system and their control and protection from local and remote control shall be provided.
- c. Motors shall be capable of starting and accelerating the load with the permissible voltage and frequency variations under the applicable method of starting, without exceeding acceptable winding temperature limits.
- d. The locked rotor current of the motor shall not exceed 600% of full load current.
- e. Motors shall be designed to withstand 120% of speed for two minutes without any damage.
- f. The motor vibrations shall be within the limits specified in applicable standard.

25.6.2.2 Insulation:

- a) Any joint in the motor insulation such as at the connections or between slot and winding shall have strength equivalent to that of the sections of the coil.
- b) The insulation shall be of class F and suitable for humid climatic conditions, tropical and water resistant for successful operation of the motor. The tropicalising treatment shall be as per the applicable standards.

25.6.2.3 Temperature Rise

The insulation of winding of motor shall be class F and the temperature rise shall not exceed 90° C over an ambient temperature of 38° C.



25.6.2.4 Constructional Features

The motor construction shall be suitable for easy disassembly and reassembly. The enclosure shall be sturdy and shall permit easy removal of any part of motor for inspection and repairs.

Motors shall be provided with eye bolts, lugs or other means to facilitate safe handling.

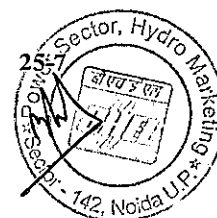
Horizontal motors shall be foot mounted type unless otherwise specified.

When the motor is supplied with driven equipment including a common base (bed plates, channels etc.), the bidder shall ensure that such bed plates are adequately braced to keep vibrations and misalignment within limits specified in the relevant standards.

25.6.2.5 Bearings

- a) Greased ball bearings or greased roller bearings shall be of reputed make subject to the purchaser's approval. The life expectancy of the bearings shall be stated in the bid.
- b) Construction of bearings shall be such that the loss of grease is kept to a minimum and greasing shall be possible without any dismantling operation.
- c) The bearings shall prevent dirt and water from getting into the motor. Bearing lubricant shall not find access to motor windings.
- d) The bearings shall permit running of the motor in either direction of rotation.
- e) Unless otherwise approved, bearing lubricating system shall be such that no external force or water is necessary to maintain the required oil supply or keep bearing temperature within design limits.
- f) Lubricants shall be selected for prolonged storage and normal use of the motors in tropical climate and shall contain corrosion and oxidation inhibitors. Grease shall have suitable bleeding characteristics to minimise setting.
- g) Sleeve bearings for use with motors having flexible couplings with limited end play, shall have adequate axial end play to permit assembly so as to prevent transmitting of thrust from driven equipment to motor bearings.

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25.6.2.6 Terminal Box

- a) Terminal boxes shall be of weather proof construction designed for outdoor services to eliminate entry of dust and water. Gaskets of neoprene or approved non-aging type rubber equivalent shall be provided at cover joints and between box and motor frame.
- b) The terminal box shall be suitable for top and bottom entry of cables.
- c) Unless otherwise approved, the terminal box shall be capable of being turned through 360 degree in steps of 90°.
- d) The terminals shall be of the stud type with necessary plain washers, spring washers and check-nuts. They shall be substantially designed for the current carrying capacity and shall ensure ample phase to phase and phase to ground clearances.
- e) Suitable cable glands and cable lugs shall be provided.
- f) Sizes of terminal boxes and lugs shall be as per applicable Indian standards.

25.6.2.7 Paint and Finish

Motor external parts shall be finished and painted to produce a neat and durable surface which would prevent rusting and corrosion. The equipment shall be thoroughly degreased. All rust, sharp edges and scale removed and treated with one coat of primer and finished with two coats of grey enamel paint. The motor fan shall also be similarly painted to withstand corrosion.

25.6.2.8 Space Heaters

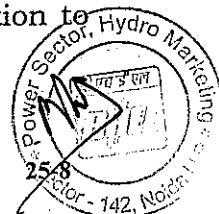
Space heaters will be provided on each motor for heating and elimination of any condensation of moisture during idle conditions.

25.6.2.9 Accessories

- a) Two independent earthing points shall be provided on opposite sides of motor for connection with the purchaser's earthing mat. These earthing points shall be in addition to earthing stud provided in the terminal box.



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- b) Except when otherwise specified, the motor shall be provided with a bare shaft extension having a key slot at the driving end.
- c) When the motor, coupling and fan etc. are supplied by subvender driven equipment bidder, the motor bidder shall strictly adhere to the dimensional requirements and other related to accessory for proper matching of these parts. All control and power wiring, cable support system, etc. shall be provided by the supplier.

25.6.2.10 Tests

Motor shall be subjected to all the routine tests as per applicable standard in the presence of the purchaser's representative. Copies of test certificates of type and routine tests, as specified in the relevant standard shall be furnished for the Purchaser's approval after award.

25.6.3 Filters

25.6.3.1 Fibre Type

Filter medium shall consist of a suitable fibrous material (e.g. coir, extruded sections of polyethylene etc) packed into a frame of galvanised sheet steel of 20 gauge thickness. Filter element shall be supported by galvanised steel wire mesh of 15 square mm on either side. Filter frames shall be provided with suitable handles.

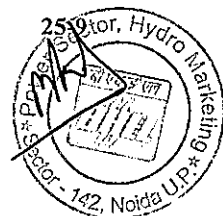
- 25.6.3.2 Air velocity across the working section of filters shall be up to 3.0 m/s. The filters shall be able to remove particles 80% down to 20 microns and shall be cleanable type with compressed air.

25.6.4 System of air ducts

- 25.6.4.1 The system of air ducts shall consist of:

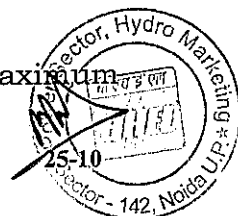
- a) Air-intake grills wire mesh installed at inlet of ventilation tunnel / filters for outdoor air to blower room housing ventilation fans
- b) Air duct at suction of fans;
- c) Flexible inserts connected directly to suction opening of ventilation plant and air duct at air suction;
- d) Flexible inserts connected to exhaust opening of ventilation plant and pressure air duct;
- e) Check valve (or, back draft damper) arranged on pressure air ducts after each ventilation plant;
- f) Pressure air duct running from ventilation plant to the premises to be ventilated.

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25.6.5 Air ducts**25.6.5.1 General**

- a) Air ducts shall be air tight and smooth inside. The air ducts shall be securely fixed to structural elements and shall be vibration-free.
Air velocity in the main air ducts (ventilation tunnel) shall be taken as per relevant international/ national standards.
- b) Air duct elbows shall be fabricated with a radius 1-2 times air duct diameter. The air ducts, elbows, dampers etc shall be fabricated from galvanized steel.
- c) The thermometers and pressure gauges shall be installed on air ducts behind fans.
- d) The air ducts which are to be embedded into concrete shall be fabricated from electric welded steel pipes of medium duty which shall be securely anchored to concrete or angular iron frames shall be provided wherever the ducts crosses the walls, slabs & opening etc..
- e) All support system such as Angle iron, clamps, fixtures and hangers etc. to be used for ducts supports shall be included in the offer. The brackets and supports shall preferably be of adjustable type to ensure proper alignment of ducting. They shall be of strength sufficient to ensure that the duct will remain rigid. The drilling in rock/slab/walls etc. and providing and fixing/embedding of anchors etc. for supports is also included in the bidder's scope of supply.
- f) Ducting over false ceiling shall be supported from the slab or beam or wall or rock. In no case, duct shall be supported from false ceiling hangers or be permitted to rest on false ceiling.
- g) The proposed routing and sizes of the complete duct work (fresh air, supply air, return air) shall be based on space constraints due to layout of other equipment shown in various drawings of this bidding document. The bidder shall check the duct cross-sectional area as per his design practice and minor changes, if any, proposed by the bidder can be accepted by the purchaser.
- h) Wall thickness for rectangular air ducts with maximum side dimensions:



Up to 750 mm 24)	0.6 mm	(Gauge 24)
751 - 1500 mm	0.8 mm	(Gauge 22)
1501mm & above	1.0 mm	(Gauge 20)

- i) Ducts can also be joined with hot dip galvanised nuts and bolts. A good quality of uniform thickness and width shall be used for sealing the flanged joints. The felt shall be fixed by a suitable adhesive and holes be made by passing a heated rod through it.
- j) The ventilation supply & exhaust air ducts to be installed in the fire hazardous areas such as transformer chambers, insulating oil and lubricating oil plant rooms shall be covered with a suitable thickness of fire resistant board (e.g. calcium silicate board) so as to withstand damage due to fire for a period of minimum 60 minutes.

25.6.5.2 Material Requirements

The rolled steel sheet before galvanising shall be properly annealed or normalised so as to allow fabrication of ducts without developing cracks and zinc coating on the steel shall not be less than 275 gms/sq.m as per the IS-277-1992 or its latest revision.

The aluminium sheets shall be of grade SIC or NS3 and shall be suitable for grilles / duct fabrication work as per IS-737-1965 or its latest revision.

25.6.5.3 Construction Features

The thickness of sheets, the type of bracings and other fabrication details shall be as mentioned in the forthcoming various clauses. The seams on duct may be continuous welded or grooved longitudinal seam. Ducts may be joined together in one of the following ways: By welding

The ducts shall be swedged 40mm from the ends so that the larger end will butt against the swedge and are held in place with sheet metal screws. Where the swedges are not used, the joints shall be pasted with asbestos papers to ensure a tight joint.

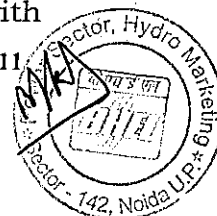
25.6.5.4 Duct Supports

Air ducts (rectangular & circular) shall be supported on steel structure comprising MS rods and MS angles of suitable size. The MS rods and angles shall be given a coat of primer paint. The duct supports shall be at a distance of not more than 1800 mm. The MS rods shall be hung from building steel with

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provision of necessary auxiliary or special steel members or by hooks fixed to the ceiling slab. Auxiliary or special steel members, hooks, screws and all other supporting material required shall be provided by bidder. Wherever the ducts are thermally insulated, the MS angles and supports shall not be in direct contact with ducts.

25.6.5.5 Transformation and Branches

All curves, bends, off sets and other transformations shall be made for an easy and noiseless flow of air.

25.6.5.6 Caulking and Drain

Wherever duct passes through wall, all the openings between masonry concrete and duct work shall be neatly caulked or sealed to prevent movement of air from one space to the adjoining space. Where duct passes through the floor at the lowest point in the elbow, a drain trap of 100 mm width across the width of the duct and 50 (mm) deep shall be provided with a suitable plug.

25.6.5.7 Access Doors

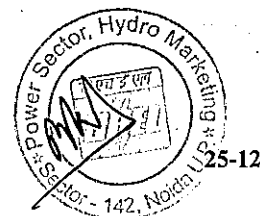
Access doors shall be provided in the duct work or casing on both sides of the equipment to be serviced. All access doors shall be of adequate size and shall be lined with substantial felt edging to prevent air leakage. Access doors shall be of built up construction, structurally strong and each shall have at least two hinges. Access doors shall have two rust proof window sash locks of approved type. All doors shall be set so as to flush with any insulation or plaster finish on the duct.

25.6.5.8 Vanes

All elbows shall be such that the throat radius is 75% of the duct width. In case the throat radius is smaller, suitable single thickness vanes of approved details shall be provided.

25.6.5.9 Painting

Outer and inner surfaces of equipment for supply and exhaust ventilation systems as well as air ducts for D.C. battery room, acid room etc. shall have acid resistant coating to prevent deteriorating effect of sulphuric acid fume on the material of air ducts and equipment.



25.6.5.10 Acoustic Lining

Wherever it is essential to reduce the noise level of the fans to a comfortable limit the ducts shall be acoustically lined.

A noise level of not more than 60 db (A) shall be there inside the blower rooms & not more than 45 db (A) in all other rooms, measured at a distance of 1.5 m from any grille or diffuser. Silencers as required shall be provided by the bidder to guarantee the above noise levels.

25.7 INSPECTION AND TESTING

The ducts, branches, elbows, etc. shall be inspected and the joints & connections are to be checked before they are assembled in position. After assembly, the system shall be checked for tightness, vibration and noise.

25.8 BALANCING

The air distribution system shall be tested/balanced by bidder so that the requisite temperature and air flow are maintained throughout the space to be ventilated. Final balance of air quantities through each grille and diffusers shall be recorded and submitted to the purchaser for approval.

All instruments required for testing / balancing the air distribution system shall be provided by bidder.

25.9 FLEXIBLE INSERTS

The fans shall be connected to the air ducts through flexible inserts to preclude vibration transfer.

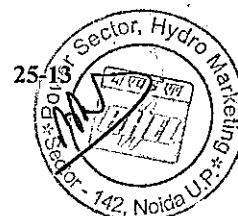
The flexible inserts shall be fabricated from glass cloth and shall be connected to the fans and air ducts with steel straps. The flexible inserts shall be minimum 120 mm long.

25.10 VENTILATION GRILLES & DIFFUSERS

25.10.1 The ventilation grills shall be fabricated from aluminium and finished with powder coating.

25.10.2 The air supply grills shall consist of adjustable flow deflectors permitting variation of air flow exit within 30° from the horizontal plane and air dynamic controller permitting variation of velocity and temperature coefficient values. The exhaust registers shall consist of a fixed front plate and motor controlled movable dampers.

