206 MW PSPCL SHAHPURKANDI
HYDRO ELECTRIC PROJECT (HEP)

TECHNICAL SPECIFICATION

FOR

HVAC SYSTEM

SPECIFICATION NO.: - PE-TS-406-571-11000-A001 (REV00)

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
BHEL SADAN
PLOT NO.-25, SECTOR-16A, , NOIDA, INDIA

CONTENTS

This Technical specification consists of two sections:

SECTION - I

SUB- SECTIONS	TITLE			Page No
Sub-Section-A	INTENT OF SPECIFICATION			4
Sub-Section-B	PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA			7
Sub-Section-C	TECHNICAL SPECIFICATIONS			10
	Sub Section-C1	SPECIFIC TECHNICAL REQUIREMENT		10
	Sub Section-C2	CUSTOMER SPECIFICATION		27
		C2 - A	TECHNICAL REQUIREMENT	27
		C2 - B	PROJECT SPECIFIC GENERAL REQUIREMENTS INCLUDING:	34
			GENERAL TECHNICAL REQUIREMENT	
			QUALITY ASSURANCE	
	Sub Section-C3	TECHNICAL SPECIFICATION (ELECTRICAL PORTION)		41
	Sub Section-C4	TECHNICAL SPECIFICATION (C&I PORTION)		205
	Sub Section-C5	TECHNICAL SPECIFICATION (MH PORTION)		259
Sub Section-D	STANDARD TECHNICAL SPECIFICATIONS			272
Sub Section-E	ANNEXURE-I	LIST OF MAKES OF SUB-VENDOR ITEMS		323
	ANNEXURE-II	MANDATORY SPARE LIST		331
	ANNEXURE-III	LIST OF TOOLS & TACKLES AND LIST OF COMMISSIONING SPARES.		332
	ANNEXURE-IV	DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE		333
	ANNEXURE-V	MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION		341
	ANNEXURE-VI	SITE STORAGE AND PRESERVATION		346
	ANNEXURE-VII	PAINTING SPECIFICATION & COLOUR SCHEME		362
	ANNEXURE-VIII	PACKING PROCEDURE		363

SECTION – II

SUB SECTIONS	TITLE	Page No
Sub Section-1	INSPECTION AND TESTING WITH STANDARD QUALITY PLAN	365
Sub Section-2	LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	369
Sub Section-3	COMPLIANCE CUM CONFIRMATION CERTIFICATE	371
Sub Section-4	PRE BID CLARIFICATION SCHEDULE	374
Sub Section-5	TENDER DRAWINGS	376

SECTION-I

SUB-SECTION-A

INTENT OF SPECIFICATION

1.0 INTENT OF SPECIFICATION

1.1 The specification covers design (i.e. Preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable) fill of lubricants & consumables, spares alongwith spares for erection, startup and commissioning as required, forwarding, proper packing, shipment and unloading, handling, transportation to stores area & storage, transportation and delivery at site, (from stores area) & in-site transportation, assembly, erection & commissioning, final painting at site, minor civil work, trial run at site and carrying out Performance guarantee / Functional / Demonstration tests at site (As applicable), training of customer/client O&M staff and handover in flawless condition of the package to the end customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification as specified above, amendment & agreements till placement of order for **206 MW PSPCL SHAHPURKANDI** HYDRO ELECTRIC PROJECT (HEP).

1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **HVAC SYSTEM.**

1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to highest standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.

1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all tems required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.

1.5 The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification **within 10 days of receipt of tender documents.** In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Vol – III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.

1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, Section – C1 shall prevail over section – D, however more stringent requirement as per the interpretation of the owner shall apply.

Further, In case of any discrepancy in section 'C1' and section 'C2', Section-C2 shall prevail (customer specification).

1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.11 For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser Employer, consultant, please refer relevant clause of GCC.

SECTION: I

SUB-SECTION: B

PROJECT INFORMATION

SECTION – 1

General Technical Specifications

1.3 PROJECT DETAILS AND DRAWINGS

1.3.1 INTRODUCTION

PSPCL hereinafter referred to as owner, is setting up a Hydro Electric Project, named Shahpurkandi HEP of capacity 206 MW 3x33 MW + (3x33+8) MW. The Shahpurkandi Project has been accorded techno economic approval by the Central Electricity Authority. The DPR of the Project has been updated upto April.2008 price level. The Project is scheduled for commissioning during the 11th Plan period (2015-16).

Power Sector, Hydro Marketing
Sector - 142, Noida U.P.

001

Sr. Xen/SKPP
PSPCL, Patiala

BACKGROUND OF THE PROJECT

The Shahpurkandi Hydro Electric Project (206MW) is a run-of- River scheme envisaged to utilize the drop of River Ravi from downstream of Ranjit Sagar Dam (already commissioned and in operation). The reservoir of Shahpurkandi Dam Project is proposed to act as a balancing reservoir and utilize the releases from Ranjit Sagar Dam to fulfill the Irrigation requirement of various commands through Irrigation Canals. The 7.7KM long concrete lined Head race Hydel Channel having 385 cumecs capacity shall carry water from Dam to UBDC Canal through Power House I & II. The installed capacity of Power House I is 3x33 MW and Power House II is 3x33+8 MW. The annual energy generation in 90% dependable year is estimated to be 999.49 MUs.

LOCATION:-

The reservoir of the Project shall be located near Shahpurkandi in District Gurdaspur (Pb.).

A] Seismic factors to be considered

- Horizontal : 0.21g
- Vertical : 0.14 g

Storage area shall be as per following

a) Covered storage sheds are situated in Shahpur Kandi Township, Jugial which is approximately 5-6Km from PH-1 and 9-10Km from PH-2.

b) Project Open storage yard (developed by BHEL PSNR) is near to PH#2 (approx. 1 Km from PH #2).

c) All the above mentioned Open & closed storage space/locations are common for both powerhouse material.

SECTION: I

SUB-SECTION: C 1

SPECIFIC TECHNICAL REQUIREMENT

1.0 FUNCTION

The Shahpur Kandi HEP-I & II, is being executed on Ranjit Sagar Dam, in the state of Punjab. Its Is having two separate Power houses as per below

- Powerhouse I is 3x33 MW
- Powerhouse II is 3x33MW + 1 x8 MW

HVAC system is to be provided for each power house to serve the following purpose:

i. To prevent temperature stratification
ii. To remove contaminated air
iii. To remove waste heat from equipment
iv. To provide outside fresh air necessary for human comfort
v. To evacuate smoke and remove heat

2.0 SYSTEM DESCRIPTION

Conditioned and dehumidified air shall be supplied to different zones of the powerhouse in accordance with heat generated in each zone. The power station shall be divided into two zones as below:

(A) Air Conditioning Zone
(B) Ventilation zone

(A) AC SYSTEM ZONE CONSIST OF THE FOLLOWING AREAS.

AC Areas	
Office Room at 352.50	By Hi wall Air cooled Split AC
Conference Room at 352.50	
Control room at EL. 352.50	

(B) VENTILATION SYSTEM ZONE CONSIST OF THE FOLLOWING AREAS

Supply air from AHU (Evaporative type with Spray Bank) shall be fed to various areas of power house as detailed below through ducting (typical for a powerhouse. Same shall be followed for both Power house I and II.

Ventilation Areas by Wet type Ventilation	
Elevation	**Description**
EL. 335.6	Area for Upper galley and Inspection gallery floors
EL. 340.2	Area for fire-fighting/ HVAC system and Area for Cooling water system.
EL. 347.50	Compressor Floor and Other area. Turbine-Generator floor, Cable Gallery, Space for CO2 Bank, Various Panels, O&M room
EL. 352.50	Control room, Conference room, Office, Mechanical W/S, Machine hall area, Service Bay area, Toilets, Excitation Panels, Electrical Testing room, Transformer Oil room , etc.
EL. 357.80	Battery / DCDB Room & HVAC Room, Pantry, toilet

DRY TYPE MECHNICAL VENTILATION SYSTEM

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

a) Toilets, and Battery Room , O&M room for power house.
b) MCC room
c) DG room

Complete Structural work for erection of mechanical, electrical and C & I equipment, support, inserts for duct / fans / pipes / cable tray etc. is in bidder's scope. Following may please be noted.

a) Duct support structure outside and inside power house for routing supply / exhaust duct / cable trays etc. from AHU room shall be in bidder's scope. Necessary supports may be taken from nearest structure / walls / roofs / floors etc. by bidder subject to customer / BHEL acceptance during detail engineering.
b) Fixing frame works for diffusers and grilles in the scope of Vendor.
c) Anchor fastener / HILTI fasteners shall be used by vendor for fixing duct/ pipes etc. wherever applicable.
d) Duct supporting and accessories material such that hangers, tie rods, nut, bolts, lock nut, washer, HILTI fastener, gasket, bracing, adhesive, sealant, rivets, angles, channels, bracket support etc. for completeness of duct installation in all aspects shall be in bidder scope.

Any other type of structural work for complete HVAC system is deemed to be in bidder's scope even though specifically not mentioned above.

3 DESIGN CRITERIA

3.1 SYSTEM DESIGN CRITERIA – AMBIENT CONDITIONS

The outside design conditions considered shall be under: -

	Summer	Monsoon	Winter
DBT (°C)	**39**	33	**8**
WBT (°C)	23.8	24.3	6.9

3.2 SYSTEM DESIGN CRITERIA - AIR CONDITIONING SYSTEM

a) The inside design conditions to be maintained shall be as under: -

25±1 ^{o}C & RH 50% ± 5% for control room etc.

b) Fresh air requirement shall be minimum 1.0 air change per hour for control room areas or 16 CFM per person whichever is higher. For other areas like office, Fresh air shall be considered

c) A design margin of 10% on total sensible and latent heat shall be considered while designing the AC Plant capacity for each area.

d) Necessary Oil filled Room Heater shall be provided.

3.3 SYSTEM DESIGN CRITERIA - VENTILATION SYSTEM

a) Inside temperature range during summers & monsoon: 30±2 °C
b) Inside temperature range during winters: Around 20 °C
c) Noise level: Not to exceed 70 db
d) Maximum air velocity in main ducts: 11.1 m/s
e) Maximum air velocity in Branch ducts: 9.1 m/s
f) Maximum air velocity in occupied zones: 2 m/s

3.4 Ventilation provision for various location is envisaged as follows

S.No.	Name of premises	Type of Ventilation	ACPH
1.	Power House area	Ventilation by Evaporative AHU and Mechanical exhaust from Wall mounted axial fans.	
a.	Lift & staircase area	Evaporative AHU	2
b.	Machine Hall	Evaporative AHU	2
c.	Service bay	Evaporative AHU	2
d.	Switchgear room in power house	Evaporative AHU	4
e.	Generator floor	Evaporative AHU	2
f.	Electrical workshop & Engineer's room	Evaporative AHU	4
g.	Turbine floor	Evaporative AHU	2
h.	Compressor room (Part of Power House)	**Fresh air supply**: Evaporative AHU	4
i.	MIV Floor	Evaporative AHU	2
2.	Battery room / Battery charger room	Wall mounted exhaust fans (spark proof with flame proof motor) with ducting (if required) Fresh air supply through of Louvers	8
3.	Toilets & pantries for Power House and other areas	Exhaust by means of propeller type exhaust fan. Supply through door undercuts / door louvers	8
4.	Mechanical workshop	**Exhaust Air**: Evaporative AHU / axial flow exhaust**:** by Fresh air : Through Louvers	4
6.	DG set Room	Exhaust by means of wall mounted axial flow exhaust fans. Fresh air supply through of Louvers	10
7.	Switchgear room for outside power house	Fresh air supply through axial supply air fan. Exhaust by mean axial exhaust fan / gravity damper as per requirement.	4
8.	Staircase at either end of upper gallery and drainage gallery	Ceiling mounted exhaust axial fans of suitable capacity may be provided	4

Air quantities shall be calculated based on heat load basis based on heat dissipation values from the various equipment, other heat source in various areas and the air quantity calculated based on air changes per hour and adopting higher of the two values.

