	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM TECHNICAL SPECIFICATION (C&I PORTION)	SPECIFICATION No: PE-TS-479-571-11000-A001
		SECTION : I
		SUB-SECTION : C4
		REV. 00 / DATE: June 2023

SECTION: I

SUB-SECTION: C4

TECHNCIAL SPECIFICATION

(C&I PORTION)

	SPECIFIC TECHNICAL REQUIREMENT FOR AIR CONDITIONING & VENTILATION SYSTEM 2x20 MW Rahughat HEP	SPECIFICATION NO.
		VOLUME II-B
		SECTION : C
		REV. NO. 00 DATE: 15.03.22
		SHEET OF

C&I TECHNICAL SPECIFICATION FOR HEATING, VENTILATION & AIRCONDITIONING (HVAC SYSTEM)

TABLE OF CONTENTS

A. SPECIFIC TECHNICAL REQUIREMENTS.

B. SPECIFICATION FOR **JUNCTION BOX.**

C. INSTRUMENTATION DATA SHEET.

D. INSTRUMENT CHECK LIST.

E. SPECIFICATION FOR CONTROL PANELS

F. LCP QUALITY PLAN

G. INSTALLATIONDIAGRAMS

H. CONTROL & INSTRUMENTATION CABLE

I. LIST OF DELIVERABLES

BHEL	**SPECIFIC TECHNICAL REQUIREMENT FOR AIR CONDITIONING & VENTILATION SYSTEM** 2x20 MW Rahughat HEP	SPECIFICATION NO. VOLUME **II-B** SECTION : **C** REV. NO. 00 DATE: 15.03.22 SHEET OF

SPECIFIC TECHNICAL REQUIREMENTS

BHEL	**SPECIFIC TECHNICAL REQUIREMENT FOR AIR CONDITIONING & VENTILATION SYSTEM** **2X20 MW RAHUGHAT HEP#**	SPECIFICATION NO. VOLUME **II-B** SECTION : **C** REV. NO. 01 DATE: 03.05.2023 SHEET 1 OF 3

#

1. Complete Control & Instrumentation for Air Conditioning & Ventilation System is in bidder scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder.

2. Bidder to include Field instrumentation along with necessary fittings, accessories and valve manifold etc. and Field Junction Box (JB's), in his scope of supply. Each instrument/ equipment shall have a unique KKS Tag No. Field instrument specification and Data Sheet are given elsewhere in this specification. Bidder to provide local control panel wherever required.

3. All fields cabling for instruments/motor/pump/blower to JB is in bidder's scope and details are given elsewhere in the specification. The field I/O s should be grouped together in JBs suitably and a common trunk cable shall be taken to the panel. Cable schedule, cable interconnection details and wiring diagram for the same shall be in bidders' scope.

4. Instrument installation drawings are to be provided by bidder. All instrument fitting and erection hardware/racks as per instrument installation diagram shall be in bidder's scope.

5. The requirements given below are to be read in conjunction with detailed Technical specification enclosed.

6. Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

7. Provision for input fire signal from fire alarm system to be ensured for opening/ closing of the motor operated fire dampers.

8. Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.

9. Provision for earthing of the panel to be provided by vendor.

10. Vendor to submit GA drawing of control panel indicating layout of instruments, construction details, wiring diagram, class of protection for enclosure, paint type, paint color, thickness and material of enclosure sheet, control scheme during detailed engineering.

11. Layout & space requirement of panel to be specified during detailed engineering.

	SPECIFICATION NO.	
SPECIFIC TECHNICAL REQUIREMENT FOR AIR CONDITIONING & VENTILATION SYSTEM 2X20 MW RAHUGHAT HEP#	VOLUME II-B	
	SECTION : C	
	REV. NO. 01	DATE: 03.05.2023
	SHEET 2	OF 3

#

12. All bidirectional drives (Motor Operated Valves, MOVs) are integral starter type.

13. Bidder shall provide Cable Schedule in BHEL excel format. Also, Cable Interconnections details and wiring diagram for Complete System shall be in Bidders' scope.

14. Bidder to provide all control panels, system cabinets, termination & relay cabinets complete with all accessories, wiring and all mounting and erection hardware including junction boxes, canopies, structural steel as required. All instruments/drives shall be terminated on Junction Boxes/Panel in Bidder scope of supply. 20% Spare terminals shall be provided on Junction Boxes.

15. Bidder to delegate/depute their person/experts as per owner/consultant requirements.

16. The make of all the items shall be from approved sub-vendor list.

17. The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE, IS etc.

18. Controls

All air conditioning and ventilating equipment shall be controlled from local control panels. Control panels shall house all starters, isolators, fuses, relays, controllers, contactors, time switches, instrumentation and associated equipment for the system they serve. Control panels shall indicate the following:

- Fault/trip conditions for all motor and electrical equipment.
- Control circuit fuse fail.
- Filter blocked.
- High/low temperature, pressure and humidity alarms.

Control panels shall be connected to the main supervision system, and alarms shall also be monitored by the main control room.

19. Panels shall be provided at different locations for supply and control of different motors for blower's/ exhaust fans, and motorized dampers, etc. Panel shall include necessary relay, push buttons, indicating lamps and electronic display unit for voltage, current, kW and power factor and electronic energy meter at incomer feeder. Provision for display of flow rate (m3/hr) shall also be made in the control panel of ventilation / booster blower system panel.

	SPECIFICATION NO.	
SPECIFIC TECHNICAL REQUIREMENT FOR AIR CONDITIONING & VENTILATION SYSTEM 2X20 MW RAHUGHAT HEP#	VOLUME II-B	
	SECTION : C	
	REV. NO. 01	DATE: 03.05.2023
	SHEET 3	OF 3

#

20. For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.

21. Number of pairs to be selected for Screen/ Control cable
a. F-Type: 2P/4P/8P (Size : 1.5 mm2)
b. G-Type: 2P/4P/8P (Size : 1.5 mm2)
c. Core Cable: 3CX2.5sqmm2

NOTES:

1. All equipment items shall be of latest design with proven on track record from reputed experienced manufacturers of specified type and range of equipment. The make/model of various instruments/items/systems and instrument sub-vendor shall be subject to approval of BHEL/Customer during detailed engineering stage.

2. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.

3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.

CLAUSE NO.	TECHNICAL REQUIREMENTS

10.00.00 FIELD MOUNTED LOCAL JUNCTION BOXES

(i)	No. of ways	12/24/36/48/64/72/96/128 with 20% spares terminals.
(ii)	Material and Thickness	4mm thick Fiberglass Reinforced Polyester (FRP).
(iii)	Type	Screwed at all four corners for door. Door gasket shall be of synthetic rubber.
(iv)	Mounting clamps and accessories	Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands required for erection shall be of SS, included in Bidders scope of supply.
(v)	Type of terminal blocks	Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm^2. A M6 earthing stud shall be provided.
(vi)	Protection Class	IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.
(vii)	Grounding	To be provided.
(viii)	Color	RAL 7035

	AIR CONDITIONING & VENTILATION SYSTEM 2x20 MW Rahughat HEP	SPECIFICATION NO.
		VOLUME **II-B**
		SECTION : **C**
		REV. NO. 00 | DATE: 15.03.2022
		SHEET OF

INSTRUMENTATION DATA SHEET

	SPECIFICATION FOR TEMPERATURE GAUGE	SPECIFICATION NO.: PES – 145 – 027
		VOLUME II B
		SECTION D
		REV. NO. 00 DATE : 23-04-2010
		SHEET 1 OF 3

1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for tran sportation and delivery to sit e of Temp erature Gauge for use in Utility/Captive Power Station/Combined Cycle Station.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 The Design and Materials used fo r the components shall al so comply with th e relevant National an d International standards.

2.3 As a minimum requirement, the following standards shall be complied with :

Enclosure - ISA: RP:8.1
Thermowell - ASME : PTC-19.3

3.0 TECHNICAL REQUIREMENTS

3.1 General

The thermometers shall be suitable for an ambie nt temperature of 0-55°C and relative hu midity of 0-95%.

3.2 Bourdon tube and movement

Bourdon shall be made of suitable AISI 316 and the movement shall conform to AISI 304.

3.3 Case

Shall be made of Die cast aluminium and painted with Black stoving enamel paint over a suitable etch primer.

3.4 Bezel Ring

Shall be made of anodised aluminium with anti corrosive finish.

3.5 Dial and Scale

The dial shall be made of suitable material with anti corrosive finish.

The scale shall be concentric and graduated in degrees centigrade. The markings shall be in black on a non-reflective white background.

The pointer deflection angle shall be 270 degrees.

The unit of measurement Deg.C shall also be marked on the dial.

3.6 Pointer

Shall be made of suitable metal with black finish. The pointer shall be provided with suitable mechanism for zero adjustment without opening the case.

3.7 Bulb and Stem

Bulb and stem shall be made of stainl ess steel AISI 316. The bulb O.D. shall be 12 ±0.1 mm. T he process connection shall be adjustable gland type. The immersion length shall be adjustable between 100mm to 300mm. The material of the adjustable gland is AISI 316. The stem shall be flexible suitable for bending.

3.8 Temperature compensation

The thermometer shall be provided with compensating arrangement for ambient temperature changes.

3.9 Capillary

Capillary shall be SS-316 and 1.5mm dia, covered with 4.5mm dia of SS Spiral Sheath

3.10 Accuracy

± 1% of the full-scale deflection.

3.11 Mounting & Connection

Flush Mounting, back connection, clamp fixing, Direct mounting bottom connection.

3.12 Thermowell

Gauge shall be supplied along with the thermowell. The thermowell shall be of AISI 316 SS/Cr.Mo. Steel and shall be designed to suit the process conditions. For details of the thermowell see enclosed drawings for Thermowell.

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 The following test shall be conducted as a minimum requirement.

a) Routine Tests

i) Accuracy test.
ii) Overload test
iii) Response time test

b) Type Tests

i) Ambient temperature compensation test.
ii) Weather proof water tight and dust tight tests.

4.3 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 4.3 (b), "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House / Laboratory approved by BHEL.

4.4 The Standard QP is included in this specification to enable bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the agreed QP, taking care of customer requirements mentioned in Sec-C and submit QP for final approval by BHEL / Customer.

5.0 SPARES AND CONSUMABLES

5.1 Recommended Spares

The bidder shall furnish a list of Recommended Spares alongwith the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with unit rate against each item to enable BHEL/BHEL's Customer to place a seperate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies alongwith the bid :

6.1.1 Data sheet-B, completely filled-up alongwith all enclosures.

6.1.2 Quality Plan.

6.1.3 Catalogs with detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for procurement, manufacture, testing and despatch.

	SPECIFICATION FOR TEMPERATURE GAUGE	SPECIFICATION NO.: PES – 145 – 027
		VOLUME II B
		SECTION D
		REV. NO. 00 DATE : 23-04-2010
		SHEET 3 OF 3

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage :

6.2.1 For approval

i) Dimensional/Installation drawings.

ii) Data sheet-C, completely filled-up alongwith all the enclosures.

iii) Quality Plan of vendor/sub-vendor.

iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final / As-built drawings / CDs in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sunlight, high temperature, rain, moisture, humidity, dust, sea- water spray (where applicable) as well as rough handling and delays in transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

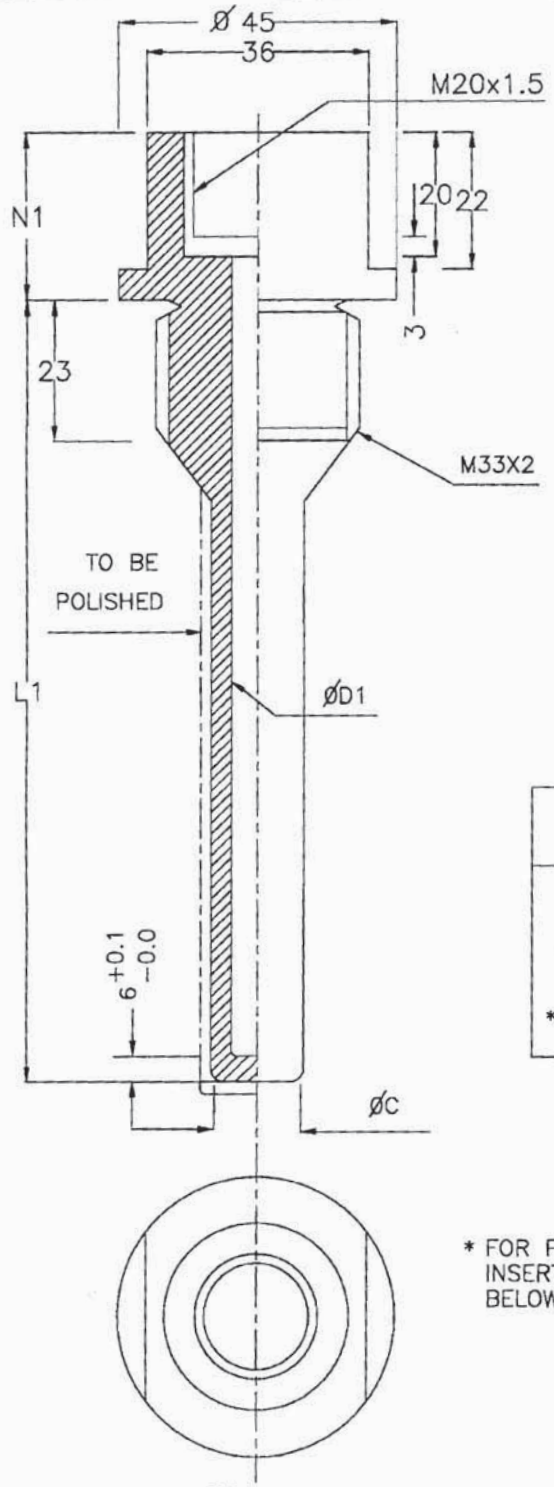
This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Temperature Gauge : Data sheet no. PES-145-27-DS1-1
- Data sheet C for Temperature Gauge : Data sheet no. PES-145-27-DS2-1

FORM NO. PEM – 6666–0

THERMOWELL MEDIUM PRESSURE (40 Kgf/Cm2)

SPECIFICATION NO	PES–145–27
VOLUME	IIB
SECTION	D
REV. NO. 02	DATE 16-5-2007
SHEET 4	OF 8



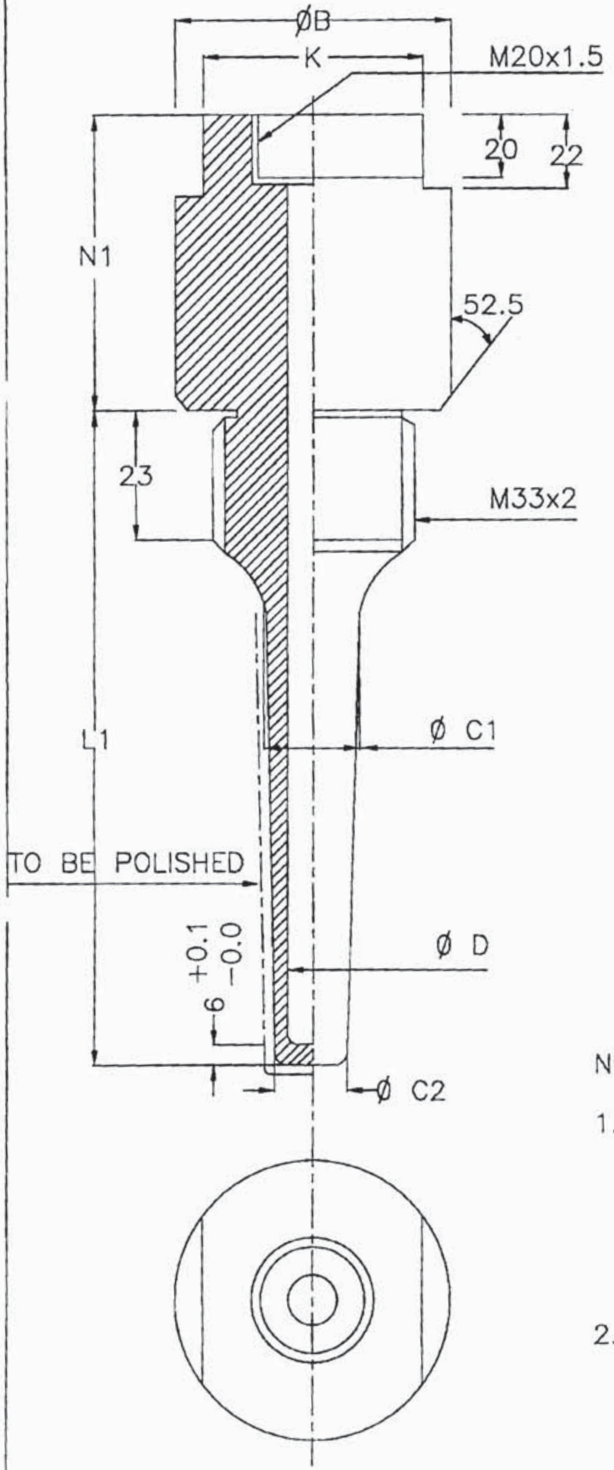
PIPE O.D.	INSERTION LENGTH (L1)
Ø 509 & ABOVE	325
Ø 506 TO 369	250
Ø 368 TO 274	175
*Ø 273 BELOW	150

* FOR PIPE O.Ds UP TO 159mm THE THERMOWELL INSERTION WILL BE STRAIGHT. FOR PIPE O.Ds BELOW 159mm, THE INSERTION SHALL BE SLANT.

Fig.1

FORM NO. PEM - 6666-0

THERMOWELL–HIGH PRESSURE (250 Kgf/Cm2)	
	SPECIFICATION NO. PES-145-27
	VOLUME IIB
	SECTION D
	REV. NO. 02 DATE 16-5-2007
	SHEET 5 OF 8



PIPE O.D.	INSERTION LENGTH L1
Ø 509 & ABOVE	325
Ø 508 TO 368	250
Ø 367 TO Ø274	175
Ø 273 BELOW	150

NOTE :–

1. THE CORRESPONDING ELEMENT ELEMENT LENGTHS ARE GIVEN FOR INFORMATION ONLY. THE ELEMENT LENGTHS ARE WORKOUT AS PER THE FORMULA L=L1+N1−6.

2. FOR PIPE OD'S UPTO 159mm, THE THERMOWELL INSERTION WILL BE STRAIGHT. FOR PIPE OD'S BELOW 159mm, THE INSERTION SHALL BE SLANT.

Fig. 2

FORMAT NO. - 6666-0

भेल BHEL	**SPECIFICATION FOR TEMPERATURE GAUGE**	SPECIFICATION NO. : PES - 145 - 27 VOLUME II B SECTION D REV. NO. 02 DATE 16-5-2007 SHEET 6 OF 8

ALL DIMENSIONS IN mm

Instrument stem dia D+0.0 -0.1	DIA D1 +0.2 0	DIA C	Insertion Length L1	Extention element length N1	Corres ponding element length(L)
12	12.5	19	150	27	171
				75	219
				100	244
			175	27	196
				75	244
				100	269
			250	27	271
				75	319
				100	344
			325	27	346
				75	394
				100	419
14	14.5	21	150	27	171
				75	219
				100	244
			175	27	196
				75	244
				100	269
			250	27	271
				75	319
				100	344
			325	27	346
				75	394
				100	419

NOTE: The corresponding element lenghts are given for information only. The elements lengths are worked out as per the formula :

$$L = L1 + N1 - 6$$

FORMAT NO. - 6666-0

BHEL	**SPECIFICATION FOR TEMPERATURE GAUGE**	SPECIFICATION NO. : PES - 145 - 27 VOLUME II B SECTION D REV. NO. 02 DATE 16-5-2007 SHEET 7 OF 8

THERMOWELL-MEDIUM PRESSURE
(40 KG/CM2)

ALL DIMENSIONS IN mm

Instrument stem dia D+0.0 -0.1	DIA D1 +0.2 0	DIA C	Insertion Length L1	Extention element length N1	Corres ponding element length(L)
6	6,5	12.5	150	27	171
				75	219
				100	244
			175	27	196
				75	244
				100	269
			250	27	271
				75	319
				100	344
			325	27	346
				75	394
				100	419
8	8.5	15	150	27	171
				75	219
				100	244
			175	27	196
				75	244
				100	269
			250	27	271
				75	319
				100	344
			325	27	346
				75	394
				100	419

बी एच ई एल BHEL	THERMOWELL HIGH PRESSURE (250 KGf/Cm²)	SPECIFICATION NO. : PES - 145 - 27 VOLUME II B SECTION D REV. NO. 02 DATE 16-5-2007 SHEET 8 OF 8

ALL DIMENSIONS IN mm

Instrument stem dia D (+0.0 -0.1)	DIA D1 (+0.2 0.0)	DIA C1	DIA C2	K	DIA B	Insertion Length L1	Extention Length N1	Corresponding Element Length (L)
6	6.5	19	12.5	36	45	150	27 75 100	171 219 244
						250	27 75 100	271 319 344
8	8.5	21.5	15	36	45	150	27 75 100	171 219 244
						250	27 75 100	271 319 344
12	12.5	25.5	19	36	45	150	27 75 100	171 219 244
						250	27 75 100	271 319 344
14	14.5	27.5	21	36	45	150	27 75 100	171 219 244
						250	27 75 100	271 319 344
16	16.5	29	23	46	55	150	27 75 100	171 219 244
						250	27 75 100	271 319 344

FORM NO. PEM-6666-0

	TECHNICAL REQUIREMENT FOR TEMPERATURE GAUGE	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 1

TAG No. …… Qty……. Data Sheet No.: **PE-DC-326-145-I027-1**

Data Sheet A & B

DATA SHEET-A FOR TEMPERATURE GAUGE (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER		
	MODEL NUMBER		
	STANDARD TO BE FOLLOWED	■ ISA:RP:8.1 (ENCLOSURE) ■ ASME: PTC-19.3 (THERMOWELL)	
TECHNICAL	TYPE	MERCURRY FILLED (FOR <450 DEG C) INERT GAS ACTUATED (FOR >450 DEG C)	
	PRESSURE ELEMENT	BOURDON	
	MATERIAL	PRESSURE ELEMENT: ■ SS 316 (FOR Hg IN STEEL) CASE: ■ DIE CAST AL ■ SS BULB & CAPILLARY: SS 316 MOVEMENT: SS 304	
	DIAL	SIZE: 150 MM COLOR: WHITE NUMERALS: BLACK SCALE: LINEAR, 270° ARC GRADUATED IN DEG C	
	CASE	COLOUR : BLACK (IN CASE OF DIE CAST AL CASING)	
	ENCLOSURE	CLASS: ■ IP 55 PAINT: ■ EPOXY (IN CASE OF DIE CAST AL CASING)	
	MOUNTING	■ LOCAL ■ PANEL OR RACK	
	ZERO ADJUSTMENT	REQUIRED	
	RANGE SELECTION	SHOULD COVER 125% OF OPERATING PARAMETER	
	OVER RANGE PROTECTION	125% OF FSD FOR RANGE UPTO 400 Deg C 110% OF FSD FOR RANGE BETWEEN 400 TO 500 Deg C	
	COMPENSATION	CASE COMPENSATION TO BE PROVIDED AS PER BS 5235 FOR 0 TO 60 °C.	
	CAPILLARY MATERIAL	SS 316, 1.5 MM DIA COVERED WITH SS SPIRAL SHEATH OF 4.5 MM DIA	
	CAPILLARY LENGTH	5 MTR FOR LOCAL MOUNTED	
PERFORMANCE	ACCURACY	± 0.5% / ± 1% OR BETTER OF FULL SCALE DEFLECTION	
	RESPONSE TIME (WITHOUT THERMOWELL)	AS PER ASME PTC 19.3	
CONNECTION	CONNECTION WITH THERMOWELL	■ M20 x 1.5 (M) ■ 3/4" NPT (M) ■ ½" NPT(M)	
	LOCATION	BOTTOM / BACK	
THERMOWELL	MATERIAL (BAR STOCK)	■ SS 316	
	TYPE	■ SCREWED ■ WELDED ■ FLANGED	
	PROCESS CONNECTION	■ M33X2 ■ 150 RF ■ R 1 ■ R 1½	
	IMMERSION LENGTH (L1)	½ ID OF PIPE SUBJECT TO CONFORMANCE WITH ASME PTC 19.3	
	EXTENSION LENGTH (N1)	INSULATION THICKNESS - STUB HEIGHT + 25 MM	

FORM NO. PEM-6666-0

BHEL	**TECHNICAL REQUIREMENT FOR TEMPERATURE GAUGE**	SPECIFICATION NO.: VOLUME SECTION REV. NO. / DATE: SHEET 2 OF 1

TAG No. …… Qty…….

Data Sheet No.: **PE-DC-326-145-I027-1**

Data Sheet A & B

DATA SHEET-A FOR TEMPERATURE GAUGE (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

ACCESSORIES	NAME PLATE / METAL TAG	ENGRAVED WITH SERVICE LEGEND OR PHINOLIC NAME PLATE		
OTHER REQUIREMENT	1. AMBIENT TEMPERATURE 0-55 DEG C, RH 0-95%. 2. BULB O.D. 12 ± 0.1 MM 3. BEZEL RING SHALL BE OF ANODIZED ALUMINIUM / ABS PLASTIC INCASE OF DIE CAST AL CASING 4. ADJUSTABLE GLAND (BETWEEN 100 MM TO 300 MM) OF SS316 TO BE PROVIDED FOR CONNECTION OF STEM WITH THERMOWELL			
	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME				NAME
SIGNATURE/DATE				SIGNATURE /DATE

FORM NO. PEM-6666-0

	SPECIFICATION FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE	SPECIFICATION NO.: PE-SS-999-145-I026	
		VOLUME II B	
		SECTION D	
		REV. NO. 03 DA	TE : 16-05-2007
		SHEET 1 OF 4	

1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site of Pressure/Differential Pressure Gauge for use in Utility/Captive Power Station/Combined Cycle Station.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 The Design and Materials used for the components shall also comply with the relevant National and International standards.

2.3 As a minimum requirement, the following standards shall be complied with:

Pressure and vacuum gauges	-	IS-3624
Enclosure	-	IS-12063

3.0 TECHNICAL REQUIREMENTS

3.1 General

The gauges shall be suitable for an ambient temperature of 0-55°C and relative humidity of 0-95%.

3.2 Bourdon tube, Movement & Shank

Bourdon shall be made of stainless steel to AISI 316 and the teeth shall be polished to have frictionless movement without backlash. Movement material shall be AISI 304.I

3.3 Case

Shall be made of die cast aluminum and painted with black stoving enamel paint over a suitable primer. The case shall be provided with a blowout disc, to safeguard the window glass.

3.4 Bezel Ring

Shall be made of anodized aluminum with anti corrosive finish.

3.5 Dial Scale

The dial shall be made of a suitable material with anti corrosive finish, meeting the requirements of IS-3624.

The scale shall be concentric and graduated in kg/sq.cm. in the pressure gauge. MM of Hg on vacuum side and kg/sq.cm on pressure side in case of vacuum / compound gauges. The marking shall be black on a non-reflecting white background. The pointer deflection angle shall be 270 Deg.

The unit of measurement shall also be marked on the dial.

FORM NO. PEM-6666-0

	SPECIFICATION FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE	SPECIFICATION NO.: PE-SS-999-145-I026	
		VOLUME II B	
		SECTION D	
		REV. NO. 03 DA	TE : 16-05-2007
		SHEET 2 OF 4	

3.6 Pointer

Shall be made of suitable metal with black finish. The pointer shall be provided with suitable mechanism for zero adjustment without opening the case.

3.7 Switch device

Switch device shall be snap acting micro switch. The rating of contact shall be 5 A 230 V AC, 0.25 A 220 V DC. Setting range shall be field adjustable over the full range.

3.8 Accuracy

±1% of the full scale deflection.

3.9 Mounting & connection

Flush mounting, back connection, clamp fixing. Direct mounting bottom connection.

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 The bidder shall strictly follow the Quality Plan (s) included in Volume-IIB.

4.3 The following tests shall be conducted as a minimum requirement:

a) Routine tests

i) Accuracy Test.
ii) Overload test.
iii) Hysteresis
iv) Contact Rating (for switch)
v) Repeatability (for switch)
vi) HV / IR (for switch)

b) Type tests

i) Blow out disc
ii) Weatherproof, water tight and Dust tight tests.

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 4.3 (b), "Type Test Certificates" as per Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House/ Laboratory approved by BHEL.

4.5 The Standard QP is included in this specification to enable bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the agreed QP, taking care of customer requirements mentioned in Sec-C and submit QP for final approval by BHEL / Customer.

FORM NO. PEM-6666-0

	SPECIFICATION FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE	SPECIFICATION NO.: PE-SS-999-145-I026	
		VOLUME II B	
		SECTION D	
		REV. NO. 03 DA	TE : 16-05-2007
		SHEET 3(OF 4(	

5.0 SPARES AND CONSUMABLES

5.1 Recommended Spares

The bidder shall furnish a list of Recommended Spares along with the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 **DRAWINGS AND DOCUMENTS**

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

6.1.1 Data sheet-B, completely filled-up along with all enclosures.

6.1.2 Quality Plan.

6.1.3 Catalogues with detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for procurement, manufacture, testing and dispatch.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage :

6.2.1 For approval

i) Dimensional/installation drawings.

ii) Data sheet-C, completely filled-up along with all the enclosures.

iii) Quality Plan of vendor/sub-vendor.

iv) Test Certificates.

6.2.2 Final/As-built Drawings

Final / As-built drawings / CDs in required number of copies shall be submitted.

6.3.0 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

FORM NO. PEM-6666-0

BHEL	SPECIFICATION FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE	SPECIFICATION NO.: PE-SS-999-145-I026 VOLUME II B SECTION D REV. NO. 03 DA TE : 16-05-2007 SHEET 4. OF 4.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sunlight, high temperature, rain, moisture, humidity, dust, sea- water spray (where applicable) as well as rough handling and delays in transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

Data sheet A & B and C for Pressure / Differential Pressure Gauge
(Data sheet no. PE-DC-999-145-I026-1)

1512098(1)/2023/PS-PEM-MAX

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 1

TAG No. ……. Qty..... Data Sheet No.: **PE-DC-999-145-I026-1**

Data Sheet A & B

	DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	PRESSURE ELEMENT	☐ BOURDON ☐ DIAPHRAGM ☐ BELLOW	
	MATERIAL	SENSING ELEMENT – AISI 316 SS MOVEMENT – AISI 304 SS CASING – ■ DIE CAST AL ☐ SS	
	ENCLOSURE	☐ INDOOR MOUNTED IP-55 ☐ OUTDOOR MOUNTED IP-67 ☐ FUEL GAS HAZARDOUS APPL. EXPL. PROOF	
	DIAL	SIZE: ☐ 100MM ■ 150MM COLOR: WHITE NUMERALS: BLACK SCALE: ☐ LINEAR ☐ SQUARE ROOT	
	CASE C	OLOUR : BLACK	
	ADJUSTMENT	☐ EXT. MICROMETER SCREW ☐ INT. MICRO SCREW	
	MOUNTING	☐ LOCAL ☐ PANEL OR RACK	
	OVER RANGE PROTECTION	115% ABOVE 150 KG/CM2 FSD 125% ABOVE 150 KG/CM2 FSD	
	BLOW OUT DISC	REQUIRED	
	SWITCHING FACILITY	■ YES ☐ NO	
	TYPE	☐ MICRO SWITCH ☐ OTHER	
	NO. / TYPE OF CONTACTS	2 NOS. SPDT	
	CONTACT RATING	5A 230V AC, 0.25A 220V DC	
	SETTING RANGE	FIELD ADJUSTABLE OVER FULL RANGE	
	REPEATABILITY	± 1% OF FSR	
	POWER SUPPLY	230V AC (if required)	
PERFORMANCE	ACCURACY	± 1% OR BETTER OF FULL SCALE DEFLECTION	
CONNECTION	PROCESS	M20 x 1.5 (M)	
	LOCATION	☐ BACK ☐ BOTTOM	
ACCESSORIES	NAME PLATE / METAL TAG	SS	
	MOUNTING	☐ WALL ☐ PIPE – U CLAMPS & BOLTS ☐ PANEL / RACK	
	OTHER	AS PER ENCLOSED DIAGRAM	

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH**	SPECIFICATION NO.: PES – 145 – 031
		VOLUME II B
		SECTION D
		REV. NO. 03 DA TE : 16-05-2007
		SHEET 1 OF 3

1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site of Pressure/Differential Pressure Switch for use in Utility/Captive Power Station/Combined Cycle Station.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 The Design and Materials used for the components shall also comply with the relevant National and International standards.

2.3 As a minimum requirement, the following standards shall be complied with :
Enclosure : ISA:RP:8.1

3.0 TECHNICAL REQUIREMENTS

3.1 General

The pressure switches shall be suitable for an ambient temperature of 0-55°C and Relative Humidity of 0-95%.

3.2 Housing

Weather proof and dust tight housing made of Die-cast aluminium alloy. The external surface of the housing shall have a finish of light grey epoxy enamel.

3.3 Pressure Element

The pressure element shall be seamless hydraulically formed DIAPHRAGM/BELLOWS in Stainless steel/Phosphor Bronze for low pressure applications and stainless steel bourdon/piston for high pressure applications.

3.4 Switching differential

The switching differential shall be adjustable. The set point adjuster for the differential setting shall be inside the housing and shall be adjustable against a calibrated scale.

3.5 Pressure Connection

The pressure connection shall be at bottom. Size shall be 1/4" NPT (F) and material shall be stainless steel.

3.6 Electrical entry

Cable gland with Neoprene gourmet to suit PVC cable up to 17.5mm outside diameter.

3.7 Accuracy

$\pm$1% of scale range.

3.8 Micro-switch data

Micro-switch for AC/DC, single pole double throw, contacts having ratings 5 Amps at 230 V AC, 0.25 Amps at 220V DC.

3.9 Over pressure range

The pressure switch shall function without any deterioration in the accuracy as specified in clause 3.8 when subjected to an over pressure of 25% above the ranges.