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25.10.3 The live section of the register shall be varied by moving the damper in horizontal direction. At full opening, the live section shall be minimum 66%. Wind velocity in plenum grilles shall be taken equal to 2-2.5 m/s and that in exhaust grilles as 3-3.5m/s

25.10.4 All the plenum chambers or connections to fans, dampers etc. shall be constructed in 18 gauge Galvanised Sheet Steel supported on 40x40x6mm MS angle frames. All vertical angle shall be riveted at approximately 125mm centers to the casing. Pecora or equivalent caulking compound shall be inserted between the base of angle and all masonry construction to which angles are fastened.

25.10.5 The type and quantity of diffusers and grills required shall be worked out by the bidder and detailed calculations shall have to be submitted for approval by

the purchaser. The supplier shall ensure that the diffusers/grills offered are of requisite capacity/throw and terminal velocity. The air pressure drop and the noise level shall be minimum / as specified. The diffusers/grills shall be approved by the purchaser.

25.11 AIR DAMPERS

25.11.1 The air dampers shall be fabricated from a 2 mm thick steel plate. The dampers shall have two flanges for their connection to the air ducts. The damper shall consist of shell housing a blade. The blade shall be moved manually or with electric drive mounted on a damper.

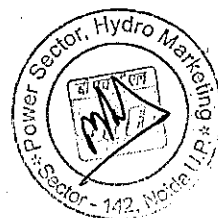
25.11.2 Every damper should be accessible and shall be provided with indicating / central as well as local & remote control device showing damper position.

25.12 PLENUM DAMPER (AIR FLOW CHECK DAMPER)

The plenum damper is intended to preclude air flow through the branch ducts to the shut off fans. The plenum damper consists of enclosure with two flanges. Inside the enclosure two half-axles mount a flap. Besides, one of the half-axles is counterweighted. The damper shall open at the air velocity ≥ 4 m/sec at the vertical stretches and ≥ 5 m/sec at the horizontal stretches. The damper flap shall be made of 1 mm thick steel sheet.



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25.13 FIRE DAMPERS

The fire dampers shall be located in the ventilating openings of fire hazardous rooms. The damper shall be made of 2 mm thick steel sheet. The damper shall consist of enclosure with vanes and have two flanges for connection to air ducts. The vanes shall be operated by an electric drive to be mounted on the damper. The enclosure and vanes shall have flame retardant coating with fire withstand limit of 1 hr or shall be fabricated from material with fire withstand limit of 1 hr.

25.14 DILATOMETRIC THERMOSTATIC SWITCH

The thermostatic switch is intended for indication and two-position control of ambient temperature & shall be installed at the junction of MAT & service bay. The operation of 2/3 fans of system of M/c hall & Transformer Hall & opening of return air dampers in the four ventilation rooms located in Annexe floors of M/c hall & Transformer Hall shall be through this switch.

Its functioning is based on proportional change in the length of sensitive tube and rod due to change in the temperature of controlled medium. Change in the length converted into elastic deformation of the spring/stretching opens/closes the contacts.

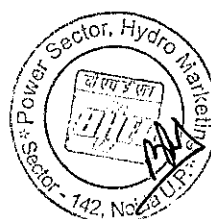
Dilatometric sensitive element consists of sensitive tube and rod. The sensitive tube shall be fabricated from material having large coefficient of linear expansion.

The thermostatic switch comprises dilatometric element, contact device and setting adjustment.

25.15 POWER SUPPLY

- 25.15.1 The power supply to the various ventilation systems shall be arranged from motor control centers (MCC), located near respective ventilation system.
- 25.15.2 The fire preventing valves (i.e. fire dampers) shall be fed from the ventilation MCC.
- 25.15.3 The ratings of the equipment mentioned for MCC and size of power supply cables are tentative and shall be reviewed by the bidder based on the actual motor ratings offered as per this technical specification which will be got approved from the purchaser.

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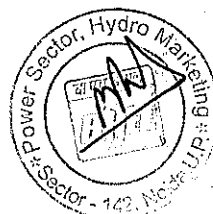
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25.16 OPERATION REQUIREMENTS

- 25.16.1 The ON/OFF commands for ventilation systems of machine hall and transformer hall in remote mode of operation will be organized from the operating station, ventilation control and annunciation panel installed in computerized control room and in local mode from MCC or by push-buttons, located in ventilation chambers of different supply / exhaust air systems.
- 25.16.2 Non essential ventilating systems shall be operated only from MCC or push-button stations located at ventilating systems.
- 25.16.3 The ventilation systems of Butterfly valve chamber shall be operated in local mode from MCC or by push-buttons, located in the ventilation room.
- 25.16.4 One central ventilation control and annunciation panel shall be supplied for installation at Station Control Area (SCA) with control switches, alarm annunciators, ON/OFF position lamps, ventilation systems mimic diagram etc.
- 25.16.5 Engraved Mechanical Mimic Diagram shall be provided with aluminium / steel sheet. Ventilation systems position lamps shall be provided on mimic diagram.
- 25.16.6 The ventilation systems, which will serve and stand-by modes of operation, shall be provided with control board near ventilation system. Selector switches (service/stand-by), control switches, relays shall be provided with these control boards.
- 25.16.7 All other control functions, necessary blockings shall be organized into control modules of corresponding MCC.
- 25.16.8 The control boxes shall be installed at the fire dampers. The front face of the control boxes shall mount selector switches "Local/Remote" and push buttons "Open/Close".
- 25.16.9 In the remote mode, the fire dampers shall get closed in case of fire in respective locations automatically & fans supplying exhausting air from / to the premises shall stop.
- 25.16.10 Provisions shall be made for entering "the fire dampers close" signal into the control boxes from the corresponding Fire Detection and Alarm Panels.
- 25.16.11 All wiring required to meet the above requirements shall be in the scope of supplier



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25.17 OPERATION OF VENTILATING SYSTEMS

25.17.1 Outside Fresh Air Supply ventilation System. The operation requirement of fans is described in clause 25.38.1.

25.17.2 Ventilating System

Each supply and exhaust fan shall be provided with facility to operate in the main and stand-by modes of operation. The standby fan shall start automatically when the main fan shuts down.

These ventilating systems shall create positive air pressure during fire in the smoke-free stairway & lift shafts located at each end of machine hall & transformer hall. The system shall also operate intermittently at regular intervals during normal operation.

Therefore, besides the manual control from MCC, SCA and local control, necessary control for automatic start-up of the ventilating system to be initiated by the Fire Detection and Alarm Panel to be located in computerized control room shall be provided.

The supply and exhaust systems shall start simultaneously. Necessary control cabinet with respective selector switches and automatic relays to select the mode of fan operation shall be provided. The fans shall stop automatically on receipt of signal from fire detection & alarm panel.

25.17.3 Reversible air flow ventilation system. The operation requirements of the fan are described in clause 25.38.1.2.

25.17.4 Butterfly valve chamber Ventilating system

One fan shall run continuously. The stand by fan shall come automatically on line when the main fan stops.

25.18 MOTOR CONTROL CENTER (MCC)

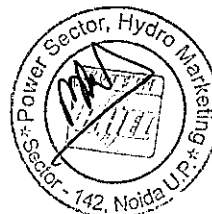
25.18.1 MCCs installed for power supply and control of ventilation systems shall have following requirements.

MCC shall be indoor, air insulated, floor mounting and fully draw out type.

MCC shall be made as a cabinet with one side servicing.

MCC's should be supplied in accordance with the requirements specified in the technical specifications.

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MCC may be fed power from two sources.

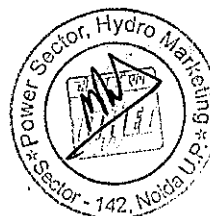
As MCC being fed power supply from two sources, it shall be provided with automatic change over unit.

Air Circuit / Moulded case circuit breakers (MCCB) shall be used in MCC as incoming and outgoing.

- 25.18.2 Incoming MCCB shall be provided with motor wound spring charging mechanism, shunt trip and switching coil and outgoing MCCB shall have manually operated spring charged mechanism.
- 25.18.3 All incoming feeders of MCC shall have a switch disconnecter in the input of power supply with handle on compartment door. Alternatively, incoming feeders shall have rotary handle operating mechanism on compartment door.
- 25.18.4 All incoming feeders shall normally be energized. The two incoming circuit breakers of the MCC's shall be interlocked in such a way that only one of them can be closed at a time. Each of the two incoming feeders shall be locally selectable at the respective MCC as the primary feeder to distribute the load evenly. Automatic changeover unit will select a secondary feeder if the primary feeder loses power supply and back again when power supply is restored. Delay on automatic changeover shall be adjustable 0-10 s. The voltage control relays shall be provided with the necessary quantity of potential free contacts for specified indications, protection, control, alarms, supervision and interlocks.
- 25.18.5 Controlled outgoing feeders (motor starter units) shall be a draw-out combination of a circuit breaker and a contactor, relays, push buttons, lamps etc mounted in one cassette together with all other associated equipment.
- 25.18.6 Each MCC shall be provided with one spare MCCB for every rating included in this MCC.
- 25.18.7 One current transformer shall be provided for each incoming feeder. One voltage transformer shall be provided for measurement of busbar voltage. A moving-iron voltmeter with selector switch shall be located on the front panel, along with moving-iron ampere meters with selector switch for all incoming feeders.



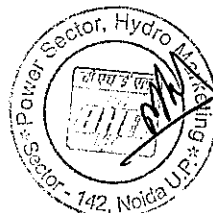
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25.18.8 Technical data and ratings of MCC

- | | | |
|-----|---------------------------------------|---|
| 1. | Rated voltage | 415 $\pm$ 10% V |
| 2. | Frequency | 50 $\pm$ 3% Hz |
| 3. | Insulation level | 2.5 kV for 1 min |
| 4. | No. of Phase | 3 |
| 5. | Neutral | Solidly grounded |
| 6. | Rated current | 2000 A- main, 630A |
| a) | of bus bar at | - |
| | Moulded case circuit breaker | Tap off. |
| b) | | Up to 630 A |
| 7. | Rated short time withstand current, | 50 kA for 1 Sec. |
| 8. | Cubicles | |
| | Type | Indoor, metal enclosed |
| | Cooling/ventilation | Natural |
| | Door | Hinged |
| | Protection class | IP 54 |
| 9. | MCC: Incoming circuit breakers | |
| | Circuit breaker type | Air circuit breaker / Molded case circuit breaker, draw out |
| | Operating mechanism | Motor wound spring charged |
| | Live parts cover | Automatic when withdrawn |
| | Operating mode | Local and remote(motor wound) |
| 10. | MCC: Outgoing feeders: | |
| | Circuit breaker type | Moulded case circuit breaker |
| | Operating mechanism | Manually operated spring charged |
| | Feeder type | Draw-out cassette |
| | Live parts cover | Automatic when withdrawn |
| | Mode of operation of outgoing feeders | Local and remote |
| 11. | Control Voltage -AC equipment | 240V AC $\pm$ 10% |
| 12. | Service voltage - AC equipment | 240V AC $\pm$ 10% |

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25.19 CONTROL CIRCUITS

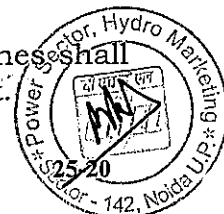
- 25.19.1 The control circuit supply voltage for incoming, outgoing and sectionalised circuit breakers shall be 240V AC.
- 25.19.2 Miniature circuit breakers shall be provided with an alarm contact for remote indication of tripped condition for protection of the control circuits. The miniature circuit breakers shall be of the fixed type for mounting on a DIN rail. All means shall be provided for easy removal and handling of the miniature circuit breakers.
- 25.19.3 All miniature circuit breakers shall be provided with the necessary quantity of potential free contacts for specified indications, alarms and interlocks. All auxiliary contacts shall be wired to terminal blocks in the cable compartment.
- 25.19.4 Auxiliary contacts shall be wired to terminal blocks for the following remote indications:
- Circuit breaker trip conditions (common for each of MCC).
Ventilation systems ON position.
Malfunction at MCC (common for each of MCC).
- 25.19.5 Each controlled outgoing feeder unit shall be equipped with facility for remote operation, if it is not provided in the individual local control cubicles.
- 25.19.6 Each cassette unit shall be equipped with a local start-stop push button and an indicator showing the position of the contactor. All these devices shall be located in the unit compartment door.
- 25.19.7 The terminals shall be provided in one of the MCC cubicles to which all the signals from ventilation systems fed from this MCC shall be connected & then these signals by means of one or two cables shall be transmitted to computerised control room.

25.20 METERING

- All measuring equipment shall be located in the respective circuit breaker compartment.
- All metering circuits shall be terminated on marked terminal blocks for remote metering purposes.
- All meters, indicators, control and selector switches shall be located in the hinged door of this compartment.



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25.20.1 Each MCC shall have

- One bimetal/moving-iron ampere-meter with selector switch on all incoming feeders;
- One voltmeter with selector switch for bus voltage;

25.20.2 Current measurements:

Current transformers shall be mounted in the compartment or cassette with their respective feeder.

Secondary leads of the current transformers shall be connected to marked terminals in the cable compartment in each cubicle. Secondary windings shall be earthed at one point only and means shall be provided on the equipment to facilitate the secondary circuits of the current transformers being short-circuited in the terminal blocks.

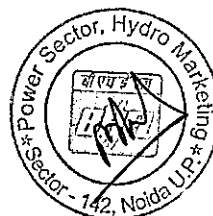
25.20.3 Voltage measurements

The secondary leads of the voltage transformer shall be connected to miniature circuit breakers with alarm contacts and wired to terminals. The secondary winding shall be earthed at one point only.