3.5 CODES AND STANDARDS

The following standards, codes and technical documents are used for the design of HVAC system.

a. ASHRAE**/** ISHRAE Guide and data book, American Society of Heating, Refrigerating and Air Conditioning Engineers.
b. IS: 655/ IS 277 for Sheet Metal Air ducts.
c. IS: 4720, Indian Standard Code of Practice for Ventilation of Surface Hydel Power Stations.
d. IS: 3103- Code of practice for industrial ventilation
e. ANSI/ Standard 62- Ventilation for acceptable indoor air quality
f. IS 659- Safety code for Air-conditioning.

3.6 GENERAL PRINCIPLES

a) Washed air shall be supplied generally at low points of the powerhouse and exhaust air shall be at high points via Axial exhaust fans
b) Areas such as battery room, toilet and pantry which are exposed to harmful gases or odors shall be maintained at negative pressure and these harmful gases / odors shall be exhausted outside the power building with the help of separate exhaust air fans.
c) Lighting load considered shall be 1 Watts/sq. feet.
d) The Occupancy considered shall be 1 person in 25SQM or (actual) whichever is higher.
e) All the equipment for HVAC system shall be designed for continuous duty.
f) For winter Load calculations, only the lighting load shall be considered and equipment load shall be considered as Zero (0).
g) The heat dissipation values from various equipment / Occupants shall be taken into consideration while designing the HVAC system.

4. GENERAL DESCRIPTION OF VENTILATION AND AIR CONDITIONING SCHEME

4.1 VENTILATION SYSTEM

4.1.1 POWER HOUSE AREA

4.1.1.1 Evaporative Air Handling units/ Air washer units shall be provided for maintaining an air temperature of <32 degree in summer season & ≥18 degree in winter season with RH Less than 65%.

4.1.1.2 The supply air quantity requirement will be worked out based on heat load calculation from first principle as well as for maintaining minimum no. of air changes as per IS:4720 / as mentioned in table given above, under clause 3.3.1 (higher of the two). The higher value of the two shall be adopted for supplying air to various areas of power house.

4.1.1.3 In order to meet the above requirements, 2x50% Evaporative Air Handling Units (AHU) shall be provided.

4.1.1.4 Each AHU units of required capacity shall be placed inside HVAC room at an elevation of **357.8 M** floor. Sheet metal type Evaporative air handling unit with centrifugal fan (DIDW) with motor, pumps (End Suction Horizontal) with motors, spray bank, air handling internals, inlet air louvers, pre-filters, piping as per IS:1239, Part-I(heavy class galvanized), valves, nozzles, instruments, back wash arrangement, galvanized medium class drain piping.

During summer and monsoon seasons, there shall not be any return air intake. However, during winters, a part of air from Machine Hall shall be fed back to AHU room as return air and remaining quantity of air (required only for human comfort) shall be taken as fresh air through Fresh Air Intake Louver provided in AHU room. Make up water shall be from makeup water pumps(kept at 340 M floor) to MS make up tanks .These pumps shall be provided by bidder with required strainers(SS filters) and valves with facility to trip in case the makeup tanks are Full. Makeup tanks shall be placed above HVAC room. Return air damper/louver and Fresh air damper/louver shall be fitted with motorized Damper to regulate the air flow.

4.1.1.5 In summer, 60% of fresh air supplied to Power House area except Battery rooms & toilets, shall be exhausted with the help of exhaust fans. These fans shall be mounted at a higher level in Machine hall all through the equally distributed on upstream & downstream wall. These fans shall be complete with air inlet bird mesh, exhaust air cowl with gravity louver and bird mesh and supporting/ fixing frame. During winters, a part of air from Machine Hall shall be fed back to AHU room as return air and remaining quantity of air (required only for human comfort) shall be taken as fresh air through Fresh Air Intake Louver provided in AHU room. Return air and Fresh air shall be modulated by motorized Damper

4.1.1.6 For winter heating of power house strip heater along with control system of suitable capacity shall be provided.

4.1.1.7 The exhaust air from toilets and battery room in power house shall be evacuated by means of separate exhaust fans.

4.1.1.8 Automatic motorized dampers shall be provided at the common discharge duct of AHU's at power house. Fire rating of dampers shall be 90 minutes.
In order to avoid spreading of fire, the motorized damper with in-built controller having a provision of interfacing with the control panel of fire-fighting equipment of power house shall be considered.

4.1.1.9 For Exhaust of Stale air from Power House Complex a group of exhaust Air fans each of suitable capacity shall be provided on the wall of power house. in addition to these exhaust fans for stale air, additional fans for smoke exhaust (total 4 no. of each power house) shall be provided which shall be made operational in case of detection of fire. These fans shall be placed on the two longitudinal sides of the Machine Hall and Service Bay near roof top. Provisions shall also be made for an automatic shutdown of the fresh air supply from AHU to the respective area in case of fire by using a signal of fire protection system. In such a case all exhaust fans shall work as a smoke exhaust fan. Due to these additional fans, draft will increase and smoke will be disposed outside the power house.

4.2 AIR-CONDITIONING SYSTEM

4.2.1 POWER HOUSE AREA

4.2.1.1 Air cooled Split type air conditioners shall be provided for power house as per details given below.

Area	Load/ Capacity
AC Areas	
Office Room at 352.50	2 X 2TR(2W) by Multiple Air cooled Split AC
Conference Room at 352.50	3 X 2TR(3W) by Multiple Air cooled Split AC
Control room at EL. 352.50	2TR (10W +1S) by Multiple Air cooled Split AC

'*' = Configuration of the units shall be decided based on Heat Load Calculations.

4.2.1.2 As per heat load calculation, the load / capacity of the air conditioning system for above areas shall be works out during detailed engineering stage.

4.2.1.3 Winter heating section shall be provided by Electric room filled heat Oil filled (min 2000W).

5. LAYOUT CONSIDERATIONS:

5.1 AIR CONDITIONING SYSTEM

Split type air conditioners AC shall be housed at various locations, as per clause 4.2.1.1
The locations and space requirement of the AC equipment given above may change during detail engineering. Outdoor unit shall be suitably placed at roof / area nearby Control rooms

5.2 VENTILATION SYSTEM

2 nos Evaporative AHU (2x85000CMH) in HVAC Room at auxiliary floor EL. 357.8M level

Area	Load/ Capacity
Various areas for Machine hall	Supply air from Air Handling Unit (AHU) **1,70,000 CMH** and exhaust from axial exhaust fan 8x15000=**1,20,000CMH**).
Various areas for Generator Floor	
Various areas for Service Bay	
Various areas for Auxiliary and Control Block	
Ventilation for Drainage gallery etc.	

6. SCOPE OF SUPPLY AND ERECTION (FOR EACH POWER HOUSE)

a) Two nos. Evaporative type air handling units (2x50%) AHU-1 , AHU-2 for ventilation areas of required capacity i.e. 85000 CMH each (with 1x100% Fans and 2X100% pumps)
b) Auxiliary Axial supply/exhaust Fans
c) One no. set for Air duct distribution system for supply, return ducts for Ventilation and 1 no. set for supply air ducts for Ventilation system, in galvanized sheet metal construction (zinc coating 180gms/sq.m). The battery room ducts shall be with suitable protective coating against acidic fumes (if required).
d) One no. set Supply & Return air grilles/ diffusers, duct dampers etc.
e) One no. set Thermal insulation on and exposed duct for Ventilation system, if any
f) Insulation shall be as per standard BHEL specification PES-554-06. Acoustic insulation 25 mm thick of fibre glass with 48kg/m3 of first 5 M of ducting after AHUs limited to plenum

g) Painting of Equipment shall be as per Individual manufacturer standard.
h) Individual controlled AC units for AC areas: Non-Ductable units for Control Room , Office & Conference room.
i) Mandatory Spare parts for both units in total comprising of following:
j) One Set special tools required for maintenance of HVAC equipment.
k) One Set of Duct mounted heating elements for heating of Ventilated areas
l) One set Electrical MCC , PLC and associated cabling for MCC/PLC , instruments etc for completion of HVAC system.

7. AC EQUIPMENT

7.1 SPLIT AIR CONDITIONER

Split type air conditioners (air cooled) shall be provided to cater to the air conditioning requirements for auxiliary / local control room etc. For these areas multiple working split ACs shall be provided. Local isolator / MCB shall be provided with split units.

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

Air conditioners shall in general consist of the following:
i) Casing
ii) Hermetically sealed rotary/scroll Compressor
iii) Air-cooled condenser
iv) Evaporator and condenser cooling fan
v) Cooling coil
vi) Filters
vii) Piping, valves, refrigerant strainer, etc.
viii) Controls, instruments, control panel/starter panels.
ix) Vibration isolator pads, ducting (if applicable), etc. as required.
x) Refrigerant as per manufacturer practice.

Split AC shall conform to latest available highest BEE rating.