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

FORM NO. PEM-6666-0

	SPECIFICATION FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH	SPECIFICATION NO.: PES – 145 – 031	
		VOLUME II B	
		SECTION D	
		REV. NO. 03 DA	TE : 16-05-2007
		SHEET 2 OF 3	

4.2 The bidder shall furnish the Quality Plan in the format enclosed in volume-III. In case the Quality Plan(s) is/are included in volume-IIB, the bidder shall furnish his Quality Plan strictly in line with the same. The Quality Plan shall be discussed and finalised with the technically accepted bidders before opening the price bid. The stages where the purchaser would like to be associated for witnessing or verification would be indicated by the purchaser in the Quality Plan before approval.

4.3 The following test shall be conducted as a minimum requirement.

a) Routine Tests

i) Repeatability.

ii) Over load.

iii) Contact Rating.

b) Type Tests

i) Enclosure Class (Weatherproof, water tight & dust tight test).

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted ed by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 4.3 (b), "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House / Laboratory approved by BHEL.

4.5 The Standard QP is included in this specification to enable bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the agreed QP, taking care of customer requirements mentioned in Sec-C and submit QP for final approval by BHEL / Customer.

5.0 SPARES AND CONSUMABLES

5.1 Recommended Spares

The bidder shall furnish a list of Recommended Spares alongwith the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies alongwith the bid :

6.1.1 Data sheet-B, completely filled-up alongwith all enclosures.

6.1.2 Quality Plan.

6.1.3 Catalogs wtih detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for procurement, manufacture, testing and dispatch.

6.2 The successful bidder shall furnish the following documents in required number of copies during the contract stage :

6.2.1 For approval

i) Dimensional/Installation drawings.
ii) Data sheet-C, completely filled-up alongwith all the enclosures.
iii) Quality Plan of vendor/sub-vendor.
iv) Test Certificates.

FORM NO. PEM-6666-0

	SPECIFICATION FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH	SPECIFICATION NO.: PES – 145 – 031	
		VOLUME II B	
		SECTION D	
		REV. NO. 03 DA	TE : 16-05-2007
		SHEET 3 OF 3	

6.2.2 Final/As-built Drawings

Final / As-built drawings / CD in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M Manuals shall also contain storage & commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sunlight, high temperature, rain, moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Pressure/Differential Pressure Switch : Data sheet no. PES-145-31-DS1-0
- Data sheet C Pressure/Differential Pressure Switch : Data sheet no. PES-145-31-DS2-0

1512098(1)/2023/PS-PEM-MAX

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 1

TAG No. ……. Qty..... Data Sheet No.: **PES-145-31-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	TYPE OF ELEMENT	☐ DIAPHRAGM ☐ BELLOW (for low range) ☐ PISTON ☐ BOURDON (for high range)	
	MATERIAL	ELEMENT: ☒ AISI 316 SS ☐ Ph. Br. CASING : DIE CAST AL	
	ENCLOSURE	☐ INDOOR MOUNTED IP-55 ☐ OUTDOOR MOUNTED IP-65 ☐ IP-67 ☐ FUEL GAS HAZARDOUS APPL. EXPL. PROOF	
	SWITCH TYPE	☐ MICRO ☐ ENCLOSURE HERMETICALLY SEALED	
	SWITCH CONTACT	TWO NOS. SPDT	
	SWITCH RATING	☐ 5A 230V AC ☐ 0.25A 220V DC	
	SETTING & DEAD BAND	ADJUSTABLE	
	MOUNTING	☐ DIRECT ☐ PANEL OR RACK	
	OVER RANGE PROTECTION	115% ABOVE 150 Kg/Cm2 125% BELOW 150 Kg/Cm2	
PERFORMANCE	ACCURACY (SCALE)	± 1%	
	REPEATABILITY	± 0.5%	
CONNECTION	PRESSURE CONNECTION	¼" NPT (F) AT BOTTOM	
	ELECTRICAL	WITH GLAND TO SUIT CABLE OF MAXIMUM O.D. 17.5 MM.	
INSTALLATION ACCESSORIES	AS PER ENCLOSED DRAWING		

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 1

TAG No. ……. Qty..... Data Sheet No.: **PES-145-31-DS2-0**

Data Sheet C

DATA SHEET-C FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER	
	MODEL NUMBER	
TECHNICAL	TYPE OF ELEMENT	
	MATERIAL	
	ENCLOSURE	
	SWITCH TYPE	
	SWITCH CONTACT	
	SWITCH RATING	
	SETTING & DEAD BAND	
	MOUNTING	
	OVER RANGE PROTECTION	
PERFORMANCE	ACCURACY (SCALE)	
	REPEATABILITY	
CONNECTION	PROCESS	
	ELECTRICAL	
INSTALLATION ACCESSORIES	AS PER DRG. ENCLOSED.	

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

HUMIDITY SENSOR

Sensor	:	Capacitance type
Accuracy	:	+/-3% R.H
Range	:	0-100% R.H
Output	:	4-20 ma
Time constant	:	2 mins.

Output from the sensor is to be connected to respective control system. Contractor can also provide combined instrument for measurement of humidity and temperature subject to Employer's approval during detailed engineering. In all such cases, 4-20 ma outputs, each for temperature and humidity measurements are to be provided.

TEMPERATURE / HUMIDITY INDICATOR

Sensor	:	RTD for(Pt 100) for temperature
	:	Capacitance Type for Humidity (specs for humidity and temperature shall be as mentioned above)
Display	:	Combined enclosure with two three digit seven segments LED display with decimal point after two digits. LED height shall be 4 inches, clearly legible from a distance of at least 10 meters.
Range	:	0-60 Deg C for temperature.
	:	0-95.0 % for Relative Humidity.
Accuracy	:	Better than +/_0.5 % for Temperature
	:	Better than +/_2.5 % for Relative Humidity
Mounting	:	Table Top/ wall mounting.
Power supply	:	240 V AC, 50 Hz.
Output	:	4-20 mA signal each for temperature.

FORM NO. PEM-6666-0

	SPECIFICATION FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER FOR AUX PACKAGES	SPECIFICATION NO.: PES – 145 – 001A	
		VOLUME II B	
		SECTION D	
		REV. NO. 01	DATE : 27.07.94
		SHEET 1 OF 4	

1.0 TECHNICAL REQUIREMENTS

1.1 General

The transmitter shall be suitable for ambient temperature 0-55°C. and Relative humidity 0- 95%. Transmitters shall be equiped with all accessories required for specific service conditions. Syphons shall be provided for steam service applications. Pulsation dampeners shall be provided for unstable process media such as discharge of pump. Diaphragm seals shall be used where the sensing element comes in contact with corrosive or dirty process fluid. The transmitter measurement for viscous process fluid shall be filled system type with separate Capillary and other required accessories. The transmitters shall be provided with suitable drain & vent points.

1.2 Principle of operation

The electronic differential pressure & pressure transmitters shall be as specified in the data sheet.

1.3 Output Signal

4-20mA DC two wire system unless otherwise specified.

1.4 Material

- Body : Forged Carbon Steel.
- Diaphragm : 316 SS
- Capsule : 316 SS
- Bellow : 316 SS
- Bourdon : 316 SS
- Measurement seal element : Teflon

1.5 Body Rating

Transmitter Body and measuring element (other than electronic housing shall be atleast 1.5 times the maximum process fluid pressure.

1.6 Zero and Span Adjustment

The transmitter zero and span shall be continuously adjustable through a simple field adjustment. The span and zero adjustment shall not interfere with each other. The ratio of maximum span to minimum span shall be atleast five (5) Each transmitter shall be factory callibrated to the range specified in instrument data sheet.

1.7 Zero Elevation or Supression

Zero Elevation or Suppression for level measurement shall be provided as standard feature. The continuously adjustable zero elevation device wherever required by the operating range of the transmitter (range specified in data sheet) shall be supplied.

FORM NO. PEM-6666-0

	SPECIFICATION FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER FOR AUX PACKAGES	SPECIFICATION NO.: PES – 145 – 001A	
		VOLUME II B	
		SECTION D	
		REV. NO. 01	DATE : 27.07.94
		SHEET 2 OF 4	

1.8 Working temperature of the cell body shall not be less than 100°C.

1.9 Process Connection

The transmitter shall be supplied fitted with 3/5 way valve manifolds having 1/2" NPT (F) connection for Process.

1.10 Mounting

The transmitter shall be suitable both for wall and pipe/stand mounting. Necessary mounting brackets, clamps, bolts and nuts shall be supplied along with transmitter as standard feature. The actual mounting requirement i.e. wall or pipe stand is indicated in the instrument data sheet.

1.11 Power Supply

The transmitter supply shall be 12 to 48V DC (4-20mA/0-20mA output).

1.12 Load Limit

The load limit shall be 500 Ohms at 24V DC and 1500 Ohms at 48V DC.

1.13 Reverse Polarity Protection

For reverse polarity connection of the power supply, there shall cause no damage to transmitter. Reverse current should be limited to 1 mA.

1.14 Signal Grounding

The design of transmitter electronic shall be such that either of the output wires may be grounded, causing no damage to transmitter.

1.15 Cable Entry

Cable gland complete with neoprene gromet suitable for PVC cables with maximum diameter of 17.5mm shall be provided for cable entry. The actual size of the cable shall be indicated during contract stage. Any other satisfactory arrangement for cable entry with proper sealing at entry shall also be acceptable.

1.16 Enclosure

The transmitter enclosure shall be as per NEMA-4 unless otherwise specified. Explosion proof enclosures shall be as per NEMA-7.

1.17 Terminal Box

A terminal unit accessible without exposing the transmitter mechanism shall be provided for signal/supply cable terminations and for test terminals.

FORM NO. PEM-6666-0

	SPECIFICATION FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER FOR AUX PACKAGES	SPECIFICATION NO.: PES – 145 – 001A	
		VOLUME II B	
		SECTION D	
		REV. NO. 01	DATE : 27.07.94
		SHEET 3 OF 4	

1.18	Performance Data		
1.18.1	Linearity	:	± 0.1% of span or better.
1.18.2	Hysterisis	:	± 0.1% of span or better.
1.18.3	Dead Band	:	± 0.1% of span or better.
1.18.4	Repeatability	:	± 0.1% of span or better.
1.18.5	Accuracy	:	± 0.5% of span or better.
1.18.6	Sensitivity	:	± 0.05% of span or better.
1.18.7	Stability	:	± 0.25% of span or better for six months.
1.18.8	Supply voltage variation effect	:	± 0.05% of span or better per volt.
1.18.9	Load resistance	:	± 0.0005% of span or better variation per ohm.
1.18.10	Vibration effect	:	Mechanical vibration in 3 mutually perpandicular planes with 0.07 mm amplitude from 10 to 60 Hz and 10m/sec2 acceleration from 60 to 150 Hz. shifts at 50% input shall be <0.01% of span.
1.18.11	Temperature variation effect	:	± 0.5% of span or better per deg.C.
1.18.12	EMI effect	:	DC magnetic field effect at 0% and 100% input upto 50 gauses. - On Zero : Less than 0.1%. - On Span : Less than 0.1%.
1.18.13	RFI effect	:	Radio frequency interference (up to 500 MHz), with field strength of 5 V/M shall not deviate the accuracy by more than 0.1%.
1.18.14	Damping	:	Damping shall be step or continuously adjustable so that time constant varies from 0-3s or 0-6s.
1.18.15	Static pressure	:	Zero shift < 0.5% of span for effect pressure change up to static pressure limit.
1.19	Accessories		
1.19.1	Valve Manifolds		

All differential pressure and pressure transmitters shall be supplied with 5 way and 3 way valve manifold respectively.

FORM NO. PEM-6666-0

	SPECIFICATION FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER FOR AUX PACKAGES	SPECIFICATION NO.: PES – 145 – 001A	
		VOLUME II B	
		SECTION D	
		REV. NO. 01	DATE : 27.07.94
		SHEET 4	OF 4

2.0 TESTING

2.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

2.2 The vendor shall conduct following tests as a minimum requirement and shall furnish test certificate/results thereof, for BHEL approval before despatch of the same.

a) Calibration test to confirm compliance with clauses 1.18.1 to 1.18.5 of this specification.

b) Enclosure as specified in data sheet (Type Test).

c) Over range pressure test to confirm compliance with clause 1.5 of this specification.

3.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Pressure/Differential Pressure Transmitter : Data sheet no. PES-145-01A-DS1-0

- Data sheet C for Pressure/Differential Pressure Transmitter : Data sheet no. PES-145-01A-DS2-0

FORM NO. PEM-6666-0

	DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 2

TAG No. ……. Qty..... Data Sheet No.: **PES-145-01-DS1-0**

Data Sheet A & B

	DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	TYPE	☐ INDUCTANCE ☐ CAPACITANCE ☐ STRAIN GAUGE ☐	
	POWER SUPPLY	24V DC	
	TRANSMITTER MEASUREMENT	☐ PRESSURE ☐ DIFF. PRESSURE	
	OUTPUT SIGNAL	4-20MA	
	NO. OF WIRE	TWO	
	ACCURACY	± 0.5% OF SPAN	
	LINEARITY, HYSTERISIS, DEAD BAND AND REPEATABILITY	± 0.1% OF SPAN	
	STABILITY	± 0.25% OF SPAN OR BETTER FOR 6 MONTHS	
	SENSITIVITY ±	0.05% OF SPAN	
	MATERIAL		
	A) BODY	FORGED CARBON STEEL	
	B) ELEMEN T	316 SS	
	C) SEAL	TEFLON	
	CONTINUOUSLY ADJUSTABLE SPAN AND ZERO ADJUSTMENT PROVIDED	☐ YES ☐ NO	
	MOUNTING	☐ WALL/PIPE STAND ☐ TRANSMITTER RACK	
	ENCLOSURE	☐ NEMA-4 ☐ NEMA-7	
	TURN DOWN RATIO	TO BE SPECIFIED BY BIDDER	
	INSULATION RESISTANCE	TO BE SPECIFIED BY BIDDER	
	ZERO SUPPRESSION RANGE	TO BE SPECIFIED BY BIDDER	
	ZERO ELEVATION RANGE	TO BE SPECIFIED BY BIDDER	
	INTEGRAL INDICATOR	☐ YES ☐ NO	

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 2 OF 2

TAG No. ……. Qty..... Data Sheet No.: **PES-145-01-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	TRANSMITTER SHALL BE ABLE TO DRIVE OUTPUT IMPEDANCE OF 500 OHMS.	YES	
	ZERO DRIFT	< 0.1%	
	SPAN DRIFT	< 0.1%	
	MANIFOLD		
	a) PRESSU RE MEASUREMENT	3 WAY	
	B) DIF FERENTIAL PRESSURE MEASUREMENT	5 WAY	
	CABLE ENTRY DETAIL	SUITABLE FOR DIA OF 17.5 mm	

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 2

TAG No. ……. Qty..... Data Sheet No.: **PES-145-01-DS2-0**

Data Sheet C

DATA SHEET-C FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER	
	MODEL NUMBER	
TECHNICAL	TYPE	
	POWER SUPPLY	
	TRANSMITTER MEASUREMENT	
	OUTPUT SIGNAL	
	NO. OF WIRE	
	ACCURACY	
	LINEARITY, HYSTERISIS, DEAD BAND AND REPEATABILITY	
	STABILITY	
	SENSITIVITY	
	MATERIAL	
	A) BODY	
	B) ELEMEN T	
	C) SEAL	
	CONTINUOUSLY ADJUSTABLE SPAN AND ZERO ADJUSTMENT PROVIDED	
	MOUNTING	
	ENCLOSURE	
	TURN DOWN RATIO	
	INSULATION RESISTANCE	
	ZERO SUPPRESSION RANGE	
	ZERO ELEVATION RANGE	
	INTEGRAL INDICATOR	

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 2 OF 2

TAG No. ……. Qty..... Data Sheet No.: **PES-145-01-DS2-0**

Data Sheet C

DATA SHEET-C FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

TRANSMITTER SHALL BE ABLE TO DRIVE OUTPUT IMPEDANCE OF 500 OHMS.	
ZERO DRIFT	
SPAN DRIFT	
MANIFOLD	
b) PRESSU RE MEASUREMENT	
B) DIF FERENTIAL PRESSURE MEASUREMENT	
CABLE ENTRY DETAIL	

	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

FORM NO. PEM-6666-0

	SPECIFICATION FOR TEMPERATURE ELEMENT (WITH THERMOWELL)	SPECIFICATION NO.: PES – 145 - 03	
		VOLUME II B	
		SECTION D	
		REV. NO. 01	DATE : 27.07.94
		SHEET 1 OF 10	

1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site of Temperature Element (with Thermowell) for use in Utility/Captive Power Station/Combined Cycle Station.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 The Design and Materials used for the components shall also comply with the relevant National and International standards.

3.0 TECHNICAL REQUIREMENTS

3.1 General

The temperature sensor elements shall be duplex type, either thermocouple (T/C) or resistance temperature detector (RTD). Unless otherwise specified in the data sheet, the type of sensors for different applications shall be as follows:

i) Chromel - Alumel T/C medium temp. range (250˚C to 600˚C)

ii) Platinum-Rhodium Platinum High temp. range (600˚C and above). Type S/R/B.

iii) Platinum RTD Low temperature & high accuracy (-50˚C to 250˚C).

3.2 Process Parameters

Process parameters such as line size, pressure, temperature, fluid medium are given in the instrument data sheet.

3.3 Thermocouple Wire Size

The thermocouple wire size for a given temperature application shall be as per table – 3.1A of ASME PTC 19.3 – 1974.

3.4 Sensor Grounding

Thermocouple junction shall be generally ungrounded type unless specified otherwise in the data sheet for the thermocouple.

3.5 Sensor Protective Sheath & Wire Insulation

The sensor protective sheath shall be 8mm OD 316 SS seamless tube using compacted magnesium oxide packing/porcelain for insulation.

FORM NO. PEM-6666-0

	SPECIFICATION FOR TEMPERATURE ELEMENT (WITH THERMOWELL)	SPECIFICATION NO.: PES – 145 - 03	
		VOLUME II B	
		SECTION D	
		REV. NO. 01	DATE : 27.07.94
		SHEET 2 OF 10	

3.6 Sensor Characteristics

Thermocouple calibration characteristics i.e. temperature vs. milli volt or resistance shall be as per the applicable Indian Standards (IS-2054 for thermocouple 'K' type, IS-2055 for Pt.Rd.Pt.), RTD type of sensor calibration i.e. temperature vs. resistance shall be as per the applicable Indian Standard (IS-2848).

3.7 Sensor Accuracy Limits

T/C sensor limiting accuracy shall be as per table 3.2A of ASME PTC 19.3 – 1974. RTD sensor accuracy shall be as per table 9.1 of ASME PTC – 19.3 – 74.

3.8 Insulation Resistance

Insulation resistance of RTD leads w.r.t. body shall be more than 5 mega ohms at 100V DC.

3.9 End Connection

The sensor assemblies shall have screwed M33 x 2 end connection. Specific design requirements of pressure, temperature and end connection type for a given application are indicated in the instrument data sheet.

3.10 Terminal Head

Terminal head cover shall be screwed type design having gasket with small flexible chain attached between fixed portion and head cover.

3.10.1 Terminal Head Enclosure

The terminal head enclosure shall be dust, weather proof and water proof as per NEMA-4 classification unless specified otherwise.

3.10.2 Terminals

The terminal head shall have provision of screwed terminal of 1.5 mm^2 size for external connection. The terminals shall be suitably marked '+ve' & '-ve' for thermocouple and 'Lo', 'Hi' and 'C' for three wire RTD.

3.11 Cable Entry

Cable gland complete with neoprene gromet suitable for PVC cable with maximum diameter of 17.5mm shall be provided for cable entry. The actual size of cable shall be indicated during the contract stage. Separate cable entry and cable glands shall be provided for both the elements.

3.12 Thermowell

Temperature element shall be supplied along with the thermowell. The thermowell shall be of tungstion carbide for mill air temperature and for rest of the applications of AISI 316SS forged bar stock shall be designed to suit the process conditions. For detail of the thermowell, see enclosed drawing.

3.12.1 Thermowell Extension Length

Temperature sensor assemblies shall have extension length as specified in tables so that the terminal head clears the pipe line insulation. The extra extension length requirement if any, special applications shall be indicated in the data sheet.

FORM NO. PEM-6666-0

	SPECIFICATION FOR TEMPERATURE ELEMENT (WITH THERMOWELL)	SPECIFICATION NO.: PES – 145 - 03	
		VOLUME II B	
		SECTION D	
		REV. NO. 01	DATE : 27.07.94
		SHEET 3 OF 10	

3.12.2 Material of Thermowell Assemblies

Material of the rmowell assemb lies a s indicated in clau se 3 .12 u nless sp ecified otherwise. Th e thermowell shall b e machin ed out o f solid bar stock. T he s urface of the rmowell o ver w orking length portion shall be polished. Thermowell shall be with taper profile. For details of the thermowell see Fig. (1) & Fig. (2).

3.12.3 Internal Construction

Sensor asse mblies sha ll pre ferably be me tal s heathed with spring loa d on to the th ermowell tip fo r better response. The sheathed sensor assembly shall be replaceable (in-situ) type without removal of thermowell.

3.12.4 Compensating cable should be used for co nnecting elements to secondary Instruments/Device unless there is specific requirement for cold junction compensation. Field mounted cold junction compensation box as pe r NEMA-4 sha ll be provided for all thermocouples. The CJC bo x sha ll have a utomatic temperature control at reference junction temperature of 60 Deg. C. Ea ch CJC box shall be provided with duplex RTD for remote monitoring.

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 The bidder shall furnish the Quality Plan in the format enclosed in volume-III. In case the Quality Plan(s) is/are included in volume-IIB, the bidder shall furnish his Quality Plan strictly in line with the same. The Quality Plan shall be discuss ed and finalised w ith all th e technically accepted bidders before opening the price bid. The stages where the purchaser would like to be associated for witnessing or verification would be indicated by the purchaser in the Quality Plan before approval.

4.3 The following routine tests shall be conducted as a minimum requirement :-

4.3.1 Physical dimension of the sensor assemblies as per approved drawing.

4.3.2 Electrical c haracteristic o f s ensor s uch a s c ontinuity of the th ermocouple wires, an d in sulation resistance of the RTD leads w.r.t. body.

4.3.3 Temperature vs. Resistance / milli volt for the sensor assemblies shall be tested with reference to standard resistance thermometer by comparison method. This test may be carried out once for the T/C or RTD sensor wires for each batch production.

4.3.4 Each type of h igh pressure thermowell assembly with thread end connection sha ll b e tested ag ainst hydrostatic test p ressure of one & a half times the maximum working pressure for any leakage. However dimensional checks an d thread conformity with g auges shall b e checked for each sen sor assembly.

FORM NO. PEM-6666-0

	SPECIFICATION FOR TEMPERATURE ELEMENT (WITH THERMOWELL)	SPECIFICATION NO.: PES – 145 - 03	
		VOLUME II B	
		SECTION D	
		REV. NO. 01	DATE : 27.07.94
		SHEET 4 OF 10	

4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the items, "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House / Laboratory approved by BHEL.

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

Nil.

5.2 Mandatory Spares

Nil.

5.3 Recommended Spares

The bidder shall furnish a list of Recommended Spares along with the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with unit rate against each item to enable BHEL / BHEL's Customer to place a separate order later, if required.

5.4 Special Tools & Tackles

Nil.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

6.1.1 Data sheet-B, completely filled-up along with all enclosures.

6.1.2 Quality Plan of bidder.

6.1.3 Catalogs with detailed technical information.

6.1.4 Bar-chart to indicate the time schedule for manufacture testing and despatch.

6.1.5 Schedule for manufacturing, testing and dispatch (Enclosed in Vol.-II B).

6.2 The successful bidder shall furnish the following documents in required number of copies to BHEL during the contract stage :

6.2.1 For approval

i) Dimensional drawings.

ii) Installation drawings with overall dimensions of the completed equipment and clearances for operation and maintenance.

iii) Data sheet-C, completely filled-up along with all the enclosures.

iv) Quality Plan of vendor/sub-vendor.

v) Test Certificates.

FORM NO. PEM-6666-0

	SPECIFICATION FOR TEMPERATURE ELEMENT (WITH THERMOWELL)	SPECIFICATION NO.: PES – 145 - 03	
		VOLUME II B	
		SECTION D	
		REV. NO. 01	DATE : 27.07.94
		SHEET 5 OF 10	

6.2.2 For information

i) Storage instructions.

ii) Commissioning instructions.

6.2.3 Final/As-built Drawings

Final/As-built drawings/RTFs in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted.

7.0 MARKING AND PACKING

7.1 Marking

A metal name-plate should be permanently fixed on each equipment giving its Tag Number and technical specifications.

7.2 Packing

All equipment / materials shall be suitably packed and protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sun light, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in transmit and storage is open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Temperature Element (With Thermowell) : Data sheet no. PES-145-03-DS1-0
- Data sheet C for Temperature Element (With Thermowell) : Data sheet no. PES-145-03-DS2-0

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR TEMPERATURE TRANSMITTER**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 2 OF 2

TAG No. ……. Qty..... Data Sheet No.: **PES-145-03A-DS1-0**

Data Sheet C

DATA SHEET-C FOR TEMPERATURE ELEMENT (WITH THERMOWELL)
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER	
	MODEL NUMBER	
TECHNICAL	ELEMENT TYPE	
	T / C GROUNDED	
	ELEMENT THICKNESS (AWG)	
	LIMIT OF ERROR	
	INSULATION RESISTANCE	
	TIME CONSTANT	
	MOUNTING THREAD SIZE	
	CONDUIT THREAD SIZE	
	EXTENSION WIRE TYPE	
	THERMOWELL	
	THERMOWELL LENGTH	
	LINE SIZE	
	PRESSURE RATING	
	TEMPERATURE RATING	
	FLUID MEDIUM	

NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

	AIR CONDITIONING & VENTILATION SYSTEM 4X225 MW ARUN-3 HEP	SPECIFICATION NO.
		VOLUME **II-B**
		SECTION : **C**
		REV. NO. 00 | DATE: 25.10.2019
		SHEET OF

INSTRUMENTATION CHECK LIST

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST			P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL,
P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to carry out ROUTINE TEST on 100 %.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. When material corelation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST			P	W	V	
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE		P	W	V	
5	REVIEW OF TC FOR	FOR LOT		V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

	AIR CONDITIONING & VENTILATION SYSTEM 2x20 MW Rahughat HEP	SPECIFICATION NO.
		VOLUME **II-B**
		SECTION : **C**
		REV. NO. 00 | DATE: 15.03.2022
		SHEET OF

LOCAL CONTROL PANEL SPECIFICATION

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS –999- 145 –054A	
		VOLUME II B	
		SECTION D	
		REV. NO. 03	DATE : 16-09-2013
		SHEET 1 OF 6	

1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site, supervision, erection, and commissioning at site of Local Panels required for control and monitoring of the Auxiliary Plant & Equipment.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 As a minimum requirement, the following standards shall be complied with:

a) IS-6005 : 1998 : Code of practice for phosphating of iron and steel.
b) IS-5 : 2007 : Colors for ready mixed paints and enamels.
c) IS-1248:2 003 : Direct Acting Indicating Analog Elec Measuring Instruments.
d) IS/IEC 60947:Part 1:2004 : Low Voltage switchgear & control gear: Part-I (General Rules)
e) IS-8828:1996 : Circuit breaker for household and similar installations.
f) IS-13947 (Part-I):1993 : Low Voltage switchgear & control gear : Part-I (General Rules)
g) ISA-18.1:1979 : Annunciator Sequences and Specification
h) NFPA-496:2003 : Purged & Pressurised Enclosure fo r Elect rical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single lo op controller, Control switches / push buttons, indicating lamps/LED cluster, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure o r folde d con struction by she et m etal formatio n dep ending upon th e equipments to be mounted on it. The panels shall be robustly built and stiffeners as necessary shall be provided.

3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel
Frame thickness: Not less than 3.0mm
Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments)
1.6 mm for doors and Not less than 2.0 mm for others

Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at mi nimum three places. The door width shall not be more than 550mm.The doors shall be provided with suitable stiffeners to prevent buckling. The handle shall be on the right side of the door. The door shall be remov able type with conceal ed hinges to facilit ate maintenance work. Suitable pocket inside the door sh all be provid ed for kee ping the drawi ngs / docum ents. Double door shall be provided with suitable glass windows, as per the requirement.

3.1.6 Suitable neoprene gasket shall be p rovided on a ll doors and removable covers. Suitable ventilation system along with louvers shall be provided at bottom and top of the doors covered with removable wire mesh.

3.1.7 The class of protection shall be in accordance with IP-42 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).

3.1.8 All steel surf aces shall be cle aned b y sand / pellet blastin g, treated fo r pi ckling, de greasing an d phosphating etc. by seven tank method. The p anel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / syntheti c enamel based final paint of color shade and fini sh as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.

3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.

3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. re quired for re alization of control l ogics shall be mo unted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.
No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.

3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto ch angeover unit sh all be mounte d on the pan el are in the panel su pplier's scope. Whe re DC control po wer sup ply is specified an a dditional 24 0V, 50 Hz AC supply feed er for po wering of spa ce heater and lighting shall b e provided by the purcha ser. Suitable arrangement shall be provided in side the panel to receive an d termin ate the powe r supply feeder(s). For thi s pu rpose M CBs of suitabl e current rating shall b e pro vided by the vendor. A su pervisory relay along with a pilot lamp t o indicate control supply 'ON' shall b e provide d on the pan el. Any other po wer supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.

3.1.12 The inter nal wiring shall b e carried out with 1100 volt grade PV C insulated copper m ulti strand wire / flexible of 1.5mm2 si ze. AC & DC wires shall be k ept sepa rate from eac h other. Separate colou red wires to b e used for AC and DC circuits. All wire s shall b e p roperly nu mbered an d identi fied with ferrules as per the Control sche me / wiring dia gram. Wires shall be routed and run th rough PVC troughs.

3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate termin al blocks sh all be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm2 to 2.5mm2 external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for sh orting CTs. Each terminal st rip shall be provided with identification strip. T he te rminal shall not be m ounted bel ow 25 0 mm height from fini shed floor. The panel shall have ten (20) percent spare terminal.

3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps / tube lights with shrouded cover of minimum 15W operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.

3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system sh all be provided at the pa nel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.

3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated i nternally with 10 mm bolts at extreme ends for connection to; mai n station earth. The panel m ounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm2 size.

3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 2 0 mm height. The individ ual devices on the pa nels sh all be a s provided with separate name plate with inscription of 3 mm height. The instrum ent / devices shall be provided with stick on label plates insi de the panel. T he mate rial of the main and individu al labels shall be three (3) pl y 3 mm thi ck Traffolyte

Sheet / 2 mm Anodised Aluminium Plate. The inscriptio n shall be with white letters on bl ack background on traffolyte sheet. The labels shall be fixed by self tapping non-rusting screws.

3.1.18 Vendor shall furnish electric load and heat load list (in case pa nel is to be placed in ac environ ment) of each panel.

3.2 Hazardous Area Panel Requirement

3.2.1 The L ocal Panel lo cated in ha zardous are a s hall b e pressu rized as per NF PA-496 requirements to render it no n-hazardous. Alarms shall be p rovided for lo cal and rem ote annu nciation wh en pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be po ssible to swit ch ON the power of purged section unless it is pu rged a s per the recommendation of NFPA-496. Vend or mu st p rovide a protective devi ce on the p anel to protect the panel from over pressurisation.

3.2.2 Vendor shall su pply p ressurisation kit co nsisting o f valves, re striction o rifices, du al filter regulation, pressure gauges, pressure switches, rotameter et c. Pressurisation kit shall be surface mounting on a metal boa rd and lo cated outside the l ocal panel. Pressu risation kit shall fu rther consist of sole noid valve flow switch, timer bl ow off safety device etc., so a s to m ake purging fully automatic. Ho wever final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.

3.2.4 All components in the local panel like in dicating instruments, push buttons switche s, lamps etc., whi ch are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push butt ons et c. req uiring frequ ent operatio n durin g ma chine run ning shall have go od po sitive sealing. Weatherproof ho using o r cover to be pr ovided wherever n ecessary. Vendo r shall provid e pressurisation bypass switch o utside explosi on proof e nclosure of p ressurized p anel with lam p indication. This shall be used only during maintenance. All hinge s, screws, other n on-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off m anually all typ es of power shall be provided in the panel. In a ddition, it sh all also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in ca se of pressurization failure. All such cable s from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring devices

3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.

3.3.2 Alarm Annunciator System

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, havin g two (2) la mps per windo w, and hooter of 10W, an d provision for re peat g roup ala rm at remote. Th e ann unciator sh all be provided with t en (1 0) p ercent sp are windows or minimum two (2) windows along with electronics.

3.3.3 Relay s

The relays shall be electromagnetic type suitable fo r specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

3.3.4 Timers

The timers shall be ele ctronic type suit able for sp ecified control supply. Its contact co nfiguration and rating shall b e suitable for the specified control fun ction. Ho wever, minimum co ntact rating shall be 5 Amp AC & 2 Amp DC as applicable.

3.3.5 Control / Selector Switches

Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position / functions.

3.3.6 Push Buttons / Indicating Lights

The push buttons shall be momentary action self-resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate / inscription plate. Colour coding of push buttons shall be as under:

RED	Motor OFF / Valve CLOSE	YELLOW	Alarm acknowledge	Left Hand Side
GREEN	Motor ON / Valve OPEN	BLACK	Lamp test	Right Hand Side

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with LED cluster type lamp replaceable from front.