25.21 REQUIREMENTS FOR POWER, CONTROL AND INSTRUMENTATION CABLES 0.66 / 1.1 KV

- 25.21.1 All power cables from MCC to electric motors and control cables within the limits stipulated by this technical specification shall be included by the bidders in their scope of supply.
- 25.21.2 The scope of supply shall include, but not limited to the external measuring, control, signaling cables and their accessories, including the cables for remote control and annunciation panel of ventilation system.
- 25.21.3 The cables shall be heavy duty type and suitable for continuous operation under climatic conditions prevailing at the site, i.e. hot & humid tropical climate.
- 25.21.4 The cables shall have a termite, vermin, rodent-proof covering.
- 25.21.5 The cables shall be of fire-retardant and flame-retardant, low smoke (FRLS) type.
- 25.21.6 All AC power supplying cables shall have multi core/single core aluminium conductors and XLPE/HR-PVC insulation.

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- 25.21.7 Flexible power cables shall be provided for connection of the motors as well as for the difficult laying conditions.
- 25.21.8 All control and instrumentation cables shall be multi core annealed high conductivity copper conductor solid or wire stranded type, insulated with HR-PVC insulation, PVC sheathed, conforming to IS 1554 (part I or II). The outer sheath shall be of specially formulated PVC compound.
- 25.21.9 All control cables (except for current circuits) shall have at least 20% or 1 spare cores whichever is more.
- 25.21.10 Control cables shall be standardized as much as possible in order to supply only a few different types (e.g. 4, 5, 7, 14, 19 and 27).
- 25.21.11 Control, annunciation's, secondary wiring shall be 650/1100 V grade, multi-conductor cables. Single conductor cables shall be used for short runs.
- 25.21.12 For the cables for pick-ups, for data transmission to remote panel in CCS and elsewhere the flexible cables are necessary. The conductors shall be plain copper, stranded wire type with PVC core insulation and shall have braided screen of tinned Cu or steel wires.
- 25.21.13 The cables for analog signals transmission to computers of Computerized Control System shall be 300 V grade screened twisted pair solid multi-conductor of 0.8 millimeter diameter.
- 25.21.14 The cables for outdoor installation and where mechanical damages are possible, shall have armouring. The armouring applied for cables over the inner sheath, can be of steel strips/tapes and shall conform to IS: 375.
- 25.21.15 The cables shall be capable of satisfactory operation under a power supply system having frequency variation of $\pm 3\%$, voltage variation of $\pm 10\%$ and a combined frequency & voltage variation of 10% (absolute sum). The number of cores and sizes of the cables required for various circuits shall be as specified in the "Schedule of Requirements and Price Schedule".
- 25.21.16 The cables covered by this specification shall be supplied in one length or in standard length as approved by the purchaser.
- 25.21.17 To facilitate easy identification of phases a color scheme of Red, Yellow and Blue for phases and Black for neutral shall be adopted for power cables. Multi-core control cables shall be color coded for identification of cores as per IS:1554 - 1976.



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25.21.18 Following color scheme shall be adopted:

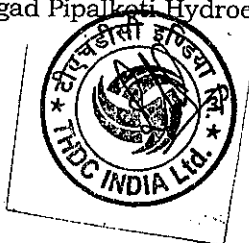
single-core	Red, Yellow, Blue or Black
2-core	Red and Black
3-core	Red, Yellow and Blue
4 - core	Red, Yellow, Blue and Black
5-core	Red, Yellow, Blue, Black and Light Grey

Where the number of cores exceeds 5, two adjacent cores (counting core and direction core) in each layer are colored Blue and Yellow respectively, and the remaining cores are Light Grey. Control cables with core identified by numbers also can be provided.

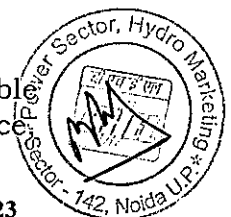
25.22 REQUIREMENTS FOR CABLE LAYING

- 25.22.1 All cables that shall be laid by the supplier shall be terminated at both ends. The supplier shall provide numbered ferrules at each connecting terminal in order to check connections without any difficulty. Terminal blocks have to be provided in various panels/equipment for these terminations. One termination shall mean connecting both ends of one core of a cable to given terminal blocks. The cables shall be terminated by crimping lugs to the ends.
- 25.22.2 It is also proposed to procure lugs corresponding to the cable sizes. These shall be made of copper tube electroplated. The supplier shall ensure that no bimetallic action takes place, between the aluminium conductor of the cable and the cable connecting lug by filling the lugs with suitable compound.
- 25.22.3 The supplier shall supply and install all necessary cable trays and cable support systems complete with brackets, supports, hardware and special fittings for power and control cables in cable trenches, ceiling and ducts, etc. as specified herein or as approved by the engineer incharge. Special fittings shall include tees, wyes, bends crosses, dividers, reducers, dropouts, connectors and supports and all other materials required to form a complete cable tray system.
- 25.22.4 The power and control cables shall be run separately on racks/trays, in cable trenches/cable tunnels and on columns, walls, ceiling and pulled through pipes/conduits.
- 25.22.5 The bidder in his design shall give preference to the use of cable trays through out. Where this is not feasible because of space, cable supports may be used, subject to Engineer's approval.

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- 25.22.6 The supplier shall be responsible for carrying out proper dressing of the cables and supply non magnetic/ moulded fiber glass cable fixing strips, fasteners and clamps, wherever necessary to hold the cables firmly to the trays.
- 25.22.7 Cushion type cable clamps shall be provided to hold the cables firmly on the steel supports without harming the cable insulation.
- 25.22.8 Cables shall be properly clamped at regular intervals with the help of non magnetic/molded fiber glass strip clamps/PVC sleeved clamps, of suitable size. Bidder shall submit typical drawings along with tender giving proposed clamping arrangement and also give distance of clamping at bends and in regular run of cables.

25.23 EQUIPMENT REQUIREMENTS.

25.23.1 Cubicles

25.23.1.1 Sheet Metal work

- i) The frame shall be fabricated using suitable mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2.5mm.
- ii) Frames shall be enclosed by sheet steel of thickness not less than 2mm cold rolled or 2.5mm hot rolled, smoothly finished, levelled and free from flaws. Doors and covers shall be made of sheet steel of thickness not less than 1.6mm cold rolled or 2mm hot rolled. Stiffeners shall be provided wherever necessary.
- iii) All panel edges and door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members.
- iv) Cut-outs shall be true in shape and devoid of sharp edges.
- v) The complete structure shall be rigid, self-supporting, free from vibration, twists and bends.

25.23.1.2 Constructional Features

- i. MCC shall be of metal enclosed, indoor, floor mounted modular type and shall be made up of the requisite vertical sections of dust and vermin proof construction.



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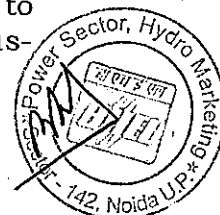
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- ii. Provided with a degree of protection of IP 54, easily extendable on both sides by the addition of vertical sections after removing the end covers.
- iii. Provided with a metal sill frame made of structural steel channel section properly drilled for mounting the switchgear alongwith necessary mounting hardware. Hardware shall be zinc plated and phosphated.
- iv. Provided with labels on the front and rear indicating the switchgear designation.
- v. Provided with cable entry facilities at top/bottom with 3mm thick removable gland plates and necessary cable glands. For 1 core cables these plates shall be non-magnetic.
- vi. Of uniform height of not more than 2150mm of single or double front execution.
- vii. Provided with gaskets all round the perimeter of adjacent panels, panel and base frame, removable covers and doors.
- viii. Provided with bus-bars running at the top or bottom as required, all along the length of the switchgear in a separate sheet steel enclosure.
- ix. Operation devices shall be incorporated only in the front of the switchgear.
- x. The switchgear shall be divided into distinct vertical sections and each comprising of:
- xi. A completely metal enclosed busbar compartment running horizontally.
- xii. Individual feeder modules arranged in multi-tier formation. It is essential that the modules are integral multiples of the base unit size to provide for flexibility in changes, if any, at site.
- xiii. Enclosed vertical bus-bars serving all modules in the vertical section. For safety isolation of the vertical bus-bars, insulating barrier with cut-outs shall be provided to allow the power stab contacts to engage with vertical bus-bars.
- xiv. A vertical cable alley covering the entire height.

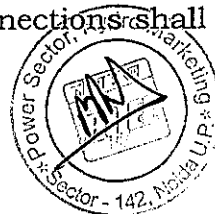
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- xv. The cable alley shall be minimum 200mm wide for motor controlled modules and 500mm wide for circuit breaker controlled modules.
- xvi. A horizontal separate enclosure for all auxiliary power & control boxes as required, shall be located so as to enable easy identification, maintenance and segregation from the main power buses. Tap-off connections from these buses shall be arranged separately for each vertical section.
- xvii. Each vertical section shall be equipped with space heaters which may be located in the cable alley.
- xviii. One metal sheet shall be provided between two adjacent vertical sections running to the full height of the switchgear except for the horizontal busbar compartment. However, each shipping section shall have metal sheets at both ends.
- xix. All equipment associated with a single circuit shall be housed in a separate module compartment of the vertical section. The compartment shall be sheet steel enclosed on all sides and the rear, with the withdrawable units in position or removed, except on the cable alley side. A plate cover with a slot to permit wiring connections shall be provided on the side corresponding to the cable alley. The front of the compartment shall be provided with hinged door.
- xx. For draw-out type modules, only the handles of control and selector switches, push buttons, knobs & cut outs for lamps and meters shall be arranged on the front doors of the respective compartments to permit operation without opening the door. On circuit breaker controlled circuits, protective relays shall be mounted on the front door of the compartment. All other equipment pertaining to a circuit shall be mounted on the withdrawable chassis. All cut-outs shall be provided with gaskets for the purpose of dust-proofing.
- xxi. Current transformers shall not be directly mounted on the buses. Current transformers on circuit breaker controlled circuits shall be mounted on the fixed portion of the compartment.
- xxii. In breaker compartments, suitable barriers shall be placed between circuit breakers and all control, protective and indication circuit equipment including instrument transformers. External cable connections shall be carried



out in separate cable compartments for power and control cables.

- xxiii. After isolation of the power and control connections of a circuit, it shall be possible to safely carry out maintenance in compartment with the bus-bars and adjacent circuit live.
- xxiv. The withdrawable chassis shall move on suitable guides and on suitably plated steel or stainless steel rollers or balls to facilitate easy withdrawal.
- xxv. Cable alleys shall be provided with suitable hinged doors. It shall be possible to safely carryout maintenance work on cable connections to any one circuit with the bus-bars and adjacent circuits live. Adequate number of slotted cable support arms shall be provided for clearing the cables.
- xxvi. Rear of single front switchgear shall be provided with removable panels. It shall be possible for one person to remove and fix the removable panel.
- xxvii. All doors shall be provided with concealed type hinges and captive screws.
- xxviii. The withdrawable chassis housing circuit breakers shall be of the fully draw-out type.
- xxix. The withdrawable chassis housing feeder control and motor control equipment not incorporating circuit breakers shall be of the fully draw-out type.

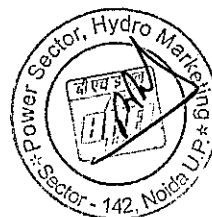
25.23.1.3 Fully draw-out type withdrawable chassis

In this type of construction it shall be possible to drawout the withdrawable chassis without having to unscrew and unbolt any connections to the equipment mounted on the withdrawable chassis. The power and control drawout type connections shall be of the stab in or sliding type. All drawout contacts, including for auxiliary and control wiring shall be of self-aligning type.

25.23.1.4 Interchangeability

- i. All identical equipment and corresponding parts including chassis of drawout modules of the same size shall be fully interchangeable, without having to carryout modifications. For trouble free interchangeability, the drawout arrangements shall be designed such that

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normal dimensional variations are taken care of by self-aligning feature of the modules.

- ii. Components of equipment that are not fully interchangeable are liable for rejection. Supplier shall replace all such equipment by fully interchangeable equipment at his cost.
- iii. The drawout contacts shall be only between copper/copper alloy/ aluminium faces, which are silver or tin plated. The contact design shall be such that there shall be no arcing/deformation under the rated peak short circuit current.
- iv. Switchgear shall be designed in such a way that all components of equipment and bus bars operate satisfactorily without exceeding their respective maximum permissible temperature rise limits under ambient temperature condition prevailing within the switchgear cubicle, with reference to ambient temperature outside the switchgear cubicles.
- v. Bus ducts, if required for incoming circuits or for interconnecting switchgears, shall be supplied. The rating, material of the bus-bars and enclosure shall be same as the switchgear, unless otherwise specified.

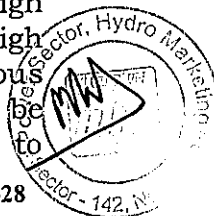
25.23.2 Bus and bus taps

- 25.23.2.1 Switchgear shall be provided with three phase or three phase and neutral bus-bars as per the requirement and same shall be approved by the purchaser during details engineering.
- 25.23.2.2 Bus-bars shall be of uniform cross section throughout the length of the switchgear, and upto the incoming terminals of feeder circuit breakers/ switches.
- 25.23.2.3 The bus-bars shall be made of high conductivity aluminium alloy of E91E grade.
- 25.23.2.4 Bus-bars shall be provided with at least the minimum clearances in air as per applicable standards for a 500V, 3 phase system.
- 25.23.2.5 All bus-bars, bus-taps shall be insulated with close fitting sleeve of hard, smooth, dust and dirt free plastic insulation of high dielectric strength (450V/mil) to provide a permanent high dielectric non-ageing and non-tracking, protection, impervious to water, tropical conditions and fungi. The insulation shall be non-inflamable and self-extinguishing and in fast colors to



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indicate phases. The joints shall be insulated in such a way as to provide for accessibility of contact bolts for maintenance. The dielectric strength and properties shall hold good for the temperature range of 0° C. to 90° C.

If the insulating sleeve is not colored but black, bus-bars shall be color-coded with colored bands at suitable intervals.