8.0 VENTILATION EQUIPMENT:

8.1 EVAPORATIVE AIR HANDLING UNIT/Air washer unit (DOUBLE SKIN TYPE)

Each air handling unit shall comprise of the following: -.

a) One (1) no. (85000CMH) Centrifugal fan backward inclined, DIDW Type, complete with electric drive motor, drive Pulleys, V-belt, belt guards, cushy foot mountings, slide rails, removable drain plug, and other accessories etc. and filter back wash arrangement.
b) Two (2) nos. (2 x 100 % duty) Back pull out /END SUCTION pumps for circulation of water shall be considered. Pump suction shall be provided with pot strainer with by-pass valves, inlet and outlet pressure gauge and filter back wash arrangement.
A spray nozzle system consisting of two banks spray system each connected to individual headers, flow regulating valves (Globe valve at Pump outlet) for controlling flow to spray header. Nozzles shall be of stainless steel, pressure drop across nozzle shall be 1.4 - 2.4 Kg./sq.cm.
c) Moisture eliminators of die-extruded PVC construction.

d) Automatically cleanable type Stainless Steel mesh filters complete with SS / Aluminum frame continuously flooded with water by double bank of spray header with Stainless Steel water spray nozzles spraying water over the filters in the direction of airflow.
e) Air filters (SS-316) complete with fixing frame.
f) Intake louver with frame & bird screen (of GI Construction).
g) All valves, pipes, nuts & bolts, pipe hangers, supports, internal fittings and supports including ball float valves for makeup water connection, Low-level Switch with Alarm, quick- fill connection with valve, drain piping with valve up to the nearest drain point and overflow connection with siphon.
h) Inspection door and marine lights with ladder for different section and cat walks as required.
i) Drain pipe with siphon, marine light in each section.
j) No masonry Room shall be provided for the Air washer units including its accessories. All accessories including centrifugal Fans, AHU shall be placed inside a double skin sheet metal casing. However, the water circulating pump sets shall be located outside this AWU casing which shall be provided with canopy. Double skin panel (inside and outside) shall be fabricated using (24 G) galvanized steel, with 25 mm. thk. Outside skin shall be pre plasticized & inside sheet shall be plain GI.
k) Polyurethane insulation in between GSS channels. Outside skin shall be pre-plasticized & inside sheet shall be plain GI.
l) Each Air washer shall have one local push button station for Fan located near each air washer unit for its control. For further details of please refer Section-I, Sub-Section C2A.
m) Mist Eliminator to be provided
n) Efficiency of centrifugal fan and pump shall not be less than 70%.
o) Minimum. Pump and Fan characteristics shall be as per below table

Sr. no.	Items	Min . Motor rating (Kw)
1	Centrifugal fan (min 85000CMH / min 75 mm WC SP	30
2	Centrifugal pump (min 85 CMH / min 30 m head)	15

MOC for Air washer

a) Moisture Eliminators plates: 100% virgin PVC die-extruded construction of minimum finished thickness of 2 mm.
b) Moisture Eliminator Frame: 22 SWG GI sheets and GI angle of adequate strength. ft sleeve: EN - 8 or eqv.
c) Distribution plates: 18 G GSS to have 50% free area.
d) Tank: Black MS for sheet metal Air washer (6mm) thk (Epoxy paint both inside and outside of tank). Min depth -800mm
e) Piping: MS Heavy class (Galvanized) to IS: 1239 Part I or IS: 3589 depending on size.
f) Suction Screen for Water: SS (40 mesh size 2 nos for each air washer)
g) Spray and flooding nozzles: SS

Centrifugal flow fan units

Each centrifugal fan shall be complete with
a) Fan impeller (backward curved) with casing with removable drain plug, Steel Frame / Supporting Structures, as required.

b) Electric drive motor.
c) Drive Pulleys, V-belt, belt guards, slide rails Cushy Foot type Mountings etc.
d) Dampers and flexible connection with matching flanges.
e) Vibration isolators, foundation bolts and nuts.
f) Rain Protection canopy for drive motor for outdoor.

MOC for Centrifugal Fan

a) Fan Scroll: Heavy Gauge MS (IS-2062 Gr.B) with Galvanized.
b) Fan Casing (side plates & stiffeners): Mild Steel Sheets/plate to IS: 2062 Gr.B / IS: 1079 /Eq. The minimum thickness of casing shall be 3.15 mm.
c) Impeller: M.S. sheet/plate (IS-2062 Gr.B) duly spray galvanized
d) Impeller hub: Mild Steel
e) Impeller back plate blade & shroud: Mild Steel to IS: 2062 Gr.B.
f) Shaft: EN - 8 or eqv.
g) Fan Supports, frames and structure: Mild Steel (IS-2062 Gr.B)
h) Flexible connection at outlet/inlet: Fire resistant type plastic impregnated canvas with M.S. flange and cleats (3 mm thick).
i) V Belt (matched sets): ISI marked (Reinforced rubber section to (IS: 4776)
j) V Pulley: Cast Iron multi-groove to Gr-20 as per IS: 210.
k) Slide rails: M.S. /C.I.
l) Connection pieces: G.I. according to supplier's design.
m) Bolts & nuts: Galvanized / MS (Epoxy painted).
n) Vibration isolating cushy foot mountings, foundation bolts and nuts etc.
o) Dampers: Heavy Gauge MS (IS-2062 Gr.B).

8.2 CIRCULATION WATER PUMP SETS

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

i. One No. for taking water from upstream/ sump to AHU's, Horizontal end suction centrifugal pump of adequate capacity to match the system requirement.
ii. One No. adequately sized TEFC sq. cage induction motor suitable for 415 V, 3 phase, 50 Hz AC supply.
iii. One set of base plate, coupling guard, anti-vibration pads, foundation bolts etc.
iv. Valves, Instruments other fittings etc along with chilled water pumps.
v. One No. Pot Strainer at inlet complete with all accessories, drain arrangement, etc.
vi. 150 mm dia dial type pressure gauges one each at suction & discharge side of the pump set.
vii. 150 mm dia dial type temperature gauges at suction side of each of the pump set.
viii. Gate valves, one each at suction and discharge side of the pump set.
ix. One No. non-return (check) valve at discharge side of pump set.
x. One No. Pressure Transmitter at discharge side of pump set.
xi. Drain Piping from pump to nearest drain.
xii. Mechanical seals and all accessories as specified shall be provided.
xiii. MOC of Pump
    - Pump Casing — Cast steel (ASTM A216 WCB)
    - Pump Shaft — Stainless steel (AISI 420 or better)
    - Impeller — High grade duplex stainless steel

- Pump Bearings — Anti friction
- Impeller wear rings — Stainless Steel
- Casing wear rings — Stainless Steel
- Shaft sleeve — Stainless Steel Gr. 410 H
- Base Plate — MS Plate to IS 2062
- Stuffing box seal — Gland Packing / Mechanical seal (C vs SiC & C vs TC) to suit silty water
- Companion Flange — IS 2062 Gr.B
- Insulation class F (temp rise limited to b)

8.3 WALL MOUNTED AXIAL FLOW FAN/ TUBE AXIAL FAN / PROPELLER FANS

Each wall mounted axial flow fan shall be complete with:

(i) Fan impeller with aerofoil section of cast aluminium alloy & casing/short duct as required.
(ii) Electric drive motor with coupling if any, including motor brackets.
(iii) Inlet cone and grouting framework, if any.
(iv) Rain protection cowl with bird-screen adjustable damper, vibration isolators, back draft dampers etc. shall be provided.
(v) Axial fans will be of propeller type, for fans with 5 mm of wc fan static pressure and Tube Axial type for fans with static pressure above 5 mm of wc.
(vi) Each Axial fan comprises of fan, fan motor, inlet and outlet cone (for Tube axial), Louvered shutter (exhaust fans), bird screen and supporting arrangement.
(vii) For other details please refer relevant clauses of Customer technical specification section C2-A.
(viii) Local Modification /grouting of openings shall be in bidder's scope.

S. No.	Capacity	Motor rating	Wall opening
1	**Axial flow supply fans with 30 mmwc static pressure.**		
a.	10,000 CMH	2.2 KW	800mmx800mm
b.	7,500 CMH	1.5 KW	700mmx700mm
c.	6,000 CMH	1.1 KW	600mmx600mm
d.	4,000 CMH	0.75 KW	500mmx500mm
2	**Axial flow supply fans with 20 mmwc static pressure.**		
a.	10,000 CMH	1.5 KW	800mmx800mm
b.	7,500 CMH	1.1 KW	700mmx700mm
c.	6,000 CMH	1.1 KW	600mmx600mm
d.	4,000 CMH	0.75 KW	600mmx600mm
3	**Axial flow exhaust fans (Bifurcated type) with 15 mmwc static pressure.**		
a.	15,000 CMH	2.2 KW	900mmx900mm
b.	10,000 CMH	1.5 KW	800mmx800mm
c.	7,500 CMH	1.1 KW	700mmx700mm
d.	4,000 CMH	0.75 KW	600mmx600mm
e.	2,000 CMH	0.55 KW	500mmx500mm
4	**Axial flow exhaust fans with 10 mmwc static pressure.**		
a.	15,000 CMH	1.1 KW	900mmx900mm

b.	10,000 CMH	0.75 KW	800mmx800mm
c.	7,500 CMH	0.55 KW	700mmx700mm
d.	6,000 CMH	0.55 KW	600mmx600mm
e.	4,000 CMH	0.55 KW	600mmx600mm
f.	2,000 CMH	0.37 KW	500mmx500mm
5	**Exhaust fan (propeller type) with 5 mmwc static pressure.**		
a.	1000 CMH	100 W	330 mm circular

8.4 SHEET METAL WORK

a. Lot – GSS (Galvanized Steel Sheet) supply and return air Ducting (as per IS-277) with 180 g/sq. m. of zinc coating complete with vanes, damper, hangers / supports etc.

b. Lot- Supply air diffusers / grilles (Frame and Louvres of Diffuser/Grilles shall be of extruded aluminum of 1.2 mm thick section, duly powder coated) with volume control dampers. Return air Diffusers will have no Volume Control Damper.

c. Rectangular ducts of size up to 750mm and above shall be supported by 15mm M.S. rods and 50 x 50 x 3 mm M.S. angles while ducts below 750mm shall be supported by 10 mm M.S. rods and 40 x 40 x 3mm M.S. angles. The M.S. rods and angles shall be given a coat of primer paint. The spacing of duct supports shall not be more than 2500 mm. Arrangement like drilling and placing anchor fasteners for duct support, auxiliary or special steel members, hooks coach screws and all other supporting material required shall be provided. wherever the ducts are thermally insulated the M.S. angles and supports shall not be in direct contact with ducts.

d. For other details please refer to clauses no 6.03.00 and other relevant clauses of Customer technical specification section C2-A.

9. INSULATION FOR HVAC SYSTEM

Insulation shall be provided as under:

S.No	Surface	Insulation Material	Insulation Form	Thickness (mm)	Finish
i)	AC Duct	resin bonded fiber glass, (25 Kg/m3 density)	Roll / Slab	25	24 gauge Al cladding
ii	Ventilation duct (running outside the building)	resin bonded fiber glass, (25 Kg/m3 density)	Roll / Slab	25	Covered with 500 Gauge Polythene sheet, chicken wire mesh, 12mm thick sand cement plaster and an overall cladding of 24 G GI sheet.
iii)	Acoustic insulation of first 5M of ducting after AHUs but limited to plenum	Fibreglass (48 Kg density)	Roll / Slab	25	Perforated Al sheet
iv)	Refrigerant Piping	Al foil faced Nitrile rubber / Eqvt	Roll / Slab	39	Al cladding

For other details please refer to clauses no 6.03.06 and other relevant clauses of Customer technical specification section C2-A.

10. CONTROL PHILOSPHY

Control system for Ventilation **system shall be controlled through PLC panel and shall have soft connectivity to "Power House SCADA**" and following equipment shall be controlled through PLC.

- Air Handling Units Fan
- Air handling units Pumps
- Fire damper
- Smoke Exhaust fans
- Motorized Damper on Return air and Fresh air
- Heater and Humidifier
- Motorized Fire Damper
- Make up water pumps through Level switch of Tank
- High RH trip
- Any other drive/instrument required for system completion during detailed engineering

All fire dampers shall be closed on getting signal from the respective fire panels. Necessary cabling required for the purpose shall be covered under HVAC bidder's scope. Further the respective AHU motor / AHU Pump motor etc shall stop on closure of fire damper.

In winters, Fresh Air and Return Air damper shall be altered as per requirement to meet required inside temperature for ventilated areas.