GREEN	Motor OFF / Valve CLOSED condition	AMBER	Motor tripped	Left Hand Side
RED	Motor ON / Valve OPEN condition	WHITE	Normal / healthy	Right Hand Side

3.3.7 Ammeters

Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type as called for in the data sheet-A (No. PES-145-54A-DS1-0). Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication

3.3.8 Miniature Circuit Breaker (MCB)

These shall be instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal trip feature for over current protection. The housing of MCB shall be made of non-ignitable, high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

3.3.9 Makes of various instruments / devices shall be as given below

1.	Alarm Annunciators	:	Procon / IIC
2	Ammeters	:	AEP / IMP
3.	Control / Selector Switches	:	Alsthom / Kaycee / Siemens / L&T
4.	Push Buttons / Indicating Lamps	:	Siemens / L&T / Teknic / Alsthom
5.	Auxiliary Relays	:	Jyoti / Siemens / L&T / OEN
6.	Timers	:	L&T / Alsthom / Bhartiya Cutler Hammer
7.	MCBs	:	S&S Power Engg. / Indo Asian / MDS
8.	Terminal Blocks	:	Jyoti / Elmex

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 BHEL's standard Quality Plan for LCP is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS –999- 145 –054A	
		VOLUME II B	
		SECTION D	
		REV. NO. 03	DATE : 16-09-2013
		SHEET 5	OF 6

4.3 The vendor shall conduct the following tests as a minimum requirement:

4.3.1 RoutineTests

1. High Voltage (H.V.)
2. Insulation Resistance (I.R.)
3. Functio nal

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

5.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

1. Data Sheet no. PES-145A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract:

1. Data Shee No. PES-145A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs.

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrossion, incidental damage due to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Local Panels : Data sheet no. PES-145A-DS1-0
- Data sheet C for Local Panels : Data sheet no. PES-145A-DS2-0

1512098(1)/2023/PS-PEM-MAX

FORM NO. PEM-6...

BHEL	**DATA SHEET FOR LOCAL PANELS**	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 — DATE: 16.09.2013
		SHEET 1 OF 3

TAG No. …………. Qty................. Data Sheet No.: **PES-145A-DS1-0**

Data Sheet A & B

			DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER			
	CONSTRUCTION		■ FOLDED ☐ WELDED	
	ENCLOSURE SHEET THICKNESS **(As per Section 8.13,Volume V of contract specification)**	FRONT	☐2.0 mm	
		OTHER	☐ 2.0 mm	
		DOOR	☐ 1.6 mm	
		HEIGHT	☐ 2365 mm for stand alone panels. ☐ Other …………	
		OTHER	☐ Load bearing sheet front shall have 3mm thickness	
TECHNICAL	INPUT POWER SUPPLY * **(As per Electrical specification)** (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY)		☐ 240V 50 Hz AC ☐ 220V DC ■ 415V 3 PHASE 3W ☐ 400V 3 PHASE 4W	
	NO. OF FEEDERS **(As per Electrical specification)**		☐ ONE ☐ TWO	
	STARTER WITH MCC		☐ REQUIRED ■ NOT REQUIRED	
	IPR POSITION		■ MCC ☐ RELAY PANEL	
	CONTACT RATING OF RELAY		■ 5 Amp, 230 V AC ■ 0.25 Amp, 220V DC	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		______NOS. (AS REQUIRED)	
	TEMP SCANNER (IF REQUIRED –NO. OF CHANNELS TO BE SPECIFIED UNDER SEC-C)		☐ REQUIRED ■ NOT REQUIRED	
	PAINT TYPE **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**		☐ EPOXY ENAMEL ☐ EPOXY POWDER COATED	
	MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)		■ REQUIRED ☐ NOT REQUIRED	
	PANEL COLOUR (EXTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**		☐ LIGHT GREY ☐ OPALINE GREEN	
	FINISH (EXTERNAL) **(As per Annex-1, Section 7.6,Voulme IV of contract specification)**		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**		☐ WHITE ☐ CREAM ☐ OFF WHITE	
	FINISH (INTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)**		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	CLASS OF PROTECTION		■ IP-55 (FOR INDOOR SERVICE) ■ IP-67 (FOR OUTDOOR SERVICE) ☐ ANY OTHER	
	CONTROL HARDWARE		■ RELAY BASED	
	FOUNDATION ARRANGEMENT		☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)		…………………..(Vendor to specify)	

FORM NO. PEM-6000-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 / DATE: 16.09.2013
		SHEET 2 OF 3

TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet A & B

	DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	PANEL TYPE	☐ PRESSURISED ☐ UNPRESSURISED As per Requirement	
	CABLE GLAND	■ DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT) *	☐ 1 Amp CT ☐ 4-20 mA	
	SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING	☐ APPLICABLE ■ NA	
	* TO BE CO-ORDINATED WITH PEM ELECTRICAL		

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME	AANCHAL CHOUDHARY	SACHIN SRIVASTAVA	MA MANSOORI	NAME:
DESIGNATION	SR.ENGR	DY.MNGR	D. GM	
SIGNATURE				SIGNATURE:
DATE	16.09.2013	16.09.2013	16.09.2013	DATE:

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 / DATE: 16.09.2013
		SHEET 3 OF 3

TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER			
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT		
		OTHER		
		DOOR		
		HEIGHT		
		OTHER		
TECHNICAL	INPUT POWER SUPPLY			
	NO. OF FEEDERS			
	CONTACT RATING OF RELAY			
	TEMP SCANNER			
	CONTROL SUPPLY			
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)			
	PAINT TYPE			
	PANEL COLOUR (EXTERNAL)			
	FINISH (EXTERNAL)			
	TYPE OF MIMIC MATERIAL OF MIMC THICKNESS OF MIMIC			
	PANEL COLOUR (INTERNAL)			
	FINISH (INTERNAL)			
	CLASS OF PROTECTION			
	CONTROL HARDWARE			
	FOUNDATION ARRANGEMENT			
	WEIGHT OF PANEL (Kg.)			

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS-999-145-054A
		VOLUME
		SECTION
		REV. NO. 02 / DATE: 16.09.2013
		SHEET 3 OF 3

TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

	PANEL TYPE		
	CABLE GLAND		
	AMMETER (TYPE OF INPUT)		
	SCOPE OF SUPERVISION		

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME	AANCHAL CHOUDHARY	SACHIN SRIVASTYAVA	MA MANSOORI	NAME:
SIGNATURE				SIGNATURE:
DATE	16.09.2013	16.09.2013	16.09.2013	DATE:

BHEL	**SPECIFIC TECHNICAL REQUIREMENT FOR AIR CONDITIONING & VENTILATION SYSTEM 2x20 MW Rahughat HEP**	SPECIFICATION NO.
		VOLUME **II-B**
		SECTION : **C**
		REV. NO. 00 DATE:
		SHEET OF

LCP QUALITY PLAN

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 1 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
	RAW MATERIAL													
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	√	P/W	V		
		2. Bend Test	CR	Mech. test	Sample	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	√	P/W	V		
		3. Surface finish	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		4. Waviness	MA	Visual	100%	10%	Manufacturing Standard	No Waviness	Inspection Report	√	P/W	---		
		5. Thickness	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
		6. Mill marking	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Sample	IS:2062	IS:2062	Test Certificate	√	P/W	---		
		2. Surface Defects	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		3. Straightness	MA	Measurement	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		4. Mill marking	MA	Visual	100%	10%	IS:2062	IS:2062	Inspection Report	√	P/W	V		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/10/2020	KUNDAN PRASAD
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 2 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		2. IR and HV	MA	Electrical	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		3. Conductor a) Resistance b) Size c) Sheet colour	 MA MA MA	 Electrical Measurement Visual	 100% 100% 100%	 10% 10% 10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		4. Type / Routine Test Certificates	MA	Verification	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays	1. Verification at make and Type	CR	Visual	Sample	Sample	Approved Drg/Datasheet	Approved Drg/Datasheet	Test Certificate	√	P/W			
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
		3. Operation / Functional check	CR	Electrical	Sample+ 100% @	Sample+ 10% @	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			+ for relay & contactors only

352

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/12/2020	CHETAN MALIK	Checked by:	14/12/2020	KUNDAN PRASAD		
Reviewed by:	14/12/2020	RK RAINA	Reviewed by:	14/12/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 3 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6 M	6 C/N	7	8	9	D	** M	C	N	
	Timers, Space Heaters, Thermostat, Indicating meters etc.	4. I.R.	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
		6. Calibration	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W	V		
		7. Pick up / Drop off Voltage	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
		2. Surface defects	MA	Visual	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
	IN PROCESS INSPECTION													

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/12/2020	CHETAN MALIK	Checked by:	14/12/2020	KUNDAN PRASAD		
Reviewed by:	14/12/2020	RK RAINA	Reviewed by:	14/12/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

353

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 4 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Surface defects after bending	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W			
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Deburring	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
	ASSEMBLY													
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Alignment	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		3. Welding Quality	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		4. Surface defects	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			

354

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	14/4/2020	CHETAN MALIK	Checked by:	14/04/2020	KUNDAN PRASAD			Reviewed by:			
Reviewed by:	14/4/2020	RK RAINA	Reviewed by:	14/4/2020	RK JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 5 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Periodic	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		3. Dipping / Removal Time	MA	Measurement	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		4. Surface quality after every dip	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		5. Primer after phosphating	MA	Visual, Thickness	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		6. Putty Application & Rubbing after primer	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		7. Paint first coat	MA	Visual, Thickness	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		

355

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/04/2020	KUNDAN PRASAD			Reviewed by:			
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/4/2020	RK JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 6 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		3. Ferrule numbers	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		4. Colour of wiring	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
		5. Size of Conductor	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
11.	Component Mounting	1. Correct components	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Fixing	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

356

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 7 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
	FINAL TESTING													
12.	Final Inspection	1. Workmanship	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	W		
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		At Random by BHEL, based on 100 % internal test reports by Mfr.
		3. Components identification Marking / Name plates	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		5. Dimensions	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		6. Door functioning	MA	Functional	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		At Random by BHEL, based on 100 % internal test reports by Mfr.
		7. Paint Shade	CR	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		

357

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD			Reviewed by:			
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 8 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
		8. Paint Thickness	CR	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		9. Workmanship of Gaskets	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	W		
		10. Wiring Layout	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		11. Wire Termination	MA	Pulling manually	Sample	Sample	-----	Firm termination	Inspection Report	√	P/W	W		
		12. Continuity	MA	Electrical	100%	10%	-----	Continuity OK	Inspection Report	√	P/W	W		
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	Sample	Approved Drg/Datasheet Relevant IS-13947 Part-1, IS-2148.	Approved Drg/Datasheet Relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	√	P/W	V		
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	10%	Approved Drg/Datasheet Relevant IS.	Approved Drg/Datasheet Relevant IS.	Inspection Report	√	P/W	W		

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/12/2020	CHETAN MALIK	Checked by:	14/12/2020	KUNDAN PRASAD		
Reviewed by:	14/12/2020	RK RAINA	Reviewed by:	14/12/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

358

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 9 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		2. Instrument Calibration	CR	Electrical	10%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		3. Temperature rise	CR	Electrical	100%	10%	Approved Drg/Datasheet Relevant IS.	Approved Drg/Datasheet Relevant IS.	Inspection Report	√	P/W	W		

359

NOTES:

1. Customer's specification for painting shall be included in the technical specification. In the absence of Customer's spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
2. Copies of all TC's (Test Certificates) for components shall be submitted to BHEL for verification and acceptance.
3. BHEL reserves the right to conduct repeat tests, if required.

LEGENDS:
*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION, **D**: DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/12/2020	CHETAN MALIK	Checked by:	14/12/2020	KUNDAN PRASAD		
Reviewed by:	14/12/2020	RK RAINA	Reviewed by:	14/12/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	CONTROL & INSTRUMENTATION CABLE FOR AIR CONDITIONING & VENTILATION SYSTEM **2x20 MW Rahughat HEP**	SPECIFICATION NO. VOLUME **II-B** SECTION : **C** REV. NO. 00 DATE: 15.03.2022 SHEET 1 OF 8

CONTROL & INSTRUMENTATION CABLE

9.2.3 Control and Instrumentation Cables

a) General

All control and instrumentation cable shall be 650/1100 V grade multi-conductor, colour-coded, PVC insulated armoured cable as per IEC/IS standard. Each multicore cable shall have not less than 20 percent 2 spare cores, whichever is the greater.

b) Conductor

Copper conductor shall be of stranded circular non-compacted cross-section. The sectional area of the core conductor shall not be less than 2.5 sq.mm and shall conform to the following requirements:

Current transformer secondary circuits :

The total burden of instruments and relays connected plus that of cable shall be less than the rated burden of respective current transformer. The Contractor shall calculate the load of CT core considering all connected loads and submit to the employer for approval. In case of CT burden constrain, CT circuit cable cross sectional area shall be increased. In this case the Contractor shall supply and install the cable of required cross-section area without any additional cost to the Employer.

Potential transformer secondary circuits :

Allowable voltage drop in the cables under the total burden of instruments and relays connected shall be less than two (2) percent.

AC and DC circuits :

Allowable voltage drop in the cable shall be less than 10 volts.

1100V, PVC insulated wires shall be used for power and heater circuits for auxiliary equipment.

The minimum size shall be 4.0 sq.mm PE insulated wires connecting the low-tension cubicle to the motor control centres, AC panels, DC panels, crane trolley, etc. shall have sectional area of at least 35sq.mm.

c) Insulation

The electrically and thermally stable PE insulation shall be extruded onto the conductor so as to prevent contamination and voids, if any, shall be between insulation and conductor.

d) Assembly

1) Single core and multicore conductor cables shall be assembled in accordance with applicable IEC standards.

2) A flame-retardant binder tape may be used underneath the overall jacket of multi-conductor cables, if required, to achieve the desired flame retardative characteristics. Tapes, if used, shall be non-hygroscopic.

e) Jacket

1) The cable core assembly shall be covered with a flame retardant and resistant jacket.

2) The overall jacket shall be clean, dry, and free from grease and shall be suitable for paint application.

3) Cable jacketing shall be free from water. Evidence of water shall be the ground for rejection of the cable.

f) Anti- Termite Covering

Anti-termite protection shall be applied to the cable and shall consist of either a non-magnetic metallic barrier or layer of nylon sheathing.

g) Identification

Each cable shall have a printed legend on the overall jacket, with the manufacturer's name, voltage class, the number, material and size of conductors, type of insulation and a unique number or code indicating the production run or batch. The identification shall remain legible for the life of the cable.

9.2.4 Communication Cables

a) All cables and wiring shall have copper conductors and FRLS PVC insulation and shall comply with IEC standards.

b) Each communication cable shall have not less than 20 percent or 4 spare twisted pairs whichever is the greater. Cabling and wiring installations shall be arranged to minimize the risk of fire and damages, which might be caused in the event of fire.

c) For telephone type cables, 2 conductor wires of not less than 0.6 mm dia shall be used. Where twin or quad make up is required in any cable, the cores shall be uniformly twisted and the lays arranged such that cross talk is reduced to a minimum.

d) No conductor smaller than 32/0.2mm (1 mm^2), or having less than three strands, shall be used for interconnecting the cables except in the case of telephone extensions. All cables shall have insulation, which will withstand the highest temperature to be experienced in service.

e) Each conductor of a multicore cable shall be readily identified by a numbered marker tape or, in the case of telephone type cables, color-coded insulation.

9.2.5 Cable trays

a) The Contractor shall design, supply and install cable trays as required within the powerhouse, including associated fittings, accessories, supporting racks and brackets and all hardware. The cable tray system layout shall be submitted by the contractor in accordance with the Nepal Regulations, the IEE Regulations and / or North-American National codes (CSA Standard C22.1 or NEC ANSI/NFPA-71981). Cable trays in the cable trenches between the powerhouse and switchyard (11 kV cables to GSU transformers, 11 kV LSC to 11 kV terminal poles in switchyard and between various bays of switchyard are to be covered by metallic cover. Cable trays at other locations of powerhouse are also included in scope of supply.

Cable trenches in switchyard, other areas of the project (and powerhouse, if any) shall be constructed by Lot 1 Contractor as per requirements of Lot 2 Contractor. However, all supports (angles, embedded plates, bolts etc. for supporting cable trays) shall be supplied by Lot 2 Contractor.

b) The cable tray shall be designed and manufactured in accordance with the NEMA Standard publication No. VE1-1979. The tray shall be still hot-dip galvanized after fabrication in accordance with the ASTM A386.

c) The trays shall be:

- Ladder type, NEMA class 8A, 600 mm wide, 76 mm deep (inside measurement), rung spacing 300mm.

- Ventilated type, NEMA class 8A, 600mm wide, 76 mm deep (inside measurement).

d) All ladder tray fitting shall be ladder type tray fitting. All ventilated tray fittings shall be ventilated or solid tray type.

e) All ladder and ventilated tray bends, tees and crosses shall have a 600mm inner radius.

f) Cable tray supports shall be of heavy duty reinforced type, hot-dip galvanized steel, suitably sized in accordance the tray system, cables and live loads normally experienced during cable installation. The maximum deflection between two consecutive supports shall not exceed 7.5 mm for ladder type trays and 4.0 mm for ventilated type trays. The Contractor shall design to supports to walls and ceilings, and shall submit them for approval of the Engineer.

g) The contractor shall supply and install galvanized steel cable tray covers, where cables are liable to mechanical damage in various sections including vertical cable tray runs. Design of such cable tray covers with details of locations for its use shall be submitted to the Engineer for approval.

h) Prefabricated galvanized steel barriers shall be supplied and installed if deemed necessary and only with prior written approval of the Engineer.

i) Power cables shall be fastened to the trays to ensure equal spacing and a neat workman like appearance with nylon self locking ties in accordance with Table B-2M of the IEE regulations. Where single conductor cables are installed to form a three –phase feeder, they shall be made for power cables, LV cables, control and instrumentation cables by providing cable tray in tiers.

j) Special care shall be taken to adequately support cables on all vertical cable runs using cable clamps of approved design.

k) In outdoor areas the supply of complete cable trays with cover, of approved design and materials, shall be included and erected as necessary to protect the cables against the effect of sun/ weather/ rain and mechanical damage etc.

9.3 SPECIAL REQUIREMENTS

Small cut piece lengths of cables will not be accepted. Cables up to 500 meters in length or as approved by Employer shall be of one length shipped in a drum of adequate size. For higher quantities, multiple lengths/drums may be shipped subject to the approval of Engineer.

The routing of cables should be such as to limit interference to a minimum. Any auxiliary supplies necessary to power solid-state circuits shall be derived from the main station battery and not from batteries internal to the protection.

All construction materials such as conduit pipes, PVC pipe, steel angle, steel channel, steel plates, cable supporting brackets and racks, wooden cleats, bolts, nuts and other items required for completeness sake shall be provided without extra charge and shall comply with the highest grade specified in the relevant standards.

Steel conduit pipe or PVC pipe shall be provided in the places where control cables or insulated wires will be exposed in the powerhouse/switchyard/other locations.

Steel plates shall also be supplied to cover the block-out or extra space left where conduit pipes or cables shall run through.

The cables in cable trench between outdoor switchyard and powerhouse and as well as other areas of powerhouse/switchyard/other locations are supported by hot dip galvanized steel cable tray.

The cable tray support shall not exceed 2 meter interval and the vertical spacing shall be 300mm measured from the bottom of the upper tray to the top of the lower tray. A

minimum of 230mm clearance shall be maintained between the top of a tray and beams, piping, etc. to facilitate installation of cables in the tray.

The cable trays for cables of different voltage levels shall be stacked in descending order which the higher voltage at the top.

11kV power cables should be installed in cable trays separate from low voltage power and control cables and signal /communication cables.

Analog signal cables should be run separate from all power and control cables, and from unshielded cables carrying digital or pulse type signals.

9.4 DRAWINGS, DATA & MANUALS

The following information shall be furnished along with the bid.

a) Manufacturer's leaflets giving constructional details, dimensions and characteristics of different cables.

b) Current rating of various cables including de-rating factor due to grouping, ambient temperature and type of various installation.

9.5 SPARE PARTS

9.5.1 Mandatory Spare Parts

The Tenderer shall supply but not limited to each type of following cables with terminations etc.:

- 10% of power cables
- 10% of control & instrumentation cables
- 10% of communication cables

9.5.2 Recommended Spare Parts

The Tenders are required to provide the itemised price list under the respective price schedule for the recommended spare parts recommended by him for five (5) years operation of the plant after commissioning.

9.5.3 TOOLS AND MAINTENANCE DEVICES

All tools, devices, equipment and testing instruments etc. for proper handling, maintenance, assembly, and dis-assembly of any part of the cables shall be supplied. List of tools/ devices etc. shall be included in the technical bid.

Itemised price of such tools/devices shall deem to be included in the relevant price schedule.

9.6 TESTS

9.6.1 Routine and Type/Design Tests

Routine Tests

The cables shall have passed the following routine tests and any other relevant routine tests for power, control and communication cables at the manufacturer's works. Routine test certificates shall be provided for the cables for approval of the Employer/Engineer before shipment.

- Construction inspection
- Measurement of electrical resistance as per clause 14.2 (IEC 502)
- Partial discharge tests
- High voltage tests
- Insulation resistance tests
- Physical and aging tests for insulation and jackets.

Type Tests

The cables, related equipment and materials shall be type tested standard products of competent manufacturers. Type test certificates shall be submitted to Employer/Engineer.

Workshop tests shall be carried out in compliance with the certified QC plan and the relevant IEC Standards.

Type tests (both electrical and non-electrical) after installation as per IEC 502, Section 3 article 16, 17 and 18; including the below noted tests; shall be carried out to prove the general qualities and design of a given type of cable and for the purpose of acceptance of the lot:

a) Partial discharge test
b) Bending test, followed by a partial discharge test
c) Tan delta measurement
d) Heating cycle test, followed by a partial discharge test
e) Impulse test, followed by voltage test for 4 hours.

Special Tests

The cable shall be subjected to the following special tests as per clause 15 of IEC 502 and test certificates shall be provided.

- Conductor examination
- Check of dimension

- Electrical tests
- Hot set tests

The Bidder shall submit copy of type test reports from recognized testing laboratory for the offered power cables along with the bid.

9.6.2 Field Tests

Field/site tests shall be carried out in compliance with the approved QC plan and the IEC Standards. The following tests are the minimum requirement as applicable.

a) Measurement of insulation resistance
b) DC di-electric test
c) Inspection of the completed cable systems;
d) Continuity tests;
e) Voltage test on outer sheath;
f) High voltage withstand test.

9.7 PERFORMANCE GUARANTEE

The performance figures quoted on schedule of Technical Data shall be guaranteed within the tolerance permitted by relevant standards and shall become part of the Contract. In case of failure of the cables to meet the guarantees, the Employer reserves the right to reject the item. The Contractor shall have to rectify/replace the defect/defective part after approval from Employer at no extra cost to the Employer during defect liability period.

27.4 Minimum Cross Sections

Power cables	2.5 mm^2
Control and measuring cables	1.5 mm^2
Current transformer secondary cables	4.0 mm^2
Telephone cables, diameter	0.8 mm

The cross section of the neutral and protective conductors of all cables shall be as follows in percent of the phase conductor:

Phase Conductor	Neutral Conductor	Protective Conductor
2.5 — 16 mm^2	100%	100%
25 — 95 mm^2	50%	-
over 96 mm^2	50%	-

Apart from the requirements set out under Sub-Clauses 27.3 and 27.4 the cross section of cables must also be chosen in a way to meet the short circuit temperature rise limitations and the load capacity limitations as given in the manufacturer's tables.

27.5 Conductors

The conductor material of all cables shall be electrolytic copper, and the conductors of all cables shall be of the stranded type except for telephone cables.

27.6 Insulation Material

All power supply cables (MV and LV) shall be insulated with a material complying with the following:

- to inhibit fire propagation
- to be fire resisting
- not to produce corrosive gases and vapours in case of fire
- to have low smoke generation
- to have high dielectric strength and insulation resistance
- to be highly resistant against environment influences, in particular humidity, fungus and vermin
- to be safe against overloads and short circuits
- to provide easy handling

The cable insulation shall be designed to meet with its various characteristics requirements set out in the pertinent standards. Regarding other LV and control cables, cable insulation and sheath material shall be XLPE/PVC. Insulation and sheath material meeting all or most of the above criteria would be preferable.

Cable Schedule format

UnitCableNo	FROM	TO	Purpose	CableSize	REMARKS	PATHCABLENO

	SPECIFIC TECHNICAL REQUIREMENT FOR AIR CONDITIONING & VENTILATION SYSTEM 2x20 MW Rahughat HEP	SPECIFICATION NO.
		VOLUME **II-B**
		SECTION : **C**
		REV. NO. 00 DATE: 15.03.2022
		SHEET OF

LIST OF DELIVERABLES

SECTION: I

SUB-SECTION: C5

TECHNCIAL SPECIFICATION

(MH PORTION)

Material Handling Equipments

1.0 ELECTRIC HOIST AND MANUAL HOIST (CHAIN PULLEY BLOCK)

Required number of electric hoist / manual hoist of adequate capacity, to meet the erection and maintenance requirements are to be provided for the various areas.

DESIGN CRITERIA

Electric hoist/ manual hoist to be provided as per following criteria-
for 250 kg to < 2000 kg – Chain pulley block with travelling trolley
for above 2000 kg– Electric hoist to be provided

Capacity of electric and manual (Chain pulley block) hoists shall be decided keeping 20% margin over equipment to be handled.

For hand operated hoists, the hoists shall be suitable for operation from floor level. Hand chain shall be provided for long travel of trolley and the Hoisting mechanism. The operator shall be able to control the movement of the electrical hoist with the help of floor operated pendant

Note;

1. Area, type, capacity mentioned are minimum requirement and shall be finalised during detail engineering without any commercial implication
2. Travel and Lift are layout dependent and shall be finalised during detail engineering without any commercial implication
3. Additional electric/manual hoist required during detail engineering shall be provided as per design criteria given above without any commercial implication.

2.0 SCOPE OF SUPPLIES

Equipment and services to be furnished by the bidder for the ELECTRIC HOIST/ MANUAL HOIST with accessories as per the details given in the technical specification and data sheet A. Any equipment / accessories not specified in the specification but required to make the ELECTRIC HOIST/ MANUAL HOIST complete and efficient operation shall also be under the bidder's scope of work.

Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

2.1.0 **A.** Electric hoist shall include but not be limited to the following: -

a. Hoisting and CT drive arrangement
b. All electrical equipment including cables (as per electrical scope matrix) and panels.
c. PVC insulated shrouded bus bar DSL
d. Earthing arrangement.
e. Initial fill of lubricant.
f. Painting of electric hoist and accessories.
g. Maintenance tools & Tackle
h. Erection & Commissioning spares
i. Power cable from isolator switch to DSL
j. Isolating switch in enclosure at operating floor for disconnecting supply to DSL while

maintaining the electric hoist.

k. Mandatory spares

B. Manual hoist shall include but not be limited to the following:

a. Chain pulley blocks with/without traveling trolleys
b. Maintenance Tools and Tackles
c. Painting

2.2.0 Erection and Commissioning spares (ELECTRIC HOIST)

The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. The initial fill of lubricants, oil etc. shall also be supplied by the bidder.

2.3.0 Services to be provided by the bidder

Packing, forwarding and transportation to site, storage and handling at site.

2.4.0 Erection and Commissioning

2.5.0 Functional test (Overload testing, load testing at rated speed, travel and hoisting motion checks as per relevant design standards)

2.6.0 Obtaining clearance and acceptance certificate from the concerned competent authority after site test as applicable. Necessary fees/expenditure as required shall be borne by the supplier.

3.0 Inspection and Testing

As per quality plan approved during detail engineering. Prime inspection agency shall be BHEL. Equipment supplied shall be strictly in accordance with nomenclature & technical specification.

4.0 Runway beam

Shall be supplied by civil contractor

5.0 PAINTING SPECIFICATION

As per painting specification included.

6.0 PACKING

As per packing details specified elsewhere in specification.

7.0 DEMONSTRATION TEST

Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as specified in QAP and as per IS 3938 for electric hoist and IS 3832 for manual hoist.

The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

If the shop performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at bidder's cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

8.0 MAKE OF SUB - VENDOR ITEMS

Makes of bought out items will be as per list specified in the specification. No other make will be acceptable, until and unless specifically got it approved by the purchaser/ end client.

9.0 TESTING AT SITE

A) ELECTRIC HOIST:
As required for statutory clearance for operating at site i.e., overload test, load test and other tests as per IS 3938.

Test for Operation -After the supply has been connected, tests shall be carried out to prove the following:
a) The satisfactory operation of each controller, switch, contactor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavorable conditions;
b) The correctness of all circuits and interlocks and sequence of operation; and
c) The satisfactory operation of all protective devices.

Overload Test -After test but before the hoist is put into service, it shall be tested with overload relays appropriately set, to lift and sustain a test load of 125 percent of the working load. During the overload test, the hoist shall sustain the load under full control. The specified speeds need not be attained but the hoist shall show itself capable of dealing with the overload without difficulty.

B) MANUAL HOIST:
As required for statutory clearance for operating at site with following minimum test i.e., overload and load test.

10.0 TECHNICAL DATA SHEET:

A) ELECTRIC HOIST:

Sl. No.	DESCRIPTION	TECHNICAL PARTICULARS
1.0	Type	Steel wire electric hoist with electrically operated trolley.
2.0	Scope (Qty., Capacity, lift, travel length)	Refer the clause no. 1.0 above
3.0	Type of service	Indoor/ outdoor (as per scope at Annexure-A)
4.0	Overload test	125% of SWL
5.0	Design ambient temperature	50 Deg C
6.0	General design	As per IS: 3938 / 1983 or latest, Class-II duty
7.0	Operating speed	
7.1	Hoisting speed	3 MPM
7.2	Trolley speed	10 m/min
8.0	Type of transmission	Through electric motor and gear box
9.0	Wire rope	
9.1	Construction/ core	6x36 construction, fibre core/ steel core
9.2	Code	IS: 2266
9.3	Number of falls	Min. 4

9.4	Factor of safety	Not less than 5.
10.0	Load hook and block	Normalized hook only.
10.1	Type of load hook	Shank type swiveling with safety latch
10.2	Load hook code	IS: 15560
10.3	Load hook material	as per IS: 1875
10.4	Hook suspension	Thrust bearing
10.5	Material of block suspension	Fabricated from steel plate, Material: IS: 2062
11.0	Gearing	
11.1	Type	Spur/ Helical, hardened and tempered with machine cut teeth
11.2	Gear & pinion	As per IS 3938
11.3	Lubrication	Oil splash/ grease lubricated
11.4	Bearing type	Antifriction ball/ roller
12.0	Trolley drive	
12.1	Wheel	Single flanged taper thread
12.2	Wheel confirm to (Std./ Code)	IS: 3938
12.3	Wheel material	Heat treated carbon steel/ low alloy steel, graded cast iron.
12.4	Bearing type	Antifriction ball/ roller
12.5	Hardness	MAX HARDNESS 200 BHN
13.0	SHEAVE	
13.1	Material	As per IS 3938
13.2	Bearing type	Antifriction ball/ roller
14.0	BRAKE (HOIST)	
14.1	Type	DCEM brakes disc/ shoe type (fail to safety).
14.2	Capacity	As per IS: 3938.
14.3	Number	One number for each motor.
15.0	BRAKE (TROLLEY)	
15.1	Type	DCEM brakes disc/ shoe type (fail to safety).
15.2	Capacity	As per IS: 3938.
15.3	Number	One number for each motor.
16.0	ROPE DRUM	
16.1	Material	Cast iron, cast steel or mild steel
16.2	Flange/ Flangeless	Flanged
17.0	TYPE OF DSL	
17.1	CT travel	Shrouded bus bar GI conductor type DSL
18.0	MOTORS	
18.1	Type	Sq. cage induction, TEFC, S4 duty, 40% CDF.
18.2	Number of start	150 starts/hr.
18.3	Voltage, phase and frequency	415V +/- 10%, 3 phase, 50 Hz, 4 wire.
18.4	Class of insulation	Class “F” and temperature rise limited to class B.
18.5	Type of enclosure	TEFC
18.6	Degree of protection provided for enclosure	IP-55
18.7	Margin	Motor ratings shall be 15% (at least) over the maximum

		power requirement.	
19.0	LIMIT SWITCHS (automatic reset type)	Hoisting	Trolley (two way lever type)
	Qnty	1+1	1
20.0	Pendent push button	Up /down / forward / Reverse push buttons along with Start/stop and emergency push button shall be provided on the pendent. Indicative marking for easy operation shall be provided.	
21.0	Panel of isolating switch	One No. isolating switch panel shall be provided for each electric hoist. Location of isolating switch panel shall be at respective operating floor of the area.	
22.0	Control transformer	One no. for each hoist (1x100%)	
23.0	Control voltage	110 V	
24.0	Control panel		
24.1	Material & size	A 14 SWG thick corrosion resistant sheet steel weather proof, water shedding, dust and vermin proof control panel/cabinet conforming to degree of protection IP55 with 16 SWG thick sheet steel water tight hinged and padlocked doors, fully wired, shall be provided for terminating all wiring for control, protection and alarm circuits of each transformer. Suitable stiffeners shall be provided wherever required.	
24.2	DOP	IP-55	
24.3	Location	Mounted with respective hoists.	
25.0	Power cables	1.1 KV grade FRLS PVC/ EPR Cu cable	
26.0	Control cable	1.1 KV grade FRLS PVC/ EPR Cu cable	
27.0	Flexible trailing cable	1.1 KV grade FRLS PVC/ EPR Cu cable	

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

1.0	**Type**	Chain pulley block with/without trolley
2.0	**General Design**	IS: 3832
3.0	**Duty Class as per IS:3832**	Class –II
4.0	**Hoisting Mechanism**	
a)	Type	Hand operated gear transmission
b)	Type of gear	Spur / Helical
c)	Load Chain	
i)	Type	Link type
ii)	Material	As per relevant standard
iii)	Conforms to (Std./Code)	IS: 6216 / IS 3077/IS 3019
d)	Hand Chain	
i)	Type	Link type
ii)	Material	Mild steel Grade 30
iii)	Conform to Std.	IS:2429 (Part II)

e)	Load Hook & Hook Block	
i)	Type of load hook	Plain shank- Trapezoidal section/ 'C' type
ii)	Load hooks conforms to	IS: 15560
iii)	Type of hook suspension	Swivelling type with safety latch
iv)	Type of make of bearing	Thrust ball bearing of hook suspension
v)	Type & Material of hook	As per IS 15560
f)	Gears/ Pinions	
i)	Type	Spur
ii)	Material	Alloy steel / carbon steel/ High graded cast iron
	Type of Bearing	Antifriction ball bearing / Roller
g)	Sprockets :	
	Type of bearings used	Antifriction ball bearing / Roller
i)	Method of lubrication	
	Bearings	Grease
	Gearing & Pinions	Grease
	Sprocket	Grease
h)	Brakes	
	Type	Screw and friction disc type
5.0	**Trolley and Bridge drive**	
a)	Trolley	
i)	Type	Geared (Manually operated)
ii)	Material of frame	Mild steel (IS:2062 Grade A or B)
b)	Drive Chain	
i)	Type	Link type
ii)	Material	Steel Gr.30
iii)	Design of drive chain	IS : 2429 part 1 :1870
c)	Wheel	
i)	Number of pairs of wheel	Two in each trolley/bridge
ii)	Flange	Single flanged
iii)	Type of bearings need	Antifriction
iv)	Wheel material	As per IS 3832
d)	Gears	
i)	Type	Spur / helical
ii)	Material	Cast iron/EN8
iii)	Type of bearings used	Antifriction
e)	Method of lubrication for	
i)	Bearings	Grease
ii)	General	Grease
iii)	Sprockets	Grease

11.0 Maintenance Tools and Tackles

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual shall be supplied. Tools shall be of suitable sizes for

maintenance of electric hoist of each type and capacity. Each tool and wrench shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality, specially protected against rusting. The following shall be provided as minimum requirement:

S-No.	Description	Qty.
1	Complete set of ring spanners (Indicate the sizes offered)	1 Set
2	Complete set of screwdrivers (Indicate the sizes)	1 Set
3.	Adjustable Spanner	1 No.
4.	Insulated plier	1 No.
5.	Grease gun	1 No.
6.	Oil gun	1 No.
7.	Line tester	1 No.