25.23.2.6 Bus-bars supports shall be adequately braced to withstand the stresses due to the specified short circuit currents for the associated switchgear. Bus-bar reinforced moulded plastic material, permal wood or cast resin.

25.23.2.7 Separate supports shall be provided for each phase of the bus-bars. If a common support is provided for all three phases, anti racking barriers shall be incorporated between each phase as well as for neutral.

25.23.2.8 Bus-bars joints shall be complete with high tensile steel bolts and spring washers and nuts. Bus-bars shall be thoroughly cleaned at the joint locations and suitable contact grease shall be applied just before making a joint.

25.23.3 Auxiliary Buses

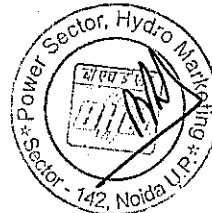
23.23.3.1 Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequately supported and sized to suit specific requirements. The material of control power supply buses shall be electrolytic copper. The material for space heater power supply buses shall be same as that for the main power buses.

25.23.4 Control module

25.23.4.1 Moulded Case Circuit Breakers

- i. Moulded case circuit breakers (MCCBs) shall be provided for the motor controls. The MCCBs shall conform to the latest applicable standards.
- ii. MCCBs in AC circuits shall be of triple pole construction arranged for simultaneous three pole manual closing and opening and for automatic instantaneous tripping on short circuit. Operating mechanism shall be quick-make, quick-break and trip-free type. The ON, OFF and TRIP position of the MCCB shall be clearly indicated and visible to the operator when mounted as in service. Operating handle shall be provided in front of board.

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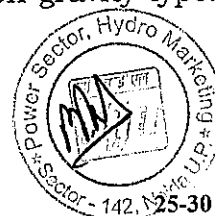
- iii. MCCBs shall be capable of withstanding the thermal stresses caused by overloads and locked rotor currents of values associated with protective relay settings starting current and the mechanical stress caused by the peak short-circuit current of value associated with the switchgear rating. The maximum tripping time under short circuit shall not exceed 20 milliseconds.
- iv. The instantaneous short circuit release shall be so chosen by the bidder as to operate at a current in excess of the peak motor inrush current and a range of setting shall be provided for the purchaser's selection.
- v. MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.
- vi. Under-voltage release and overload inverse time release shall be provided.
- vii. Short circuit withstand capacity shall be 50 kA for 1 sec.

25.23.4.2 Contactors

- Motor starter contactors shall be of the electromagnetic type rated for uninterrupted duty as defined in applicable standards.
- Main contacts of motor starter contactors shall be of silver plated copper.
- Each motor starter contactor shall be provided with two NO and two NC potential free auxiliary contacts.
- Insulation class of operating coils shall be class E or better.
- Operating coils of contactors shall be suitable for operation from the 240V AC supply system.
- Contactors shall comply with all other requirements of applicable standards.
- Contactors shall be of the double break, non-gravity type.



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25.23.4.3 Direct-on-Line Starters

Direct-on-line starters shall be suitable for class AC 3 utilization category as specified in applicable standards.

25.23.4.4 Automatic Star-Delta Starters

For motor capacity more than 50 kW, automatic star-delta starters shall comprise three sets of contactors, one for the line, one for the star point and one for the delta, and a timer relay to automatically change the connections from star to delta.

Star-delta contactors shall be electrically interlocked to permit starting of the motor in the proper sequence, namely star contactor closing, line contactor closing, energisation of timer, timer contact de-energizing the contactor and delta contactor closing.

Star-delta starters shall be suitable for AC 3 utilization category as specified in applicable standards.

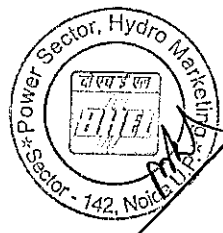
25.24 SINGLE PHASING PREVENTERS

- i.) Single phasing preventer relay shall be provided to protect motors against single phasing. The relay shall not operate for supply voltage unbalance of $\pm 5\%$ but shall positively operate for supply voltage unbalance of more than $\pm 5\%$. The relay shall operate in the event of a single phase fuse blowing even though the motor emf in the concerned phase is of the order of 85%.
- ii.) The relay shall be suitable for application to protect motors. The relay operation shall be independent of the motor kW rating, the loading conditions prior to the occurrence of the single phasing and rpm of the motor. The relay shall be of the fail-safe type and shall operate to trip the motor when the relay internal wiring is accidentally open circuited.

25.25 INDICATING INSTRUMENTS AND METERS

- Electrical indicating instruments shall be of minimum 96mm square size, suitable for flush mounting.
- Indicating instruments shall have provision for zero adjustment outside the cover.

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- Instruments dials shall be parallex free and provided with a suppressed extended scale to indicate motor starting current.
- Ammeters provided on motor circuits shall be provided with a suppressed extended scale to indicate motor starting current.
- Watt hour meters shall be of the direct reading electro-dynamometer type complete with cyclo-meter type dials and reverse running stops.

25.26 INDICATING LAMPS

Indicating lamps shall be of the filament type/LED, of low watt consumption provided with series resistors. These shall be provided with translucent lamp covers of colours red, green and amber.

Bulbs and lenses shall be easily replaceable from the front.

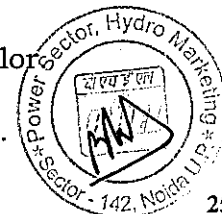
25.27 CONTROL AND SELECTOR SWITCHES

- 25.27.1 Control and selector switches shall be of the rotary type, adequately rated for the purpose intended (minimum acceptable rating is 10A continuous at 240V AC and inductive break 220V DC) and provided with escutcheon plates clearly marked to show the positions.
- 25.27.2 Control switches shall be of the spring return to normal type and provided with pistol grip type handles.
- 25.27.3 Control switches for circuit breaker control shall be provided.
- 25.27.4 Selector switches shall be of the maintained contact stay-put type. Switches in ammeter circuits shall have make-before-break type contact and provided with oval handles.

25.28 PUSH BUTTONS

- 25.28.1 Push button shall be of the momentary contact, push to actuate type rated to carry 10A at 240V AC with inductive breaking at 220V DC and fitted with self reset, 2 NO and 2 NC contacts. Push buttons shall be provided with integral escutcheon plates marked with its function.

- Start push buttons shall be green in color.
- Stop push buttons shall be red in color.



- All other push buttons shall be black in color.

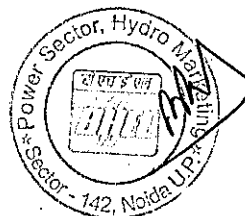
25.28.2 Emergency stop push buttons shall be of the lockable in the pushed position type and shall be shrouded to prevent accidental operation. Key shall not be required for the operation of the push button.

- Push button switches with a built-in indicating lamp shall be supplied.

25.29 ALARM ANUNCIATORS

- Alarm annunciators shall be installed at central ventilating control and annunciation panel in SCA as well as various MCCS.
- The alarm annunciation scheme alongwith complete wiring shall incorporate the following features:
- Visual indication of the fault by means of steadily lit alarm lights.
- Audible alarm on the occurrence of the fault.
- Red facia units to differentiate trip alarm from non-trip alarms.
- Acknowledgement of occurrence of fault, incorporating audible alarm cancellation features.
- Resetting the scheme after the faults have been cleared.
- Facility to test the healthy condition of the lamps automatically excluding units indicating existing faults.
- Prevention of mal operation of the scheme when the push buttons are pressed incorrect or in a wrong sequence.
- Initiation of the complete sequence of audio-visual alarms in the event of a new fault occurring at the time of accepting an existing fault.
- Suitable for operation on a 2 wire, DC supply voltage with a supply voltage variation between 80% and 110% of the rated voltage.
- Suitable for operation for fleeting (15 millisecond duration) as well as the persistent faults.

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- Facility for a separate audio-visual alarm to indicate alarm supply failure suitable for operation from a 2 wire, 240V AC supply.
- Facility for duplicating the audio-visual alarm in remote computerised control system room.
- The alarm annunciation scheme shall comprise the following equipment:
 - A common alarm bell
 - Accept reset and lamp test push buttons.
 - Alarm supply failure, accept and reset push buttons.

25.30 SPACE HEATERS

Space heaters for switchgear and starter panels shall be suitable for operation on 240V AC provided with single pole MCB with overload, short circuit release and provided with thermostats to cut off the heaters at 45° C.

25.31 CABLE TERMINATIONS

25.31.1 Suitable compression type, heavy duty brass cable glands with check nuts, rubber sealing ring and brass washers mounted on a removable gland plate shall be provided to support all power and control cables entering the MCC. Cable glands shall incorporate built-in facilities for earthing the wire armour of cables. Cable glands shall be plated to avoid corrosion.

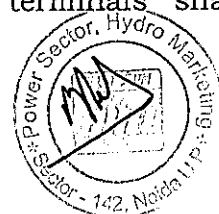
25.31.2 Power cable glands and crimping type lugs shall be supplied to suit the cable sizes. Approximate quantity of control cable glands for different types of modules shall be indicated in the module drawing/bill of material. If during course of detailed engineering of the switchgear it is found necessary to provide more glands of higher size than those envisaged, the bidder shall provide and accommodate the same without extra cost.

25.31.3 For clamping cable cores at regular interval inside the cable alleys, suitable slotted angles, up to the respective terminal blocks, shall be provided.

25.31.4 Necessary crimping of tinned copper cable lugs for connecting the individual cores to the respective terminals shall be provided.



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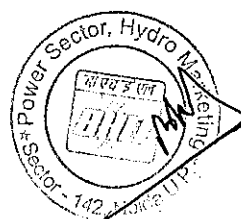
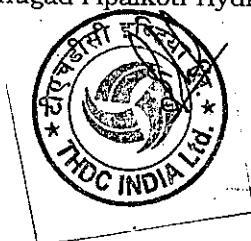
25.32 INTERNAL WIRING

- 25.32.1 Wiring inside the MCC and control panels shall be carried out with 1100/650V grade, PVC insulated, Stranded Aluminium conductor wires. Minimum size of conductor for power circuits is 4 sq.mm copper or equivalent size aluminium conductor. Control circuit shall be wired with copper conductor of at least 2.5 sq.mm for CT circuits, 1.5 sq.mm. for other circuits & the number and size of strands shall be 7 of 0.67mm and 0.5mm diameter respectively.
- 25.32.2 Engraved identification ferrules, marked to correspond with the wiring diagrams shall be fitted to each wire. Ferrules shall be of yellow color with black lettering.
- 25.32.3 Wires forming part of a tripping circuit of circuit breaker shall be provided with an additional red ferrule marked T.
- 25.32.4 Spare auxiliary contacts of all equipment forming part of the switchgear shall be wired up to the terminal blocks. Wiring for equipment if supplied by the purchaser for which the supplier has to provide cut-outs (where indicated in the data sheets) shall be provided upto the terminal block. Spare and unassigned modules shall be complete with internal wiring.
- 25.32.5 Wiring shall be terminated on preferably stud type terminal blocks such that the wires are connected by cable lugs with nuts & washers/lock-nuts.
- 25.32.6 Not more than two connections shall be made on any one terminal.

25.33 TERMINAL BLOCKS

- 25.33.1 Terminal blocks (both for power and control circuits) shall be of reputed make specially for CT & VT circuits. It shall comprise finely threaded pairs of brass studs of at least 6mm diameter, links between each pair of studs, washers, nuts and locknuts. The studs, shall be securely locked within the mounting base to prevent their turning. Insulated barriers shall be provided between adjacent terminals.
- 25.33.2 Terminals for circuits with voltage exceeding 125V shall be shrouded. Terminal blocks shall be grouped depending on circuit voltage. Different voltage groups of terminal blocks shall be segregated.

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- 25.33.3 Terminal blocks shall be adequately rated to carry the current of the associated circuit. Minimum rating of the terminal block is 10A.
- 25.33.4 Terminals shall be numbered for identification. Engraved white-on-black labels shall be provided on the terminal blocks, describing the function of the circuit.
- 25.33.5 Where duplication of a terminal block is necessary, it shall be achieved by solid bonding links.
- 25.33.6 Terminal blocks, CT secondary lead wires shall be provided with shorting and disconnecting/earthing facilities.
- 25.33.7 Terminal blocks shall be arranged with at least 100mm clearance between two sets of terminal blocks. Control terminals for external connections shall be suitable for terminating at least two conductors each of 2.5sq.mm size. Screwless cage Clamp / Plug in type terminal block can also be considered.

25.34 LABELS

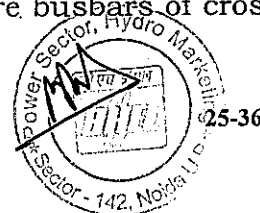
- All labels shall comprise white letters on a black background.
- Labels shall be made of non-rusting metal or 3-ply lamicaid, or engraved PVC.
- Labels shall be properly fixed, with provision to prevent distortion due to expansion.
- Size of lettering shall be 6mm, unless otherwise specified.

25.35 EARTHING

- 25.35.1 Each control cubicle shall be provided with an earth busbar running along the entire length of the board. Material and size of the earth busbar shall be as specified in data sheets. At either end of the earth bus, one (1) clamp type terminal with nuts, bolts and washers shall be provided for bolting the purchasers earthing conductor.
- 25.35.2 Earth busbars shall be supported at suitable intervals.
- 25.35.3 Positive connection between all the frames of equipment mounted in the switchboard and earth bus bar shall be provided by using insulated copper wires/bare busbars of cross



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section equal to that of the busbar, or equal to half the size of circuit load current carrying conductor, whichever is smaller.

- 25.35.4 All instruments and relay cases shall be connected to the earth busbar using 1100/650V grade, 2.5 sq.mm stranded, copper earthing conductor.