Detailed control philosophy shall be discussed and approved during detailed engineering stage.

For other details please refer to relevant clauses of Customer technical specification section C2-A.

11. POWER SUPPLY ARRANGEMENT

The power supply (rated voltage, frequency, phase) of the equipment will be 415V +/- 10%, 3ph, 50 Hz +/- 5% or 240V+/- 10%, 1ph, 50 Hz +/- 5% as the case may be.

Refer Electrical and C&I part of this specification for details on MCC, Cabling, Local motor starter, PLC etc.

MCC shall be kept in HVAC room with PLC to be kept near MCC or in Control Room.

12. ACCEPTANCE TEST

a. Air conditioning system: Room condition test shall consist of taking the reading of dry bulb and wet bulb temp at different locations points to be mutually decided at site in the areas which are air-conditioned by the respective system/plant. This will be carried out for 24 hrs continuously and readings will be taken every two hours. Standby equipment should be changed over during these 24 hours. This test shall be carried out during summer during month April to June when the dry bulb temp is generally high and during. The format for recording the readings shall be defined in PG / Demonstration test procedure during detailed engineering stage. Relative humidity shall be determined from psychometric chart

b. Ventilation system: Temperature test at the outlet of AHU(Evaporative) and at different floors at mutually agreed locations. The dry bulb temp shall be measured by sling

psychrometer which will have accuracy of +/-0.5% with a least count of 0.5 deg C. This will be carried out for 24 hrs continuously and readings will be taken every two hours. Standby equipment should be changed over during these 24 hours. This test shall be carried out during summer between months April to June. The format for recording the readings shall be defined in PG / Demonstration test procedure during detailed engineering stage.

c. All shop testing and test at site as specified shall be carried out.
d. The Noise level of the AC system shall not be exceeded 55dB (A) in rooms as in the Control Rooms, Offices & Reception Room.
e. The Noise level of the rotating drive shall not be exceed 85dB (A) at 1.5m from source.

Acceptance Test to be covered for ventilation system and should cover followings;

1. Performance Testing (Air Quantity at various floors)
2. Air Balancing
3. Leakage
4. Noise level
5. Vibration level
6. Fire Dampers working
7. Interlocking with SCADA
8. Motor Current
9. Temperature/Humidity at various location of different floors
10. All equipment (fans, blowers, motors, Compressors, Pumps, heater etc.) checking

For other details please refer to Electrical and C&I spec and other relevant clauses of Customer technical specification section C2-A.

13.0 GENERAL

1) Basis of design, all calculations including heat load calculations for summer seasons, equipment selection criterion, layout drawings/ schemes/G.A. dwg and documents like data sheet/ technical particulars etc are subject to Customer approval during detail engineering stage.

2) Vendor to furnish characteristic curves for all major equipment offered indicating duty point during detailed engineering.

3) All drawings and documents shall be computer based.

4) All commissioning spares & consumables for trouble free operation shall be provided by Vendor.

5) Quality Requirements in the Technical Specification are indicating minimum requirements for inspection and testing. Vendor shall note that quality plan is subject to Customer & BHEL-approval during detail engineering stage. Standard QP format is enclosed in the technical specification.

6) Indicative list of makes is enclosed elsewhere in the specifications; however, these equipment/ items shall be subject to Customer & BHEL approval during detail engineering Stage.

7) Drain piping within room and up to the drain point to be provided by the Vendor.

8) Tools & tackles as required for regular maintenance shall be supplied by Vendor.

9) Instruments, consumables, lubricant required for performance testing of various equipment / system of the package shall be arranged by Vendor at site.

10) Only calibrated instruments shall be used by HVAC supplier for testing of various equipment.

11) Temperature gauges shall be provided with thermo wells and fixing arrangement.

12) Pressure gauges shall have provision for air venting. Three way valves shall be used which shall have air venting provision.

13) Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied.

14) Bidders shall guarantee to maintain specified inside design conditions during summer, monsoon and winter and also even if the internal equipment load varies from 100% to 25%.

15) Besides the system performance as above, bidder shall guarantee major technical parameters of various equipment as per design basis / details furnished.

16) The guarantee tests shall cover but not limited to the following rated parameters for smooth operation of HVAC system.

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

17) For motorized fire damper / 3 Way valve actuators / motorised valves, power supply shall be derived by vendor from respective control panels. BHEL shall not provide any feeder for them. Suitable transformer shall be provided by bidder (if required) to derive the power input. Further distribution through junction box / distribution board shall be in vendor scope and shall have provision for isolation of individual fire damper/ valves.

18) Tender drawings enclosed form the part of specification and the bidder shall check the space requirements for installing the equipment as per the specification and layout requirements given in the specifications.

19) Bidder should suitably group the signals coming from various instruments etc. & the same shall terminate in local JB, from Local JB common cable to PLC / panel / MCC shall be selected. Any Electrical / C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope.

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

21) Bidder to note that BHEL reserve the right for drg/doc submission through web-based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Bidder to ensure proper net connectivity at their end.

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

23) Vendor shall fix the equipment using anchor fasteners to secure the equipment obtain parameters related to vibration and noise.

24) HVAC plant supplier to furnish drawings/ documents as per the dwg. / documents distribution as per project requirement.

25) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.

26) The bidder shall furnish complete tech. Particulars in data sheet and schedules as specified elsewhere in the specification during detailed engineering.

27) The bidder shall arrange to provide training on complete HVAC system including operation & Maintenance for Employer Personnel.

28) The tools and machine required for erection of equipment shall be arranged by Vendor.

29) Finishing/Grouting of openings after erection, for routing the ventilation and installation of axial fans, shall be in bidder's scope of works. Floor openings, as available at site, for duct routing can be used by bidder during erection of duct.

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

31) Necessary duct mounted Booster fan (if required) to maintain the static pressure for Package AC / Precision AC / Ventilation duct shall be provided without any implication.

14.0 EXCLUSIONS

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

a) Construction of HVAC plant room, air handling unit room, foundations for HVAC equipment.

b) False ceiling, drop ceiling.

c) Provision of drain traps / points,

d) Fire water tank.

15.0 Codes and Standards

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

SECTION: I

SUB-SECTION: C2-A

CUSTOMER SPECIFICATION

(TECHNICAL REQUIREMENT)

Shahpurkandi HEP (Power House-I:3x33MW)

"Ventilation & Air conditioning System for Power House"

Sr. Xen/SKPP.
PSPCL. Patiala

Power Sector, Hydro Marketing
Sector - 142, Noida U.P.

734

7-70

VAC SYSTEM FOR POWERHOUSE: 1 LOT

1. SCOPE OF SUPPLY

One (1)	**Lot** Package type air-conditioning unit capacity complete with all accessories including foundation bolts, fixtures, refrigerant etc. as specified in the specification for Air Conditioning of the control room and shift Engineer Room and offices.
One (1)	**Lot** Galvanized steel sheet ducts with insulation as specified in the specification complete with necessary anchoring & clamping fixtures as required.
One (1)	**Lot** Air control devices, viz., grills, diffusers, dampers, filters as specified in the Specification as required.
One (1)	25 mm thick Thermo Cole or its equivalent insulation for fixing under the slab for control room/office room and shift Engineers room as required.
One (1)	**Set** Control panel for air conditioning equipments.
One (1)	**Lot** Centrifugal fans each of required capacity complete with driving motor, air inlet and outlet ducts with flexible connections at the discharge side, air dampers, inlet guards and foundation, bolts, fixtures as specified in the specification.
One (1)	**Lot** Propeller type exhaust fans of suitable capacity, Three (3) exhaust air fan for exhaust of air from battery and battery charger room, and exhaust air fan for exhaust of air from workshop / welding and fabrication area, toilets at different floors of 100% of required capacity complete with driving motor, louvers, fixing devices & all other necessary accessories as specified in the specification.
One (1)	**Lot** Air duct distribution system for supply and return air of all VAC systems, with necessary galvanized sheet metal ducts (for battery room exhaust air system- complete plastic ducts, grills etc.), elbows, tees, supports, fixations, including all necessary grills, louvers, outside air louvers, adjusting duct dampers, motorizing air dampers, as required.
One (1)	**Set** Control panel for Ventilation equipments.
One (1)	**Set** PLC panel for integrating the control logic with plant SCADA Coordination and provision of necessary contacts and/or ports for integration with plant SCADA system.
Fifty (50)	**Nos.** Ceiling Fans of 1200 mm sweep for different areas.
Twenty (20)	**Nos.** Mechanical Ventilator fans for different areas.
Twenty (20)	**Nos.** Wall hanging fans for different areas where ceiling fans/AC are not provided.

Sr. Xen/SKPP.
PSPCL. Patiala
735

7-7-1

Power Sector, Hydro Marketing
Noida U.P.

One (1) Lot of Mandatory spares as per Section -10 schedule -6 of Tender documents, as applicable.

(2) DESCRIPTION:

General Information: The Air Conditioning System shall be provided for the Control room, Shift Engineer Room & Offices. For other areas of the Powerhouse, Ventilation system shall be provided.

All air-conditioned areas (Control room, Shift Engineer Room & Offices in the auxiliary bay) shall be maintained at a temperature of 25°C±1°C and at relative humidity of not more than 55%. Rest of the areas in the powerhouse shall be maintained at an approximate temperature of 28°C to 32°C through Ventilation system.

AIR CONDITIONING SYSTEM

The system shall consist of optimum nos. and capacity of package type air conditioning units. The units of a type shall be identical & self-contained and shall be complete with evaporating units, condensing units, room units, interconnecting refrigeration piping, air fan, control panel cum distribution Board, piping insulation etc. along with all necessary accessories. The refrigerant for air conditioning units shall be environment friendly. The conditioned air from room units shall be distributed through diffusers provided with volume & direction control dampers. The system shall be complete with all requisite controls, drain pipes, refrigerating pipes. The system shall be capable of maintaining desired room temperature.

VENTILATION SYSTEM:

Fans for Air Supply

Centrifugal Fans/Axial Flow Fans: The centrifugal fans shall conform to BIS in all respects. Each fan shall be complete with totally enclosed type motors and auxiliary equipment, including keys, anchors, bolts and all other devices needed for assembly, erection and securing the fans and other equipment in place. Drives, resilient bases and inlet guards shall be provided.

Exhaust Air Fans

Centrifugal Type /Axial Flow Fans: The centrifugal fans shall conform to BIS in all respects. Each fan shall be complete with totally enclosed type motors and auxiliary equipment, including keys, anchors, bolts and all other devices needed for assembly, erection and securing the fans and other equipment in place. Drives, resilient bases and inlet guards shall be provided. The fans for battery room shall be protected against the corrosive effect of sulphuric acid fumes by a suitable protective coating or plastic, which shall be applied to the fan impeller inside the housing and that part of the shaft which is exposed to the gases passing through the fan. The coating shall be erosion and corrosion resistant, securely bonded to the basemetal.

Propeller Fans: The fan shall conform to the requirements of IS:2312 in all respects. The fans shall be direct connected complete with totally enclosed type motor, inlet and outlet guards and mounting fixtures. The fans shall have capacity and pressure characteristics suitable for the type of service for which these are used. The fan impeller shall be operating quietly, accurately balanced and securely fastened to the motor shaft.