Note: -The tools shall be supplied in one tool box .Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities of hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same shall be included in this list.

12.0 DRAWING/DOCUMENT SUBMISSION

The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:

A) ELECTRIC HOIST

Sl. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V1-XXX-XXX-A100	Manufacturing Quality Plan with Sub vendor list
2	PE-V1-XXX-XXX-A101	GA Drawing for Electric Hoist, DSL arrangement and painting details along with mechanism sizing and electrical circuit diagram
3	PE-V1-XXX-XXX-A105	O & M Manual including erection procedure

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

Sl. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V1-XXX-XXX-A200	Manufacturing Quality Plan
2	PE-V1-XXX-XXX-A201	GA Drawing for CPB with detail BOM with painting details
3	PE-V1-XXX-XXX-A202	O & M Manual including erection procedure

13.0 MANDATORY SPARES: NA

14.0

MAKES OF ELECTRIC HOIST AND CHAIN PULLEY BLOCK AS PER LIST BELOW:

TECHNICAL SPECIFICATION
Project- 2x20 MW Rahughat HEP
Electric hoist and Chain pulley block

Package Name	Vendor Name
ELECTRIC HOIST	Alpha Services
	CONSOLIDATED HOISTS PVT LTD
	CENTURY CRANE ENGINEERS PVT. LTD.
	TECHNO INDUSTRIES
	EDDY CRANES PVT. LTD.
	Grip Engineers Pvt. Ltd.,
	TRACTEL TIRFOR INDIA PVT. LTD.
	Mangla Hoists Pvt Ltd
	BRADY & MORRIS ENGINEERING CO. LTD.
	REVA INDUSTRIES LTD.
	UNIVERSAL HOIST-O-FABRIK
CHAIN PULLEY BLOCK	UNIVERSAL HOIST-O-FABRIK
	CENTURY CRANE ENGINEERS PVT. LTD.
	BAKELITE ELECTRICAL MFG. CO. PVT. LTD.
	TRACTEL TIRFOR INDIA PVT. LTD.
	BRADY & MORRIS ENGINEERING CO. LTD.
	TUOBRO FURGUSON (INDIA) PVT LTD
	TECHNO INDUSTRIES

Note: No other make will be acceptable, until and unless specifically got approved by BHEL/Customer / Customer's consultant during detail engineering only. Acceptance/non acceptance of same shall not have any impact on manufacturing, delivery schedule and on cost of the Electric hoists

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO ELECTRIC HOIST:

Sl no.	ITEM	MAKES
1.0	STEEL	SAIL/IISCO/TATA STEEL / JINDAL
2.0	HOOKS	MOOZUMDAR / SIMRITI FORGING / HARMAN MOHTA / STEEL FORGING & ENGG. CO., KOLKATA /
3.0	GEAR COUPLINGS	ALLIANCE / HICLIFF / OEM
4.0	WIRE ROPE	USHA MARTIN Black / BOMBAY WIRE ROPES / FORT WILLIAMS / UNITED WIRE ROPE/BHARAT WIRE ROPES.
5.0	BEARINGS	SKF/ FAG
6.0	MOTORS	SIEMEN/ ABB /NGEF/ CROMPTON /KIRLOSKAR /GECA / BHARAT BIJLI / MARATHON / LHP.
7.0	BRAKES	STROM CRAFT/ ELECTROMAG /SPEED-O- CONTROL / EMCO LENZE
8.0	CONTACTOR	SIEMENS / L&T /TELE MECHANIQUE / BCH
9.0	OVER LOAD RELAYS	SIEMENS / L&T / TELE MACHANIQUE / ABB
10.0	HRC FUSES	SIEMENS / L&T/ ENGLISH ELECTRIC/GE Power
11.0	ISOLATING SWITCH	SIEMENS/ L&T / CONTROL & SWITCH GEAR
12.0	SWITCH FUSE UNITS	SIEMENS/ L&T/ CONTROL/ & SWITCH GEAR/ GEC A
13.0	TIME DELAY RELAYS	SIEMENS/ L&T/ ABB/ BCH/ GEC A
14.0	TRANSFORMERS	INDCOIL/AE / LOGICSTAT/ PRAGATI / KAPPA / SOUTHERN ELECTRIC
15.0	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS/ BAJAJ/ CROMPTON
16.0	CABLE LUGS (HEAVY DUTY)	DOWELLS
17.0	CABLES	
a)	POWER CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER TORRENT / CCI / ICL / RADIANT / FINOLEX/ POLYCAB/KEI/HAVELL
b)	CONTROL CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER / DELTON / FINOLEX / TORRENT / CCI / ICL / RADIANT POLYCAB / KEI/ HAVELL.

c)	TRAILING CABLE	UNIVERSAL/ FGL/CCL/HVP/KEI/RADIANT.
18.0	CABLE GLAND	COMMET / SIEMEN / SUNIL&CO.
19.0	PUSH BUTTONS	SIEMENS / L&T / BCH /TEKNIC/VAISHNO
20.0	LIMIT SWITCHES	SPEED-O-CONTROL / ELECTROMAG / JAI BALA JI / KAYCEE / BCH
21	SELECTOR SWITCHES	KAYCEE/ SULZER
22	PENDENT PUSH BUTTON STATION	OEM
23	INDICATING LAMPS	TECKNIC / BCH / SIEMENS / STANDARD/ VAISHNO
24	MCB	MDS / INDO COPP / STANDARD
25	PANELS	OEM/BCH
26	DSL	SUSHEEL/STROMAG
27	TERMINAL BLOCKS	ELMEX/CONNECTWELL/WAGO (FOR CONTROL ONLY)
28	VVVF	YASAKAWA(L&T)/ABB/SIEMENS/SCHNIDER
29	CASTING	KOLHAPUR STEEL / GNAT FOUNDARY / KIRTI ALLOYS
30	Tools & tackles	Reputed make

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO MANUAL HOIST:

Sl no.	ITEM	MAKES
1.0	STEEL	SAIL/IISCO/TATA STEEL / JINDAL
2.0	HOOKS	STEEL FORGINGS/ KARACHIWALA/SMRITI/NASIK FORGE.
3.0	STEEL FORGINGS	CHOWDHARY/WESTERN INDIA FORGINGS/ HINDUSTAN STEEL FORGINGS/ RUBY FORGINGS OR AS APPROVED BY BHEL.
4.0	BRAKES	OEM

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

	MANUFACTURER'S NAME & ADDRESS :	**MANUFACTURING QUALITY PLAN** **ITEM :** Chain Pulley Block **QP No.:** PE-TS-479-11000A-A005 **REV**.:0, **Date.:, PAGE**: 1 OF 4	**PROJECT : 2X20 MW RAHUGHAT HEP** **PACKAGE : CHAIN PULLEY BLOCKS** **VOL IIB, SEC C**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY M	AGENCY C	AGENCY N	REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.			11.
1	**RAW MATERIAL & B/OUT ITEMS:**											
1.1	HOOKS	DIMENSIONS,	MA		One sample	IS: 15560	IS: 15560	MTC	P	V	V	UT FOR SHANK DIA 50MM AND ABOVE
		CHEMICAL COMPOSITION, MECHANICAL, PHYSICAL PROPERTIES	MA	LAB ANALYSIS	PER LOT	Material specification as per approved drawings		T.C.	P	V	V	
		IDENTIFICATION & COMPLIANCE WITH TC.	MA	VISUAL	100%	HOOK TC FROM COMPETENT AUTHORITY		IR	P	V	V	
		INTERNAL DEFECTS	MA	UT	100%	ASTM A-388 (REFER NOTE 1)		TC	P	V	V	
		PROOF LOAD TEST	MA	REVIEW	100%	IS 15560		TC	P	V	V	
		NDT AFTER PROOF LOAD	MA	DPT	100%	ASTM E-165	NO RELEVANT IDENTIFICATION	TC	P	V	V	
1.2	LOAD CHAIN	- DIMENSIONS	MA	MEASUREMENT	100 %	IS: 6216 &	IS: 6216 &	IR	P	V	V	
		- BREAKING STRENGTH	MA	-TENSILE TEST	1/LOT	APPD. DRGS.	APPD. DRGS.	MTC	P	V	V	
		- PROOF LOAD	MA	-TENSILE TEST	100%			MTC HT	P	V	V	
		-HEAT TREATMENT	MA	REVIEW	100%			CHA	P	V	V	
		-GRADE	MA	REVIEW	1/BATCH			RT MTC	P	V	V	
1.3	RAW MATL. FOR GEAR/ RATCHET PAWL / RATCHET WHEEL	CHEMICAL COMPOSITION, MECHANICAL PROPERTIES	MA	LAB ANALYSIS	ONE SAMPLE PER LOT	MATERIAL SPECIFICATION AS PER	MATERIAL SPECIFICATION AS PER	MTC	P	V	V	TC or inspection report for components

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR SUB-CONTRACTOR	** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

	MANUFACTURER'S NAME & ADDRESS :	**MANUFACTURING QUALITY PLAN** **ITEM :** Chain Pulley Block **QP No.:** PE-TS-479-11000A-A005 **REV**.:0, **Date.:, PAGE**: 2 OF 4	**PROJECT : 2X20 MW RAHUGHAT HEP** **PACKAGE : CHAIN PULLEY BLOCKS** **VOL IIB, SEC C**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.			11.
						APPROVED DRAWING	APPROVED DRAWING					shall be given.
		INTERNAL DEFECTS	MA	UT	10%	ASTM A-388 (REFER NOTE 1)		IR	✓	P	V	V	
1.4.	LOAD CHAIN WHEELS	- CHEMICAL COMPOSITION MECHANICAL PROPERTIES	MA MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	APPD. DRG.	APPD. DRG.	MTC	✓	P	V	V	
1.5	BEARINGS	MAKE, TYPE, CATALOGUE NO.	MA	VISUAL	RANDOM	APP DRG / MFR"S CATALOGUE	APP DRG / MFR"S CATALOGUE	IR	✓	P	V	V	
1.6	HAND CHAIN WHEEL	CHEMICAL MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	
1.7	HAND CHAIN	GRADE/ DIMENSION	MA	GRADE DIMENSION	100 %	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	
1.8	TROLLEY GEARS, PINION,WHEELS, AXLE	CHEMICAL & MECHANICAL	MA	LAB ANALYSIS,	100%	APPVD DRGS	APPVD DRGS	IR/TC	✓	P	V	V	
2	**IN PROCESS**												
2.1	RATCHET PAWL / RATCHET WHEEL	-HARDNESS	MA	HARDNESS	100%	IS:3832 / APPD DRG.	IS:3832/ APPD. DRG.	IR	✓	P	V	V	

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR SUB-CONTRACTOR	** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

	MANUFACTURER'S NAME & ADDRESS :	**MANUFACTURING QUALITY PLAN** **ITEM :** Chain Pulley Block **QP No.:** PE-TS-479-11000A-A005 **REV**.:0, **Date.:, PAGE**: 3 OF 4	**PROJECT : 2X20 MW RAHUGHAT HEP** **PACKAGE : CHAIN PULLEY BLOCKS** **VOL IIB, SEC C**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.			11.
		-SURFACE CRACK	MA	DPT	100 %	ASTM E165	NO DEFECT	IR	✓	P	V	V	
2.2	GEARS AND PINIONS AFTER MACHINING	SURFACE HARDNESS HEAT TREATMENT, SURFACE CRACK, CASE DEPTH	MA	HARDNESS HT CHART, DPT FOR SURFACE CRACK	RANDOM ASTM E 165 FOR DPT	MFG STANDARD NO DEFECT	MFG STANDARD	IR IR	✓ ✓	P P	V V	V V	
3.0	**FINAL INSPECTION**												
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION	MA	MEASUREMENT	100 %	IS:3832 /APPD DRG	IS:3832 /APPD DRG	IR	✓	P	W	V	
		PROOF LOAD TEST	CR	LOAD TEST	100%	-DO-	No cracks, flaws & other defects	IR	✓	P	W	V	
		LIGHT LOAD TEST	MA	LOAD TEST	100%	IS 3832	IS 3832	IR	✓	P	W	V	
		HEIGHT OF LIFT	MA	MEASUREME NT	100%	-DO-	-DO –	IR	✓	P	W	V	
		SWIVELING OF HOOK	MA	VISUAL	100 %	-DO-	-DO-	IR	✓	P	W	V	
		EFFORT	MA	PULL ON CHAIN	100%	-DO-	-DO-	IR	✓	P	W	V	
3.2	PAINTING	-CLEANING	MA	VISUAL	AT RANDOM	APPROVED	APPROVED	IR		P	--	--	
		- SHADE & DFT OF PAINT (Blue / Black)	MI	VISUAL	AT RANDOM	DRAWING/ SPECIFICATION	DRAWING/ SPECIFICATION	IR		P	W	-	

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR SUB-CONTRACTOR	** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

	MANUFACTURER'S NAME & ADDRESS :	**MANUFACTURING QUALITY PLAN** **ITEM :** Chain Pulley Block **QP No.:** PE-TS-479-11000A-A005 **REV**.:0, **Date.:, PAGE**: 4 OF 4	**PROJECT : 2X20 MW RAHUGHAT HEP** **PACKAGE : CHAIN PULLEY BLOCKS** **VOL IIB, SEC C**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.			11.
3.3	NAME PLATE	VERIFICATION	MA	VISUAL	100%			IR		P	V	--	
3.4	PACKING	-VERIFICATION	MI	VISUAL	100%	SPECS.	SPECS.	IR		P	--	-	
3.5	REVIEW OF QA DOCUMENTATION	VERIFICATION	MA	VISUAL	100%	APPD. QP	APPD. QP		✓	V	V	V	

CR – CRITICAL, MA – MAJOR , MI – MINOR

NOTE 1: BACK WALL ECHO SHALL BE ADJUSTED TO 100% OF FULL SCREEN HEIGHT IN SOUND (DEFECT FREE) AREA. DEFECT ECHO HEIGHT MORE THAN 20% OF SCREEN HEIGHT SHALL BE TREATED AS UNACCEPTABLE. BACK WALL ECHO SHALL NOT BE LESS THAN 80% OF SCREEN HEIGHT IN ANY CASE.
NOTE 2: RECORDS IDENTIFIED WITH TICK SHALL BE ESSENTIALLY INLCUDED IN QA DOCUMENTATION.

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR SUB-CONTRACTOR	** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

SECTION: I

SUB-SECTION: D

STANDARD TECHNICAL SPECIFICATIONS

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO. PES- 571-11000-A-002	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 1 OF 5	

SECTION-D

AIR HANDLING UNITS

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES- 571-11000-A002
		VOLUME II B
		SECTION D
		REV. 00 | JAN 2020
		SHEET 2 OF 5

1. GENERAL

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

2. CODES AND STANDARDS

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

2.1.1 IS-659 : Safety code for air conditioning

2.1.2 IS-660 : Safety code for mechanical refrigeration

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

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

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

2.1.6 AMCA : 211 and 311

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

3. CONSTRUCTION FEATURES

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

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

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

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

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

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

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

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

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

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

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

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

4. TESTING AND INSPECTION AT MANUFACTURERS WORKS:

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

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

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

4.3 Shaft: Mechanical and chemical.

4.4 Motors (of approved make): Routine TC.

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

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

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

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

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

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

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES- 571-11000-A002
		VOLUME II B
		SECTION D
		REV. 00 JAN 2020
		SHEET 5 OF 5

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

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

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

5.3 Installation and erection manual.

5.4 Inspection, operation & Maintenance Manuals.

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

5.6 Test Certificates.

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

5.8 Performance Test Certificates.

5.9 Vendor shall also provide soft copy of each drawing in AutoCAD format.

5.10 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

TITLE	SPECIFICATION NO. PES- 571-11000-A-002
AIR HANDLING UNIT	VOLUME - II-**B**
DATA SHEET - A	SECTION - D
	REV 00 / DATE JAN 2020
	SHEET 1 OF 2

DESCRIPTION		**DATA**
1.	Nos. required/working	: Refer to Section-C of Specific technical requirement.
2.	Location	: Refer to Section-C of Specific technical requirement.
3.	Service/type	: Ventilation /Double skin.
4.	Fan type	: Centrifugal (forward/backward curve Blade) limit load.
	a) Capacity	: To Suit as per calculation.
	b) Static pressure	: To suit but not less than 100 mm wc for AHU's with pre filters.
	c) Discharge direction	: To suit layout.
	d) Motor	: By Bidder,
	e) Local push button station (Start/Stop)	: By Others
	f) Motor location	: Inside AHU Casing.
	g) Drive	: Belt, pulley, belt guard.
5.	Face and Bypass Damper	: Not Required
6.	Cooling coil	
	a) Duty sensible heat	: To suit as per calculations
	b) Duty latent heat	: -do-
	c) Type of coil	: Cooling Water.
	d) No. of rows	: To suit but not less than four (4)
	e) Material of tube /Thickness	: Seamless Copper to ASTME-75/Equivalent.
	f) Material of fins	: Aluminium to SAE-1100-/1145-0
	g) Number of fins	: Not greater than 5 per cm (13 per inch).
	h) Max. face velocity	: 2.5 m/sec.
	i) Air flow quantity	: To suit as per tender drawings/documents.
7.	3 - way motorised mixing valve with thermostat.	: Required with thermostat & actuator for cooling water system for each AHU.

8.	Damper at discharge	: Manually operated at discharge of each AHU outlet.
	a) Material of construction	: Mild Steel, galvanised.
9.	Filters	
	a) Type & thickness	: Dry panel type/ 50 mm
	b) Filter area. as specied in section-c.	: To suit as per velocity requirements. "V" – Bank-
	c) Filter efficiency 20micron	: Average arrestance efficiency of 80 % down to
	d) Press drop (Clean)	: Not to exceed 2.5 mmwc when clean & 6.5 mmwc while dirty.
10.	Humidification section	: As per the System requirement.
	a) Type	: Pan type, unless otherwise specified.
	b) Operation	: Automatic with Humidification.
11.	Fresh air arrangement	: Required.
	a) Fresh air fan	: Tube axial flow fans with motor.
	b) Accessories	: i) Inlet cone with Bird screen. : ii) Dry panel pre-filters, : iii) High efficiency filters for control room areas. : iv) Volume Control Dampers, : v) Supports etc.
12.	Vibration isolator required.	: Yes
13.	Type of vibration isolator.	: Neoprene ribbed Rubber for AHU's.
14.	Any other requirement	: i) In addition to dry panel filters on AHU, High efficiency filters (average arrestance efficiency of 80-90 %) shall be provided in supply air duct side of AHU for all power house and transformer cavern and allied areas. : ii) Bidder to also provide suitable electrical strip heaters for winter heating & monsoon reheating with Contactor box etc. Heaters to be interlocked with airstat.
15.	Instrument & controls	: Lot.(including Control box for strip heaters, pan humidifiers etc. in each AHU room.)
16.	Insulation of drain piping	: Lot.

	TECHNICAL SPECIFICATION VENTILATION FANS	SPECIFICATION NO. PES-571-11000-A-03	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 1 OF 5	

SECTION-D

VENTILATION FANS

	TECHNICAL SPECIFICATION VENTILATION FANS	SPECIFICATION NO. PES-571-11000-A-03	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 2 OF 5	

1. GENERAL

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

2. CODE AND STANDARDS

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

2.1.1 IS:4894 -Centrifugal fans

2.1.2 IS:3588 -Electric Axial Flow fans

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

2.1.4 IS-3963 -Roof extractor units

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

2.1.6 AMCA publication 99 standards handbook

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

3. DESIGN AND CONSTRUCTION

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

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

3.3 CASING

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

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

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

3.4 IMPELLER

3.4.1 Centrifugal fan impeller shall have die formed, aerofoil or laminar blades welded to the rim and back plate and shall have non-overloading, self cleaning characteristics. Rim shall be spun to have smooth contour. If required, intermediate stiffening rings

shall be provided. Shaft sleeves shall be furnished, if specified. The impeller, pulley and shaft sleeve shall be secured to the shaft by key and/or nuts (threaded opposite to direction of rotation of impeller). The impeller shall be statically and dynamically balanced.

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

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

3.5 BEARINGS:

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

3.6 INLET CONES AND GUARDS

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

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

3.7 GUIDE VANES:

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

3.8 BASE PLATE AND VIBRATION ISOLATORS

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

3.9 HOOD AND COWL

3.9.1 Roof exhaustors shall be provided with hinge type hood providing easy access to motor and impeller. Weather proof lockable type disconnect switch shall be provided such that hood can open only when the disconnect switch is in'off' position. On larger size of roof ventilators hoods may be of split construction. 15 mm mesh galvanised bird screen shall be provided.

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

3.10 SPEED

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

	TECHNICAL SPECIFICATION VENTILATION FANS	SPECIFICATION NO. PES-571-11000-A-03	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 4 OF 5	

4. MOTORS

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

5. ACCESSORIES

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

6. TESTING AND INSPECTION

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

- Visual inspection of sheets/plates, angles, channels etc. – Pitting, lamination in sheets/ plates, angles and channels shall be avoided.- visual inspection by main contractor of BHEL.
- Sheets/ Plates - Test certificate shall be furnished for physical and chemical properties for sheets / plates- for review by BHEL
- Shaft: Mechanical and chemical–– review by BHEL
- Motors (of approved make): Routine TC ,FLP TC if applicable
- Workmanship and dimensional check as per manufacturing drg. and approved Drgs.- by main contractor of BHEL.- Shall be checked by BHEL/ Customer during final inspection.
- Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked/ welded to avoid loosening. - witness by manufacturer - TC to be furnished for review by BHEL(consisting of weight of impeller, radius of correction and balancing rpm). For spare impellers Dynamic Balancing shall be witnessed by BHEL.
- Performance test of one Centrifugal fan or Axial Fan /per type/per size as per applicable standard – by BHEL.
- Centrifugal/ Axial fans 100% run tested by main contractor of BHEL. Run test by BHEL/Customer may be at random or 100%- Vibration shall be within satisfactory zone of VDI 2056 (group- G) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient

	TECHNICAL SPECIFICATION VENTILATION FANS	SPECIFICATION NO. PES-571-11000-A-03	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 5 OF 5	

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

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

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

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

7.4 Test Certificates.

7.5 Performance Test Certificates.

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

7.7 Installation and erection manual.

7.8 Inspection, operation & Maintenance Manuals.

7.9 Vendor shall also provide soft copy of each drawing in AutoCAD format.

7.10 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

TITLE

CENTRIFUGAL FAN

DATA SHEET - A

SPECIFICATION NO. PES-571-11000-A-03	
VOLUME II-B	
SECTION D	
REV 00	DATE: JAN 2020
SHEET 1 OF 2	

No.	Particulars	Data
1	**General Information**	
1.1	Fan Designation/application.	Refer schedule of Ventilation system.
1.2	Nos. required/capacity	Refer Section-C of Specific Technical Requirement
1.3	Location	Refer layout drg. Attached.
2.0	**Design Data**	
2.1	Type	DIDW for Ventilation
2.2	Type of blades	backward curved
2.3	Arrangement	To suit application as per layout.
2.4	Discharge direction	To suit application as per layout.
2.5	Duty	Continuous
2.6	Capacity at site (Cubic Meter/hr) & static pressure.	Refer Section-C of Specific Technical Requirement
2.7	Suction pressure (mm Wg)	As per system requirement.
2.8	Fluid	Atmospheric Air.
2.9	Suction Temperature	Refer weather data attached.
2.10	Suction humidity	Refer weather data attached.
3.0	**Materials**	
3.1	Fan Scroll	Heavy Gauge Mild Steet to IS: 2062 with galvanised
3.2	Fan Casing (side plates & stiffeners)	Heavy Gauge Mild Steet to IS: 2062 / IS: 1079 / Eq. Minimum 3 mm thick casing.
3.3	Impeller	Mild Steel/plate to IS: 2062
3.4	Impeller hub	Mild Steet/plate to IS: 2062
3.5	Impeller back plate blade & shroud	Mild Steet to IS: 2062 / IS: 1079 / Eq.
3.6	a) Shaft b) Shaft sleeve	EN-8 or eqv. -do-
3.7	Support frame and structure.	Mild Steet to IS: 2062
3.8	Flexible connection at outlet canvas with MS Flanges and cleats (3mm thick).	Fire resistant type plastic impregnated

3.9	V Belt	ISI marked (Reinforced rubber section to IS: 4776)
3.10	V Pulley	Cast Iron multi groove to grade FG 20 as per IS: 210. Having taper lock type
3.11	Slide rails	M.S./C.I.
3.12	Connection pieces	G.I. according to supplier's design
3.13	Bolts & nuts	M.S. Galvanized / Epoxy painted.
3.14	Vibration isolating pads, washers and spring if any.	Hard synthetic rubber
4.0	**ACCESSORIES**	
4.1	Common base plate	Required.
4.2	Anchor bolts	-do-
4.3	Vibration Isolators	Hard synthetic rubber
4.4	V-belt pulleys	-do-
4.5	V-belts	Reinforced rubber of appropriate section
4.6	Belt guard	Required.
4.7	Outlet damper	Required(M.S. Heavy Gauge)
4.8	Inlet guard	Required.
4.9	Inlet Vane (variable)	Not required.
4.10	Drain valve	Required.
4.11	Acoustic silencers	Not required.
5.0	**Motor**	
5.1	Motor by	Bidder
5.2	Starter by	Bidder
6.0	Painting of fans including base frame	Galvanized / epoxy painting (as per Section-C & painting specifications)

NOTE:

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

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

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

TITLE	SPECIFICATION NO. PES-571-11000-A-03	
Ventilation Fan (Axial Flow Type)	VOLUME II-B	
DATA SHEET - A	SECTION D	
	REV 00	DATE: JAN 2020
	SHEET 1 OF 2	

No.	Particulars	Data
	General Information	
1)	Designation	Supply/Exhaust Fans.
2)	Nos. required	Refer schedule of Ventilation system in section-C under specific technical requirement.
3)	Service	To exhaust warm air/to supply fresh air.
4)	Location	Wall mounted.
5)	Area	Same as above in 2.
	Design Data	
6)	Type supply	Axial fans suitable for 415V/3 phase for Motor.
7)	Air delivery capacity	As per schedule of ventilation system.
8)	Fluid	Atmospheric Air.
9)	Temperature	Refer Section of specific technical requirement
10)	Static Pressure required	As per Section'C' schedule of ventilation system.
11)	Outlet Air Velocity	Not more than 12 m/sec.
	Materials	
12)	Casing	M.S. (IS-2062)
13)	Impeller	Cast A1uminium. (Alloy A-6M, IS-617)
14)	Hub	Al Alloy.
15)	Support frame and structure. (Galvanized/	M.S. of adequate thickness Painted) IS-2062.
16)	Neoprene rubber pads	As required.
17)	Coned inlet for wall exhausters/supply fans	MS (IS-2062)
18)	Supporting frame for mounting.	Required.
19)	Protective screen at inlet.	Yes (Min 14 SWG Galvanized wire knitted in 1" square mesh.
20)	Rain Protection Cowl	Aluminum or hot dip Galvanized after fabrication from M.S.

TITLE	SPECIFICATION NO. PES-571-11000-A-03	
Ventilation Fan (Axial Flow Type)	VOLUME II-B	
DATA SHEET - A	SECTION D	
	REV 00	DATE: JAN 2020
	SHEET 2 OF 2	

Motor

21)	Motor by	Bidder
22)	Starter by	Bidder

NOTE:

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

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

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

	TECHNICAL SPECIFICATION CENTRIFUGAL PUMPS	SPECIFICATION NO. PES-571-11000-A-04	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 1 OF 9	

SECTION-D

CENTRIFUGAL PUMPS

	TECHNICAL SPECIFICATION CENTRIFUGAL PUMPS	SPECIFICATION NO. PES- 571-11000-A004
		VOLUME II B
		SECTION D
		REV. 00 | DATE: JAN 2020
		SHEET 2 OF 9

1. GENERAL

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

2. CODES AND STANDARDS

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

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

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

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

2.1.4 BS - 599 : Method of testing Pumps.

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

2.1.6 API - 610

2.1.7 Hydraulic Institute Standards of USA

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

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

3. DESIGN REQUIREMENTS

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

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

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

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

4. CONSTRUCTION FEATURES:

4.1 **PUMP CASING**

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

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

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

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

4.2 **IMPELLER**

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

4.3 **WEARING RING**

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

4.4 **SHAFT**

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

4.5 **BEARING**

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

4.6 **STUFFING BOX**

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

	TECHNICAL SPECIFICATION CENTRIFUGAL PUMPS	SPECIFICATION NO. PES- 571-11000-A004
		VOLUME II B
		SECTION D
		REV. 00 | DATE: JAN 2020
		SHEET 4 OF 9

4.7 **SHAFT COUPLING**

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

4.8 **BASE PLATE AND SOLE PLATE**

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

4.9 **PRIME MOVER**

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

4.10 **LIFTING ARRANGEMENT**

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

	TECHNICAL SPECIFICATION CENTRIFUGAL PUMPS	SPECIFICATION NO. PES- 571-11000-A004
		VOLUME II B
		SECTION D
		REV. 00 | DATE: JAN 2020
		SHEET 5 OF 9

5. PERFORMANCE REQUIREMENTS

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

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

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

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

6. DRIVE RATING

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

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

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

7. SCOPE OF INSPECTION AND TESTING

7.1 CASTING

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

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

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

7.1.4 Verification of Heat treatment charts (as applicable)

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

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

7.2 **FORGING**

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

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

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

7.3 **FABRICATED ITEMS**

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

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

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

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

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

7.4 **IN PROCESS INSPECTION AND TESTING**

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

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

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

a) Cracks, flakes, seams and laps

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

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

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

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

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

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

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

	TECHNICAL SPECIFICATION CENTRIFUGAL PUMPS	SPECIFICATION NO. PES- 571-11000-A004
		VOLUME II B
		SECTION D
		REV. 00 | DATE: JAN 2020
		SHEET 7 OF 9

7.5 **PERFORMANCE TEST**

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

a) Capacity V/s Head

b) Capacity V/s Power absorbed by pump

c) Capacity V/s pump efficiency

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

7.5.2 NPSH test in case specifically mentioned elsewhere.

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

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

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

7.5.6 Painting and packing as per technical specification.

7.6 **TEST AT SITE**

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

7.7 **PERFORMANCE GUARANTEE**

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

8. CLEANING, PROTECTION , PAINTING & PACKING

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

	TECHNICAL SPECIFICATION CENTRIFUGAL PUMPS	SPECIFICATION NO. PES- 571-11000-A004
		VOLUME II B
		SECTION D
		REV. 00 | DATE: JAN 2020
		SHEET 8 OF 9

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

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

a) Foundation base plate and sole plate details as applicable

b) Civil foundation and anchor bolts details and loading data

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

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

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

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

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

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

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

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

10. MANUFACTURERS NAME AND TAG. PLATES

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

a) Manufacturer's name and trade mark.

b) Design Capacity and Head.

c) Design.

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

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

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

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

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

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

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

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

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

11.8 Installation , operation and maintenance manual.

11.9 Other drawings and data, if necessary.

11.10 Vendor shall also provide soft copy of each drawing in AutoCAD format.

11.11 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

TITLE	SPECIFICATION NO. PE-TS-413-571-11000-A004.
CENTRIFUGAL PUMPS	VOLUME II-B
DATA SHEET - A	SECTION D
	REV 00 / DATE: JAN 2020
	SHEET 1 OF 2

DESCRIPTION		**DATA**
1.	Designation	: Cooling Water pumps for Ventilation plant.
2.	Type	: Horizontal, Centrifugal pump or vertical split type casing pump .
3.	Quantity	: Refer to section-C of Specific Technical Requirements
4.	Installation	: On floating type foundation.
5.	Fluid to be handled	: Water
6.	Temperature of fluid	: To suit.
7.	Capacity M3/hr and TDH at rated	: To suit system requirements but head shall not be less than 25 MWC.
8.	Duty	: Continuous (24 hours / day)
9.	Suction condition	: Flooded
10.	Type of drive	: Direct
11.	Prime Mover	: LV AC motor
12.	Maximum speed	: 1500 RPM
13.	Type of lubrication	: Grease Lubrication
14.	Material	
	a) Impeller	: Refer to section-C of Specific Technical Requirements
	b) Pump shaft	: Refer to section-C of Specific Technical Requirements
	c) Casing	: Refer to section-C of Specific Technical Requirements
	d) Wearing ring	: Refer to section-C of Specific Technical Requirements
	e) Shaft Sleeve	: Refer to section-C of Specific Technical Requirements
	f) Base plate	: Refer to section-C of Specific Technical Requirements
	g) Bolt and nuts.	: Refer to section-C of Specific Technical Requirements
	h) Stuffing Box gland/bush	: Refer to section-C of Specific Technical Requirements

i) Stuffing box Packing. : Refer to section-C of Specific Technical Requirements

j) Pump motor coupling. : Refer to section-C of Specific Technical Requirements

15. **ACCESSORIES REQUIRED:-**

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

a) Suction & Discharge pressure gauges. : Yes.

b) Vent connection : Yes.