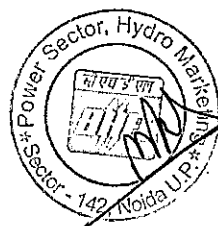
25.36 PAINTING

- 25.36.1 All sheet steel work shall be phosphatised in accordance with applicable standards.
- 25.36.2 Oil, grease, dirt and other adhesive foreign matter shall be thoroughly removed by emulsion cleaning.
- 25.36.3 Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
- 25.36.4 After phosphatising, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.
- 25.36.5 The phosphate coating shall be sealed by the application of two coats of zinc chromate primer. The first coat may be flash dried while the second coat shall be stoved.
- 25.36.6 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, with each coat followed by stoving. The second finishing coat for the external of panels shall be applied after completion of tests.
- 25.36.7 Each coat of primer and finishing paint shall be of a slightly different shade to enable inspection of the painting.
- 25.36.8 The final finished thickness of paint film on steel shall not be less than 100 microns, and shall not be more than 150 microns.
- 25.36.9 Finished painted appearance of equipment shall present an aesthetically pleasing appearance, free from dents and uneven surfaces. The color of the finish paint shall be approved by the purchaser during details engineering.

25.37 TECHNICAL PARTICULARS

Technical particulars shall be furnished along with bid as per Annex II&III. Any other information not covered herein may also be furnished.

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25.38 DESCRIPTION OF VENTILATING SYSTEMS

Cooling arrangement for cooling the outside air ,type of coolers and the source from where the cooling water has to be taken to cool the air may be specified by the supplier in technical bid.

25.38.1 Fresh Air Supply

The proposed ventilation of the power house complex shall cater to three (3) areas along with their approach/access/escape passage isolated from each others namely, machine hall, cavern including annex bays floors, transformer hall and GIS Hall cavern, main access tunnel.

Air changes for various rooms and different areas shall be as per relevant Indian or International standard.

25.38.1.1 When the indoor temperature is below 18°C the temperature controlled system will operate return air dampers of M/C hall and Transformer hall ventilation supply air rooms to the fully open position and a portion of the used air will be sucked by the supply fans which will get mixed with the cool fresh supply air entering into the power house.

25.38.1.2 When the power house indoor temperature is above 18°C , the temperature controlled system will operate return air dampers of M/C hall and Transformer hall to the fully closed position. The hot air will be discharged outside the power house alongwith exhaust air of toilets, batteries etc. through exhaust fans.

25.38.2 Ventilation system in the premises of Machine Hall cavern including Annexe Blocks (Supply System & Exhaust System)

25.38.2.1 The machine hall cavern with annexe blocks at either end shall be furnished air from two service and one standby ventilation plants for each of the systems located in the annexe blocks near S/Bay & Unit-4 bay respectively. Outside air will be taken from the ventilation tunnel /drainage gallery up to the ventilation plants of system. Air shall be supplied to each floor over air ducts to various locations in the M/C hall including annexe blocks and upto the drainage gallery. Air shall be fed into ventilation ducts which pass through various floors, and branch ducts are tapped from the vertical ventilation duct for distributing air to all premises of the machine hall cavern including annexe blocks. The total capacity of the ventilation plant of the systems has to be estimated by the contractor and approved by the THDC.



25.38.2.2 From all levels of the machine hall cavern, air shall come out through the gratings/openings to be provided for installation/removal of runner & through staircase etc. by the stack (chimney) effect. Some of the exhaust air will pass through the main access tunnel on its own to outside the power house. Hot air which is accumulated near the crown shall be sucked through return air grilles in the machine hall and shall be exhausted alongwith exhaust of some of the premises in Annexe blocks such as D.C. Battery room, DCDB room, toilets, domestic sewage tank pump rooms & lubricating oil plant room to out side the power house through exhaust fans of systems located in exhaust air blower rooms in the Annexe blocks near S/bay & unit-4 side. The rating of the exhaust fan has to be estimated by the contractor and approved by purchaser.

25.38.2.3 The exhaust ducts of fan systems shall be combined together & laid in the crown of the vantilation-cum emergency escape tunnel. The combined exhaust duct from fan systems of the transformer hall shall also join this duct at the junction point of ventilation tunnels, and the combined exhaust shall be delivered to a blower room having another set of exhaust air fans (1 working & 1 standby) system. This blower room is proposed in the service building near Main Access Tunnel and the capacity would be estimated by bidder & approved by purchaser.

25.38.3 Storage Battery Room in Annexe Block near S/Bay

25.38.3.1 The battery room shall receive fresh supply by induction i.e. by using exhaust fans to avoid pressurized room which would emanate acid fumes and hydrogen into the machine hall etc. The exhaust air from battery room area shall not get mixed with fresh air supply. The fresh air shall enter the battery room from louvers. The exhaust system shall have 100 % redundancy.

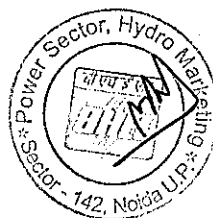
25.38.3.2 The ducts, fans etc. shall be acid proof.

25.38.3.3 Air removal quantities designed to reduce the hydrogen concentration to the permissible limit will be handled from the upper zone of the battery room with the aid of ventilation plant E-1 located in another Ventilation Chamber at El 531.5m in annexe block. Air will be discharged outside power house via an exhaust duct made of sheet metal located in the ventilation-cum- emergency escape tunnel which will be coated with acid resistant paint.

25.38.4 Amenity rooms (W.Cs. etc.) in Annexe blocks

Air from the amenity rooms (toilets) and the domestic sewerage disposal tank/pump station shall be exhausted with the

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exhaust ventilation fans systems consisting of two ventilation units. Fresh air into the amenity room area shall be sucked through sashes/louvers provided in the bottom half portion of doors.

25.38.5 Vaults of Power Transformers (Supply Systems & Exhaust System) :

25.38.5.1 The transformer vaults are fire hazardous locations. Air shall be supplied to the transformer vaults by the air supply system comprising two service and one standby ventilation plants. The capacity of each ventilation system would be calculated by the contractor and approved by the purchaser.

25.38.5.2 Outside air shall be supplied by the ventilation tunnel leading to the ventilation chambers located in annexe blocks at either end of the transformer-cum-GIS hall.

25.38.5.3 Air shall be exhausted from the transformer vaults through the open fire doors of the transformer vaults as well as through exhaust ducts. In case of emergency (fire), the fire doors shall be shut automatically and smoke (after the fire is extinguished) shall be sucked through the air duct of exhaust system running near the ceiling of floor in the transformer vaults area with the aid of the exhaust plants located in the ventilation chambers in the two annexe bays of the transformer hall. Air shall be discharged outside through the exhaust ducts to be laid in the ventilation-cum-emergency escape tunnel. The supply and exhaust air ducts shall be equipped with fire dampers which shall close automatically, if fire breaks out in any of the transformer chambers. The above exhaust fans shall also discharge hot air entrapped in the crown of GIS hall for which requisite number of return air grilles shall be provided in the crown of the GIS hall.

25.38.6 Bus-Duct Galleries

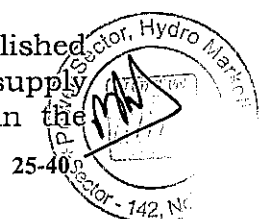
Each of the four bus-duct galleries shall be supplied air from the GIS hall side by the above supply systems. Air at a temperature of about 34^o C shall discharge into the machine hall & shall pass out of the power house through the Main Access Tunnel.

25.38.7 420 KV GIS Hall, Transformer Transfer Zone, Switchgear & other rooms in Annexe Blocks of Transformer Hall

Supply ventilation of the above locations shall be accomplished with the above ventilation systems. The air ducts shall supply air from the supply ventilation plants to the rooms in the



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annexe blocks at either end of transformer hall, 420 kV GIS hall & transformer transfer zone. Air exhausted from the rooms of annexe blocks & GIS hall shall be let out through 400 kV cable tunnel to outside the power house in the pothead yard area. Some of the air shall also be exhausted through the access tunnel to the transformer hall.

25.38.8 Transformer oil handling facility & amenity rooms in Transformer Hall area & Exhaust System

The amenity rooms & transformer oil handling facility shall be provided with the same supply/exhaust system. Air shall be discharged outside through the exhaust duct laid in the ventilation tunnel to the approach road area. As the oil handling facility belongs to the fire hazardous location, supply & exhaust air ducts shall be equipped with fire dampers to be installed at the inlet to the room which shall close automatically in case of fire in the room. For amenity rooms, sashes are proposed at the bottom portion of doors from where fresh air supplied by the above system would enter. Only return air grilles in the exhaust duct are envisaged for amenity rooms.

25.38.9 Smoke free air pressure system

25.38.9.1 Provision shall be made to create positive air pressure (minimum 20 mm w.c.) during fire (with one of the doors being opened) in the smoke-free stair way and elevator hoist way with the aid of the ventilation systems. The capacity of ventilation fans and plant would be calculated by the contractor and approved by the purchaser.

25.38.9.2 These fans shall operate automatically at preset regular intervals as well as during emergency condition & the pressurised air in the stair case / lift shaft areas shall prevent entry of smoke, thus helping power house personnel to escape out from the underground power house to outside through the ventilation-cum-emergency escape tunnel.

25.38.10 Butterfly Valve chamber

Refer Clarification No. 1 Sl. No. 422

Two Nos. fresh air supply fans are proposed at the portal of access tunnel to B.F.V chamber which shall carry fresh air through ventilation duct installed in the crown of access tunnel upto the BFV chamber. Exhaust air shall come out of the tunnel/construction adit on its own, thus ventilating these zones also.

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25.38.11 Main Access Tunnel

The exhaust air coming out of the power house caverns through the main access tunnel on its own shall be sucked intermittently by a fan system through air grilles in the access tunnel so as to clear the tunnel from any smoke of the vehicle (entering the power house) expeditiously. At the time of emergency (i.e. fire in the power house) a set of motorized dampers installed at the inlet & outlet of fans shall get automatically closed and another set of dampers (installed in the branches to inlet & outlet of fans) shall open. The fans shall also start automatically and inject fresh air into tunnel, and near the junction points of access tunnel with the M/C hall & transformer hall, thereby producing a sort of air curtain, thus retarding the outflow of smoke from the power house cavern to the main access tunnel, so that power house personnel can come out safely.

The bidder shall study the above scheme proposed for supply & exhaust ventilation system particularly smoke free air pressure system and reversible flow fan system and may suggest alternative scheme for consideration of the purchaser. The final scheme as prepared by the bidder has to be approved by the purchaser.

25.39 DRAWINGS, DATA & MANUALS

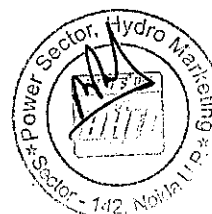
Drawings, Data & Manuals shall be submitted in 7 copies of quantities and procedures as specified in General Condition of Contract and/or elsewhere in the specification.

To be submitted with the Bid:

- a) General arrangement drawing showing constructional features, space required in front for withdrawals of breakers, power & control cable entry points for control panels, centrifugal blowers & motors etc.
- b) Bill of Materials.
- c) Typical breaker and ventilation system control schematic.
- d) Type test reports on circuit breaker.
- e) Technical leaflets on circuit breaker & other electrical equipment to be provided on MCC, centrifugal blowers & motors, filters, dampers, grilles etc.
- f) Guaranteed and other technical particulars as per format in the specifications, schedule of supplies, spares, tools etc.



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INFORMATION TO BE FURNISHED BY THE SUPPLIER AFTER AWARD OF THE CONTRACT.

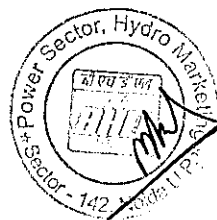
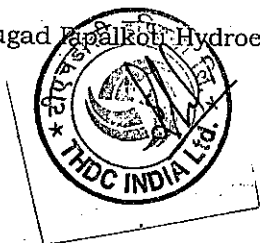
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The supplier shall furnish to the purchaser within 60 days after the award of the contract the following information and technical documents for approval.

- a) Detailed drawings for general arrangement of installation of ventilation system in power house complex & B.F. valve chamber.
- b) Design calculations for designing the ventilation system of the powerhouse complex and butterfly valve cavern.
- c) Provision for safety features for the system.
- d) Write ups, description, catalogues, and photographs of components and assembly of the system.
- e) Information of materials, standards, shop tests, site tests, site assembly and erection procedure.
- f) Complete O and M manuals (6 copies).
- g) Performance characteristics of fans and motors
- h) Characteristics of each type of grilles and diffusers.
- i) Outline drawings of the principal pieces of equipment showing major dimensions.
- j) Layout of ducts and grilles/diffusers.
- k) Weights and foundation plan drawings for designing foundations on floor slabs.
- l) Spare parts.
- m) Complete schematic diagram framed in a glass frame with suitable colour scheme of the ventilation system for hanging in the control room of the powerhouse for understanding/reference of the operating personnel.
- n) Data on materials of major items giving mechanical properties and chemical constituents.
- o) A consolidated list of various relevant Indian or other standards to which items of the systems pertain.
- p) Outline dimensional drawing of the switchgear and control panels showing general arrangement, space requirements and bus duct/cable entry points.
- q) Cross-section with parts list.
- r) Cable routing arrangement with details of cable racks, supports etc. from MCCs to various equipment.
- s) Single line diagrams.
- t) Control schematics.
- u) Wiring diagrams.
- v) Instruction manuals of switchgear & individual equipment

The manual shall clearly indicate the installation method, check-up and tests to be carried out before commissioning of the equipment.