736 Sr. Xen/SKPP PSPCL. Patiala 172

Power Sector, Hydro Marketing Sector - 142, Noida U.P.

Drives: Belt drives shall be V-belt type selected for 120 percent of motor power. Each drive shall consist of a fan pulley, motor pulley, and endless rubber and fabric-V-belts of suitable thickness.
Pulleys shall be accurately proportioned so that the fan will be driven at the correct speed, grooved for the proper number of V-belts, statically and dynamically balanced and bored, fitted and keyed to their respective shafts.
Flexible coupling shall be ruggedly constructed and shall be adequate for its application. It shall be carefully fitted and secured to the fan and motor shaft. A removable metal guard of substantial construction shall be furnished for each flexible coupling. The guard shall adequately protect the operators and others from contact with the coupling.
Suitable drive guards shall be fitted to fans. These guards shall be designed to allow adequate ventilation and to permit the measurement of shaft speeds without removal.
Inlet / Outlet Guards: Suitably designed guards shall be provided to prevent accidental contact with the rotating blades of the fans. The guards shall be substantially constructed of heavy wire screen firmly held in a steel frame. The screen shall be square or diamond mesh, woven from steel wire of suitable size. The frame shall be of steel of adequate strength, carefully fitted to the fan inlet/outlet, and shall be provided with suitable clips or other approved devices for attaching to the fan housing.

Air Filters: The filter shall be constructed so as to ensure that no leakage can take place past the filtering medium. The housing of air filters may be modular type, and shall be provided with suitable air tight access doors. There shall be adequate clearances for cleaning and replacement. Filters shall be flame-resistant, shall not support growth of bacteria and shall not impart any noticeable odor. Filters shall offer minimum resistance to the air and shall be of proven design. A suitable indicator shall be provided to each filter bank to show when the filter requires cleaning.

Supply and Exhaust Air Duct Work: The supply and exhaust air-duct work for the entire ventilation system shall be designed, fabricated and fully and neatly installed as per IS: 655 except where specified otherwise. Galvanized steel sheets conforming to IS: 277 shall be used for construction of ducts.

The size of the air ducts shall be worked out from the permissible air velocities specified in IS:4720-19.

Grills: The grills for outlet of air from the ducts shall be complete with horizontal and vertical air deflectors and necessary regulating arrangements. The dimensions of grills shall be coordinated with the mounting height of the grill, air volume, throw, drop and angle of projection. Grills shall be constructed for an easy removal. The grills shall be complete in all respects including clamps, flexible connections and other duct fittings.

Noise: The noise levels shall not exceed 55 dB(A) in the control room, reception room, office room, relay panel room etc. and 60 dB (A) in all other rooms and areas, at a distance of 1.5 M. The same shall be 70 dB (A) for all diffuser grills and 85 db(A) for motors, fans etc.

Quality Control and Assurance: The equipment for Ventilation & Air Conditioning system shall be of the best quality. The quality control during manufacturing of equipment as well as testing shall be maintained as per the approved quality assurance plans.

Installation and Commissioning: All labor, supervision, tools, supplies, bracing, spiders, shims and supports and all other provisions or materials necessary to assemble, erect, install, test and commission of the equipment in a thorough workman like manner following the best modern practices shall be provided.

737
Sr. Xen/SKPr.
PSPCL. Patiala

I-73

Power Sector, Hydro Marketing, Noida UP

3. TEST SCHEDULE

All the tests shall be carried out as per the approved Quality Assurance Plan.

Shop Tests

The Ventilation and AC equipments shall be routine shop tested as per relevant IEC/ IS Standards. All tests certificates and reports shall be submitted to the customer.

Site Tests

After installation, the Ventilation & AC system shall be field tested for operational tests, visual inspection of completed installations, main air flow rates, performance of Fresh air units, Package type air conditioner, functional test of louver, damper, thermostat/ temperature sensor, pressure test or leakage test etc.

Sr. Xen/SHPP.
PSPCL. Patiala

Sector, Hydro Marketing
142, U.P.

738

7-74

ANNEXURE 1:

Sr. Xen/SKPP.
PSPCL. Patiala

7-75

SECTION: I

SUB-SECTION: C2-B

CUSTOMER SPECIFICATION

(PROJECT SPECIFIC GENERAL REQUIREMENTS)

Defects and Repairs

Plates with laminations discovered after cutting shall be rejected unless the laminated portion is only local and can easily be repaired; such repairs shall require the consent of the Engineer.

Defects in welds, which are to be repaired, shall be chipped out to sound metal and the areas to be DP or ultrasonically tested to ensure that the defective material has been completely removed before repair of welding is carried out. Repairs shall be carried out in accordance with the relevant Standards and to the approval of the Engineer. The Contractor shall be fully responsible for the in-service performance of all welding work.

The Work shall be 100% inspected again by the method used first to determine such faulty work.

Heat Treatment

Heat treatment shall be performed on all fabricated parts which are stressed during service and are to be finish machined as per the approved heat treatment / weld procedure.

Heat treatment of field erection welding seams shall be performed according to the specifications for the welding procedure for the corresponding parts, which shall be submitted to the Engineer for approval.

1.7 PROTECTION OF MACHINED SURFACES

1.7.1 General

Machine-finished surfaces shall be thoroughly cleaned of foreign matter. Finished surfaces of large parts and other surfaces shall be protected with wooden pads or other suitable means. Unassembled pins or bolts shall be oiled or greased and wrapped with moisture-resistant paper or protected by other approved means.

1.7.2 Corrosion Protection

All ferrous metal work shall be provided with an effective painted or galvanized finish, applied in accordance with the best trade practice to protect from corrosion.

The Contractor's services shall cover the procurement of all materials, and the preparation and application of the painting and other protective coats as specified. All costs of painting or galvanizing shall be included in the Tender Price.

The Contractor shall submit for the Engineer's approval full details of the preparation, type of materials, methods and sequences he proposes to use to comply with the requirements for the protection of the Works.

Sector - 142, Noida U.P.

019 810

PSPCL, Patiala

Painting

Powder coating along with epoxy paint wherever applicable for various cubicles and other enclosures shall also be applicable

Surface Preparation

All surfaces to be painted shall be thoroughly cleaned by suitable means before application of paint. After cleaning the surfaces shall be rinsed in a manner that no residues will remain.

For removing rust and mill scale on structural steel, piping and other steel surfaces, particularly parts which will be in contact with water, exposed to heavy condensation and humidity or subjected to high temperature shall be sandblasted. Parts, which cannot be sandblasted, shall be cleaned of rust by power tool cleaning to the highest degree possible.

The sandblasted clean surfaces shall receive a shop coat with a quick-drying highly pigmented 2-pack zinc-rich primer, unless otherwise specified.

Primed surfaces contaminated with oil or grease shall be de-greased in a manner not affecting the quality of the primer. 2-component coatings older than six (6) months shall be roughened prior to the application of the next coat.

Application Procedure

The most commonly used methods of application are painting by brush, roller, pressure and airless spraying equipment. Selection of the application method depends on the surface to be painted. The quality of the paint shall in no way be negatively influenced.

For all paints the surface temperature of the metal shall not be higher than +50°C during the painting. Concerning special paints, the requirements set by the paint manufacturer shall be followed. All painting shall be free of cracks and blisters and all runs shall be brushed out immediately. After application of the last coat the paint system shall be free of pores.

Parts, which are embedded in concrete, shall be painted with cement base paints.

COATING

General

Unless otherwise specified, and insofar as possible, all of the Contractor's supply shall be shop painted according to the following specifications. Only touch-ups shall be done on site. The paint manufacturer's recommendations shall be followed for film thickness, drying time, application method moisture, temperature and other parameters. These recommendations shall be transmitted to Engineer for approval, before the start of the application of coating.

After painting, surfaces shall be protected from cold; moisture, dirt or new paint until they are completely dry.

For every planned field weld, an area 50 mm on either side of the weld shall not be painted. After the weld, the surface to be painted shall be considered a touch-up.

Sector - 142, Noida U.P.

020

Sr. Xen/SKRP
PSPCL. Patiala

Unless otherwise specified, surface preparation shall be SSPC-SP6 "Commercial blast cleaning". Every surface preparation shall be inspected before painting and an inspection report shall be given to the Owner. SSPC Standards are published by the Society for Protective Coatings.

All surfaces destined to be embedded in concrete shall not be surface-prepared or painted.

There are no particular paint requirements for mass-produced standard components such as instruments, panels, cubicles, etc. However, exposed plain steel surfaces of these parts shall be supplied painted by the manufacturer, at the very least.

The protective coating shall be guaranteed with respect to materials and workmanship. This guarantee covers, among other things, the separation between the base and the coating.

Care shall be taken to protect workers against fumes and irritants, with the use of proper ventilation, masks, protective clothing, as specified in the respective MSDS instructions. The personnel assigned to the preparation of surfaces and application of paint shall be qualified for and experienced in this type of work, and be directed by an experienced supervisor.

Approximately 5% extra paint shall be provided to the Owner in sealed containers once the work is completed, for additional touch-ups at later times.

1.7.3 Requirements for Specific Components

- Piping:
  Carbon steel piping, including any interface with stainless steel, shall be painted with two coats of alkyd paint.
- Steel surfaces designed for permanent contact with water:
  Unless otherwise specified, two coats of polyamine epoxy paint shall be applied within four hours of SSPC-SP10 near white blast cleaning.
- Machined surfaces designed for contact (i.e. flanges or seal surfaces):
  No surface preparation and no paint shall be applied. However, surfaces shall be cleaned according to SSPC-SP1 "Solvent cleaning" and protected for shipping using an appropriate surface protector such as Cosmoline or Rustveto.
- Other steel surfaces, except for embedded surfaces:
  One coat of zinc rich primer and one coat of alkyd paint.

1.7.4 Touch-up Paint

Contractor shall touch-up all surfaces that have been burned, dented, welded, deeply scratched or have been damaged in any other way during site installation.

The surface preparation for the touch-ups shall be done according to SSPC-SP3 "Power Tool Cleaning". All touch-ups shall be done with the original paint system and thicknesses shall be as specified by the paint manufacturer.

The paint shall be inspected after any touch-ups and touched-up again if necessary

1.7.4 Colors

Unless otherwise specified, colors of the finishing coat shall be as below:

Turbine	:	Sky Blue
Generator	:	Sky Blue
Control panels	:	Grey (as per manufacturer's standard)

Power Sector, Hydro Marketing * Sector - 142, Noida U.P.*

021

Sr. Xen/SKPP. PSPCL, Patiala

Oil components	:	Orange
Water piping	:	Sky Blue
Fire protection	:	Red
Compressed air	:	Yellow/Green

Galvanising

Hot-dip galvanized or electrolytically galvanized for the fasteners and steel structures including ladders, platforms, hand rails and the like and all exterior and interior steel surfaces of outdoor Works shall be provided as per usage requirements i.e. water protection etc.

For galvanizing, only original blast furnace raw zinc shall be applied, which shall have a purity of 98.5%.

The thickness of the zinc coat shall be:

For bolts and nuts of sizes above M36 approx. 60 micrometer and for sizes below M36, 25 micrometer.