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

d) Companion flanges. : Yes

e) Common base plate. : Yes.

f) Suction strainer. : Yes

g) Isolating valve : Yes

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

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

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

	TECHNICAL SPECIFICATION PACKAGE AIR CONDITIONING UNIT	SPECIFICATION NO. PES-571-11000-A-05	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 1 OF 6	

SECTION-D

PACKAGE AIR CONDITIONING UNIT

1 GENERAL

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

2 CODES AND STANDARDS

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

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

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

3 DESIGN AND CONSTRUCTIONAL REQUIREMENTS

3.1 Compressor

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

3.2 Condensing unit

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

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

3.2.2 Drain plug, air vent and test valve.

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

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

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

3.3 AIR HANDLING FAN

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

3.4 Filters

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

3.5 Cooling Coil

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

3.6 Controls

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

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

3.7 Refrigerant Piping

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

3.8 Cabinet

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

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

All the electric wires within the cabinet shall run in flexible conduits and carry identification tags. The bottom side of the panel shall be specially ribbed to take care of the transportation.

3.9 Other Accessories

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

4 CONTROL AND INTERLOCK REQUIREMENTS

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

The interlocking requirement shall be as indicated below:

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

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

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

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

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

5 TEST AND INPSECTION

5.1 Inspection and Testing at Manufacturer's Works

5.1.1 static and dynamic test for fans

5.1.2 Hydrostatic static test on condenser and cooling coil.

5.1.3 vacuum/pressure test for the complete refrigeration circuit.

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

5.1.5 Free running test on compressor.

5.1.6 AIR CAPACITY WITH ANEMOMETER.

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

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

5.2 Inspection and Testing at Site

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

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

5.2.1.1 Condenser inlet and outlet pressure and temperature

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

5.2.1.3 Motor current for the compressor and blower.

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

Room temperature (Dry & wet bulb)

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

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

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

6 PAINTING:

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

7 GUARANTEES

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

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

8 NAME PLATES

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

	TECHNICAL SPECIFICATION PACKAGE CONDITIONING UNIT	SPECIFICATION NO. PES-571-11000-A-05
		VOLUME II B
		SECTION D
		REV. 00 / DATE: JAN 2020
		SHEET 6 OF 6

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1 Final technical data as per Data Sheet-A

9.2 G.A. and interior view of packaged unit

9.3 Electrical wiring diagram

9.4 Catalogues for all controls

9.5 O & M Manual

9.6 Erection Manual

9.7 Vendor shall also provide soft copy of each drawing in AutoCAD format.

9.8 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

TITLE

PACKAGE AIR -CONDITIONING UNIT

DATA SHEET - A

SPECIFICATION NO. PES-571-11000-A-05	
VOLUME II-B	
SECTION D	
REV 01	DATE: JAN 2020
SHEET 1 OF 1	

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

	TECHNICAL SPECIFICATION AIR FILTER	SPECIFICATION NO. PES- 571-11000-A-006	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 1 OF 3	

SECTION-D

AIR FILTER

	TECHNICAL SPECIFICATION AIR FILTER	SPECIFICATION NO. PES- 571-11000-A006
		VOLUME II B
		SECTION D
		REV. 00 | DATE: JAN 2020
		SHEET 2 OF 3

1. GENERAL

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

2. CODES AND STANDARDS

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

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

3. GENERAL

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

3.1 POLY FIBRE AIR FILTERS

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

3.2 DRY FABRIC AIR FILTERS

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

3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

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

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

3.4 AUTOMATIC CLEANING FILTERS

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

	TECHNICAL SPECIFICATION AIR FILTER	SPECIFICATION NO. PES- 571-11000-A006	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 3 OF 3	

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

3.5 ABSOLUTE FILTERS

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

3.6 WATER REPELLANT NYLON FILTERS

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

4. INSPECTION & TESTING

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

4.1 Dimensional inspection of frame & filter media.

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

a) Gravimetric efficiency.

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

c) Efficiency as per BS EN - 779.

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

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

5.1 GA Drawing.

5.2 Drawing showing material/construction detail

5.3 Installation and\service manual

5.4 Rating curves/charts

5.5 Test certificates

5.6 Elect. diagrams (when automatic cleaning type)

5.7 Vendor shall also provide soft copy of each drawing in AutoCAD format.

5.8 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

TITLE	SPECIFICATION NO. PES-571-11000-A-06	
AIR FILTER	VOLUME II-B	
DATA SHEET - A	SECTION D	
	REV 00	DATE: JAN 2020
	SHEET 1 OF 1	

DESCRIPTION		**DATA**
1)	**General**	
1.1	Service	: Air Conditioning & Ventilation.
1.2	Location	: Ventilation plant, & Ductable Split AC plant, fresh air fan system. Also for split AC.
1.3	Nos.	: Refer Section 'C' of Specification.
1.4	Total air flow/type	: Refer Section 'C' of Specification.
1.5	Temperature	: As per project information.
1.6	Relative Humidity	: 100%
1.7	Gas Composition	: Atmospheric Air (Dusty) as prevalent in power Station.
1.8	Filter Media	: Synthetic non-woven
1.9	Efficiency filters.	: Average arrestance efficiency of 65-80 % for Dry Panel filter (pre-filters) and average arrestance Efficiency of 80 % down to 20 micron for
1.10	Allowable pressue drop	: 2.5 mm & 6.5 mm in clean and dirty condition respectively for dry panel filters(prefilters). 12 mm in clean condition for fine filters.
1.11	Frame Work	: 18 G, GSS.
1.12	Mounting	: Ladder Type M.S Angles (galvanised)
1.13	Size	: 600 x 600 mm

Note:-

1) Face velocity of air across the filters shall not exceed 2.5 m/sec and for absolute filters velocity shall not exceed 1.5 m/sec.

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO. PES- 571-11000-A-007
		VOLUME II B
		SECTION D
		REV. 00 / DATE: JAN 2020
		SHEET 1 OF 7

SECTION-D

LOW PRESSURE AIR DISTRIBUTION SYSTEM

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO. PES- 571-11000-A007
		VOLUME II B
		SECTION D
		REV. 00 | DATE: JAN 2020
		SHEET 2 OF 7

1. GENERAL

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

2. CODES AND STANDARDS

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

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

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

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

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

3. MATERIAL

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

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

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

4. CONSTRUCTION/FABRICATION

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

4.2 **RECTANGULAR DUCTS**

4.2.1

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

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

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

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

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

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

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

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

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO. PES- 571-11000-A007
		VOLUME II B
		SECTION D
		REV. 00 | DATE: JAN 2020
		SHEET 4 OF 7

4.3 **ROUND DUCTS**

4.3.1

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

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

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

4.4 **DUCT SUPPORTS**

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

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

4.5 **FLEXIBLE CONNECTIONS**

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

4.6 **TRANSFORMATIONS AND BREACHES**

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

4.7 **CAULKING**

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

4.8 **EASEMENT**

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

4.9 **ACCESS DOORS**

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

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

4.10 **DAMPERS AND SPLITTERS**

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

4.10.2 FIRE DAMPERS

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

4.10.3 VANES

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

4.10.4 FLASHING

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

4.11 **DIFFUSERS AND GRILLS**

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

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

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

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

4.12 **PLENUMS AND RA BOXING**

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

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

4.13 **ACCOUSTIC LINING**

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

4.14 **PAINTING**

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

4.15 **THERMAL INSULATION**

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

5. INSPECTION AND TESTING

5.1 **INSPECTION & TESTING DURING FABRICATION**

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

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

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

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

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

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

5.2 **INSPECTION & TESTING AT SITE.**

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

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

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO. PES- 571-11000-A007
		VOLUME II B
		SECTION D
		REV. 00 | DATE: JAN 2020
		SHEET 7 OF 7

6. BALANCING

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

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

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

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

7.2 Test certificates in line with scope of inspection.

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

7.4 Installation instruction manual and air balancing manual.

7.5 Duct air leaking test procedure/smoke test procedure.

7.6 Vendor shall also provide soft copy of each drawing in AutoCAD format.

7.7 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

TITLE	SPECIFICATION NO. PES-571-11000-A-07
LOW PRESSURE AIR DISTRIBUTION SYSTEM	VOLUME II-B
DATA SHEET - A	SECTION D
	REV 00 / DATE: JAN 2020
	SHEET 1 OF 1

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

NOTE:

1. Duct sheet thickness shall be as per IS-655
2. Opposed blade type volume control damper shall be provided at each supply air diffusers/grilles.
3. Bidder to provide suitable gasketing at each duct flange.
4. Fire damper shall be motor operated type, when otherwise specified under Section-C.
5. Access door in ducting system shall be provided as required.
6. MS Angle (painted) shall be used for duct supports etc.
7. Velocity thru duct shall normally not exceed 9.0 M/sec for Air conditioning system and 12 M/sec for Ventilation duct. Maximum velocity (outlet) for supply air diffuser shall not exceed 2.5 m/sec.
8. All Grilles & diffusers shall be supported with frame. Frame etc. shall be supplied by bidder.

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO. PES-571-11000-A-08	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 1 OF 6	

SECTION-D

THERMAL INSULATION FOR COLD SURFACES

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 2 OF 6	

1. SCOPE

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

2. CODES & STANDARDS

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

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

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

2.3 IS:3677 : Mineral wool for thermal insulation.

2.4 IS:8183 : Resin bonded mineral wool.

3. DESIGN REQUIREMENTS

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

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

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

4. APPLICATION DETAILS

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

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

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

4.4 Insulation in the form of pipe sections/rolls slabs of specified density & thickness should be stuck to the coated surface with joints staggered & well butted & secured. The adjoining sections shall be tightly pressed together. All the joints shall be sealed

with bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.

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

5. VAPOR SEALING & INSULATION FINISH

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

5.1 FINISHING SYSTEM I: EXTERNAL INSULATION WITH PLASTER FINISH

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

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

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

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

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

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

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

5.3 FINISH III: EXTERNAL INSULATION WITH SHEET METAL FINISH

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

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

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

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

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

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

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

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

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 4 OF 6	

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

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 5 OF 6	

6. INSULATION OF PUMPS & VALVES

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

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

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

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

8. PAINTING

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

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

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

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08	
		VOLUME II B	
		SECTION D	
		REV. 00	DATE: JAN 2020
		SHEET 6 OF 6	

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

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

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

a) Thermal conductivity test.

b) Sound absorption coefficient test.

c) Corrosion test.

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

e) Compressive strength & cross breaking strength test.

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

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

9.5 Instructions on erection and maintenance of insulation work.

9.6 Vendor shall also provide soft copy of each drawing in AutoCAD format.

9.7 Vendor shall also provide final-version of all drawings in 3-D as per the requirement specified elsewhere.

TITLE

INSULATION

DATA SHEET - A

SPECIFICATION NO.	PES-571-11000-A-08
VOLUME	II-B
SECTION	D
REV 00	DATE JAN 2020
SHEET 1 OF 1	

Insulation Material

Insulation	Code	Thermal Conductivity MW/cm ^{0}C	Density Kg/m^3
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 ^{0}C	At least 24 for duct insulation and 48 for acoustic lining.
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 ^{0}C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 10 ^{0}C	At least 15
Al foiled face Nitrile rubber / XLPE	EN12667	0.037 at 20 ^{0}C	At least 140

Type of Insulation

S.No.	Surface	Insulation Material	Insulation Form	Thickness (mm)
i)	Supply & Return air duct for air-conditioning system	Resin bonded roll Mineral Wool (IS:8183)	Roll/slab	25
		Or AI foiled face Nitrile rubber/XLPE	Roll/slab	25
ii)	Refrigerant Piping	a) Expanded Polystyrene	Pipe Section	75
		or b) Mineral Wool	Pipe Section	75
iii)	AHU drain pipe	a) Expanded Polystyrene	Pipe Section	25
		or b) Mineral Wool	Pipe Section	25
iv)	AHU drain pan coil section and fan section	a) Expanded Polystyrene	Slabs	25
		or b) Mineral Wool	Slabs	25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene	Pipe Section	75
		or b) Mineral Wool	Pipe Section	75
vi)	Chiller	a) Expanded Polystyrene	Slabs	100
		or b) Mineral Wool	Slabs	100
vii)	Chilled Water Pumps	a) Expanded Polystyrene	Slabs	50
		or b) Mineral Wool	Slabs	50
viii)	Expansion tank with pipe	a) Expanded Polystyrene	Slabs/Pipe Section	50
		or b) Mineral Wool	Slabs/Pipe Section	50

Insulation shall be fire retardant class.

SECTION: I

SUB-SECTION: E

LIST OF ANNEXURES

	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM LIST OF MAKES-HVAC	SPECIFICATION No: PE-TS-479-571-11000-A001
		SECTION : I
		SUB-SECTION : E
		REV 00 / DATE: June 2023
		SHEET 1 OF 1

SECTION-I

SUB SECTION E

ANNEXURE-I

LIST OF MAKES-HVAC SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT)

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	SCREW CHILLER	YORK / TRANE / CARRIER / KIRLOSKAR / DUNHAM BUSH / MCQUAY (DAIKIN) / BLUE STAR / VOLTAS
2	VAPOUR ABSORBTION MACHINE	VOLTAS / THERMAX
3	PRECISION PACKAGE UNITS	STULZ / UNIFLAIR / EMERSON / BLUEBOX / CLIMAVENETA
4	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
5	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
6	AIR HANDLING UNITS	VOLTAS / BLUE STAR / ZECO / CARRYAIRE(FLAKT) / EDGETECH / ETHOS / SYSTEM AIR / WAVES AIRCON
7	AHU FAN (CENTRIFUGAL FAN)	CB.DOCTOR / FLAKT / KRUGER / NICOTRA / COMEFRI / MARATHON / PATEL AIR
8	CHILLED & CONDENSER WATER PUMP	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO
9	COOLING TOWER	PAHARPUR / MIHIR / PCT / FLOWTECH / BELL
10	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP
11	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
12	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
13	INSULTATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
14	BALANCING VALVE	ADVANCE
15	BUTTERFLY VALVE	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE / ADVANCE
16	NON RETURN VALVE	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
17	GATE/GLOBE VALVES	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
18	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY /JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC
19	MOTORIZED BUTTERFLY VALVE	ANERGY / / BELIMO / JOHNSON / HONEYWELL / SIEMENS
20	Y / POT STRAINER	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT)

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
		PVT LTD / SUNGOV ENGINEERING
21	PIPING - ERW	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
22	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS
23	GI SHEETS FOR DUCTING	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL
24	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
25	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)
26	STRIP HEATER	ESCORTS / RACOLD / DASPASS/ ALCO/ HEATCO / HOTSET
27	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO
28	RELIEF / PURGE VALVE	BRASSOMATIC
29	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL /RANUTROL
30	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN
31	ANTI FREEZE THERMOSTAT	RANCO / HONEYWELL / PENN / DANFOSS / INDFOSS
32	PRESSURE GAUGE	GENERAL INST CONSORTIUM / BELL / H.GURU INST P. LTD. / WAAREE INSTRUMENTS / H. GURU IND / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES/ PRECISION MASS PRODUCTS PVT. LTD. / BOSE PANDA INSTT. PVT. LTD.
33	TEMPERATURE GAUGE	H. GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA/ ASHCROFT / H GURU (SI)/ BAUMER TECHNOLOGIES/ GOA THERMOSTATIC/ GAUGE BOURDON/ BUDENBERG GAUGE/ PRECISION MASS PRODUCTS
34	LEVEL GAUGE	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR/ BLISS ANAND
35	PRESSURE SWITCH / DP SWITCHES	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT/ KASTURBA UDYOG/ BARKSDALE/ PRECISION MASS PRODUCTS/ MITTAL REFRIGERATION
36	TEMPERATURE SWITCH	INDFOSS/ SEIMENS / DANFOSS/ DK INSTRUMENTS/ SOR INC / VASU / DRESSER / TOSHNIWAL / SWITZER
37	FLOW SWITCH	SWITZER / LEVCON / DK INSTRUMENT / SBEM / V. AUTOMATE/ SIEMENS

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT)

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
38	LEVEL SWITCH	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V ATUOMATE /CHEMTROLS / SIMENS / FLOW STAR / TRAC/ FLOW TECH/ NIVO CONTROLS/ PUNE TECHTROL/ SAPCON/ BAUMER TECHNOLOGIES/ GIC/ SBEM
39	TRANSMITTERS	TAYLOR / ABB/BRISTOL BABCOCK / BIRLA KENT TAYLOR / BLISS ANAND /SBEM/ SMART INST / V AUTOMATION & INST / FISHER-ROSEMOUNT/ SIEMENS/ TATA HONEYWELL/ PUNE TECHTROL/ NIVO CONTROLS/ PANAM ENGINEERS/ EMERSON/ MOORE INDUSTRIES/ TOSHINIWAL INDUSTRIES/ YOKOGAWA/ E&H/ ABB
40	SIGHT FLOW INDICATORS	SIGMA / LEVCON /V AUTOMAT / TELLACE /EUREKA / TATA HONEYWELL/BLISS ANAND/ SCIENTIFIC DEVICES/ BK EQUIPMENTS/ INSTRUMENTATION ENGINEERS
41	FLOW ELEMENT	BRISTOL BABCOCK / BALIGA /LIGHTING EQUIP /ENGINEERING SPECIALITIES /IL / MINCO/ MICRO PRECISION / STAR MECH
42	TEMPERATURE ELEMENT	GENERAL INST CONSORTIUM/ PYRO ELECTRIC /WAAREE INSTRUMENTS/ DETRIVE INST & ELECTRONICS / TOSHNIWAL/ GOA INSTRUMENTS/ GAUGE BOURDON/ TECHNO INSTRUMENTS/ TEMPSENS INSTRUMENTS/ THERMAL INSTRUMENTS/ TM TECHNOMATIC/ BAUMER TECHNOLOGIES
43	FLOW METER	EUREKA / INSTRUMENTATION ENGINEERS PVT LTD / PLACKA /TRAC / FLOW STAR/ SCIENTIFIC DEVICE
44	RH SENSOR/TEMP SENSOR	HONEY WELL /JOHNSON /SIEMENS / GENERAL INSTRUMENTS
45	PLC BASED PANEL	SIEMENS / SCHENIEDER / ROCKWELL / GE INTELLIGENT / HONEYWELL AUTOMATION / ABB/ MITSUBISHI ELECTRIC
46	OWS / PC	HP / COMPAQ / DELL / HCL / IBM / LENOVO
47	PRINTER	HP / CANON / EPSON / XEROX / IBM / LEXMARK
48	UPS	HITACHI-HIREL / APC / DELTA / EMERSON / DB POWER / APLAB
49	FIBRE OPTIC CABLE	BIRLA ERICSON / FINOLEX / AKSH FIBRE
50	ANNUNCIATOR FOR PANEL	ICC / PECON/ PROCON
51	LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR	CONTROL DEVICE / SYSTEM POWER CONTROL / JACKSON / UNILEC / ELECTRIC ALLIED PRODUCT
52	METERING PUMP	SHAPO TOOLS / VK PUMPS
53	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE / DOSI ION
54	PRESSURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL / FUJI
55	TEMPERATURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL
56	ROTAMETER	CHEMTROLS SAMIL / EUREKA IND / IL / TRANSDUCERS AND CONTROL

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT)

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
57	BATTERY CHARGER	AMARARAJA/ CHHABI ELECTRICAL / DUBAS ENGG. / HBL POWER SYSTEM / STATCON / CALDYNE
58	BATTERY (NI -Cd)	HBL POWER / AMCO SAFT / SAFT
NOTE		
	1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. LIST OF SUB-VENDOR SHALL BE FINALIZED WITH THE FINALLY SELECTED L-1 VENDOR BUT PRIOR TO ORDER FINALIZATION ON L-1 VENDOR BY THE BHEL. 2. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER. 3. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-3 & C-4 FOR ELECTRICAL AND C&I RELATED EQUIPMENT LIST OF MAKE.	

LIST OF MAKES OF SUB-VENDOR ITEMS

VENTILATION SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLIACBLE
(2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT)

S.No.	Description	Makes
1.	**AIR WASHER & UAF* / FFU/AHU**	HYDERABAD POLUTION CONTROL / SK SYSTEM / ADVANCE VENTILATION / DRAFT AIR / BLUE STAR / VOLTAS / STERLING WILSON & ROOTS COOLING SYSTEM / C.DOCTOR
2.	**CENTRIFUGAL FAN**	FLAKT / KRUGGER / DRAFT AIR / HYDERABAD POLUTION CONTROL / ADVANCE VENTILATION / PATEL AIR / NICOTRA/ SK SYSTEM / MARATHON / CB DOCTOR / SARLA
3.	**AXIAL FLOW FANS/RE UNITS**	HYDERABAD POLLUTION/ SK SYSTEM / ADVANCE VENTILATION / KRUGER / NICOTRA / MARATHON / FLAKT / CB DOCTOR/ PATEL AIR /SITAL
4.	**FAN**	FLAKT WOODS/ KRUGER/ ANDREW YULE/ AEROTHERM/ DUVENT/ SIWENT (SARLA)/ S.R PRAYAVARAN/ GEC(Alstom)
5.	**CENTRIFUGAL WATER PUMP**	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO
6.	**INDUCTION MOTORS (LT)**	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP/ KIRLOSKAR/ G.E.C.
7.	**AIR FILTER**	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER /SPECTRUM / AIR TECH / PUROMATIC/ CHEMFARM/ KIRLOAKAR/ CLEAR AIR PUROFIL/ DYNA
8.	**INSULTATION MATERIAL**	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
9.	**RESIN BOUNDED FIBRE GLASS**	UP TWIGA/ CLYOL/ COOLINE
10.	**FIRE DAMPER**	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
11.	**BUTTERFLY VALVE**	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE
12.	**NON RETURN VALVE**	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
13.	**GATE/GLOBE VALVES**	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
14.	**PIPING - ERW**	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
15.	**GI SHEETS FOR DUCTING**	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL/ NIPPON
16.	**HUMID STAT**	JHONSON CONTROL / HONEYWELL / PENN
17.	**GRILLES/ DIFFUSERS**	MOOSA HAJI/ NUTECH/ COSMOS/ OPELLA/ CARYAIRE
18.	**PRESSURE GAUGE**	GENERAL INST CONSORTIUM / BELL / H.GURU INST / WAAREE INSTRUMENTS / H. GURU IND / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES/PRECISION MASS PRODUCTS/ BOSE PANDA/ FIEBIG/ JAPSIN/ MICA
19.	**THERMOSTATS**	H.GURU/ FIEBIG/ JAPSIN/ MICA/ PENN/ HONEYWELL

VENTILATION SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLIACBLE
(2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT)

20.	**TEMPERATURE GAUGE**	H. GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA/ ASHCROFT / H GURU (SI)/ BAUMER TECHNOLOGIES/ GAUGE BOURDON/ GOA THERMOSTAT/ BUDENBERG GAUGE/ PRECISION MASS PRODUCTS
21.	**LEVEL GAUGE**	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR/ BLISS ANAND
22.	**PRESSURE SWITCH / DP SWITCHES**	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT/ KASTURBA UDYOG/ BARKSDALE/ PRECISION MASS/ MITTAL REFRIGERATION
23.	**LEVEL SWITCH**	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V AUTOMAT /CHEMTROLS / SIMENS / FLOW STAR / TRAC/ NIVO CONTROLS/ PUNE TECHTROLS/ SAPCON INSTRUMENTS/ BAUMER TECHNOLOGIES/ GIC
24.	**Y / POT STRAINER**	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA PVT LTD / SUNGOV ENGINEERING
25.	**CONTROL PANEL**	INDUSTRIAL CONTROL & APPLIANCE/ PYROTECH /POSITRONICS / CONTROL & SWITCHGEAR /SIEMENS / L&T /GE POWER /RITTAL / HOFFMAN
26.	**SWITCHGEAR**	(MCCB, CROMPTON/ SIEMENS/ ABB/ L&T CONTRACTORS ETC.)
27.	**CABLES**	FINOLEX/ NICCO/ UNIVERSAL CABLES/ GRANDLEY/ CCI/ POLYCAB/ FORT GLOSTER
NOTE		
	* Designed by C. Doctor / Blue Star / Voltas / Hyderabad Pollution Controls / SK System /Advance Ventilation / Draft Air / Sterling & Wilson / Roots cooling and fabricated by their approved fabricators.	
	1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. LIST OF SUB-VENDOR SHALL BE FINALIZED WITH THE FINALLY SELECTED L-1 VENDOR BUT PRIOR TO ORDER FINALIZATION ON L-1 VENDOR BY THE BHEL. 2. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER. 3. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-3 & C-4 FOR ELECTRICAL AND C&I RELATED EQUIPMENT LIST OF MAKE.	

SECTION-I

SUB SECTION -E

ANNEXURE-II

MANDATORY SPARE LIST

ANNEXURE - II
LIST OF MANDATORY SPARES
2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT

S. No.	Description	UNIT	Qty
1	1 (one) motor of each type used for the ventilation system to be supplied	1	Lot
2	One (1) complete set of replacement bearing or bushings, including one of each size and type used in the motors or other rotating component of the equipment supplied under this item	1	Lot
3	1 (one) set of all O-rings, packing and seals	1	Lot
4	1 (one) set each of belt used	1	Lot
5	100% air filter used	1	Lot
6	one (1) instrument of each type mounted	1	Lot
7	Cables		
7a	10% of power cables	1	Lot
7b	10% of control & instrumentation cables	1	Lot
7c	10% of communication cables	1	Lot
8	One (1) number of ACB of each used type.	1	Lot
9	One (1) number of magnetic contactor of each used type.	1	Lot
10	20 % of total number of MCCB of each ratings or at least one (1) piece of MCCB of each rating.	1	Lot
11	20 % of total number of MCB of each ratings or at least one (1) piece of MCB of each rating.	1	Lot
12	50 % of HRC fuse of used type.	1	Lot
13	100% of indicating lamps of used type.	1	Lot
14	One (1) number of selector switch of each type.	1	Lot
15	One (1) AC voltmeter	1	Lot
16	One (1) DC voltmeter	1	Lot
17	One (1) AC ammeter	1	Lot
18	One (1) DC ammeter	1	Lot
19	One (1) under volatge relay	1	Lot
20	One (1) number of key switch of each type.	1	Lot
21	Four (4) pairs of rubber gloves	1	Lot
22	Two (2) rubber aprons	1	Lot
Notes:			

a) Spares listed in Price Schedule is bare minimum requirement. In case any additional mandatory spares covered elsewhere in the tender specification apart from specified above, same shall be deemed to have been covered in bidder's scope of supply.

b) Wherever "set" is indicated, it shall mean complete replacement for one main equipment.

c) In case the spare is mentioned in %age of the total quantity, the quantity of mandatory spares offerred shall be rounded up to the next higher number.

d) All Spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is "not applicable" for particular equipment, then suitable applicable alternate spare has been offered / shall be supplied by the bidder without any financial implication."

e) Any item which is quoted as "not applicable" by the bidder in the above list and is found to be "applicable" at a later date shall be supplied by the bidder without any commercial and delivery implication.

f) Any cell left blank in the unpriced schedule shall be treated as "Quoted" and is included in total price.

SECTION-I

SUB-SECTION-E

ANNEXURE-III

LIST OF TOOLS & TACKLES
AND
LIST OF COMMISSIONING SPARES

	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM LIST OF TOOLS & TACKLES AND LIST OF COMMISSIONING SPARES	SPECIFICATION No: PE-TS-479-571-11000-A001
		SECTION: I
		SUB-SECTION : E
		REV 00 / DATE: June 2023

LIST OF TOOLS & TACKLES

SL NO	DESCRIPTION	UNIT	Qty
1	FLAT D WRENCH - 6 MM TO 32 MM (12 Pcs)	SET	1
2	BOX WRENCHES - 6 MM TO 22 MM (14 Pcs)	SET	1
3	RING SPANNER - 6 MM TO 32 MM (12 Pcs)	SET	1
4	ALLEN KEYS - 2 MM TO 10 MM	SET	1
5	CRESCENT SCREW SPANNER	NO.	1
6	SCREW DRIVER	NO.	1
7	OFFSET SCREW DRIVER	NO.	1
8	INSULATED PLIER	NO.	1
9	TORCH LIGHT FOR 2 CELL	NO.	1
10	HAMMER 1 LB	NO.	1
11	OIL CAN	NO.	1
12	POCKET THERMOMETER - 0 TO 50 DEG. C)	NO.	1
13	INSULATION TAPE ROLL	NO.	1
14	STEEL FOOT RULE - 12"	NO.	1
15	FEELER GAUGE 9 BLADES	NO.	1
16	PIPE WRENCH	NO.	1
17	FLARE NUT (1/4")	NOS.	6
18	FLARING TOOL	NO.	1
19	TUBE CUTTER	NO.	1
20	GAS CHARGING PIPE	NO.	1
21	NITOGEN CHARGING ADAPTER	NO.	1
22	FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 0 - 300 MM PSI	NO.	1
23	FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 30 - 150 MM PSI	NO.	1
24	PSYCHRO METER	NO.	1
25	LOCK WITH KEY FOR TOOL BOX	NO.	1
26	RATCHET 1/4"	NO.	1
27	MS TOOL BOX	NO.	1
28	LOCK WITH KEY FOR TOOL BOX	NO.	1
29	HAND LAMP	NO.	1
30	GREASE GUN	NO.	1
31	GAS CHARGING KIT	NO.	1

NOTE:-

Above is the minimum list. Any other Tools and tackles required for HVAC system w.r.t. Mechanical, Electrical and C&I part shall also be provided by the vendor as per system / customer requirement without any commercial & Delivery implication to BHEL.

	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM LIST OF TOOLS & TACKLES AND LIST OF COMMISSIONING SPARES	SPECIFICATION No: PE-TS-479-571-11000-A001 SECTION: I SUB-SECTION : E REV 00 | DATE: June 2023

LIST OF COMMISSIONING SPARES

SL NO	ITEM DESCRIPTION	UNIT	QTY
1	FAN BELTS (each type & size)	SET	1
2	PRESSURE GAUGE (for each type and range)	NO.	1
3	TEMPERATURE GAUGE (for each type and range)	NO.	1
4	FILTER (each size)	SET	1
5	COMPRESSOR OIL	Lot	1
6	REFRIGERANT GAS OF EACH TYPE IN A NON-RETURNABLE CYLINDERS	Lot	1
7	DRY NITROGEN CYLINDER	Lot	1

NOTE:-

Above is the minimum list. Any other commissioning spare required for HVAC system w.r.t. Mechanical, Electrical and C&I part shall also be provided by the vendor as per system / customer requirement without any commercial & Delivery implication to BHEL.