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TS- VENTILATION SYSTEM

The Bidder may note that drawings, data and manual listed herein are minimum requirements only. The Bidder shall ensure that other necessary write-ups, curves and information required to fully describe the equipment shall be submitted with his bid / after award of contract.

The test readings as obtained during testing of the equipment shall be submitted to the inspecting officer for approval.

25.41 QUALITY ASSURANCE

25.41.1 The bidder shall submit and finalize manufacturing quality plans for all the major components and equipments. These quality plans shall detail out various tests/inspections to be carried out as per the requirement of Technical Specifications and relevant Standards and quality practices and procedures followed by bidder's quality control organization. Manufacturing quality plan shall be approved by THDC.

25.41.2 All bought out items shall be of reputed make and conforming to standards:

25.41.3 No materials shall be dispatched from manufacturer's works before the same is accepted subsequent to pre-dispatch / final inspection including verification of records of all previous tests by THDC representative.

25.41.4 The bidder shall also submit field quality plan for site activities since receipt of material at site for THDC approval.

25.42 INSPECTION & TESTING**25.42.1 Inspection & Testing at Manufacturer's Works**

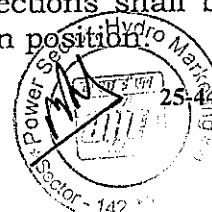
All equipments covered under this specifications shall be tested in the presence of the purchaser or his authorised representative as per relevant Indian standards at manufacturer's works and test certificates in triplicates shall be furnished to prove that the equipment supplied meets the requirements of relevant IS specifications.

The following tests shall be carried out for air duct work.

- i.) Verification of material test certificate.
- ii.) The ducts, branches, elbows, tee points etc. shall be inspected and the joints and connections shall be checked before they are assembled in position.



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iii.) After assembly, the system shall be checked for tightness, vibration and noise due to turbulence.

a) MCC and control panels shall be subjected to following tests:

- Temperature rise test on power circuits.
- Short time current tests on power circuits.
- Mechanical operation test.
- High voltage test.
- Electrical control, interlock and sequential operation tests.
- Verification of wiring as per approved schematic.
- Type tests and routine tests shall be carried out on all associated equipment as per relevant standards.

Bidder shall be responsible for conducting tests as per IS, before termination of the cables, i.e. measuring insulation resistance of each core to earth and core to core, identification of cores, all tests before and after termination etc.

Certified copy of all routine/type tests certificate shall be submitted for approval before despatch of equipment.

All fans, blowers, motors and other equipment shall be checked for correct alignment, lubrication of bearings and direction of rotation.

Entire system shall be tested under operating conditions for performance and leakage after completion of work. The rate of air flow shall be measured at each grille and shall be within $\pm 5\%$ of the specified quantity. The air quantities shall be measured in accordance with methods set out as per relevant IS.

Equipment that fails to test requirements shall be corrected and tested again until satisfactory results are obtained.

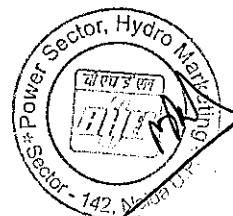
All facilities, instruments, equipments and man power required to carry out the tests shall be arranged by the bidder.

25.42.2 Tests at Site:

After completion of erection at site, tests to be performed shall include but not limited to the following:

- i.) Measurement of Insulation Resistance of Bus bars and Power circuits

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- ii.) Testing and checking of Control Scheme/Annunciation Scheme.
- iii.) Operation test of MCCB (local/remote)
- iv.) Testing of Auto-changeover Scheme of incoming breakers

Bidder shall be fully responsible for correct terminations, and if at the time of commissioning some modifications/rectifications are required the same shall also be carried out by him free of cost. If any terminations/cable boxes etc. fail at the time of commissioning, bidder shall be responsible to replace the same free of cost.

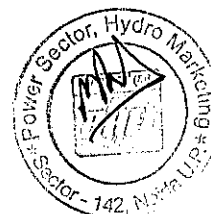
25.43 FINAL ACCEPTANCE TESTS

25.43.1 After site testing has been satisfactorily completed, the final acceptance tests scheduled below shall be conducted under the supervision of supplier and purchaser to ascertain that all manufacturing guarantees and requirements of the specifications have been met as below:

- i.) Ventilation systems (including electrical equipments) shall be operative continuously for 30 days after commissioning and prior to handing over to the owner. During this period there shall be no imbalance, vibration & noise in the system.
- ii.) All tests as per relevant standards/technical specification shall be a part of the final acceptance tests.
- iii.) A record of all performance tests shall be embodied in test report.
- iv.) Successful completion of the final acceptance tests shall be a condition precedent to a final acceptance certificate in respect of Ventilation system (including electrical equipment).

25.43.2 Erection & Commissioning

The Supplier shall provide requisite numbers of engineers and other personnel for erection, testing, and commissioning at site. The supplier shall ensure that the complete set of equipment as well as the individual components function in accordance with the requirements and guaranteed technical particulars outlined in the specifications. After commissioning, a performance test report shall be jointly prepared by engineers of supplier and purchaser.



25.43.3 Taking Over

The entire system shall be taken over by the purchaser only after the system complies the operational requirements of the specifications and remains in trouble free operation continuously for 30 days.

25.44 SPARE PARTS

25.44.1 Following spares for 5 years of operation shall be supplied:

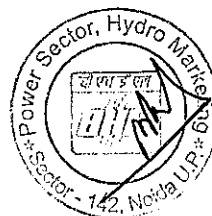
- a) Bearings set for each type of fan;
- b) Bearings set for each type of electric motor;
- c) V-belts / flexible coupling set for each type of fan.
- d) Filter element- 2 sets.
- e) Water cooler - 1 set

25.44.2 Further for assembly and operation of equipment special devices, lifting mechanisms, testing devices, etc. which is necessary shall be supplied by bidder. The list of such items alongwith price shall be indicated separately.

25.44.3 The bidder shall submit with his proposal recommended list of spare parts other than above required for the first five years of satisfactory operations. Full details of all spare parts with their relation to the equipment and item-wise prices shall be furnished.

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25.46 COMPLETENESS OF EQUIPMENT

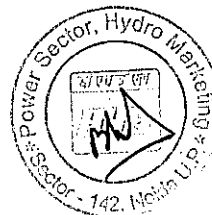
The bidder shall supply complete equipment of the package in all respects and include all fittings and accessories which may not be specifically mentioned in this specification but which are essential for the completeness and successful commissioning of the equipment offered.

The bidder shall ensure testing and commissioning of the complete ventilation equipment including start-up equipment, sensors, control cabinets, power and control cables in conformity with specifications.

The bidder shall prepare and submit all control schemes and drawings of cable connections.

25.47 QUALITY CONTROL & ASSURANCE

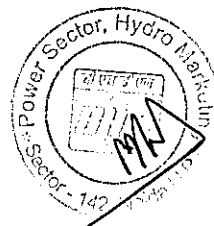
The supplier has to supply the equipment for Ventilation equipments of best quality. The Supplier has to maintain quality control and assurance during the manufacturing of equipment as per approved owner's quality assurance plans.



SCHEDULE OF REQUIREMENTS

S. No.	Description	Qty.
A)	Supply & Exhaust Air Fans	
	Supply / Exhaust air fans of suitable rating complete in all respects with motors, base frame, switchgear etc.	
I.	Supply fan system (capacity in m ³ /hr. & pressure rating in mmwc would be given for each system along with no. of fans.)	As required
II.	Exhaust fan system (capacity in m ³ /hr. & pressure rating in mmwc would be given for each system along with no. of fans.)	As required
B)	Other Equipments	
1	Air control devices such as	As required
	a) Fire dampers	
	b) Check valves (back draft dampers)	
	c) Volume control dampers	
	d) Split dampers	
2	Air filters & Air washers to be installed at	
	Ventilation room in M/c Hall annexe in SCA	As required
	Ventilation room in M/c hall annexe at far end	As required
	Ventilation room in Tr / hall near adit end	As required
	Ventilation room in Tr/ hall annexe at far end	As required
	B.F. Valve Chamber (Blower room)	As required
3	Vibration isolators for fans & motors sets	As required
4	Flexible inserts (Canvas connectors)	As required
5	Special tools required for erection , operation & maintenance of the equipment	1 Lot
6	Supply grills / ceiling diffusers	As required
7	Return air grills	As required
8	Galvanized sheet steel duct of following gauges and thickness :	

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TS- VENTILATION SYSTEM

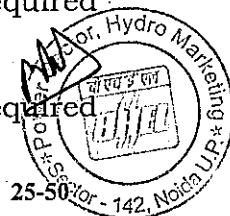
S. No.	Description	Qty.
	Gauge - 20 1 mm	As required
	Gauge - 22 0.8 mm	As required
	Gauge - 24 0.6 mm	As required
9	Galvanised steel support structures complete with embedments in concrete wall, rock foundation, hardware etc. as required for the ducts of Ventilation system.	1 Lot
10	ERW pipe (light grade) of 100 mm N.D. as per IS : 1239 (Part I)	As required
11	Temperature sensors & indicators for local & remote position indication	As required
12	Humidity sensors & indicators for local & remote position indication	As required
13	Dilatometric thermostatic switch/controller	1 No.
14	Fire resistant insulation material / board for ventilation ducts as per specification	As required
15	Acoustic lining material for fans & ducts as per specification	As required
16	Suitable earthing material complete with earthing terminals, bi-metal clamps, washers, lugs, pads, hardware etc. for complete system to be connected to the ground mat riser provided by purchaser in the vicinity of work	1 Lot

C Electrical Equipment

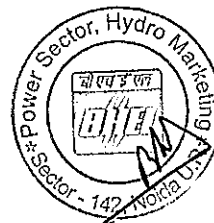
- | | | |
|---|---|-------------|
| 1 | Motor Control Centers (MCC) for air supply and exhaust ventilation systems of Machine Hall and annexes. | As required |
| 2 | MCCs for air supply and exhaust ventilation systems of Transformer Hall | As required |
| 3 | MCC for air supply of main ventilation system for M/c hall & Transformer Hall caverns | As required |
| | MCC for fresh air supply ventilation system for | As required |



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S. No.	Description	Qty.
	Butterfly Valve Chamber	
5	MCC s for air exhaust ventilation system from Tr. Hall and M/c hall	As required
6	MCC for reversible ventilation system of Main Access Tunnel of P. H.	As required
7	Central control and annunciation panel for ventilation system to be installed in Control Room	As required
8	Push-button station for local control of ventilation systems (as required for the equipment covered under the specification)	As required
9	Control boxes for local control of fire-dampers, as required for the equipment covered under the specification.	As required
10	Control boxes for power packs for sensors measuring temperature & humidity	As required
11	Terminal boxes & control modules for the equipment covered under the specification.	As required
12	Power and control cables with glands, lugs and their accessories, conduits, cable racks, cable support system, clamps, etc.	As required
13	Power cables of the below given grades. 1.1 kV grade, PVC insulated, PVC sheathed, unarmoured, 3 ½ core, solid copper conductor cables of various sizes	As required



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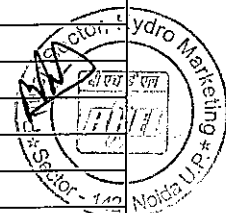
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ANNEXURE - II

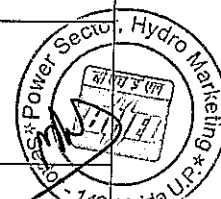
SCHEDULE OF TECHNICAL PARTICULARS FOR VENTILATION SYSTEM EQUIPMENTS
**TO BE FILLED & SUBMITTED BY THE BIDDER AFTER
AWARD OF CONTRACT**

Sl. No.	Description	Data
A)	Ventilation Fans (separately indicate for each rating of fan i.e. for fresh air, supply and exhaust fans of each ventilation system to be furnished).	
i)	Nos., Capacity & Pressure rating of the fan	
ii)	Speed of the fan	
iii)	Space required for each fan in the ventilation room where the fans are proposed to be located.	
iv)	Model number, make and impeller diameter of each fan.	
v)	Type and class of construction.	
vi)	Volumetric efficiency and noise level of each fan.	
vii)	Shaft horse power requirement of each fan.	
viii)	Overall size and weight of each fan.	
ix)	Whether performance curve of each fan enclosed (Yes/No).	
x)	Whether general arrangement/ foundation drawing of each fan system enclosed (Yes/No).	
xi)	Whether design calculations for each fan system supplied (Yes/No).	
xii)	Type of fan shaft bearings offered.	
xiii)	Type of drive with details.	
xiv)	Material of construction of important fan parts such as shaft, hub, blades, casing, bearings etc	
B)	Induction Motors Insulation Class (separately for each type of fan to be furnished)	
i)	Name of manufacturer of each motor.	
ii)	Duty/ Rating of motor.(Kw)	
iii)	Rated speed of motor (rpm).	
iv)	Full load efficiency of motor (%).	
	Whether dimensional drg. enclosed (Yes/Not).	
	Type of protection adopted.	
	Method of starting (DOL or Star/Delta Starter).	