- For all other parts, except for hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 50 micrometer
- For hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 100 micrometer.
- Cleaning: All material to be galvanized shall be cleaned carefully of rust, loose scale, dirt, oil, grease, and other foreign matters. Particular care shall be taken to clean slag from welded areas.
- Galvanising of hardware: Bolts, nuts, washers, locknuts and similar hardware shall be galvanised in accordance with the relevant standards.
- Straightening after galvanising: All plates and shapes, which have been warped by the galvanising process, shall be straightened by being re-rolled or pressed without injury to the protective coating. Materials that have been harmfully bent or warped in the process of fabrication or galvanising shall be rejected.

1.8 MANUFACTURER'S NAMEPLATES

- Each important part to be delivered under this Contract shall be equipped with permanent nameplate in readily visible locations. The nameplates shall be protected during erection and especially during painting.
- The following data shall be shown in accordance with the relevant standards:
  --Manufacturer's name
  - Work's serial number and year of manufacture
  - Main design data.
  As a general rule, standardised components, such as small or medium-sized electric motors, transformers, instruments, etc., may be delivered with the original manufacturer's standard nameplate.
- Items such as valves, which are subject to handling, shall be provided with an engraved chromium plated brass name plate or label with engraving filled with enamel.

Power Sector, Hydro Marketing * Sector - 142, Noida U.P.*

022

Sr. Xen/SKPP. PSPCL. Patiala

- Nameplates or labels for outdoor equipment are to be of non-corrodible non-hygroscope material with lettering of a contrasting colour.
  Labels for indoor equipments shall be engraved with black letters on white traffolyte.

- The wording of all labels shall be to the approval of the Engineer prior to the shipment of the plant or equipment.

1.7.5 TECHANICAL WORKS AND STEEL STRUCTURES

General: All mechanical Works and steel structures of any mechanical or lectrical installation shall comply with this General Technical Specification.

1.8.1 Bolts, Screws, Nuts, etc.

- All bolts, studs, screws, nuts, and washers shall be to the ISO metric system. Mild steel bolts and nuts shall be of the precision cold forged or hot forged type with machined faces parallel to one another.
- All parts, other than structural steel work, bolted together, shall be spot faced on the back to ensure that nuts and bolt heads bed down satisfactorily. Mild steel nuts and bolts shall be zinc or cadmium plated. Stainless steel bolts, nuts, washers and screws shall be used for holding renewable parts in water or when exposed to high humidity

- All bolts or studs which will be subject to high stress and/or temperature shall be of approved high tensile material with nuts of approved material. All bolts and studs larger than M60 shall be drilled for heaters or shall have an extension for pretensioning by hydraulic tools.
- Fitted bolts shall be a driving fit in the reamed holes they occupy, shall have the screwed portion of a diameter such that it will not be damaged in driving and shall be marked in a conspicuous position to ensure correct assembly at Site.
- The Contractor shall supply the net quantities plus 5 percent of all permanent bolts, screws and other similar items and materials required for installation at the Site. Any such rivets, bolts, screws, etc., which are surplus after the installation of the Works has been completed shall become spare parts and shall be wrapped, marked and handed over to the Owner.

1.8.2 Seals

- Rubber Seals: Seals shall be designed and mounted in such a manner that they are adjustable, water tight and shall be readily removed and replaced. Seals shall be moulded type and not extruded.
- All adjusting screws and bolts for securing the seals and seal assembly in place shall be of stainless steel.
- Seals shall be made of synthetic rubber suitable for conditions at .the Site and shall be of a material that has proven successful in similar applications. Joints shall be water/oil tight.

Sr. Xen/SKPP.
PSPCL Patiala

2.35 PACKING & MARKING

2.35.1 The Contractor shall provide such packing of the Goods as is required to prevent their damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit and open storage. Packing case size and weights shall take into consideration, where appropriate the remoteness of the Goods' final destination and the absence of heavy handling facilities at all points in transit.

2.35.2 Suitable lifting lugs should be provided in heavy consignments and clear instructions are marked on the package for handling.

2.35.3 All electrical parts shall be carefully packed in high pressure polyethylene foils where parts may be affected by vibration, they shall be carefully protected and packed to ensure that no damage will occur while they are being transported and handled.

2.35.4 All bright parts shall be thoroughly protected from rust during transit. Each package shall contain a packing list in polythene cover and six copies shall be sent to the Purchaser. All points shall be marked to facilitate erection.

2.35.5 Large articles which are not packed in cases, shall have all screwed holes, plugged suitably and machined surfaces properly protected. Weight and size limitation for transport given by the Purchaser shall be adhered to.

2.35.6 The Contractor will be required to make separate packages for each consignment and shall mark all containers with the implementing document number pertinent to the shipment. Each shipping container shall also be clearly marked on at least two sides as follows:

Consignee

Contract No.

Package number Description of Works:

Item number (if applicable) Net and gross weight volume

Country of origin

Port of entry

Power Sector, Hydro Marketing, Sector - 142, Noida U.P.

Sr. Xen/SKPP.
PSPCL. Patiala

SECTION: I

SUB-SECTION: C3

TECHNCIAL SPECIFICATION

(ELECTRICAL PORTION)

TECHNICAL SPECIFICATION

FOR

HVAC

(ELECTRICAL PORTION)

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".

b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.

c) Supply of mandatory spares as specified in the specifications.

d) Erection and Commissioning spares

e) Erection & Maintenance tools & tackles

f) Electrical load requirement for **HVAC.**

g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

h) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL

i) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.

j) Motor shall meet minimum requirement of motor specification.

k) LT switchgear panels shall meet minimum requirement of LT switchgear specification.

l) LT power & control cables shall meet minimum requirement of LT power & control cables specification.

m) Cabling, earthing & lightning protection shall meet minimum requirement of cabling, earthing & lightning protection specification

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/quality assurance requirements stipulated. In line with this

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

List of enclosures :

a) Electrical scope between BHEL & vendor

b) Technical specification, datasheets & quality plans for 415V Electric motors

c) Technical specification, datasheets & quality plans for 415V LT Switchgear

d) Technical Specification, datasheets & quality plans for LT power & control cables.

e) Technical Specification, datasheets & quality plans for cabling, earthing & lightning protection

f) Electrical Load data format

g) List of mandatory spares and special tools and tackles and E & C spares

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES : HVAC (CIVIL IN PSPCL SCOPE)
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: SHAHPURKANDI HYDRO-ELECTRIC PROJECT (HEP) 206 MW

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	Vendor	Vendor	1. 415 V AC (3 phase 4 wire) /240 V AC supply (1ph) shall be provided by Vendor.
2	Local Push Button Station (for motors)	Vendor	Vendor	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in vendor's scope b) one end equipment in vendor's scope	 Vendor Vendor	 Vendor Vendor	1. Finalisation of cable sizes shall be done by Vendor meeting specification requirements. Vendor shall provide lugs & glands accordingly. 2. Laying of cables by Vendor. 3. Termination at equipment terminals by Vendor.
4	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	
5	Cable trays, accessories & cable trays supporting system	Vendor	Vendor	
6	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
7	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer approval at contract stage.
9	Lighting	BHEL	BHEL	
10	Equipment grounding & lightning protection	Vendor	Vendor	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle.	Vendor	-	As per specification
15	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (C & I)	Vendor	-	Cable listing & cable routing for C & I systems for vendor supplied

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES : HVAC (CIVIL IN PSPCL SCOPE)
SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT: SHAHPURKANDI HYDRO-ELECTRIC PROJECT (HEP) 206 MW

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
	b) Cable interconnection details for above c) Cable block diagram	 Vendor Vendor	 - -	equipment shall be furnished during detail engineering by vendor in soft copies.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. Supply and E & C of LT cables, Cable tray and tray support system for incomer to HVAC switchgear shall be in vendor's scope. Route Length from source PMCC shall be approx. 150m.

1.9.4 Alternating Current Supply Practice

- All mains supplies shall be switched and fuse in accordance with the requirements stated in the appropriate Section. Double-pole switches shall be used to break single-phase A.C. mains supplies.

- For multi-phase supplies, each phase shall be switched simultaneously and the neutral should preferably not be switched. If it is switched, it shall be opened after and closed before the phase-lines.

- All mains circuits shall be protected only in the phase-lines by fuses of suitable rating or by other suitably protective devices. The neutral shall be connected by a removable link located near the protective devices.

- All mains transformers shall have an electrostatic screen which shall be earthed.

- Except where the prior approval of the Engineer is obtained, wires external to the equipment shall be coloured in accordance with the current IEC or relevant IS recommendation.

1.9.5 Direct Current Supply Practice

- It shall be possible to remove/replace cards from / to electronic equipment without damage and without interfering with the operation of the rest of the equipment or system; if necessary consideration should be given to switching off the supplies locally to a card to prevent inadvertent interference to the equipment or system during removing/replacing a card.

- Application of battery or earth via a test lamp to any external interface point or test point shall not lead to any component damage.
- Power supply bus bars in cubicles shall be carefully routed and each bus bar shall be shrouded. It shall not be possible to inadvertently short bus bars either between themselves or to earth.

1.9.6 Electric Motors General

shall conform to IE3 efficiency class as per IS 12615

- All motors shall be of approved manufacture high starting torque and shall comply - as far as applicable - with ISI standard motor dimensions.
- The general construction shall be stiff and rigid; no light metal alloy casings will be accepted. All precautions shall be taken to avoid any type of corrosion.

- All motors shall be fitted with approved types of lifting hooks or eyebolts as suitable.

- AC motors shall have squirrel cage type rotors. Motor Voltages and Power Ratings
- The service voltages and corresponding power ratings for electric motors to be used in the Project may be decided based on application during detailed engineering. However tentative guide lines are shall be as follows:

- - Motors up to 100 kW
  Service voltage: 3-phase AC 415/240 V,50 HZ
  Mode of starting : 1. Upto 50kW direct-on-line up
  2. 50kW & above: DOL / star- delta starter

- Motors up to 0.75 kW

- Service voltage : single-phase AC 240 V,50 HZ
- Mode of starting : condenser

- Motors intended to work on the DC System
- Service voltage: 220 V D.C.
- Mode of starting: resistor

Rating

- The rating of the motors shall be adequate to meet the requirements of its associated equipment. The service factor, being the ratio of the installed motor output to the required power at the shaft of the driven machine at its expected maximum power demand, shall be applied as follows:

Power Demand of Driven Machine	Service Factor
Up to 5 kW	1.2
More than 5 kW	1.1

- A.C. motors shall be capable of operating continuously under rated output conditions at any frequency between 95% and 105% of the rated frequency and/or with any voltage variation between 90% and 110% of the nominal voltage. A transient over voltage of 130% of the nominal voltage shall as well be sustained.

- Further, the motors shall be capable of maintaining stable operation when running at 70% nominal voltage for a period of 10 seconds. The pullout torque for continuously loaded motors shall be at least 160% of the rated torque and for intermittently loaded motors 200% of the rated torque.
- D.C. motors shall be capable of operating continuously under rated output conditions at any voltage between 90% and 110% of the nominal voltage with a fixed brush setting for all loads. Unless otherwise approved, the speed drop between no-load and full-load shall not exceed 10% of no-load speed.