SECTION-I

SUB-SECTION-E

ANNEXURE-IV

DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE

REFER CUSTOMER TECHNICAL SPECIFICATION C2-A

SECTION-I

SUB-SECTION-E

ANNEXURE-V

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-479-571-11000-A001	
		SECTION : I	
		SUB-SECTION : E	
		REV 00	DATE: June 2023
		SHEET 2 OF 6	

S. NO.	BHEL DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
1*	PE-V0-479-571-11000-A-A001	SUB-VENDOR LIST ALONG WITH INSPECTION CATEGORISATION PLAN FOR HVAC SYSTEM	1
2	PE-V0-479-571-11000-A005	QUALITY PLAN OF PRECISION AC	4
3	PE-V0-479-571-11000-A006	QUALITY PLAN OF CENTRIFUGAL FANS	5
4	PE-V0-479-571-11000-A007	QUALITY PLAN OF AXIAL FANS	5
5	PE-V0-479-571-11000-A008	QUALITY PLAN OF MOTOR	5
6	PE-V0-479-571-11000-A009	QUALITY PLAN OF MCC/SWITCHGEAR	8
7	PE-V0-479-571-11000-A010	QUALITY PLAN OF CABLES	8
8*	PE-V0-479-571-11000-A-A101	HEAT LOAD CALCULATION FOR AC AREAS	2
9*	PE-V0-479-571-11000-A-A102	HEAT LOAD CALCULATION FOR VENTILATION SYSTEM	2
10*	PE-V0-479-571-11000-A-A103	OPERATION AND CONTROL PHILOSOPHY FOR HVAC SYSTEM	3
11*	PE-V0-479-571-11000-A-A104	VENTILATION FAN SCHEDULE.	5
12*	PE-V0-479-571-11000-A-A105	SPLIT AC SCHEDULE	4
13	PE-V0-479-571-11000-A-A206	DATA SHEET & GA FOR SPLIT AC	4
14*	PE-V0-479-571-11000-A-A204	DATA SHEET & GA FOR PRECISION AC	4
15*	PE-V0-479-571-11000-A-A207	DATA SHEET & GA FOR CENTRIFUGAL FANS	5
16	PE-V0-479-571-11000-A-A208	DATA SHEET & GA FOR AXIAL AND PROPELLAR FANS	5
17	PE-V0-479-571-11000-A-A212	DATA SHEET OF INSULATION	2
18	PE-V0-479-571-11000-A-A213	DATA SHEET & GA FIRE DAMPER.	2
19	PE-V0-479-571-11000-A-A214	DATA SHEET FOR INSTRUMENTS	6
20	PE-V0-479-571-11000-A-A216	DATA SHEET OF GI AND MS SHEET.	2
21	PE-V0-479-571-11000-A-A217	DATA SHEET & GA FOR PRE AND FINE FILTERS.	2
22	PE-V0-479-571-11000-A-A218	DATA SHEET & GA FOR MOTORS (FAN, SUPPLY AND EXHAUST AXIAL FANS)	5
23	PE-V0-479-571-11000-A-A219	DATA SHEET & GA FOR HEATERS	5
24	PE-V0-479-571-11000-A-A222	GA OF AIR TERMINALS LIKE SUPPLY/RETURN AIR DIFFUSER / GRILL / BACK DRAFT DAMPER / INTAKE LOUVER ETC FOR HVAC SYSTEM	3
25	PE-V0-479-571-11000-A-A502	SCHEME FOR AIR DISTRIBUTION IN POWER HOUSE	6
26*	PE-V0-479-571-11000-A-A503	PID FOR VENTILATION SYSTEM	2
27*	PE-V0-479-571-11000-A-A504	PID FOR AC SYSTEM	2
28*	PE-V0-479-571-11000-A-A505	PAINTING SPECIFICATION FOR HVAC SYSTEM	3
29*	PE-V0-479-571-11000-A-A506	TYPICAL DETAILS OF DUCT FABRICATION DRAWING / SUPPORT / ERECTION.	4

	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-479-571-11000-A001	
		SECTION : I	
		SUB-SECTION : E	
		REV 00	DATE: June 2023
		SHEET 3 OF 6	

30	PE-V0-479-571-11000-A-A507	AC DUCT LAYOUT FOR CONTROL ROOM AND OTHER APPLICABLE AREAS	5
31*	PE-V0-479-571-11000-A-A508	VENTILATION ROOM & VENTILATION DUCT LAYOUT FOR ALL THE FLOOR FOR POWER HOUSE	5
32*	PE-V0-479-571-11000-A-A701	ELECTRICAL PANEL DRAWING INCULDING SLD	6
33	PE-V0-479-571-11000-A702	TDS OF CONTROL PANEL WITH CONFIGURATION DIAGRAM, BILL OF MATERIAL, GA &INTERNAL WIRING DIAGRAM, LOGIC FLOW DIAGRAM, IO WIRING DIAGRAM, CONTROL ROOM LAYOUT	8
34	PE-V0-479-571-11000-A-A703	ELECTRICAL FEEDER LIST.	8
35	PE-V0-479-571-11000-A-A704	CABLE SCHEDULE	8
36	PE-V0-479-571-11000-A-A705	TDS FOR POWER AND CONTROL CABLES-TYPE TEST CERTIFICATE FOR CALES, TYPE TEST PROCEDUE, CROSS SECTION	8
37	PE-V0-479-571-11000-A-A706	TDS AND GA FOR ELECTRICAL PANEL-SCHEME, SLD, BILL OF MATERIAL	8
38	PE-V0-479-571-11000-A-A707	TDS FOR CABLING-CABLE TRAY, CABLE SUPPORT, TYPE TEST CERTIFICATE, JOINTING KITS, TRIFOIL CLAMPS, ABOVE GROUND EARTHING	8
39	PE-V0-479-571-11000-A708	IO / DRIVE LIST FOR HVAC SYSTEM	6
40	PE-V0-479-571-11000-A710	LOGIC DRAWING FOR HVAC SYSTEM	8
41	PE-V0-479-571-11000-A711	TECHNICAL DATASHEET & GA , TYPE TEST OF JUNCTION BOX FOR HVAC SYSTEM	8
44	PE-V0-479-571-11000-A-A901	DEMONSTRATION TEST PROCEDURE.	12
45	PE-V0-479-571-11000-A-A902	O & M MANUAL.	14

Notes:

1. Drawings/Documents marked with '*' shall be considered as basic engineering documents.
2. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work
2. Drawings shall be prepared in auto-cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. inspection, construction, erection and maintenance etc.:-

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

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

	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-479-571-11000-A001
		SECTION : I
		SUB-SECTION : E
		REV 00 / DATE: June 2023
		SHEET 4 OF 6

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

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

e) Drawings/ documents to be submitted for purchasers review/ approval shall be under revision a, b, c… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under r-0, 1, 2, 3 ….etc.

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

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

h) All drawings shall be prepared as per BHEL'S title block and shall bear BHEL'S drawing no.

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

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

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

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

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

SECTION-I

SUB-SECTION-E

ANNEXURE-VI

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM FORMAT FOR OPERATION AND MAINTENANCE MANUAL	**SPECIFICATION No: PE-TS-479-571-11000-A001**
		SECTION : I
		SUB-SECTION : E
		REV 00 / **DATE: June 2023**

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

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

	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM FORMAT FOR OPERATION AND MAINTENANCE MANUAL	SPECIFICATION No: PE-TS-479-571-11000-A001 SECTION : I SUB-SECTION : E REV 00 | DATE: June 2023

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

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

SECTION-I

SUB SECTION E

ANNEXURE-VIII

PAINTING SPECIFICATION & COLOUR SCHEME (COVERED UNDER SECTION C2-B)

	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM PACKING PROCEDURE	SPECIFICATION No: PE-TS-479-571-11000-A001	
		SECTION : I	
		SUB-SECTION : E	
		REV 00	DATE: June 2023

SECTION-I

SUB SECTION E

ANNEXURE-IX

PACKING PROCEDURE
(COVERED UNDER SECTION C2-B)

SECTION-II

SECTION-II

SUB-SECTION-1

INSPECTION AND TESTING

1.01.00 Inspection and Tests during Manufacture.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1.02.00 Performance Tests at Site

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

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

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

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

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

	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM INSPECTION AND TESTING	SPECIFICATION No: PE-TS-479-571-11000-A001 SECTION : II SUB-SECTION : 1 REV 00 | DATE: June 2023

QAP FORMAT

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT: SYSTEM :

VENDOR : ITEM :

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

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

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

SECTION: II

SUB SECTION: 2

LIST OF DOCUMENTS TO BE SUBMITTED WITH BID

	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	SPECIFICATION No: PE-TS-479-571-11000-A001
		SECTION : II
		SUB-SECTION : 2
		REV: 00 / DATE: June 2023

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

1. Compliance cum confirmation certificate
2. Un priced format for HVAC package
    a. Unpriced format for Main package, mandatory spares, tools and tackles and commissioning spares
3. Deviation schedule /No deviation certificate in attached format 'Deviation sheet (Cost of withdrawal)'.

SECTION: II

SUB SECTION: 3

COMPLIANCE CUM CONFIRMATION CERTIFICATE

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SECTION: II

SUB SECTION: 4

PRE-BID CLARIFICATION SCHEDULE

	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM PRE-BID CLARIFICATION SCHEDULE	SPECIFICATION No: PE-TS-479-571-11000-A001 SECTION : II SUB-SECTION : 4 REV. NO. 00 | DATE: June 2023

PRE-BID CLARIFICATION SCHEDULE

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

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

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

SECTION: II

SUB SECTION: 5

NO DEVIATION CERTIFICATE
(REFER ANNEXURE-II OF GCC REV 07)

	2x20 MW RAHUGHAT HYDRO ELECTRIC PROJECT HVAC SYSTEM NO DEVIATION CERTIFICATE	**SPECIFICATION No: PE-TS-479-571-11000-A001** **SECTION : II** **SUB-SECTION : 5** **REV: 00** / **DATE: June 2023**

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

NOTES:

1. Cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. All the bidders have to list out all of their Technical & Commercial Deviations (if any) in detail in the above format.
3. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
4. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable. In absence of same, such deviation (s) shall not be considered and offer shall be considered in total compliance to NIT.
5. Bidder shall furnish price copy of above format along with price bid.
6. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
7. Bidders to note that any deviation (technical / commercial) not listed in above and asked after Part I opening shall not be considered.
8. For deviations w.r.t. Credit period, Liquidated damages, Firm prices if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VII, will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
9. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not

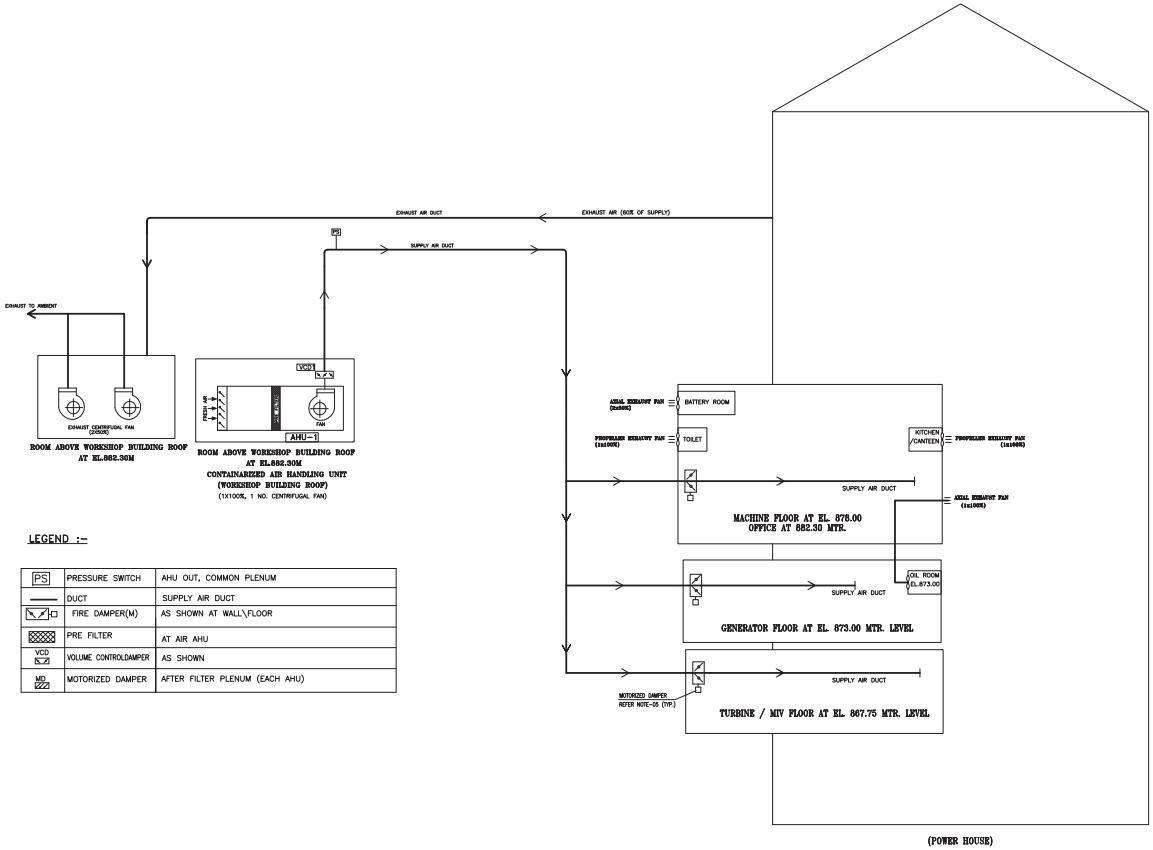
be considered.
10. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
11. Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
12. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
13. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

SECTION: II

SUB SECTION: 6

TENDER DRAWINGS

ALL DIMENSIONS ARE IN MM FIRST ANGLE PROJECTION



LEGEND :-

PS	PRESSURE SWITCH	AHU OUT, COMMON PLENUM
	DUCT	SUPPLY AIR DUCT
	FIRE DAMPER(M)	AS SHOWN AT WALL\FLOOR
	PRE FILTER	AT AIR AHU
VCD	VOLUME CONTROLDAMPER	AS SHOWN
MD	MOTORIZED DAMPER	AFTER FILTER PLENUM (EACH AHU)

NOTES :-

1 ALL EQUIPMENT DRAIN SHALL BE CONNECTED TO NEAREST BUILDING/ PLANT ROOM DRAIN (BY HVAC SUPPLIER)

2 MOTORIZED DAMPERS SHALL BE PROVIDED IN THE DUCT WHERE IT WILL CROSS THE WALL/FLOOR. FURTHER IN BRANCH DUCT, VOLUME CONTROL DAMPER SHALL BE PROVIDED

3 THE INSTRUMENTATION & CONTROL / MONITORING SHALL BE FINALIZED DURING DETAILED ENGINEERING.

4 DRAIN & VENT VALVE SHALL BE PROVIDED AS PER LAYOUT REQUIREMENT.

5 PIPE / DUCT INSULATION SHALL BE PROVIDED WHEREVER IF REQUIRED.

6 The instruments mentioned in this P&ID are bare minimum and any other instrument required as per system requirement/ customer observations during detail engineering shall be provided by bidder without any commercial implication.

7 The redundancy of the instruments shall be as per C&I portion of technical specification.

REV	DATE	ALTD	CHD	APPD
01				

JOB No. 479
STATUS CONTRACT
DISTRIBUTION
TO
No.OFF

PROJECT RAHUGHAT HYDROELECTRIC PROJECT (2X20 MW)
CUSTOMER RAHUGANGA HYDROPOWER LIMITED

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
A	DRN	TG	-SD-	21.03.2023
	DESN	VN	-SD-	21.03.2023
	CHD	LJ	-SD-	21.03.2023
	APPD	SG	-SD-	21.03.2023

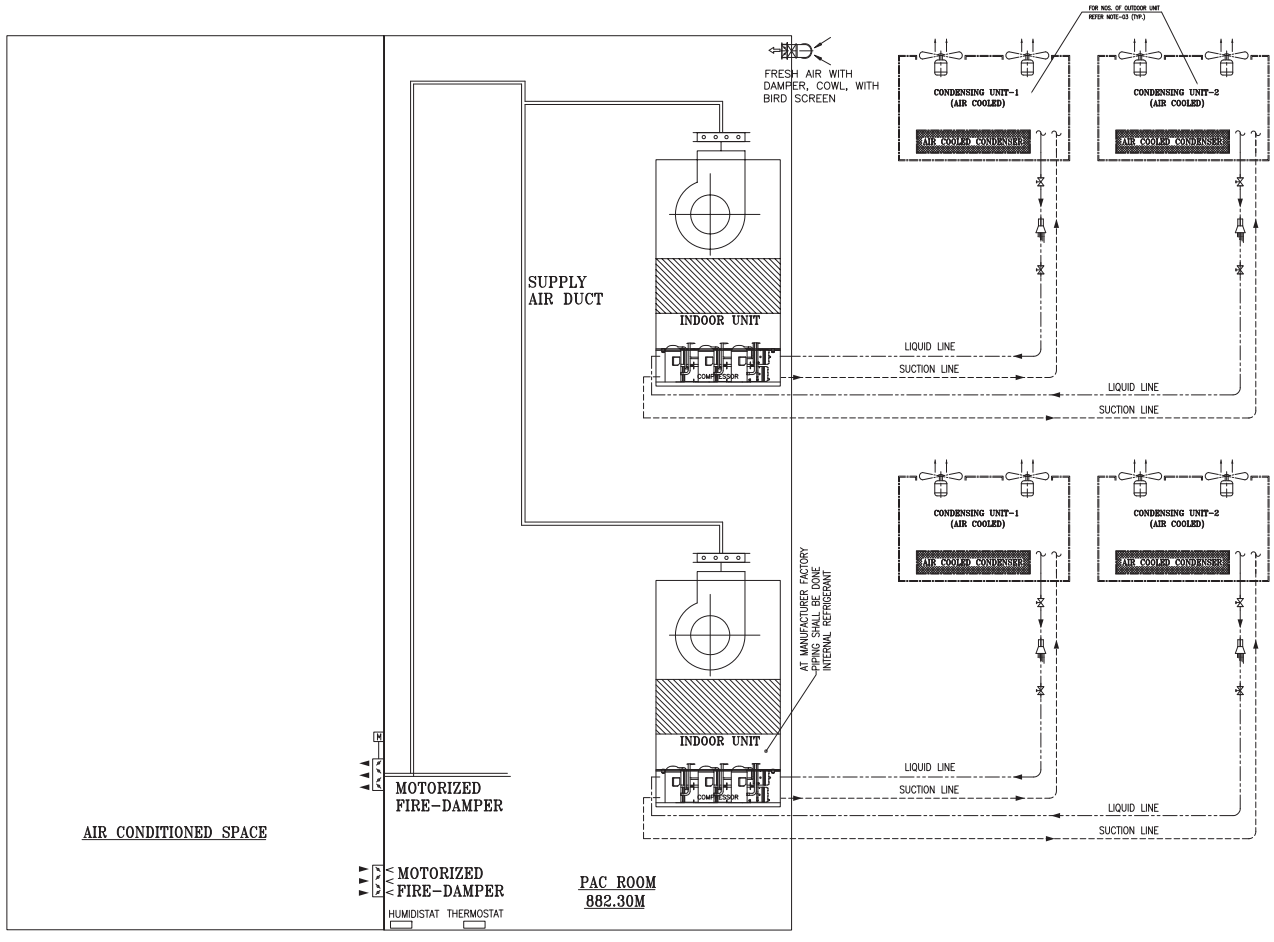
TITLE
P & I DIAGRAM FOR VENTILATION SYSTEM

MPL	C	MSE	I	MAX	E	DEPT.	SCALE TAL18	BHEL DRAWING No.
						SIGN		PE-DG-479-571-11000-A001
						DATE		SHEET 01 OF 02 REV 01

SIZE-A2

COMPUTER FILE NAME :

ALL DIMENSIONS ARE IN MM FIRST ANGLE PROJECTION



L E G E N D:

- BALL VALVE
- CATCH ALL DRIER
- THERMOSTATIC BULB
- EXPANSION VALVE
- HOT GAS SUCTION LINE.
- LIQUID LINE

SCHEMATIC FOR AIR COOLED PRECISION AIR CONDITIONERS (1W+1S) TYP.

NOTES :-

1. THIS IS A TYPICAL P&ID FOR PAC AND IT MAY VARY AS PER OEM DESIGN.
2. ACTUAL QUANTITY OF PAC SHALL BE AS PER HEAT LOAD CALCULATION OF RESPECTIVE AC AREA.
3. THE NUMBER OF COMPRESSOR & OUTDOOR CONDENSING UNIT FOR EACH PAC SHALL BE AS PER OEM DESIGN.
4. AC DUCT SHALL BE INSULATED AS PER SPECIFICATION.
5. THE INSTRUMENTATION & CONTROL SHALL BE FINALIZED DURING DETAILED ENGINEERING.
6. PIPE INSULATION SHALL BE PROVIDED WHEREVER IF REQUIRED.
7 The instruments mentioned in this P&ID are bare minimum and any other instrument required as per system requirement/ customer observations during detail engineering shall be provided by bidder without any commercial implication.
8 The redundancy of the instruments shall be as per C&I portion of technical specification.

REV	DATE	ALTD	CHD	APPD	REV	DATE	ALTD	CHD	APPD

JOB No.	479
STATUS	CONTRACT
DISTRIBUTION	
TD	
No.OFF	

PROJECT: RAHUGHAT HYDROELECTRIC PROJECT (2X20 MW)
CUSTOMER: RAHUGANGA HYDROPOWER LIMITED

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
A	DRN	VN	-SD-	13.03.2022
	DESN	VN	-SD-	13.03.2022
	CHD	LJ	-SD-	13.03.2022
	APPD	SG	-SD-	13.03.2022

TITLE: P & I DIAGRAM FOR PACKAGE AIR CONDITIONING

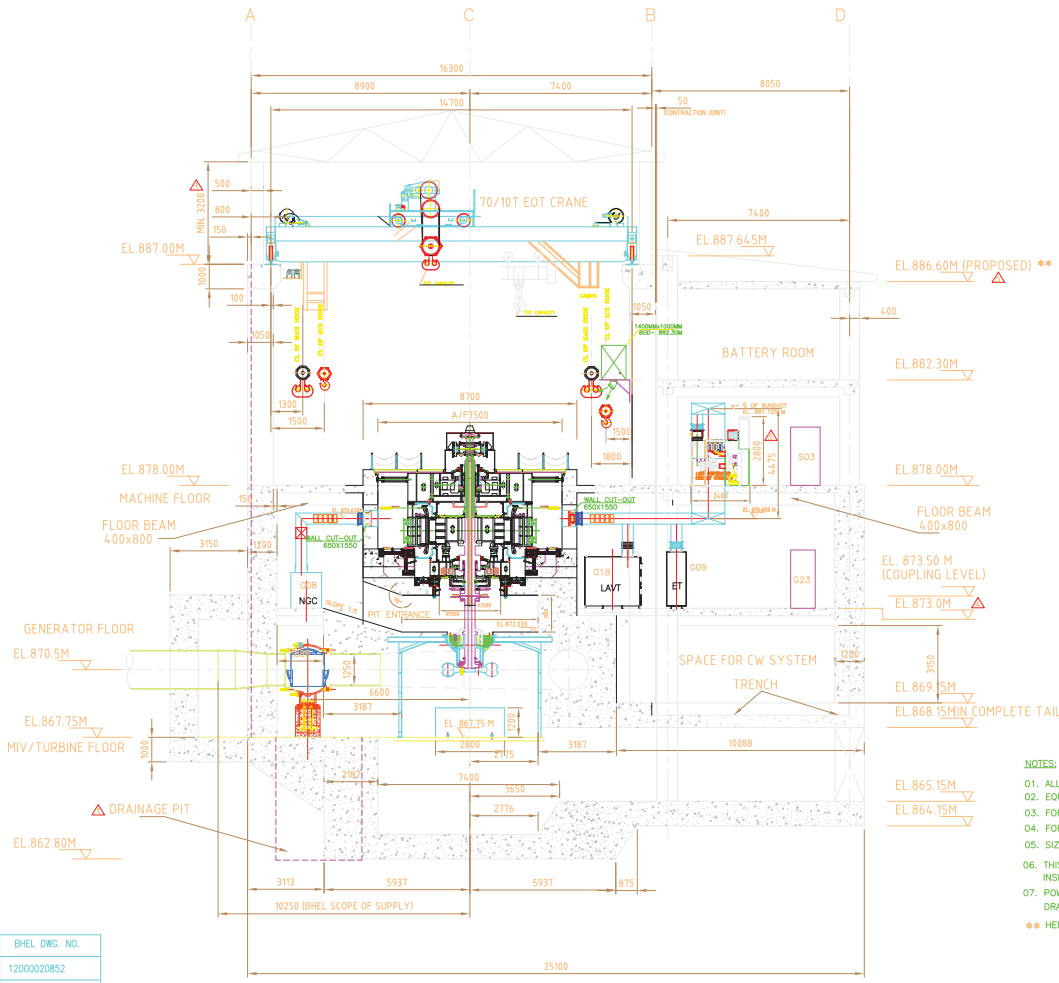
MPL	C	MSE	I	MAX	E	DEPT.	SCALE
						SIGN	
						DATE	

BHEL DRAWING No.: PE-DG-479-571-11000-A001
SHEET 02 OF 02 REV 00
SIZE-A2

COMPUTER FILE NAME :

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)



CROSS SECTION △

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. EQUIPMENT SHOWN AND LISTED ARE TENTATIVE AND SHALL BE FINALISED INCLUDING SIZES DURING DETAILED DESIGN.
03. FOR STAGE WISE CONCRETING AND EMBEDMENT DETAILS REFER TURBINE DRAWINGS OF BHEL.
04. FOR MIV, MIV FOUNDATION AND COUNTERWEIGHT DETAILS REFER TURBINE DRAWINGS OF BHEL.
05. SIZES OF COLUMNS/BEAMS/SLABS/STAIRS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.
06. THIS DRAWING IS INTENDED FOR SHOWING LAYOUT & CIVIL REQUIREMENTS OF FLOOR ONLY. FOR CIVIL DETAILS/EMBEDMENTS INSIDE BARREL/HOUSING RESPECTIVE SYSTEM DRAWING .
07. POWERHOUSE FLOOR DRAIN TO BE SUITABLY DESIGNED BY CIVIL.
DRAINAGE PIT (IF REQUIRED MAY BE PLANNED SUITABLY BY WAPCOS/CIVIL.

** HEIGHT SHALL BE INCREASED BY 1000 MM TO ACCOMMODATE THE PAC ALONG WITH THE SAD, NRD & BENDS ETC.

LINKED DRAWINGS :-

SL No.	DESCRIPTION	BHEL DWG. NO.
01	STATION LAYOUT PLAN AT EL. 867.75M (MIV/TURBINE FLOOR)	12000020852
02	STATION LAYOUT PLAN AT EL. 872.55M	12000020853
03	STATION LAYOUT PLAN AT EL. 878.00M	12000020854
04	STATION LAYOUT PLAN AT EL. 882.30M	12000020855
05	LONGITUDINAL SECTION OF POWER HOUSE	12000020356
06	GENERATOR SECTIONAL ARRGT DRG	02500008703
07	SECTION THROUGH TURBINE	02000020802
08	INSTALLATION OF TURBINE HOUSING	02021120801
09	ARRANGEMENT OF COOLING WATER SYSTEM	02292020801
10	CRANE CLEARANCE DIAGRAM OF 70/10T EOT CRANE OF PH	PE-DG-479-501-A001
11	FOUNDATION AND CUT-OUTS IN FIRST STAGE	02010020801
12	LOADS ON FOUNDATION (TURBINE)	02000020803
13	VENTILATION ROOM & VENTILATION DUCT LAYOUT FOR ALL THE FLOOR FOR POWER HOUSE	PE-VD-479-571-11000-A-A507

REV.	DATE	ALTERED	CHECKED	APPD.	ZONE	DESCRIPTION
05	11.04.23	T.KHAN	S.SAHU	R.S	△	DRAWING REVISED TO INCORPORATE CIVIL DETAILS.
04	18.01.21	T.KHAN	S.SAHU	R.S	△	DRAWING REVISED AS PER REVISED CIVIL DRAWINGS
03	09.09.20	T.KHAN	S.SAHU	R.S	△	DRAWING REVISED AS PER CUSTOMER COMMENTS
02	22.06.20	T.KHAN	S.SAHU	R.S		DRAWING REVISED AS PER CUSTOMER COMMENTS
01	13.04.20	T.KHAN	S.SAHU	R.S		DRAWING REVISED AS PER CUSTOMER COMMENTS

CUSTOMER: RAGHUGANGA HYDROPOWER LIMITED

CONSULTANT: WAPCOS LIMITED, GURGAON
(A GOVT. OF INDIA UNDERTAKING)

PROJECT: RAHUGHAT HYDROELETRIC PROJECT (2x20 MW)

BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT. CODE		NAME	SIGN	DATE
HPE 415	DRN	T.KHAN		06.12.19
	CKD	S.SAHU		06.12.19
	APPD	R.S		06.12.19

NO. OF VAR

SUB-VENDOR DRG. NO. | PO REF | NO. OF ITEMS

TITLE: CROSS SECTION ARRANGEMENT OF POWER HOUSE

DRG. NO. –

SUB-VENDOR NAME | WEIGHT (kg) | SCALE 1:100

BHEL DRG. NO. 12000020851 | REV. 05

SHEET NO. 01 | NO. OF SHT. 01

A1 SIZE

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

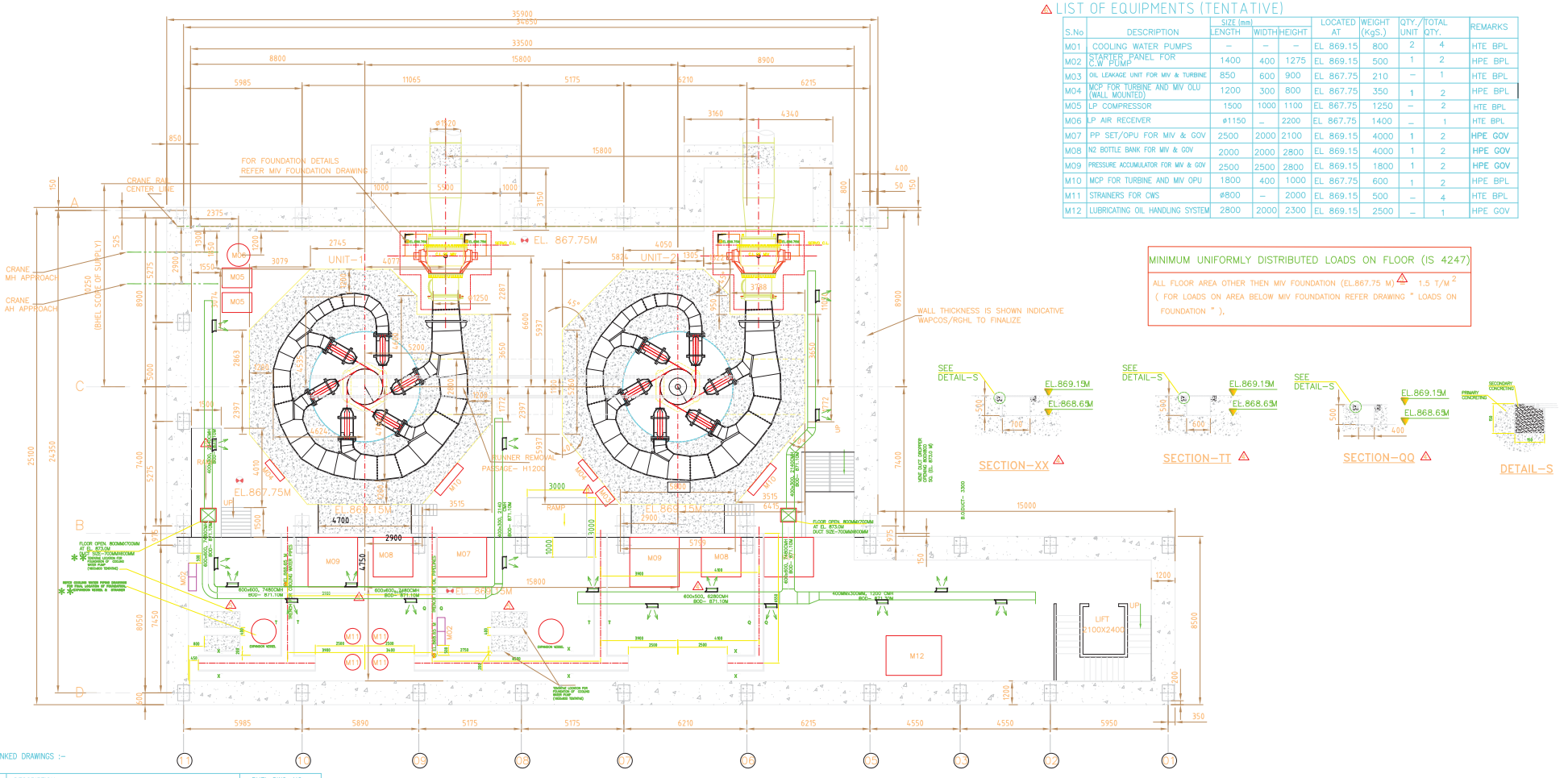
LIST OF EQUIPMENTS (TENTATIVE)

S.No	DESCRIPTION	SIZE (mm) LENGTH	WIDTH	HEIGHT	LOCATED AT	WEIGHT (KgS.)	QTY./ UNIT	TOTAL QTY.	REMARKS
M01	COOLING WATER PUMPS	–	–	–	EL. 869.15	800	2	4	HTE BPL
M02	STARTER PANEL FOR C.W. PUMP	1400	400	1275	EL. 869.15	500	1	2	HPE BPL
M03	OIL LEAKAGE UNIT FOR MIV & TURBINE	850	600	900	EL. 867.75	210	–	1	HTE BPL
M04	MCP FOR TURBINE AND MIV OLU (WALL MOUNTED)	1200	300	800	EL. 867.75	350	1	2	HPE BPL
M05	LP COMPRESSOR	1500	1000	1100	EL. 867.75	1250	–	2	HTE BPL
M06	LP AIR RECEIVER	ø1150	–	2200	EL. 867.75	1400	–	1	HTE BPL
M07	PP SET/OPU FOR MIV & GOV	2500	2000	2100	EL. 869.15	4000	1	2	HPE GOV
M08	N2 BOTTLE BANK FOR MIV & GOV	2000	2000	2800	EL. 869.15	4000	1	2	HPE GOV
M09	PRESSURE ACCUMULATOR FOR MIV & GOV	2500	2500	2800	EL. 869.15	1800	1	2	HPE GOV
M10	MCP FOR TURBINE AND MIV OPU	1800	400	1000	EL. 867.75	600	1	2	HPE BPL
M11	STRAINERS FOR CWS	ø800	–	2000	EL. 869.15	500	–	4	HTE BPL
M12	LUBRICATING OIL HANDLING SYSTEM	2800	2000	2300	EL. 869.15	2500	–	1	HPE GOV

MINIMUM UNIFORMLY DISTRIBUTED LOADS ON FLOOR (IS 4247)

ALL FLOOR AREA OTHER THEN MIV FOUNDATION (EL.867.75 M) △ 1.5 T/M^2

(FOR LOADS ON AREA BELOW MIV FOUNDATION REFER DRAWING " LOADS ON FOUNDATION ").