Sl. No.	Description	Data
viii)	Current at (a) full load (b) starting (% of F.L.).	
ix)	Temp. rise over ambient temp. ($^{\circ}\text{C}$).	
x)	Voltage	
xi)	Insulation Class	
C)	Filters (separately for each location to be furnished)	
i)	Model No., Make and type offered (washable/throwaway).	
ii)	O/A size and numbers of filters (L x W x H) provided at each location.	
iii)	Rating ($\text{M}^3/\text{Hr.}$) and efficiency.	
iv)	Pressure drop in clean and saturated (clogged) condition in (mm) of w.g.	
v)	Filter media.	
vi)	Normal period when cleaning is due and method of cleaning.	
vii)	Method of testing of filter.	
viii)	Weight of each panel.	
D)	Metal Air Ducts.	
i)	Manufacturer's name.	
ii)	Material of construction.	
iii)	Thickness of sheet adopted for max. dimensions.	
iv)	Type of construction.	
v)	Supporting frame details attached (Yes/No).	
vi)	Thickness of insulation for air conditioning ducts (mm).	
vii)	Thermal conductivity and density of material of insulation.	
viii)	Static pressure drop/unit length ((mm) wg).	
ix)	Maximum velocity of air in ducts.	
x)	Whether details of fixing ducts to walls/ceiling attached (Yes/No).	
xi)	Particulars of each duct section (Air flow, dimensions, gauge of sheet metal and location of duct).	
xii)	No. and type of bends/other fittings with friction drops.	
E)	Dampers (Separate details for Volume Control Damper, Fire Damper and Back Draft Damper to be given).	
i)	Manufacturer's name.	

Vishnugad Pipalkoti Hydroelectric Project



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TS- VENTILATION SYSTEM

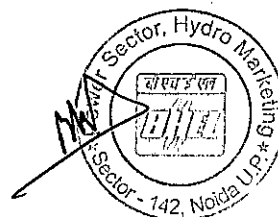
Sl. No.	Description	Data
ii)	Type and material of construction.	
iii)	Type of control (manual/automatic).	
iv)	Overall dimensions and weight.	
v)	Friction drop.	
vi)	Capacity.	
F)	Grills/Diffusers	
i)	Name of manufacturer.	
ii)	Capacity (M ³ /Hr).	
iii)	Terminal velocity (M/min).	
iv)	Outlet velocity (M/min).	
v)	Size of grills/diffusers provided at various locations.	
vi)	Material.	
vii)	Air throw and drop.	
viii)	Whether volume control damper provided behind grille / diffuser (Yes/No).	
ix)	Friction drop in grill/register.	
x)	Total number of grills/registers with sizes for each fan system provided.	
G)	INSTRUMENTS	
i)	Make, location and quantity of Pr. gauges provided.	
ii)	Make, location and quantity of Temp. gauges provided.	
iii)	Make, location and humidistats provided	
iv)	Instruments mounted on local panels (indicate full list)	

Place :

Signature of Bidder

Date:

Stamp



Pipalkoti Hydroelectric Project

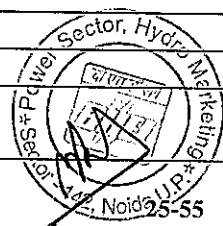
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ANNEXURE - III

**SCHEDULE OF TECHNICAL PARTICULARS FOR ELECTRICAL
EQUIPMENT AND CABLES**

TO BE FILLED & SUBMITTED BY THE BIDDER AFTER AWARD OF CONTRACT

Sl. No.	Description	Data
1.0	MCC ASSEMBLY	
	Make	
	Type	
	Reference Standard	
	Voltage (Nom./Max.) Volt	
	Phase, Frequency No., Hz	
	Short Circuit Rating	
	a) Interrupting kA Symmetrical	
	b) Short time for 1 sec. (kA rms)	
	Insulation Level	
	1-min, power withstand voltage (kV rms)	
	Construction	
	a) Metal clad, air insulated, floor mounting (Yes/No)	
	b) Suitable for mounting against building wall (Yes/No)	
	Enclosure	
	a) Degree of Protection	
	b) Minimum thickness of sheet metal (mm)	
	MCC fully assembled, wired and tested at factory (Yes/No)	
1.1	CONSTRUCTION	
	Design	
	a) Complete compartmentalised	
	b) Working height limits from floor level (mm)	
	Control Compartment	
	Whether provided with individual front access door	
	Whether MCC section provided with	
	a) Removable back cover	
	b) Full height cable chamber	
	Horizontal wireway for inter panel wiring provided for each MCC	

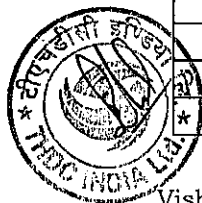


Vishnugad Pipalkoti Hydroelectric Project

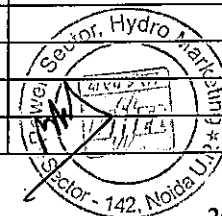


TS- VENTILATION SYSTEM

Sl. No.	Description	Data
	All meters, relays, lamps etc. flush mounted type	
	Vertical Section Size	
	a) MCC (L x D x H) (mm)	
1.2	BUSBAR	
	Make	
	Material & Grade	
	Reference Standard	
	Continuous current rating at site condition, 38°C ambient and within cubicle	
	a) Main busbar Amp	
	Vertical busbar (minimum) Amp	
	Conductor Section	
	a) Main Busbar (mm) ²	
	b) Vertical Busbar (mm) ²	
	Max. temp. rise over 38°C ambient °C	
	Short-time current for 1 second (kA rms)	
	Whether separate chamber/phase barrier/shrouding provided for	
	a) Main Busbar	
	b) Vertical Busbar	
	Bus Connections	
	a) Silver plated	
	b) Provided with anti-oxide grease	
	c) Bimetallic connectors between dissimilar metals	
	Busbar support spacing (mm)	
1.3	CONTROL MODULE	
	Control Modules:	
	Whether fully drawout (Yes/No)	
	Power/Control disconnect silver plated for good contacts (Yes/No)	
	Drawout Modules of same type & rating are physically & electrically interchangeable (Yes/No)	
	Module sizes (L x D x H)	
	a) Incoming with	
	630 A Switch (mm)	
	400 A Switch (mm)	
	200 A Switch (mm)	



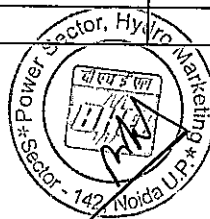
Vishnugad Pipalkoti Hydroelectric Project



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Sl. No.	Description	Data
	b) Outgoing feeder with	
	100 A Switch (mm)	
	63 A Switch (mm)	
	16 A Switch (mm)	
	c) Starter units with	
	300 A Starter (mm)	
	160 A Starter (mm)	
	63 A Starter (mm)	
	32 A Starter (mm)	
	16 A Starter (mm)	
	16 A Starter reversing (mm)	
1.4	CIRCUIT BREAKER	
	Make	
	Type	
	Reference Standard	
	Rated Voltage (kV)	
	Rated Frequency (Hz)	
	No. of Poles (No.)	
	Rated Currents	
	a) Continuous (at site condition, 40°C, ambient & within cubicle) Amp	
	Short-time Current with 1 second (kA rms)	
	Max. temp. rise over 40°C ambient (°C)	
	Rated Operating Duty	
	Interrupting Capacity at rated voltage and operating duty	
	a) Symmetrical (kA rms)	
	b) Asymmetrical (kA rms)	
	Rated Making Current (kA peak)	
	Insulation Level	
	a) 1 min 50 Hz withstand (kV rms)	
	Operating Mechanism	
	a) Type	
	b) Trip free or fixed trip	
	Whether circuit Breaker provided with	
	a) Drawout feature having SERVICE, TEST & ISOLATED positions	
	b) Mechanical safety interlock	
	c) Manual operating handle	
	d) Emergency manual trip	
	f) Mechanical ON-OFF indications	

Vishnugad Pipalkoti Hydroelectric Project



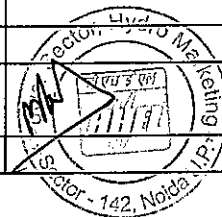
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TS- VENTILATION SYSTEM

Sl. No.	Description	Data
	g) Overload release	
	h) Short-circuit release	
	i) Auxiliary switch with 6 NO and 6 NC contacts	
	Range of release	
	a) Overload	
	b) Short Circuit	
1.5	CONTACTORS	
	Make	
	Type	
	Reference standard	
	Duty class	
	Utilization category	
	Operating Coil Voltage	
	a) Rated	
	b) Pick-up	
	c) Drop-out	
	Continuous Current rating (A) 38°C & within cubicle	
	Power Consumption	
	a) During closing (VA)	
	b) After closing (VA)	
	Auxiliary Contacts furnished per Contactor	
	a) Normally open (NO)	
	b) Normally closed (NC)	
	Aux. Contact rating	
	a) Make & Continuous Amp	
	b) Break (Inductive) at:	
	240 V A.C. Amp	
	220 V D.C. Amp	
	Time range of delayed dropout contactors furnished Sec.	
	Thermal Overload Relay & Single Phase Preventor	
	a) Temperature compensated?	
	b) Hand Reset?	
	c) No & type of contacts	
	d) Thermal overload characteristics furnished	
	e) Tolerance on current injection	

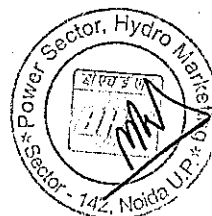


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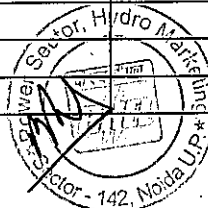
Sl. No.	Description	Data
	1 - pole	
	2 - pole	
	3 - pole	
1.6	PUSH-BUTTON LAMPS, METER, CT, TB etc.	
1.6.1	Push Button	
	a) Make	
	b) Type	
	c) Cat. No.	
	d) Contact rating	
	Make & Continuous Amp	
	Break (inductive)	
	240 V A.C. Amp	
	220 V D.C. Amp	
1.6.2	Lamps	
	a) Make	
	b) Type	
	c) Cat No.	
	d) Watts/Voltage	
	e) Series resistor Ohm	
	f) Lamp & lens replaceable from front	
1.6.3	METER	
	Make	
	Type	
	Reference Standard	
	Size	
	Scale	
	Accuracy class	
1.6.4	CURRENT TRANSFORMER	
	Make	
	Type	
	Reference Standard	
	C.T. Ratings	
	a) Current ratio	
	b) Rated burden	
	c) Accuracy class	
1.6.5	SECONDARY WIRING	
	Type of Insulation	
	Voltage Grade	
	Conductor material	



Sl. No.	Description	Data
	Conductor size (minimum)	
	a) Potential Circuit (mm) ²	
	b) Current & Control Circuit (mm) ²	
	Whether wires identified at both ends with ferrules	
1.6.6	TERMINAL BLOCK (TB)	
	Make	
	Type	
	Cat. No	
	Voltage Grade	
	Whether 20% spare terminals furnished	
1.6.7	BUS DUCT CONNECTION	
	Details of Bus duct connection included as per drawing/bill of materials	
	Average length assumed for bus duct	
1.6.8	CABLE TERMINATION	
	Whether cable entry provision from top & bottom.	
	Cable termination & connection arrangement furnished as specified	
	Power Cable Lugs	
	a) Type	
	b) Material	
	Details of Power Cable Glands	
	a) Make	
	b) Type	
	c) Materials	
	d) With tapered washers	
	Removable Gland Plate	
	a) Material for multicore cable	
	b) Material for I/C cable	
	c) Thickness of the plate	
1.6.9	GROUND BUS	
	Whether Ground bus furnished?	
	Material	
1.6.10	NAME PLATE/LABLES	
	Material	
	Thickness	
	Size	



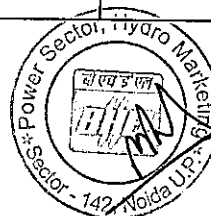
Vishnugad Pipalkoti Hydroelectric Project



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Sl. No.	Description	Data
1.7	SPACE HEATER	
	a) Thermostat controlled	
	b) Wattage	
	c) Voltage	
	Provision made for motor heater supply	
	Cubicle/Motor heater provided with individual switch fuse units	
1.8	TROPICAL PROTECTION	
	a. Details of special treatment for tropical protection proposed to be provided if any	
	b. Whether screens are of corrosion resistant materials	
1.8.1	PAINTING	
	Finish of MCC/DB	
	a. Inside	
	b. Outside	
1.9	SEISMIC PROTECTION Provided (Yes / No)	
2.0	LOCAL CONTROL CABINETS AND ANNUNCIATION PANELS	
	Make	
	Type	
	Reference standard	
	Voltage (Nom/Max)	
	Cubicle Data	
	Size, dimensions	
	Rear door (Yes/No)	
	Metal clad, floor mounting (Yes/No)	
	Suitable for mounting against building wall (Yes/No)	
	Minimum thickness of sheet metal (mm)	
	Total mass (weight) with all relays and unit (Kg)	
	Degree of protection (not less IP54)	
	Ground bus:	
	Ground bus furnished	
	Material	
	Size	
	Cubicle heater:	
	Thermostat controlled	
	Wattage	
	Voltage	
	Lockout switch	
	Tropical protection	
	Any special treatment for tropical protection	

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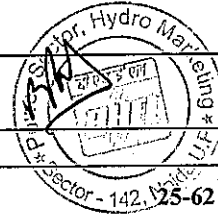
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TS- VENTILATION SYSTEM

Sl. No.	Description	Data
3.0	Cables (for each type indicate separately for control & power cables)	
1	Cable type	
a)	Type and size of cable	
b)	Standard applicable	
c)	Voltage rating (kV)	
d)	Permissible variation in i) voltage ii) frequency iii) combined voltage and frequency	
e)	Suitable for earthed/unearthed system	
f)	Name of Manufacturer	
2	Conductor and its hardness	
a)	Material copper/aluminium (indicate grade)	
b)	Nominal cross section area, (mm) ²	
c)	Form of conductor (circular/shaped)	
d)	Minimum No. of strands	
e)	Nominal dia of strand each strand (mm)	
f)	Whether strands are tinned (Yes/No)	
3	Insulation	
a)	Material (Mention type)	
b)	Minimum average thickness (mm)	
c)	Average dielectric strength, kV/(mm)	
d)	Suitability with regard to moisture. Ozone, acid, oil and alkaline surroundings	
4	Insulation screen	
a)	Material of the semi-conducting screen	
b)	Thickness of the screen (mm)	
c)	Whether extruded under triple extrusion process	
d)	Whether cooper tape screening is applied	
e)	Thickness of the cooper tape, (mm)	
f)	For braided screen, material and dia of screen wire and min. percentage coverage	
5	Outer sheath/overall covering	
a)	Material (mention type, if any)	
b)	Minimum average thickness (mm)	
c)	Whether anti-termite treatment has been given in the outer sheath (Yes/No)	
6	Electrical properties	
a)	Maximum DC conductor resistance at 20°C per km (ohm/km)	
	Maximum permissible conductor temperature (°C)	
	i) Under continuous full load	



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Sl. No.	Description	Data
	ii) Under transient over loading conditions	
c)	Suitability with regard to moisture Ozone, acid ,oil and alkaline surroundings	
7	Current ratings:	
a)	In air (continuous) Amp.	
b)	In duct (continuous) Amp.	
c)	Reference ambient temperature for the above	
8	Mechanical data:	
a)	Overall dia of the cable (mm)	
b)	Weight of cable (mm)	
4.0	Junction boxes	
	Dimensions	
	Make	
	Whether perforated	
	Thickness of sheet	
	Material	
	Standards applicable	
	Suitability with regard to moisture Ozone, acid, oil and alkaline surroundings	

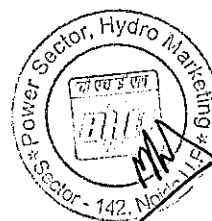
Place :

Signature of Bidder

Date:

Stamp

Vishnugad Pipalkoti Hydroelectric Project



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SECTION - 26

AIR CONDITIONING SYSTEM

26.1 Scope

This specification is intended to cover the design, manufacture, transportation to site, freight, insurance, loading, unloading, storage, handling at site, erection, testing, commissioning and handover of Air Conditioning System (AC) with control and accessories for Vishnugad Pipalkoti Hydro-electric Project.