Starting

- A.C. motors shall be designed for direct on-line starting. They shall be capable of being switched on without damage to an infinite bus bar at 110% of the nominal voltage with an inherent residual voltage of 100% even in phase opposition. For starting the motors from the individual main and auxiliary bus bars, a momentary voltage drop of 20% referred to nominal voltage should be taken into consideration. With 85% of the nominal voltage applied to the motor terminals, each motor shall be capable of accelerating its associated load to full speed with a minimum accelerating torque of 5% of full load torque.

- The maximum starting currents (without any tolerance) shall not exceed the following values:
  - 5 times of rated current for L.V. motors rated 100 kW or above
  - 2 times of rated current for D.C. motors (by means of starting resistors)

- Generally, all motors shall be able to withstand five cold starts per hour, equally spaced. In addition, each M.V. motor shall be capable of enduring two successive starts with the motor initially at operating temperature. Each L.V. motor shall be capable of withstanding three successive starts under the same conditions or once every fifteen minutes without detrimental heating.

- Motors for frequent automatic starting shall have an adequate rating. In the motor list the Contractor shall state the frequency of starts permitted in compliance with the motor design.

Insulation Class

- The insulation of all motors shall be of class F but maintain in operation the temperature limits of class B materials. It shall be suitable for operation in damp locations, for occasional contact with corrosive gases and vapours and for considerable fluctuations in temperature.

Ventilation and Type of Enclosure

- All motors shall be of the totally enclosed fan-cooled type, protection class IP 54 according to IEC Recommendation 141. Cable termination points shall be of class IP55.

- As per Tender Specification.

- Vertical motors shall be provided with a top cover to prevent the ingress of dirt, etc.

Bearings

- As far as possible, the motors shall have sealed ball or roller bearings lubricated for live. All other motors with ratings of about 1 kW and above shall be equipped with lubricators permitting greasing while the motor is running and preventing over lubrication. Additionally, the bearings shall be fitted with: grease nipples permitting the use of a universal grease gun.
- Vertical motors shall have approved thrust bearings.

Terminal Boxes and Earthing

- The terminal leads, terminals, terminal boxes and associated equipment shall be suitable for terminating the respective type of cables ~~as specified in these General Technical Specifications and in the Particular Technical Specifications.~~
- The terminal boxes shall be of ample size to enable connections to be made in a satisfactory manner. Supports shall be provided at terminal boxes as required for proper guidance and fixing of the incoming cable.

- The terminal boxes with the cables installed shall be suitable for connection to supply systems with the short-circuit current and the fault clearance time determined by the motor protective devices.

- A permanently attached connection diagram shall be mounted inside the terminal box cover. If motors are provided for only one direction of rotation,

Short time rating for terminal boxes

o 110kW & Above (breaker controlled): 40 kA for 1 sec

o Below 110kW (MCCB+ contactor controlled): 40 KA for 0.20 sec.

this shall be clearly indicated.

- For earthing purposes, each motor shall have adequately sized bolts with washers at the lower part of the frame. In addition, each terminal box shall contain one earthing screw. Each equipment/panel shall be earthed by at least two separate earthing strips.

Noise-Level and Vibrations

- Under all operating conditions, the noise level of motors shall not exceed 85 dB (A).

- In order to prevent undue and harmful vibrations, all motors shall be statically and dynamically balanced.

Tests

- Each motor shall be factory tested and shall undergo a test at site. The following tests shall be performed under full responsibility of the Contractor.

  Workshop Tests:
  - Measurement of winding resistances
  - No-load and short-circuit measurements
  - Measurement of starting current and torque - Efficiency measurement (type test) - Heat test run
  - Dielectric test
  -Measurement of insulating resistance

1.9.7 Starters and Contactors

- Motor starters and contactors shall be equipped with short circuit protection and local disconnecting devices. Preferably, all starters shall be from one manufacturer. The control circuit voltage shall be obtained from a 415/240 V isolating transformer with primary circuit breaker and secondary fuse. The secondary winding of this transformer shall be grounded. The operating coils of the contactor shall be connected between the grounded side of the transformer and the control contacts.

- Starters and contactors shall comply with IEC 292.1 or NEMA IC 1 or relevant IS and be suitable for direct on-line starting, uninterrupted electrical duty, and capable of 30 operations per hour. They shall be installed in ventilated enclosures for indoor installation and weatherproof enclosures for outdoor installation, unless otherwise approved by the Engineer. The enclosures shall be complete with locks, cable sealing boxes, conduit entries, cable gland plates, bus bars, internal wiring, terminal boards, etc as required by the duty of the starter or contactor.

- Starters and contactors shall be of minimum size compatible with motor size and capable of satisfactory operation, without damage, for a period of 5 minutes at a voltage 25 percent below nominal, at nominal frequency.

- Thermal type overload and phase failure relays shall be supplied with

Thermal type overload and phase failure relays shall be supplied with starters for motors of 7.5 kW or greater. For motors of less than 7.5 kW, suitable rated 3-phase thermal overloads will be acceptable. Current transformer and Ammeters to read current in one phase shall be provided for motors above 7.5 kW in the starter panel.

- Each starter shall have sufficient number of auxiliary contacts required for interlocking and indication purposes plus two spare convertible contacts for Owner's use.

1.9.8 Moulded Case Circuit Breakers

- All moulded case circuit breakers shall be of 2 or 3-pole type as required, having thermal time delay and instantaneous trips with "On-Trip-Off', indicating/operating mechanism. Circuit breakers used in combination type motor starters or contactors shall have the operating mechanisms interlocked with the starter or contactor cover so that the cover cannot be opened unless the circuit breaker is open. The breakers shall comply with applicable section of IEC 15 7/1 or relevant Indian Standards.

1.9.9 Control Relays

- Relays used as auxiliary control devices in conjunction with motor starters and magnetic contactors shall be of the type designed for machine tool application featuring contact convertibility. All contacts shall have a minimum thermal current rating of l0A over a range of 6 to 600 V AC.

1.9.10 Terminal Blocks

- All terminal blocks shall be mounted in an accessible position with the spacing between adjacent blocks not less than 100 mm and space between the bottom blocks and the cable gland plate being a minimum of 200 mm. sufficient terminals shall be provided to allow for the connection of all incoming and outgoing cables, including spare conductors and drain wires. In addition, 20 percent spare terminals shall be provided. In enclosed cubicles, the terminal blocks shall be inclined toward the door for facilitating terminations.

- Terminals shall be of the channel mounting type and shall comprise a system of individual terminals so that terminal blocks can be formed for easy and convenient cabling consistent with the high reliability required of the circuits.

- Terminal blocks shall be provided with shorting links and paralleling links where applicable and mounting identification numbers and/or letters.

- Terminal blocks shall conform to the applicable standards. The smallest size to be used shall be designated for 2.5 Sq mm FRLS wire and not more than two conductors shall be connected under one terminal clamp.

- Terminal identification shall be provided corresponding to wire number of connected leads.

- Circuit terminals for 415 V AC shall be segregated from other terminals and shall be equipped with non inflammable, transparent covers to prevent contact with live parts. Warning labels with red lettering shall be mounted thereon in a conspicuous position.

1.9.11 Equipment Wiring

- All wiring connections shall be readily accessible and removable for test or other purposes. Wiring between terminals of the various devices shall be point to point.
- Multi-conductor cables shall be connected to the terminal blocks in such a manner as to minimise crossovers. Approved claw washers of crimp type connector shall be used to terminate all small wiring. Each conductor shall be individually identified at both ends through a system providing ready and permanent identification, utilizing slip-on ferrules approved by the Engineer.

- Markers may be typed individually or made up from sets of numbers and letters firmly held in place. Open markers will not be accepted.

- Markers must withstand a tropical environment and high humidity and only fungus proof materials will be accepted. Ferrules of adhesive type are not acceptable.
- All trip circuits shall employ markers having a red background.

1.9.12 Cubicles And Control Panels

Cubicles and control panel enclosures shall be of sheet steel of 1.5 mm for Enclosure frame, roof, rear panel and gland plates, 2.0 mm for Doors and 3.0 mm for Mounting plate of rigid, self-supporting construction and supplied with channel bases

- Cubicles shall be fitted with close fitting, gasketted, hinged, lift-off doors capable of being opened through 180 deg. The doors shall be provided with integral lock and master key.

- Cubicles and panels shall be vermin proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. The cables and wiring shall enter from bottom or top as approved or directed by the Engineer.
- The cubicles and panels shall be adequately ventilated, if required, by vents or louvers. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.

- Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.

- Unless stated otherwise, all cubicles and panels shall be provided

with a ground bus with 40mm copper bar extending throughout the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120mm^2.

- All instruments, control knobs and indicating lamps shall be flush mounted on the panels. Relays and other devices sensitive to vibration shall not be installed on doors or hinged panels, and no equipment shall be installed on rear access doors.

- The instrument and control wiring, including all electrical interlocks and all interconnecting wiring between sections, shall be completely installed and connected to terminal blocks by the manufacturer.

- The arrangement of control and protection devices on the panels and the exterior finish of the panels shall be subject to the approval of the Engineer. The interior of all cubicles and panels shall have a mat white finish unless specified otherwise.
- Switched interior light and socket outlets shall be provided for all cubicles and control panels.
- All cubicles and control panels shall be provided with nameplates, identifying the purpose of the panel and all of its components.

1.9.13 Earthing

- Provision shall be made for earthing all equipment intended for connection in an A.C. mains supply. All structural metal work and metal chassis shall be connected to earth. Connection between circuits and metal work shall only be made for reasons of safety and/or reduction of interference. Where such connections are made, they shall not be used as normal current-carrying earth returns.
- Earthing conductors shall be at least equal in cross-sectional area to the supply conductors and shall be capable of carrying the fault current.

1.9.14 Labels And Plates

- Labels and data plates shall be provided in accordance with applicable standards and as detailed hereunder.

- The proposed material of the labels, size, exact label lettering and proposals for the arrangement of the labels shall be submitted to the Engineer for approval.

- Labels written in the Contract language shall be provided for all instruments, relays, control switches, push buttons, indication lights, breakers, etc. In case of instruments, instrument switches and control switches, where the function is indicated on the device, no label is required. The label shall be fixed close to the devices in such a way that easy identification is possible.

- Each separate construction unit (cubicle, panel, desk, box, etc.) shall be identified. Cubicles and similar units shall also bear this

identification number on the rear side if rear access is possible. The overall designation of each unit shall be given in the Contract language and - if required - also in a selected local language. These labels shall be made of anodised aluminium with black engraved inscriptions, arranged at the top section of the units. Manufacturer's trade labels shall - if desired - appear in the bottom section of the units.

- All Works inside cubicles, panels, boxes, etc., shall be properly labelled with their item number. This number shall be the same as indicated in the pertaining documents (wiring diagrams, Works list, etc.).

- Instruction plates in the Contract and selected local language, the sequence diagrams or instructions for maintenance shall be fitted on the inside of the front door of the electrical switchboards.

1.9.15 Warning Labels

- Warning labels shall be made of synthetic resin with letters engraved in the Contract and selected local language, where required in particular cases.