LINKED DRAWINGS :–

SL. No.	DESCRIPTION	BHEL DWG. NO.
01	CROSS SECTION ARRANGEMENT OF POWER HOUSE	12000020851
02	STATION LAYOUT PLAN AT EL. 872.55M	12000020853
03	STATION LAYOUT PLAN AT EL. 878.00M	12000020854
04	STATION LAYOUT PLAN AT EL. 882.30M	12000020855
05	LONGITUDINAL SECTION OF POWER HOUSE	12000020856
06	GENERATOR SECTIONAL ARRGT DRG	02500008703
07	SECTION THROUGH TURBINE	02000020802
08	INSTALLATION OF TURBINE HOUSING	02021120801
09	ARRANGEMENT OF COOLING WATER SYSTEM	02292020801
10	CRANE CLEARANCE DIAGRAM OF 70/10T EOT CRANE OF PH	PE–DG–479–501–A001
11	FOUNDATION AND CUT–OUTS IN FIRST STAGE	02010020801
12	LOADS ON FOUNDATION (TURBINE)	02000020803
13	PIPES AND EMBEDMENTS IN FIRST STAGE	02010420801
14	VENTILATION ROOM & VENTILATION DUCT LAYOUT FOR ALL THE FLOOR FOR POWER HOUSE	PE–VD–479–571–11000–A–A507

MIV/TURBINE FLOOR AT EL. 867.75M △

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. EQUIPMENT SHOWN AND LISTED ARE TENTATIVE AND SHALL BE FINALISED INCLUDING SIZES DURING DETAILED DESIGN.
03. FOR STAGE WISE CONCRETING AND EMBEDMENT DETAILS REFER TURBINE DRAWINGS OF BHEL.
04. FOR MIV, MIV FOUNDATION AND COUNTERWEIGHT DETAILS REFER TURBINE DRAWINGS OF BHEL.
05. SIZES OF COLUMNS/BEAMS/SLABS/STAIRS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.
06. ✱✱ COOLING WATER EQUIPMENT SHALL BE SHOWN LATER AFTER FINALIZATION OF COOLING WATER DRG
07. THIS DRAWING IS INTENDED FOR SHOWING LAYOUT & CIVIL REQUIREMENTS OF FLOOR ONLY. FOR CIVIL DETAILS/EMBEDMENTS INSIDE BARREL/HOUSING RESPECTIVE SYSTEM DRAWING .
08. POWERHOUSE FLOOR DRAIN TO BE SUITABLY DESIGNED BY CIVIL. DRAINAGE PIT (IF REQUIRED MAY BE PLANNED SUITABLY BY WAPCOS/CIVIL.

REV.	DATE	ALTERED	T.KHAN
06	11.04.23	CHECKED	S.SAHU
		APPD.	R.S
ZONE △	DRAWING REVISED TO INCORPORATE CIVIL DETAILS.		

REV.	DATE	ALTERED	T.KHAN
05	22.06.21	CHECKED	S.SAHU
		APPD.	R.S
ZONE △	DRAWING REVISED AS PER WAPCOS COMMENTS		

REV.	DATE	ALTERED	T.KHAN
04	18.01.21	CHECKED	S.SAHU
		APPD.	R.S
ZONE △	DRAWING REVISED AS PER REVISED CIVIL DRAWINGS		

REV.	DATE	ALTERED	T.KHAN
03	09.09.20	CHECKED	S.SAHU
		APPD.	R.S
ZONE	DRAWING REVISED AS PER CUSTOMER COMMENTS		

REV.	DATE	ALTERED	T.KHAN
02	22.06.20	CHECKED	S.SAHU
		APPD.	R.S
ZONE	DRAWING REVISED AS PER CUSTOMER COMMENTS		

REV.	DATE	ALTERED	T.KHAN
01	13.04.20	CHECKED	S.SAHU
		APPD.	R.S
ZONE	DRAWING REVISED AS PER CUSTOMER COMMENTS		

CUSTOMER : RAGHUGANGA HYDROPOWER LIMITED

CONSULTANT : WAPCOS LIMITED, GURGAON
(A GOVT. OF INDIA UNDERTAKING)

PROJECT : RAHUGHAT HYDROELETRIC PROJECT (2x20 MW)

BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT. CODE		NAME	SIGN	DATE	NO. OF VAR
HPE 415	DRN	T.KHAN		06.12.19	
	CKD	S.SAHU		06.12.19	
	APPD	R.S		06.12.19	

SUB–VENDOR DRG. NO. | PO REF | NO. OF ITEMS

TITLE : STATION LAYOUT PLAN AT EL. 867.75M (MIV/TURBINE FLOOR)

DRG. NO. –

SUB–VENDOR NAME | WEIGHT (kg) | SCALE 1:100

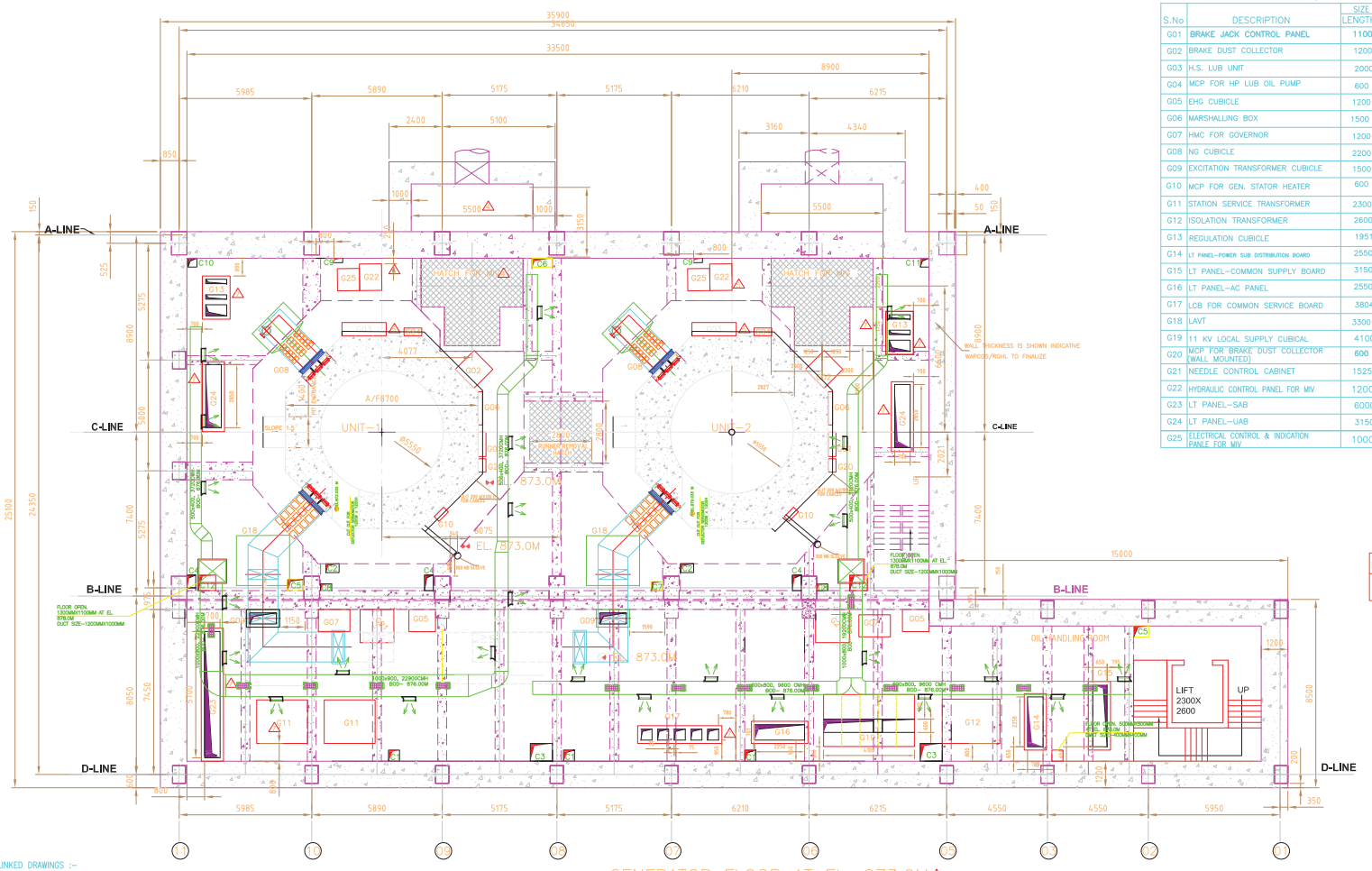
BHEL DRG. NO. 12000020852 | REV. 06

SHEET NO. 01 | NO. OF SHT. 01

A1 SIZE

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)



LIST OF EQUIPMENTS (TENTATIVE)

S.No	DESCRIPTION	SIZE (mm) LENGTH	WIDTH	HEIGHT	LOCATED AT	WEIGHT (KgS.)	QTY./ UNIT	TOTAL QTY.	REMARKS
G01	BRAKE JACK CONTROL PANEL	1100	350	1200	EL. 872.55	350	1	2	HGE
G02	BRAKE DUST COLLECTOR	1200	1200	2500	EL. 872.55	500	1	2	HGE
G03	H.S. LUB UNIT	2000	800	800	EL. 872.55	400	1	2	HGE
G04	MCP FOR HP LUB OIL PUMP	600	350	800	EL. 872.55	175	1	2	HPE
G05	EHG CUBICLE	1200	1000	2520	EL. 872.55	900	1	2	GOV
G06	MARSHALLING BOX	1500	200	1200	EL. 872.55	100	1	2	HGE
G07	HMC FOR GOVERNOR	1200	1000	2800	EL. 872.55	1500	1	2	GOV
G08	NG CUBICLE	2200	1600	2035	EL. 872.55	1400	1	2	RP
G09	EXCITATION TRANSFORMER CUBICLE	1500	800	2450	EL. 872.55	750	1	2	EDN
G10	MCP FOR GEN. STATOR HEATER	600	300	800	EL. 872.55	175	1	2	HPE
G11	STATION SERVICE TRANSFORMER	2300	1965	2300	EL. 872.55	3700	1	2	JHS
G12	ISOLATION TRANSFORMER	2600	2000	2900	EL. 872.55	4600	-1	1	JHS
G13	REGULATION CUBICLE	1951	1250	2295	EL. 872.55	2000	1	2	EDN
G14	LT PANEL-POWER SUB DISTRIBUTION BOARD	2550	1000	2375	EL. 872.55	1600	–	1	HPE
G15	LT PANEL-COMMON SUPPLY BOARD	3150	1000	2375	EL. 872.55	2200	–	1	HPE
G16	LT PANEL-AC PANEL	2550	1000	2375	EL. 872.55	1600	–	1	HPE
G17	LCB FOR COMMON SERVICE BOARD	3804	800	2295	EL. 872.55	1500	1	2	EDN
G18	LAVT	3300	2250	2500	EL. 872.55	5000	1	2	RP
G19	11 KV LOCAL SUPPLY CUBICAL	4100	2349	2634	EL. 872.55	7500	–	1	SWE
G20	MCP FOR BRAKE DUST COLLECTOR (WALL MOUNTED)	600	350	800	EL. 872.55	175	1	2	HPE
G21	NEEDLE CONTROL CABINET	1525	1500	2830	EL. 872.55	2000	1	2	GOV
G22	HYDRAULIC CONTROL PANEL FOR MIV	1200	1000	2500	EL. 872.55	1000	1	2	GOV
G23	LT PANEL-SAB	6000	1000	2375	EL. 872.55	2200	–	1	HPE
G24	LT PANEL-UAB	3150	1000	2375	EL. 872.55	3500	1	2	HPE
G25	ELECTRICAL CONTROL & INDICATION PANLE FOR MIV	1000	1000	2400	EL. 872.55	400	1	2	GOV

MINIMUM UNIFORMLY DISTRIBUTED LOADS ON FLOOR (IS 4247)

GENERATOR FLOOR AREAS = 1 T/M^2

CUTOUT DETAILS

S.No	SYSTEM	SIZE (mm)
C1	CUT OUT FOR CWS	500x500
C2	CUT OUT FOR CWS	600x400
C3	CUT OUT FOR CABLE TRAY	1000x800
C4	CUT OUT FOR CABLE TRAY	400x700
C5	CUT OUT FOR FPS	700x800
C6	CUT OUT FOR FPS	900x400
C7	CUT OUT FOR FPS	500x400
C8	CUT OUT FOR OIL PIPING	500x300
C9	CUT OUT FOR OIL PIPING	400x200
C10	CUTOUT FOR OIL PIPING/COMPRESSED AIR	400x400
C11	CUT OUT FOR SPARE	400x400
C12	CUT OUT FOR HVAC	800X700

LINKED DRAWINGS :-

SL. No.	DESCRIPTION	BHEL DWG. NO.
01	CROSS SECTION ARRANGEMENT OF POWER HOUSE	12000020851
02	STATION LAYOUT PLAN AT EL. 867.75M (MIV/TURBINE FLOOR)	12000020852
03	STATION LAYOUT PLAN AT EL. 878.00M	12000020854
04	STATION LAYOUT PLAN AT EL. 882.30M	12000020855
05	LONGITUDINAL SECTION OF POWER HOUSE	12000020356
06	GENERATOR SECTIONAL ARRGT DRG	02500008703
07	ARRANGEMENT OF COOLING WATER SYSTEM	02292020801
08	CRANE CLEARANCE DIAGRAM OF 70/10T EOT CRANE OF PH	PE-DG-479-501-A001
09	VENTILATION ROOM & VENTILATION DUCT LAYOUT FOR ALL THE FLOOR FOR POWER HOUSE	PE-VD-479-571-11000-A-A507
10	PIPE AND EMBEDMENTS IN SECOND STAGE	02020820801

GENERATOR FLOOR AT EL. 873.0M

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. EQUIPMENT SHOWN AND LISTED ARE TENTATIVE AND SHALL BE FINALISED INCLUDING SIZES DURING DETAILED DESIGN.
03. FOR STAGE WISE CONCRETING AND EMBEDMENT DETAILS REFER TURBINE DRAWINGS OF BHEL.
04. SIZES OF COLUMNS/BEAMS/SLABS/STAIRS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.
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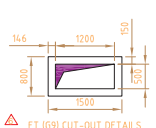
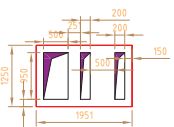
06. POWERHOUSE FLOOR DRAIN TO BE SUITABLY DESIGNED BY CIVIL.





REV.	DATE	ALTERED	T.KHAN
		CHECKED	S.SAHU
		APPD.	R.S
ZONE			

05 | 22.06.21 | DRAWING REVISED AS PER WAPCOS COMMENTS

04 | 18.01.21 | DRAWING REVISED AS PER REVISED CIVIL DRAWINGS

03 | 09.09.20 | DRAWING REVISED AS PER CUSTOMER COMMENTS

02 | 22.06.20 | DRAWING REVISED AS PER CUSTOMER COMMENTS

01 | 13.04.20 | DRAWING REVISED AS PER CUSTOMER COMMENTS

07 | 16.05.23 | DRAWING REVISED TO INCORPORATE CIVIL DETAILS.

06 | 11.04.23 | DRAWING REVISED TO INCORPORATE CIVIL DETAILS.

CUSTOMER : RAGHUGANGA HYDROPOWER LIMITED

CONSULTANT : WAPCOS LIMITED, GURGAON
(A GOVT. OF INDIA UNDERTAKING)

PROJECT : RAHUGHAT HYDROELETRIC PROJECT (2x20 MW)

BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT. CODE		NAME	SIGN	DATE
HPE 415	DRN	T.KHAN		06.12.19
	CKD	S.SAHU		06.12.19
	APPD	R.S		06.12.19

SUB-VENDOR DRG. NO. | PO REF | NO. OF ITEMS

TITLE : STATION LAYOUT PLAN AT EL. 873.0M

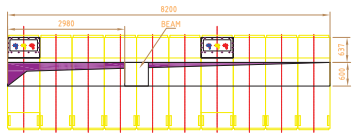
DRG. NO. : —

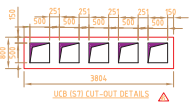
SUB-VENDOR NAME | WEIGHT (kg) | SCALE 1:100

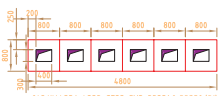
BHEL DRG. NO. 12000020853 | REV. 07

SHEET NO. 01 | NO. OF SHT. 01

A1 SIZE

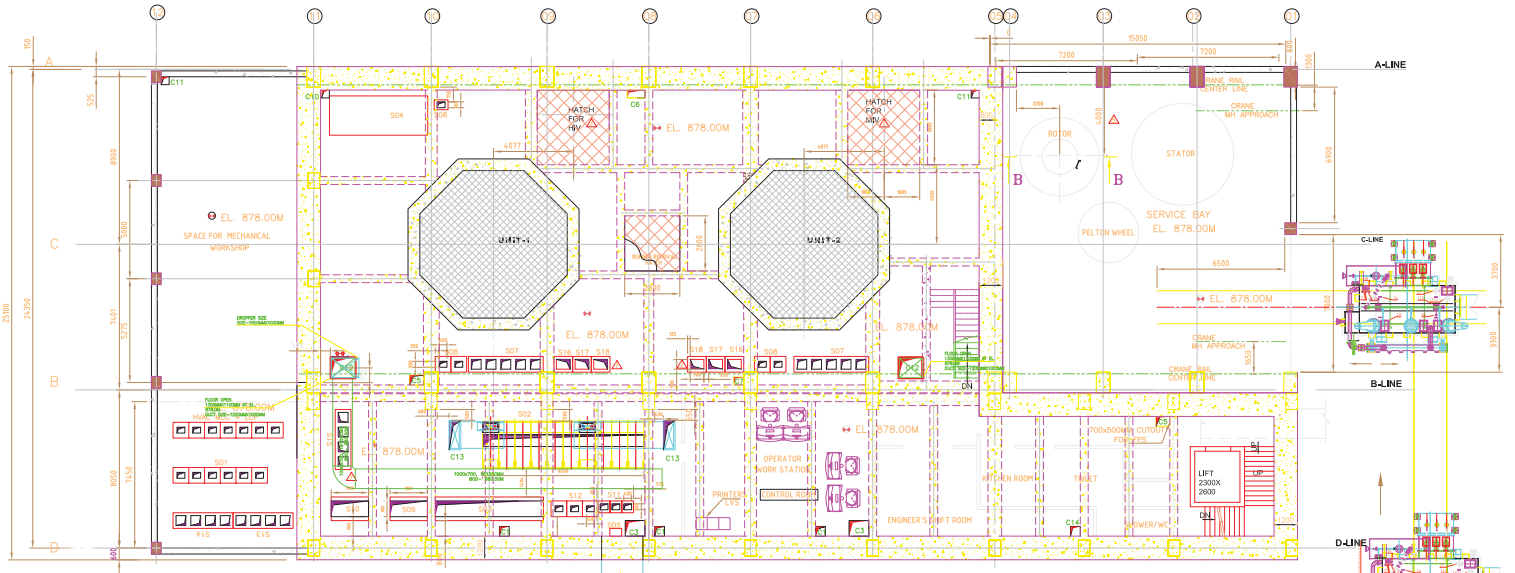






LINKED DRAWINGS :-

SL. No.	DESCRIPTION	BHEL DWG. NO.
01	CROSS SECTION ARRANGEMENT OF POWER HOUSE	12000020851
02	STATION LAYOUT PLAN AT EL. 867.75M (MIV/TURBINE FLOOR)	12000020852
03	STATION LAYOUT PLAN AT EL. 872.55M	12000020853
04	STATION LAYOUT PLAN AT EL. 882.30M	12000020855
05	LONGITUDINAL SECTION OF POWER HOUSE	12000020356
06	GENERATOR SECTIONAL ARRGT DRG	02500008703
07	CRANE CLEARANCE DIAGRAM OF 70/10T EOT CRANE OF PH	PE-DG-479-501-A001
08	LOADING ON SERVICE BAY	22500008703
09	VENTILATION ROOM & VENTILATION DUCT LAYOUT FOR ALL THE FLOOR FOR POWER HOUSE	PE-VD-479-571-11000-A-A507

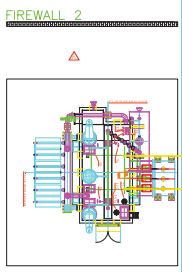


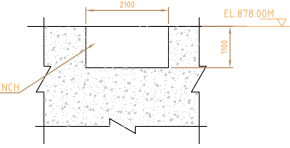
CUTOUT DETAILS

S.No	SYSTEM	SIZE (mm)
C1	CUT OUT FOR CWS	500x500
C3	CUT OUT FOR CABLE TRAY	1000x800
C5	CUT OUT FOR FPS	700x800
C6	CUT OUT FOR FPS	900x400
C7	CUT OUT FOR FPS	500x400
C10	CUTOUT FOR OIL PIPING/COMPRESSED AIR	400x400
C11	CUT OUT FOR SPARE	400x400
C12	CUT OUT FOR HVAC	1300x1100
C13	CUT OUT FOR BUS DUCT	1500x800
C14	CUT OUT FOR HVAC	500x500

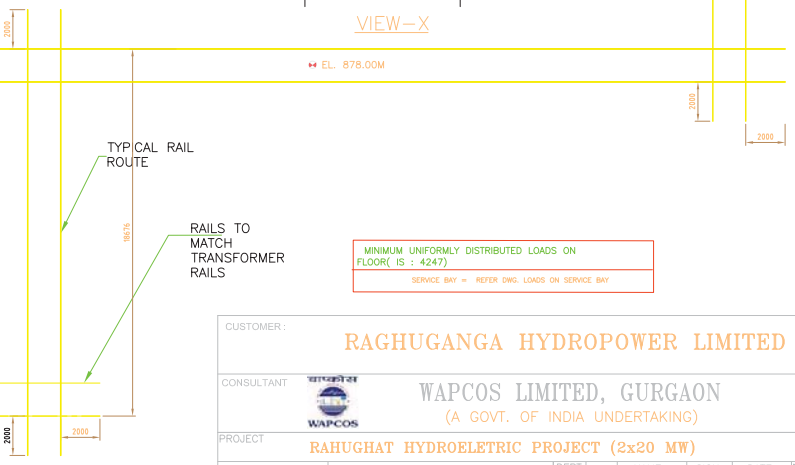
MACHINE HALL FLOOR AT EL. 878.00M

VIEW-X





VIEW-X



MINIMUM UNIFORMLY DISTRIBUTED LOADS ON FLOOR(IS : 4247)
SERVICE BAY = REFER DWG. LOADS ON SERVICE BAY

LIST OF EQUIPMENTS (TENTATIVE)

S.No	DESCRIPTION	SIZE (mm) LENGTH	WIDTH	HEIGHT	LOCATED AT	WEIGHT (KgS/U.)	QTY./ UNIT	TOTAL QTY.	REMARKS
S01	245 KV LRPA, LRPB, GTRP, EMP, BBRP1 & BBRP2	4800(6X800)	800	2230	EL 878.00	3000	–	1	SWE
S02	11KV GENERATOR CIRCUIT CUBICLES	8200	2350	2634	EL 878.00	15000	1	1	SWE
S03	ACDB	5500	1200	2375	EL 878.00	2500	–	1	TBG
S04	CO2 CYLINDER BANK FOR FIRE PROTECTION	5000	2000	2300	EL 878.00	1500		1	HGE
S05	PABX	600	400	800	EL 878.00	175	1	1	HPE
S06	PANEL FOR CO2 FIRE FIGHTING	700	500	2300	EL 878.00	200	1	1	HGE
S07	UNIT CONTROL BOARD	3804	800	2295	EL 878.00	2500	1	2	EDN
S08	GRP-1 & GRP-2	800	800	2230	EL 878.00	1000	2	4	SWE
S09	MLDB	1900	1200	2375	EL 878.00	1000	–	1	TBG
S10	ELDB	1900	1200	2375	EL 878.00	1000	–	1	TBG
S11	FOTE	600	600	2200	EL 878.00	500	–	3	TBG
S12	RTU	800	800	2375	EL 878.00	500	–	3	TBG
S13	LCB FOR 220KV SWITCHYARD CONTROL	3053	800	2295	EL 878.00	2000	–	1	EDN
S14	LCB FOR ELECTRICAL POWER SUPPLY SERVICE	3053	800	2295	EL 878.00	2000	–	1	EDN
S15	LCB FOR WEIR REGULATION AND CONTROL	3053	800	2295	EL 878.00	2000	–	1	EDN
S16	INSTRUMENT PANEL	950	800	2295	EL 878.00	500	1	2	EDN
S17	GAUGE PANEL	950	800	2295	EL 878.00	500	1	2	EDN
S18	TEMPARATURE MEASUREMENT PANEL	950	800	2295	EL 878.00	500	1	2	EDN

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. EQUIPMENT SHOWN AND LISTED ARE TENTATIVE AND SHALL BE FINALISED INCLUDING SIZES DURING DETAILED DESIGN.
03. FOR STAGE WISE CONCRETING AND EMBEDMENT DETAILS REFER TURBINE DRAWINGS OF BHEL.
04. SIZES OF COLUMNS/BEAMS/SLABS/STAIRS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.
05. THIS DRAWING IS INTENDED FOR SHOWING LAYOUT & CIVIL REQUIREMENTS OF FLOOR ONLY. FOR CIVIL DETAILS/EMBEDMENTS INSIDE BARREL/HOUSING RESPECTIVE SYSTEM DRAWING .
06. POWERHOUSE FLOOR DRAIN TO BE SUITABLY DESIGNED BY CIVIL.
07. LOCATION AND ORIENTATION OF TRANSFORMERS ARE TENTATIVE ONLY, REFER TRANSFORMER YARD AND SWITCHYARD LAYOUT DRAWINGS FOR DETAILS.

MACHINE HALL FLOOR AT EL. 878.00M

REV.	DATE	ALTERED	T.KHAN
		CHECKED	S.SAHU
		APPD.	R.S
ZONE			

REV.	DATE	ALTERED	T.KHAN
07	16.05.23	CHECKED	S.SAHU
		APPD.	R.S
ZONE	DRAWING REVISED TO INCORPORATE CIVIL DETAILS.		

REV.	DATE	ALTERED	T.KHAN
06	11.04.23	CHECKED	S.SAHU
		APPD.	R.S
ZONE	DRAWING REVISED TO INCORPORATE CIVIL DETAILS.		

REV.	DATE	ALTERED	T.KHAN
05	22.06.21	CHECKED	S.SAHU
		APPD.	R.S
ZONE	DRAWING REVISED AS PER WAPCOS COMMENTS		

REV.	DATE	ALTERED	T.KHAN
04	18.01.21	CHECKED	S.SAHU
		APPD.	R.S
ZONE	DRAWING REVISED AS PER REVISED CIVIL DRAWINGS		

REV.	DATE	ALTERED	T.KHAN
03	09.09.20	CHECKED	S.SAHU
		APPD.	R.S
ZONE	DRAWING REVISED AS PER CUSTOMER COMMENTS		

REV.	DATE	ALTERED	T.KHAN
02	22.06.20	CHECKED	S.SAHU
		APPD.	R.S
ZONE	DRAWING REVISED AS PER CUSTOMER COMMENTS		

REV.	DATE	ALTERED	T.KHAN
01	13.04.20	CHECKED	S.SAHU
		APPD.	R.S
ZONE	DRAWING REVISED AS PER CUSTOMER COMMENTS		

CUSTOMER : RAGHUGANGA HYDROPOWER LIMITED

CONSULTANT : WAPCOS LIMITED, GURGAON
(A GOVT. OF INDIA UNDERTAKING)

PROJECT : RAHUGHAT HYDROELETRIC PROJECT (2x20 MW)

BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT. CODE		NAME	SIGN	DATE	NO. OF VAR
HPE 415	DRN	T.KHAN		06.12.19	
	CKD	S.SAHU		06.12.19	
	APPD	R.S		06.12.19	

SUB-VENDOR DRG. NO. | PO REF | NO. OF ITEMS

TITLE : STATION LAYOUT PLAN AT EL. 878.00M

DRG. NO. : —

SUB-VENDOR NAME | WEIGHT (kg) | SCALE 1:100

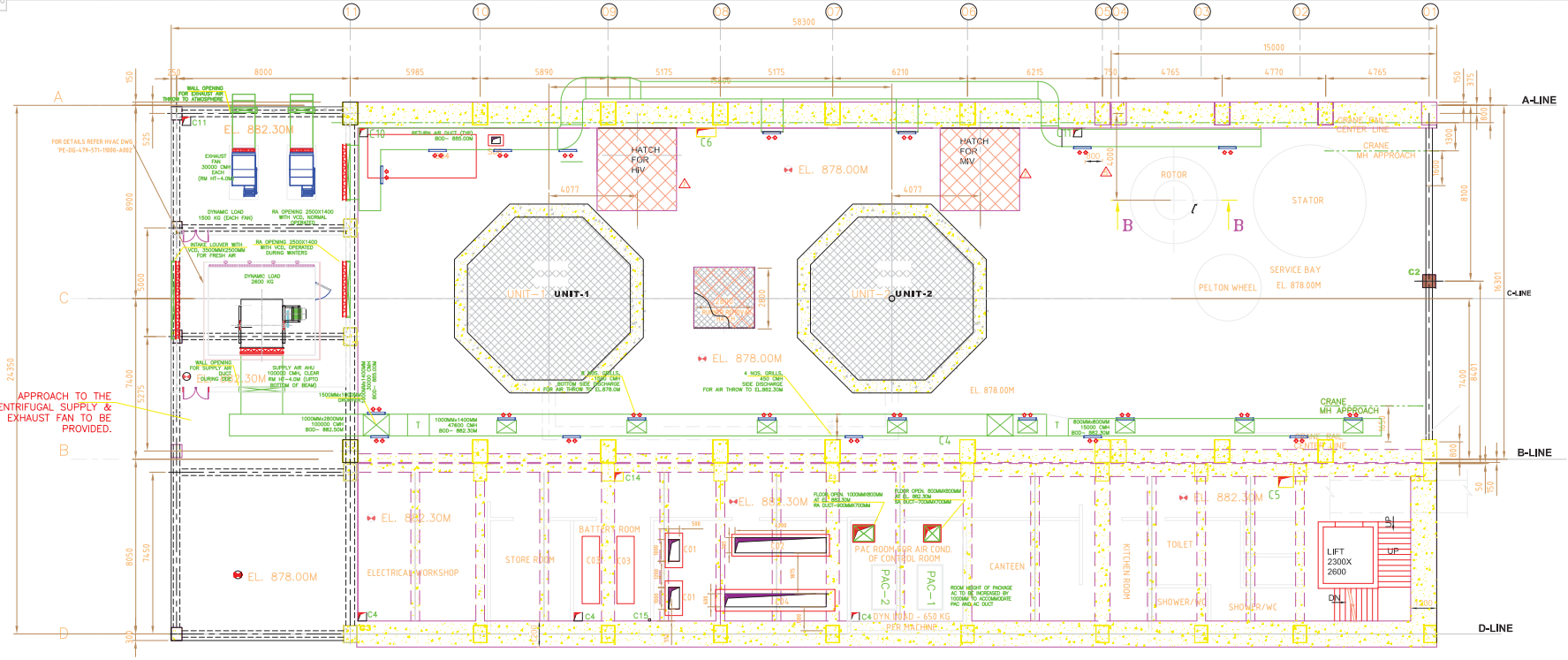
BHEL DRG. NO. : 12000020854 | REV. 07

SHEET NO. 01 | NO. OF SHT. 01

A1 SIZE

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)



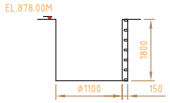
MACHINE HALL FLOOR AT EL. 882.30M

MINIMUM UNIFORMLY DISTRIBUTED LOADS ON FLOOR(IS : 4247)

SERVICE BAY = REFER DWG. LOADS ON SERVICE BAY

CUTOUT DETAILS

S.No	SYSTEM	SIZE (mm)
C4	CUT OUT FOR CABLE TRAY	400x400
C5	CUT OUT FOR FPS	700x800
C6	CUT OUT FOR FPS	900x400
C7	CUT OUT FOR FPS	500x400
C10	CUTOUT FOR OIL PIPING/COMPRESSED AIR	400x400
C11	CUT OUT FOR SPARE	400x400
C14	CUT OUT FOR FPS	400x400
C15	CUT OUT FOR COMP. AIR	100x100



SECTION-BB (TYP.) (PIT FOR ROTOR)

LIST OF EQUIPMENTS (TENTATIVE)

S.No	DESCRIPTION	SIZE (mm) LENGTH	WIDTH	HEIGHT	LOCATED AT	WEIGHT (KgS.)	QTY./ UNIT	TOTAL QTY.	REMARKS
C01	DC CHARGER	1600	800	2375	EL. 882.30	900	–	2	HPE.ELEC.
C02	110V DCDB	6000	1000	2375	EL. 882.30	3500	–	1	HPE.ELEC.
C03	BATTERY BANK	3100	1000	1200	EL. 882.30	2500	–	2	HPE.ELEC.
C04	DCDB	5500	1000	2375	EL. 882.30	2500	–	1	TBG

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. EQUIPMENT SHOWN AND LISTED ARE TENTATIVE AND SHALL BE FINALISED INCLUDING SIZES DURING DETAILED DESIGN.
03. FOR STAGE WISE CONCRETING AND EMBEDMENT DETAILS REFER TURBINE DRAWINGS OF BHEL.
04. SIZES OF COLUMNS/BEAMS/SLABS/STAIRS ARE INDICATIVE ONLY. FOR DETAILS REFER CIVIL CONSTRUCTION DRAWINGS.
05. THIS DRAWING IS INTENDED FOR SHOWING LAYOUT & CIVIL REQUIREMENTS OF FLOOR ONLY. FOR CIVIL DETAILS/EMBEDMENTS INSIDE BARREL/HOUSING RESPECTIVE SYSTEM DRAWING .
06. POWERHOUSE FLOOR DRAIN TO BE SUITABLY DESIGNED BY CIVIL.