26.2 General Information

The Air Conditioning System is to be provided at the following locations.

- i) Control room floor at EL 1046 m
- ii) Conference room at EL 1042 m
- iii) PLCC room at EL 1046 m
- iv) GIS Protection Panel room at EL 1048 m
- v) Elect. Lab. at EL 1038 m
- vi) Shift engineer room at EL 1044 m
- vii) Communication room at EL 1038 m

All rooms mentioned above are part of Power House building. In case of fire in any room of the conditioned space the supply and return air to the conditioned space shall be stopped.

26.3 Data for Design / Plant Capacity

Refer Clarification No. 1 Sl. No. 424

The data for design of the system are given at Clause 13.9 attached with the specification. Based on the design data conditions the Air Conditioning Load for the areas to be air conditioned is worked out and given out in Schedule of requirements. The Bidder shall carry out his own calculations and satisfy him regarding the refrigerating capacity required for maintaining the specified conditions inside the room before submitting the offers. If plant of higher capacity is required he shall clearly point out in his bid with justification thereof.

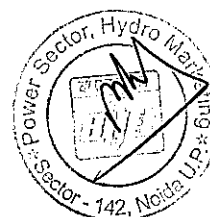
26.4 Description of Air Conditioning System

Refer Clarification No. 1 Sl. No. 428

Suitable capacity and quantity of air conditioners shall be provided for the rooms mentioned in clause 26.2 to maintain the temperature and humidity level as indicated in clause 26.9. The evaporating units shall be suspended from the ceiling of the rooms over the false ceiling. The return air shall be collected through return air slits in the false ceiling and taken back to plenum formed above false ceiling. Fresh air for each room, if required, shall be supplied from the ventilation system provided for the power house. In case of fire

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TS- AIR CONDITIONING SYSTEM

in any room of the conditioned space the supply and the return air to the conditioned space shall be stopped.

The system shall be complete with all requisite controls drain pipes, refrigerating pipes. The system shall be capable of maintaining desired room temperature adjustable by thermostatic and temperature control provided on the remote unit

26.4.1 Scope of Supply/Services

The scope of supply/services under this specification shall cover but not limited to the following equipments.

Mechanical Works

Split air conditioning units of each complete with all accessories, auxiliaries, including first charge of refrigerant and lubricating oil etc.

Ducting complete with duct hangers, supports and accessories etc

One (1) no. fresh air fan unit complete with ducting grill etc.

Drain water piping, fittings etc.

Electrical & Control & Instrumentation Works

One no. 415 V, 3 Phase, 4 wire distribution board

Necessary control units complete with equipment/devices required.

Maintenance of the above equipments for 3 years

Civil Works:

False ceiling with openings for diffusers, Venetian blinds of light colour, under deck insulation of roof slabs and beams of control room floor & openings in walls, floor, roof and foundation as required shall be done by contractor. The contractor has to close and seal off opening in walls, roof etc. as required.

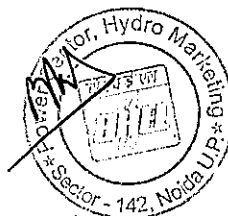
26.4.2 Equipment Specification

Evaporator unit shall be horizontally/vertically mounted type as required and constructed of galvanised steel sheet of thickness not less than 18 gauge. It shall be suitable for indoor installation above false ceiling and shall have provision for draining out condensate water.

Fan Section



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T 2968

The fan shall be centrifugal, statically and dynamically balanced and shall be made of heavy gauge aluminium. It shall be designed for low noise operation and capable of delivering required air against static head of ducting.

Cooling Coil Section

The cooling coil section shall consist of copper tubes with aluminium fins to provide efficient heat transfer between tubes and fins. Cooling coil section shall be suitably insulated. It shall be fed with liquid refrigerant through thermostatic expansion valve.

Filter Section

Synthetic washable air filter shall be provided for the blower suction. Coil filters shall not be acceptable.

Drain Pan Section

Galvanised steel drain pan having arrangement for faster disposal of condensed moisture from cooling coil section shall be provided. It shall be suitably insulated.

Condensing Unit

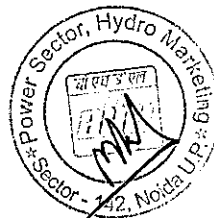
The condensate units shall be supplied in weather proof heavy gauge enclosure suitable for outdoor installation. Each unit shall comprise of 2 or 3 independent hermetically/ semi-hermetically sealed compressor units together with associated air cooled condensers, refrigerant tubing and electrical system so that if one compressor unit is down, the other compressors can remain in service. The condenser tubes shall be of copper having extended aluminium fins. The refrigerant shall be environment friendly. The condenser heat is removed with the help of a quiet, low speed propeller fan(s).

Duct Work, Diffusers and Accessories

The metal air ducts, if required, shall be made of galvanised steel. Rectangular ducts shall be provided. All duct runs shall generally be designed to have minimum frictional resistance, noise and vibration. The ducts shall be perfectly air tight. Ducts shall be designed, fabricated and installed as per IS: 655.

The ducts shall be supported by mild steel rods and mild steel angles. Mild steel rods shall be hung from building slab. All supporting material required shall be provided by bidder. Adjustable split dampers shall be placed at all suitable points for proportional volume control of the system.

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The supply air ducting upto a distance of 3 meters beyond the fan discharge shall be acoustically lined from inside with 12 mm thick resin bonded mineral wool conforming to IS: 8183 finished with wire mesh.

The duct shall be insulated with 25 mm thick resin bonded mineral wool conforming to IS: 8183 and covered with insulation wrapped with wire mesh etc. Diffusers shall be made of heavy gauge extruded aluminium metal. These shall be provided with volume control damper, frame work and gasketing at each duct flange. The bidder shall furnish the layout plan of ducting and diffusers. The location of diffusers shall be finalised in coordination with lighting and fire fighting contractors who shall be working above false ceiling of these rooms.

26.4.3 Drain Piping

Necessary Galvanised Iron drain piping shall be provided and connected to the nearest drain.

26.4.4 Fresh Air Fan Unit

Fresh air fan unit shall be complete with the following:

- a. Tube axial fan/centrifugal fan complete with drive motor.
- b. Guard Screen wall cowl & bird screen.
- c. Cleanable metallic viscous filter.
- d. High efficiency dry fabric filter.
- e. Dampers to adjust the fresh air quantity.

26.5 Electrical Work

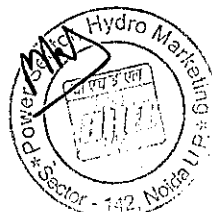
The Air Conditioning units shall be complete with electrical starters, motor, wiring and protection. The electrical system shall be capable of operating on 415 V, 3 phase, 4 wire, 50 Hz system.

The bidder shall provide 415 V, 3 phase, 4 wire two no. feeders from 415V AC system for meeting the total power requirement of Air Conditioning System. The bidder shall provide one no. 415 V, 3 phase, 4 wire distribution board for distributing power supply to each Air Conditioning unit. Supply, laying and termination of incomer cable to contractor's distribution board as also supply, laying & termination of outgoing cables emanating from the distribution board to each Air Conditioning unit shall be carried out by the contractor. Further electrical wiring shall also be in the scope of Contractor.

The distribution board to be supplied and erected by the contractor shall be of 2.0 mm thick metal pedestal/ wall mounted dust tight modular construction.



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The distribution board shall be installed in the corridor adjoining to control room.

Each compressor unit shall be provided with short circuit over load and under voltage protection.

26.6 Controls

Each Air Conditioning unit shall be controlled from a control box. The control box shall be of flawless metallic construction finished with white powder coated enamel paint.

The controls shall incorporate:

- Sequential start of compressor motors
- Overload and under voltage tripping
- ON/OFF indication of compressor and blower motors
- Temperature control switch to adjust the thermostat.

The control unit shall be fixed on the wall. Wiring between the control box, condensing and evaporator units shall be in the contractor's scope and it shall be done aesthetically.

In addition to fixed type control panel, a mobile remote control unit shall be provided for each air conditioning unit.

26.7 Erection, Testing and Commissioning

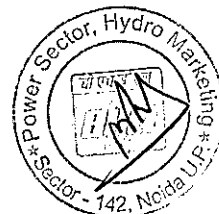
The receipt, storage and handling of materials at site are in the scope of contractor. Temporary space for storage at Site shall be provided by the contractor. Minor civil works for the purpose of erection of the package units shall be in the scope of the Contractor. After making requisite wall openings, chipping works etc. required for erection, the bidder shall restore the plaster/cover the holes to restore the finish of employer's civil works. The testing and commissioning of the units shall be carried out in professional manner by the Contractor's technical team which shall be fully equipped with necessary tools and measurement equipments required for testing and commissioning. All consumables including refrigerant required for commissioning shall be in the scope of Contractor.

26.8 Taking Over

The equipment will be taken over by the Employer after the Contractor has satisfactorily demonstrated the performance of complete equipment.

After completing the erection works and carrying out testing and commissioning, the Contractor shall offer the system to the Employer engineers for acceptance. The Employer shall observe the performance of the equipment by operating the package units for 30 days continuously in the summer season prior to taking over.

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26.9 Spare Parts

The bidder shall submit with his proposal recommended list of spare parts required for the first five years of satisfactory operations. Full details of all spare parts with their relation to the equipment and item-wise prices shall be furnished.

26.10 Air Conditioning Load – Design Data

	Winter	Summer	Monsoon	
1. Outside conditions	Max. D.B °C Min. D.B °C	31 22	30 20	20 0
	Maximum Relative Humidity		95%	
2. Inside design conditions 22-24	D.B °C	22-24	22-24	
	Relative humidity		50 % ± 5%	
3. Areas to be Air Conditioned		Control Room, Conference room, PLCC Room, GIS Protection panel room, Elect. Lab & Shift engineer room, Communication room		
4. Floor Area (Relative humidity for all the below mentioned areas should be in the range of 50 % ± 5% for comfortable environment)				
	a) Control Room :			
	b) Conference room:			
	c) PLCC room :			
	d) GIS protection panel room			
	e) Elect. Workshop			
	f) Shift Engineer room			
	g) Communication room			

5 Roof Area in exposed

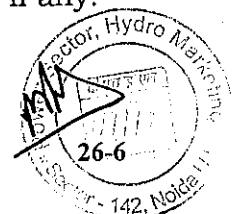
shall be taken for design if any.

6 False Ceiling

Pre-coated Aluminium.



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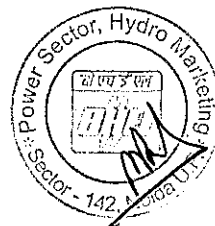


- 972
- | | |
|---|--|
| 7. False Ceiling height from indicated finished floor level | 3.0 m unless specifically |
| 8. Duration of Plant operation | 24 Hours / Day, continuously |
| 9. Fresh Air | As per relevant IS/International Standard |
| 10. Occupancy | 10 persons |
| 11. Lighting Load | 3000 W (Fluorescent) |
| 12. Equipment Load | 2000 W |
| Both Lighting & Equipment load are indicative only. These shall be specified by EPC Contractor. | |
| 13. Insulation | 50mm thick resin blended mineral wool conforming to IS: 8183 on the underside of all air conditioning rooms. |
| 14. Venetian blinds | Underground Power station, Not applicable |
| 15. Wall construction | 250 mm thick RCC end wall and 230mm thick brick side wall + 12 mm plaster inside +12 mm plaster outside. |
| 16. Roof construction | 300mm thick finished Reinforced Cement Concrete slab |
| 17. Floor Construction | 300mm thick finished Reinforced Cement Concrete slab. |

26.11 QUALITY CONTROL & ASSURANCE

The supplier has to supply the equipment for Air conditioners of best quality. The Supplier has to maintain quality control and assurance during the manufacturing of equipment as per approved owner's quality assurance plans.

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