LINKED DRAWINGS :-

SL. No.	DESCRIPTION	BHEL DWG. NO.
01	CROSS SECTION ARRANGEMENT OF POWER HOUSE	12000020851
02	STATION LAYOUT PLAN AT EL. 867.75M (MIV/TURBINE FLOOR)	12000020852
03	STATION LAYOUT PLAN AT EL. 872.55M	12000020853
04	STATION LAYOUT PLAN AT EL. 882.30M	12000020855
05	LONGITUDINAL SECTION OF POWER HOUSE	12000020356
06	GENERATOR SECTIONAL ARRGT DRG	02500008703
07	CRANE CLEARANCE DIAGRAM OF 70/10T EOT CRANE OF PH	PE-DG-479-501-A001
08	VENTILATION FAN ROOM DETAILS AT ROOF OF WORKSHOP EL 882.30	PE-DG-479-571-11000-A002
09	VENTILATION ROOM & VENTILATION DUCT LAYOUT FOR ALL THE FLOOR FOR POWER HOUSE	PE-VD-479-571-11000-A-A507

REV.	DATE	ALTERED	CHECKED	APPD.	ZONE	DRAWING REVISED AS PER
07	16.05.23	T.KHAN	S.SAHU	R.S	△	WAPCOS COMMENTS
06	11.04.23	T.KHAN	S.SAHU	R.S	△	REVISED CIVIL DRAWINGS
05	22.06.21	T.KHAN	S.SAHU	R.S	△	CUSTOMER COMMENTS
04	18.01.21	T.KHAN	S.SAHU	R.S	△	CUSTOMER COMMENTS
03	09.09.20	T.KHAN	S.SAHU	R.S	△	CUSTOMER COMMENTS
02	22.06.20	T.KHAN	S.SAHU	R.S	△	CUSTOMER COMMENTS
01	13.04.20	T.KHAN	S.SAHU	R.S	△	CUSTOMER COMMENTS

CUSTOMER : RAGHUGANGA HYDROPOWER LIMITED

CONSULTANT : WAPCOS LIMITED, GURGAON (A GOVT. OF INDIA UNDERTAKING)

PROJECT : RAHUGHAT HYDROELETRIC PROJECT (2x20 MW)

BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT. CODE		NAME	SIGN	DATE
HPE 415	DRN	T.KHAN		06.12.19
	CKD	S.SAHU		06.12.19
	APPD	R.S		06.12.19

SUB-VENDOR DRG. NO. | PO REF | NO. OF VAR | NO. OF ITEMS

TITLE : STATION LAYOUT PLAN AT EL. 882.30M

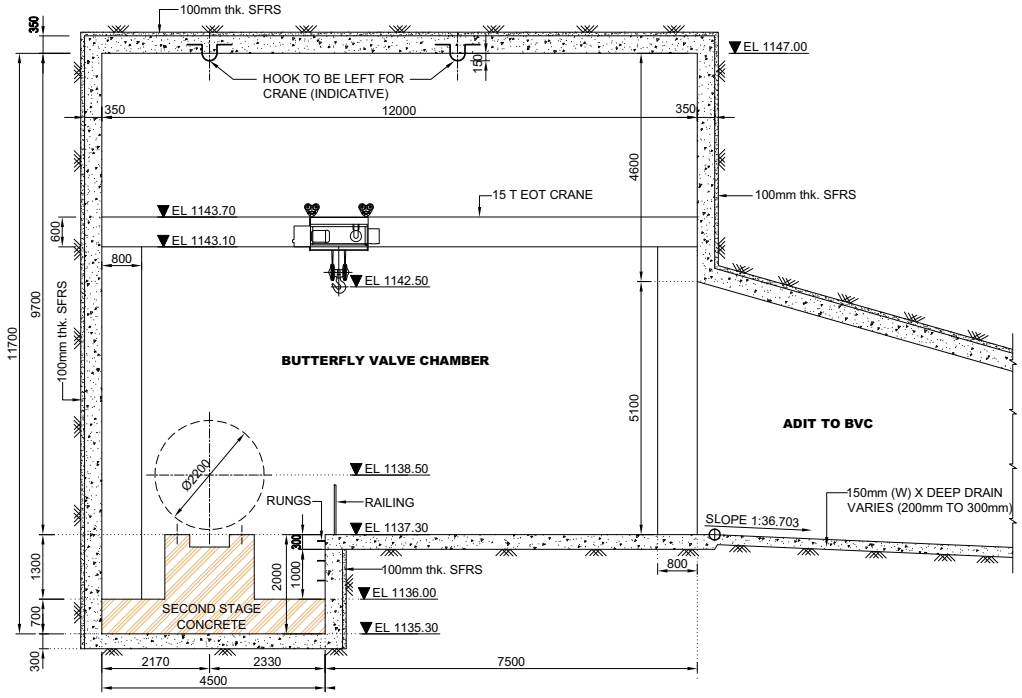
DRG. NO. : –

SUB-VENDOR NAME | WEIGHT (kg) | SCALE 1:100

BHEL DRG. NO. : 12000020855 | REV. : 07

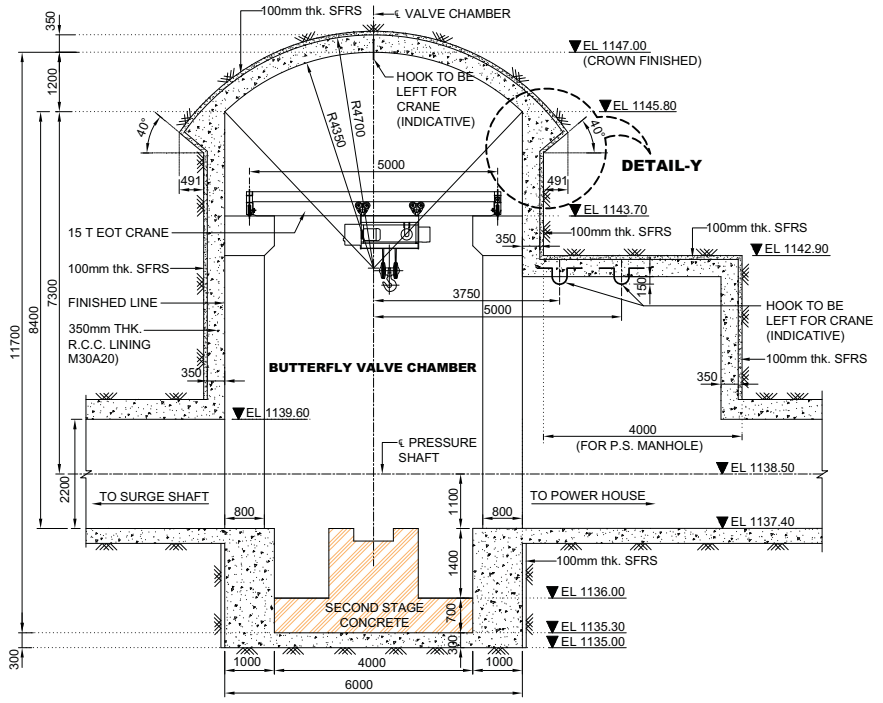
SHEET NO. 01 | NO. OF SHT. 01

A1 SIZE



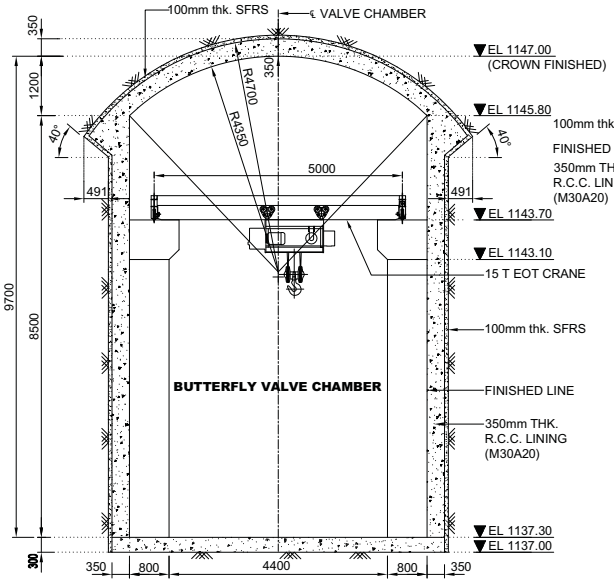
SECTION A-A

(FOR LOCATION OF SECTION REFER SHEET-1)



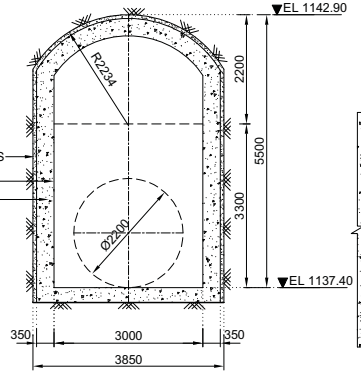
SECTION B-B

(FOR LOCATION OF SECTION REFER SHEET-1)



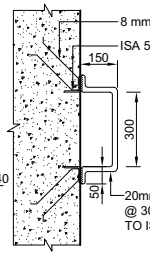
SECTION C-C

(FOR LOCATION OF SECTION REFER SHEET-1)

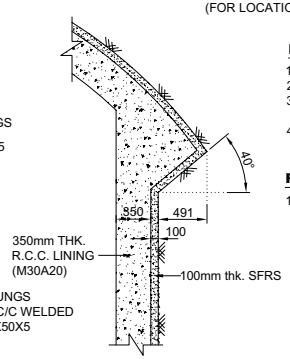


SECTION D-D

(FOR LOCATION OF SECTION REFER SHEET-1)



RUNGS DETAIL



DETAIL-Y

(NOT TO SCALE)

NOTES:-

1. ALL DIMENSIONS ARE IN mm AND ELEVATIONS IN metres UNLESS OTHERWISE SPECIFIED.
2. THIS DRAWING SHOWS THE TYPICAL DETAILS OF BUTTERFLY VALVE CHAMBER L-SECTION.
3. ALL NOTES AND REFERENCES GIVEN DRAWING NO. RGHEP-BVC-GA-001 ARE APPLICABLE TO THIS DRAWING ALSO.
4. FOR FRAME STRUCTURE FOR SUPPORTING THE EOT CRANE, REFER SEPARATE DRAWINGS.

REFERENCE DRAWINGS:-

1. DRAWING NO. RGHEP-BVC-GA-001 : BUTTERFLY VALVE CHAMBER LAYOUT PLAN & SECTIONS

SCALE : 0 2000 4000 6000

DRAWING FOR EXECUTION

LEGEND:-

CONCRETE LINING (M30A20)

SECOND STAGE CONCRETE (GRADE OF CONC. AS PER EM REQUIREMENT)

CONTRACTOR: JAYPEE GROUP — JAI PRAKASH ASSOCIATES LIMITED

CONSULTANT TO CONTRACTOR: JAYPEE INFRA VENTURES PRIVATE LIMITED, BLOCK-F, SECTOR-128, NOIDA (U.P)

REVISION:	DATE:	DESCRIPTION
R2.		
R1.		
R0.	XX.XX.XXXX	

RAGHUGANGA HYDROPOWER LIMITED, MYAGDI, NEPAL

Rahughat Hydroelectric Project (40 MW)

REV.NO.	DATE	DESCRIPTION	CHECKED	APPROVED
0	xx.xx.xxxx	ISSUED FOR CONSTRUCTION		490

WAPCOS LIMITED (A GOVT. OF INDIA UNDERTAKING)

Rahughat Hydroelectric Project (40 MW)

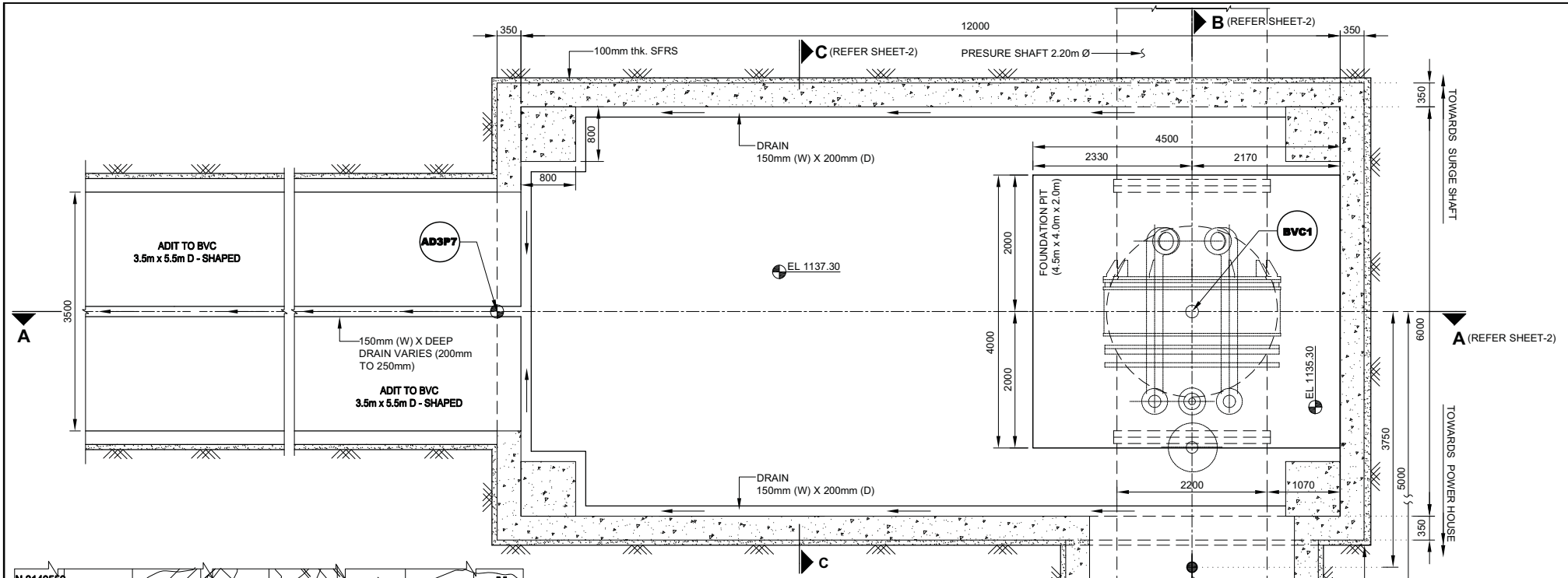
DRAWN:	K. LAL	
DESIGNED & CHECKED:	RAJNISH YADAV	
APPROVED:	VATSAL	

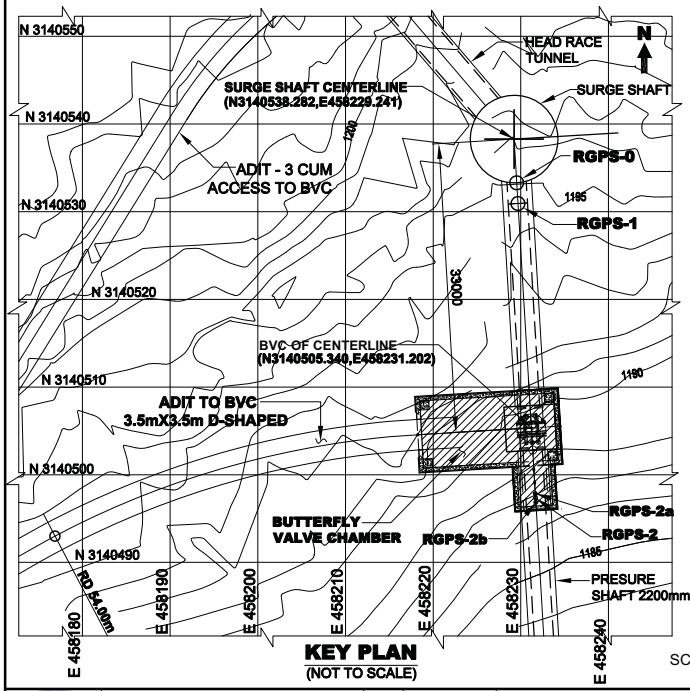
BUTTERFLY VALVE CHAMBER LAYOUT PLAN & SECTIONS (SHEET 2 OF 2)

DATE: SEP. 2022

Dwg. No. RGHEP-BVC-GA-002

REVISION 0





KEY PLAN
(NOT TO SCALE)

LAYOUT PLAN OF BUTTERFLY VALVE CHAMBER

TABLE-1 : POINT COORDINATES:-

POINT	NORTHING	EASTING	DESCRIPTION OF POINT
AD3P7	3140504.852	458221.032	START POINT OF BVC FROM ADIT-3 CENTER LINE
BVC1	3140505.340	458231.202	CENTRE LINE OF PRESSURE SHAFT WITH BUTTERFLY VALVE CHAMBER

NOTES:-

1. ALL DIMENSIONS ARE IN mm AND ELEVATIONS IN metres UNLESS OTHERWISE SPECIFIED.
2. THIS DRAWING SHOWS THE TYPICAL DETAILS OF BUTTERFLY VALVE CHAMBER.
3. CONCRETE FOR LINING SHALL CONFORM TO M30A20 GRADE AS PER IS: 465-2000.
4. FOR SECTIONS A-A, B-B AND C-C, REFER DRAWING NO. RGHEP-BVC-GA-002.
5. THE SHOWN DRAINAGE ARRANGEMENT WILL BE REVIEWED IN CONSULTATION WITH BHEL AND MODIFICATIONS, IF ANY, REFER SHALL BE CARRIED OUT.
6. FOR DETAILS OF RCC LINING, GROUTING (CONTACT & CONSOLIDATION GROUTING AS WELL AS POST EXCAVATION CONSOLIDATION), REFER SEPARATE DRAWINGS.

REFERENCE DRAWINGS (CIVIL):-

1. DRAWING NO. RGHEP-PS-GA-001 TO 003 :PRESSURE SHAFT LAYOUT PLAN & SECTION (SHEET 1 TO 3)
2. DRAWING NO. RGHEP-ADIT-GA-001 TO 002 :ADIT-3 TO HRT CUM ACCESS TUNNEL TO BVC LAYOUT PLAN & SECTION (SHEET 1 TO 2)
3. DRAWING NO. RGHEP-ADIT-EX-003 & 004 :ADIT-3 EXCAVATION & SUPPORT DETAILS (SHEET 2 OF 2)

REFERENCE DRAWINGS (E/M - M/S BHEL):-

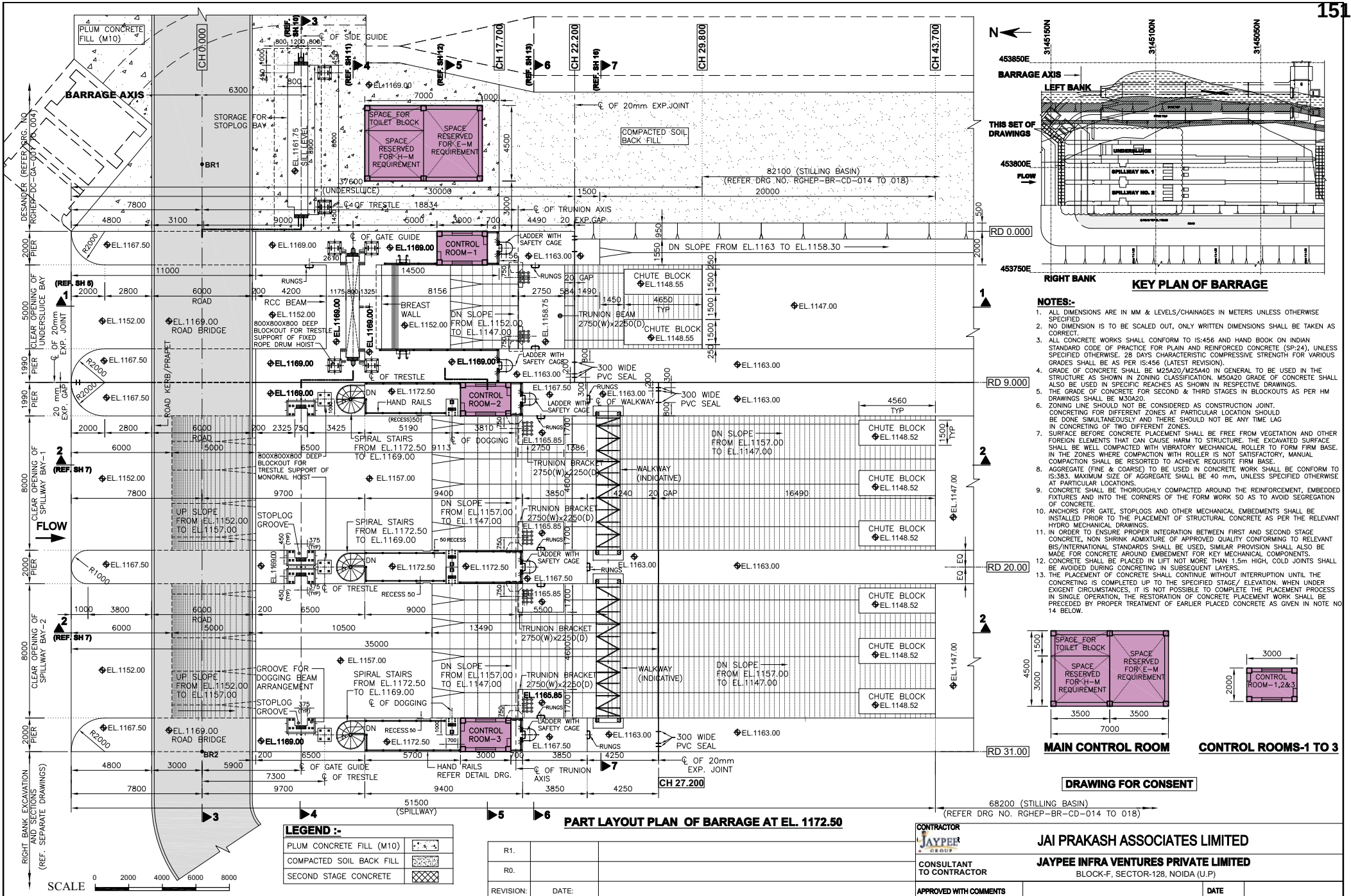
1. DRAWING NO. 12000020857 :LAYOUT AND CROSS SECTION OF B.F. VALVE HOUSE.
2. DRAWING NO. PE-DG-479-501-A002 :CRANE CLEARANCE DIAGRAM OF 15T EOT CRANE FOR VALVE HOUSE.

SCALE : 0 2000 4000 6000

DRAWING FOR EXECUTION

APPROVED WITH COMMENTS	DATE	
CONTRACTOR: JAYPEE GROUP	JAI PRAKASH ASSOCIATES LIMITED	
CONSULTANT TO CONTRACTOR	JAYPEE INFRA VENTURES PRIVATE LIMITED, BLOCK-F, SECTOR-128, NOIDA (U.P)	
R2.		
R1.		
R0.	XX.XX.XXXX	
REVISION:	DATE:	DESCRIPTION

RAGHUGANGA HYDROPOWER LIMITED, MYAGDI, NEPAL						WAPCOS LIMITED (A GOVT. OF INDIA UNDERTAKING)	DRAWN:	K. LAL	BUTTERFLY VALVE CHAMBER LAYOUT PLAN & SECTIONS (SHEET 1 OF 2)	Dwg. No. RGHEP-BVC-GA-001
Rahughat Hydroelectric Project (40 MW)	0	xx.xx.xxxx	ISSUED FOR CONSTRUCTION		491	Rahughat Hydroelectric Project (40 MW)	DESIGNED & CHECKED:	RAJNISH YADAV		
	REV.NO.	DATE	DESCRIPTION	CHECKED	APPROVED		APPROVED:	VATSAL	DATE: SEP. 2022	REVISION 0



KEY PLAN OF BARRAGE

NOTES:-

1. ALL DIMENSIONS ARE IN MM & LEVELS/CHAINAGES IN METERS UNLESS OTHERWISE SPECIFIED
2. NO DIMENSION IS TO BE SCALED OUT, ONLY WRITTEN DIMENSIONS SHALL BE TAKEN AS CORRECT.
3. ALL CONCRETE WORKS SHALL CONFORM TO IS:456 AND HAND BOOK ON INDIAN STANDARD CODE OF PRACTICE FOR PLAIN AND REINFORCED CONCRETE (SP:24), UNLESS SPECIFIED OTHERWISE. 28 DAYS CHARACTERISTIC COMPRESSIVE STRENGTH FOR VARIOUS GRADES SHALL BE AS PER IS:456 (LATEST REVISION).
4. GRADE OF CONCRETE SHALL BE M25A20/M25A40 IN GENERAL TO BE USED IN THE STRUCTURE AS SHOWN IN ZONING CLASSIFICATION. M50A20 GRADE OF CONCRETE SHALL ALSO BE USED IN SPECIFIC REACHES AS SHOWN IN RESPECTIVE DRAWINGS.
5. THE GRADE OF CONCRETE FOR SECOND & THIRD STAGES IN BLOCKOUTS AS PER HM DRAWINGS SHALL BE M30A20.
6. ZONING LINE SHOULD NOT BE CONSIDERED AS CONSTRUCTION JOINT. CONCRETING FOR DIFFERENT ZONES AT PARTICULAR LOCATION SHOULD BE DONE SIMULTANEOUSLY AND THERE SHOULD NOT BE ANY TIME LAG IN CONCRETING OF TWO DIFFERENT ZONES.
7. SURFACE BEFORE CONCRETE PLACEMENT SHALL BE FREE FROM VEGETATION AND OTHER FOREIGN ELEMENTS THAT CAN CAUSE HARM TO STRUCTURE. THE EXCAVATED SURFACE SHALL BE WELL COMPACTED WITH VIBRATORY MECHANICAL ROLLER TO FORM FIRM BASE. IN THE ZONES WHERE COMPACTION WITH ROLLER IS NOT SATISFACTORY, MANUAL COMPACTION SHALL BE RESORTED TO ACHIEVE REQUISITE FIRM BASE.
8. AGGREGATE (FINE & COARSE) TO BE USED IN CONCRETE WORK SHALL BE CONFORM TO IS:383. MAXIMUM SIZE OF AGGREGATE SHALL BE 40 mm, UNLESS SPECIFIED OTHERWISE AT PARTICULAR LOCATIONS.
9. CONCRETE SHALL BE THOROUGHLY COMPACTED AROUND THE REINFORCEMENT, EMBEDDED FIXTURES AND INTO THE CORNERS OF THE FORM WORK SO AS TO AVOID SEGREGATION OF CONCRETE.
10. ANCHORS FOR GATE, STOPLOGS AND OTHER MECHANICAL EMBEDMENTS SHALL BE INSTALLED PRIOR TO THE PLACEMENT OF STRUCTURAL CONCRETE AS PER THE RELEVANT HYDRO MECHANICAL DRAWINGS.
11. IN ORDER TO ENSURE PROPER INTEGRATION BETWEEN FIRST AND SECOND STAGE CONCRETE, NON SHRINK ADMIXTURE OF APPROVED QUALITY CONFORMING TO RELEVANT BIS/INTERNATIONAL STANDARDS SHALL BE USED, SIMILAR PROVISION SHALL ALSO BE MADE FOR CONCRETE AROUND EMBEDMENT FOR KEY MECHANICAL COMPONENTS.
12. CONCRETE SHALL BE PLACED IN LIFT NOT MORE THAN 1.5m HIGH, COLD JOINTS SHALL BE AVOIDED DURING CONCRETING IN SUBSEQUENT LAYERS.
13. THE PLACEMENT OF CONCRETE SHALL CONTINUE WITHOUT INTERRUPTION UNTIL THE CONCRETING IS COMPLETED UP TO THE SPECIFIED STAGE/ ELEVATION. WHEN UNDER EXIGENT CIRCUMSTANCES, IT IS NOT POSSIBLE TO COMPLETE THE PLACEMENT PROCESS IN SINGLE OPERATION, THE RESTORATION OF CONCRETE PLACEMENT WORK SHALL BE PRECEDED BY PROPER TREATMENT OF EARLIER PLACED CONCRETE AS GIVEN IN NOTE NO 14 BELOW.

MAIN CONTROL ROOM

CONTROL ROOMS-1 TO 3

DRAWING FOR CONSENT

PART LAYOUT PLAN OF BARRAGE AT EL. 1172.50

LEGEND :-

PLUM CONCRETE FILL (M10)	
COMPACTED SOIL BACK FILL	
SECOND STAGE CONCRETE	

SCALE 0 2000 4000 6000 8000

REVISION:	DATE:	
R1.		
R0.		

CONTRACTOR: JAYPEE GROUP — JAI PRAKASH ASSOCIATES LIMITED

CONSULTANT TO CONTRACTOR: JAYPEE INFRA VENTURES PRIVATE LIMITED, BLOCK-F, SECTOR-128, NOIDA (U.P)

APPROVED WITH COMMENTS | DATE

RAGHUGANGA HYDROPOWER LIMITED
MYAGDI, NEPAL
Rahughat Hydroelectric Project (40 MW)

REV.NO.	DATE	DESCRIPTION	CHECKED	APPROVED

492

WAPCOS LIMITED (A GOVT. OF INDIA UNDERTAKING)
Rahughat Hydroelectric Project (40 MW)

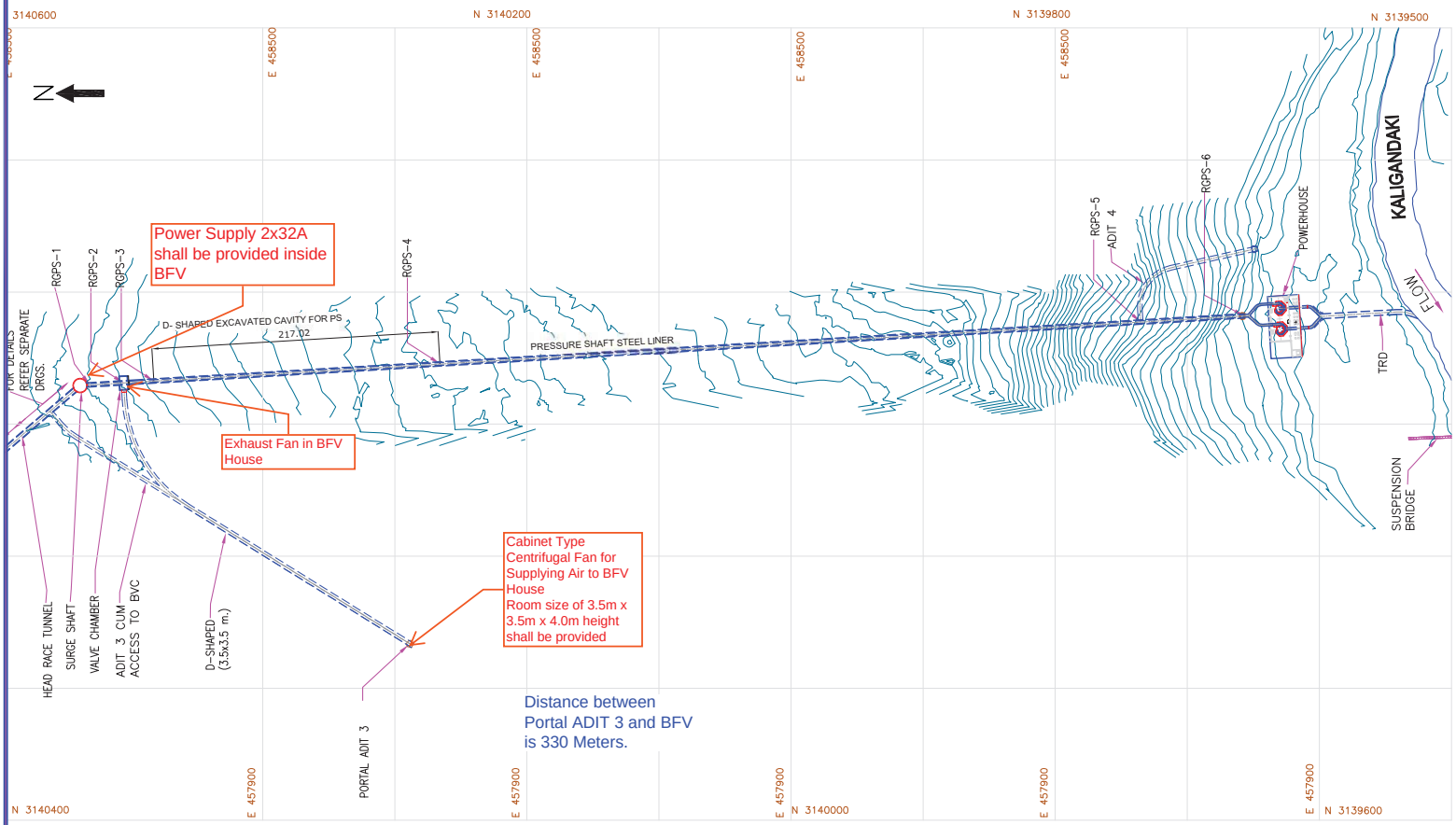
DRAWN: RAJENDRA
DESIGNED: & CHECKED: KK GUPTA
APPROVED: VATSAL
DATE: 15-05-2023

BARRAGE CONCRETE OUTLINE DETAILS PLAN AND SECTIONS (SHEET 3 OF 18)

Dwg. No. RGHEP-BR-CD-003

REVISION B

FOR TENDER PURPOSE ONLY



LAYOUT PLAN

NOTES:–

1. THIS DRAWING SHOWS THE TENTATIVE LAYOUT PLAN OF PRESSURE SHAFT.
2. NO DIMENSION SHALL BE MEASURED FROM THIS DRAWING. ONLY WRITTEN DIMENSIONS SHALL BE FOLLOWED.
3. THE DRAWING SHOULD BE READ IN CONJUCTION WITH SHEET 2/2, OF THIS DRAWING.

POINT COORDINATES

S.No.	POINT	NORTHING	EASTING	LENGTH (IN PLAN)	EL OF CENTER LINE	REMARKS
1.	RGPS-1	3140530.948	458229.679	0-0	1138.50	START OF STEEL LINER AT SS JUNCTION
2.	RGPS-2	3140505.340	458231.202	25.50	1138.50	BVC CENTERLINE
3.	RGPS-3	3140482.398	458232.646	48.64	1138.50	* POI AT BEND 1 IN STEEL LINER
4.	RGPS-4	3140265.766	458245.607	265.66	870.50	* POI AT BEND 2 IN STEEL LINER
5.	RGPS-5	3139735.330	458277.278	797.04	870.50	PS & ADIT-3 JUNCTION
6.	RGPS-6	3139656.764	458281.971	878.094	870.50	PS PORTAL(tentative)

* POI STANDS FOR POINT OF INTERSECTION

SHEET 1/2

RAGHUGANGA HYDROPOWER LIMITED

CONSULTANT
WAPCOS LIMITED
(A GOVT. OF INDIA UNDERTAKING)

RAHUGHAT HYDROELECTRIC PROJECT (2X20 MW)
PRESSURE SHAFT
LAYOUT SETTING (PLAN)

DSGN.	CHKD.	RECM.
DRAWN	REV.	APPD.
JUNE 2018	DWG.NO.	RGHEP/T/EM/2016/006