- For indoor circuit breakers, starters, etc., transparent plastic material with suitably contrasting colours and engraved lettering would be acceptable.

1.9.16 Labels For Cables

- Each cable when completely installed shall have permanently attached to each end and at intermediate positions as may be considered necessary by the Engineer, noncorrosive labels detailing identification number of the cable, voltage, and conductor size.

- The cable identification numbers shall comply with those of the cable list.

- All cables in cable pits and at the entry to buildings shall be labelled utilising the aforementioned type of label.

1.9.17 Single-Line Diagrams

- Each switchgear room shall be furnished with a copy of the final as-built single-line diagram detailing all electrical data and denominations, separate for each individual switchgear / distribution board / MCC, placed under glass and frame/wall mounted at an approved location.

- The same applies to the Station Single-Line Diagram one copy of which shall be arranged in the control room(s).

1.9.18 Key System for Electric Boards

- Key interlocked switches shall be provided with approved locks for locking in the neutral position. Similar locks shall be provided for

selector switches for locking the switches in any of the positions.

- The locks or padlocks shall be co-ordinated for the different applications and shall be supplied with three keys. The cabinet door keys shall be similar and shall be six (6) in number.

1.10 INSTRUMENTATION AND CONTROL EQUIPMENT DESIGN CRITERIA

- All components shall be of an approved and reliable design. The highest extent of uniformity and interchangeability shall be reached. The design shall facilitate maintenance and repair of the components.
- The Works shall be pre-assembled to the highest extent in the Contractor's or SubContractor's workshop, e.g., shop welding of thermometer wells and other connections, wiring of boards, desks, etc., including internal wiring and installation of devices shall be carrie out. Fragile instruments shall be removed for transportation to site.

- All components shall be suitable for continuous operation under site conditions.

- Materials for instrumentation and control equipment, including piping material, which are exposed to the measured media, shall be selected accordingly.
- All components shall be compatible with other electrical, electronic and mechanical Works.

- All instrumentation and control functions shall be shown on the piping and instrumentation diagrams. The symbols to be used shall be in accordance with ISO standard. The identification system (tag numbers) shall be in accordance with the Works identification system and is subject to approval by the Engineer. All measurements and alarms shall be listed in a measuring list of a standard form subject to Approval by the Engineer. For remote controls, a schedule of interlocks shall be provided. The features of automatic controls shall be shown in block diagrams.

- Shielded cables shall be provided for the control and supervisory equipment where required.

Sizes of Indicators, Recorders, Etc.

- The meters, instruments and recorders shall be of standard size, to be selected to guarantee unique appearance of switchgears, control panels, control desks, etc. The front glasses shall be of the anti-glare type. The scales shall be 90 degrees type for local control panels but must be 240 degrees type for control room instrumentation.

Tests

- The single components and pre-erected assemblies shall undergo functional and routine tests in the Contractor or Sub-Contractor's workshop. The ready mounted control and supervisory system shall

Refer specification of 415V Switchgear only. Vendor to prepare 415V boards to feed HVAC loads according to system requirements.

- Commissioning details.

Documentation shall be supplied according to the dates set out herein.
Final documentation shall be revised as required to reflect as built and commissioned status.
Manuals shall be supplied as 8 sets of printed, bound manuals and 3 copies on CD with full text indexing and search engine.

7.2.3 LOW VOLTAGE 415 V SWITCHGEAR FOR EACH P/H

7.2.3.1 Scope

This section covers low voltage 415 V switchgear ~~(UAB-1, UAB-2, SSB).~~

7.2.3.2 GENERAL

The switchgear shall be capable of continuous and reliable operation at the full load rating specified. Workmanship shall be the highest grade and the entire construction in accordance with the best modern practice. The switchgear shall be capable of withstanding the severest stresses likely to occur in actual service and of resisting rough handling during transport.

~~The switchgears shall be directly coupled to its transformer through a flexible braid connection. Provide as required transition cell to align connection to the transformer connection Bus bars.~~

The switchgear shall have each two incoming cells containing draw-out circuit breakers. Each incoming cell shall be capable of taking the entire load of the switchgear. There shall be 1 no. HVAC switchgear for PH-1 & 1no. HVAC switchgear for PH-2.

~~Switchgear SSB shall be equipped with two outgoing bus tie draw-out circuit breakers.~~

7.2.3.3 ELECTRICAL CHARACTERISTICS

40 kA, 1sec

The Bus bars and circuit breakers are :

Rated voltage	415 V, 3-phase, 4-wire
Rated frequency	50 Hz
Symmetrical short circuit current	~~20 kA~~ rms (minimum) at 415 V
Rated current Bus bars	~~1250 A~~

7.2.3.4 STANDARDS

The design, manufacture and testing of the various equipment covered by these specifications shall comply with the latest issue of the following standards:

IS 8623	General requirements for factory built assembly up to 1000 V;
IS 4237	General requirements for switchgear and control gear for voltage not exceeding 1000 V;
IS 4047	Specification for heavy duty air break switches and composite units of air break switches and fuses for voltages not exceeding 1000 V;
IS 2208	Specification for HRC cartridge fuse links up to 650 V;
IS 3156	Specification for voltage transformer;
IS 2705	Specification for current transformer;
IS 1248	Specification for direct acting electrical indicating instruments;
IS 3914	Code of specification for selection of AC induction motor starter.

HVAC switchgear length shall be restricted to 10.8 m. AC fuse DBs if required can be used to feed single phase loads.

7.2.3.5 SPECIFIC REQUIREMENTS

7.2.3.6 CONSTRUCTION

~~The switchgear shall be directly coupled to its primary supply transformer (UAT-1, UAT-2 and SST).~~

The switchgear shall be metal enclosed IP 54 for rating up to 1600 A and IP 42 above 1600 A type dust and vermin proof, drip proof construction for indoor installation and made up of the requisite vertical sections.

The switchgear shall be single front construction.

The structure shall contain horizontal Bus bars running throughout its length and be readily accessible. Each vertical panel structure shall contain a vertical wire/cable way with provision for suitable cable support. The cable compartment shall have hinged doors.

The switchgear shall be folded construction with minimum of 12 SWG CRCA sheet metal shaped and reinforced to form a rigid structure. All doors shall be made of 14 WG CRCA sheet metal and provided with neoprene gaskets. The panel door should have self-tightening handle/knob so that the door closes properly to prevent ingress of dust. The hinges and the screws should be SS 316.

The height of the switchgear shall be restricted to 2375 mm including a base channel of 75 mm ISMC at the bottom.

The layout for components mounted shall be standardized for providing uniformity. The components layout shall be such as to permit easy maintenance/removal. No equipment/switch operating mechanism shall be mounted on the rear side of the board as it is undesirable from maintenance considerations. The panel should have liberal internal spacing for ease of maintenance.

Provision shall be made for permanently earthing the frames and other metal parts of the switchgear through a copper earth bus bar running throughout its full length at the bottom. It shall be possible to earth at two independent points on either ends for connection to the external earthing network of the plant.

The switchgear shall be extensible on both sides for addition of vertical section in the future.

7.2.3.7 BUS BARS

The Bus bars shall be air insulated and of aluminium.

The current density shall not be more than 1600 A/sq. in inch (625 sq. mm). Bus bars shall be silver plated at joints.

The Bus bars shall be so supported and braced as to be capable of safely withstanding, without deformation, the maximum thermal and magnetic stresses corresponding to the short circuit level specified.

The main horizontal Bus bars of the switchgear shall be located at the top in a separate chamber extending the entire length of the same. The Bus bars mating surface shall be silver plated. The main Bus bars shall be PVC sleeved and color coded.

Doors shall be provided for access to the Bus bars for inspection purpose and the Bus bars shall be adequately shrouded to prevent accidental contact.

7.2.3.8 INCOMING ~~AND TIE~~ CIRCUIT BREAKERS

The incoming and tie circuit breakers shall be three-pole, draw-out, magneticblast air type and be of the three position type : “Connected”, “Disconnected” and “Draw-out”. They shall be equipped with the following devices and mechanisms:

- A set of main draw-out contacts;
- A set of secondary draw-out contacts;
- A stored-energy type charging mechanism designed in a way to prevent operation of the breaker before charging is completed;
- A worm gear levering mechanism, self-contained on the circuit breaker draw-out element and operated by a crank permitting manoeuvring of circuit breaker between the “Connected”, “Test” and “Disconnected” positions.

The circuit breakers shall be electrically controlled at 220 V DC with closing and tripping coils designed for DC operation only, of sufficient capacity.

The two incoming circuit breakers shall be electrically interlocked and provided with an automatic transfer scheme. The control voltage shall be 220 V DC. Protection lock-out scheme shall be included to prevent switchover under a fault condition.
The circuit breakers shall be equipped with push-buttons for local control, with red and green signal lamps indicating respectively the "Closed” and “Open” positions, and with devices for mechanical closing and tripping.

The incoming ~~and tie~~ circuit breakers shall be equipped with a digital automatic over current tripping system and a ground fault element ~~as shown on the drawings.~~ This system shall comprise one current sensor per pole, a digital tripping unit and a control mechanism. The sensor rating shall respect the rated values of the current transformers ~~shown on drawings.~~

The digital tripping unit shall be equipped with instantaneous, long and short delay elements, with continuous type setting adjustment, independent from one another.

7.2.3.9 OUTGOING CIRCUIT BREAKERS AND CUBICLE

There shall be line side draw-out, three pole, molded case type and shall be mounted in separate compartments and have a rating as on drawings of Bidder.
These circuit breakers shall have magnetic tripping on short-circuit faults and delayed thermal tripping on overloads with adjustable thermal tripping current.
Each circuit breaker compartment shall have a door and a handle. The door and the circuit breaker shall have a mechanical interlock to ensure that the circuit breaker shall opened before access into the compartment shall be allowed and it shall be possible to padlock the handle in the “Open” position.

The outgoing circuit breakers shall be installed in a free standing motor control center (MCC) type cubicles. Circuit breakers shall be installed in individual draw-out compartment. The MCC cubicle shall be comprised of the number of section required to house all outgoing circuit breakers. 50% unused space shall be provided. Each section will comprise a maximum of 8 circuit breakers and 4 unused spaces. Each section shall be provided with a vertical gutter to house outgoing cables. The sections shall be suitable to install combination starters if required. Each section shall be provided with a 800 A vertical tin copper bus. The MCC cubicle shall be coupled with the incoming breaker sections with a rigid bus connection. Back-to-back assembly may be required because of space limitations.

MCCB SHALL BE USED UPTO 400A. AFTER THAT ACB SHALL BE USED.

Back-to-back set-up shall be provided with independent from and rear cubicles. Compartment doors shall be pad-lockable.

It shall be possible to add or remove compartment under voltage.

7.2.3.10 METERING, CONTROL, PROTECTION AND ANNUNCIATION

Each incoming cell shall be provided with a compartment used for control, metering, protection and annunciation.

- **Metering:** A solid state power meter shall be flush mounted on the front door of this compartment. Other equipment shall be mounted inside. The energy metering device required is described under Section.

- **Annunciation:** An annunciator with visual and horn alarm shall be mounted on this compartment.

- **Protection:** Protective relays shall be flush mounted on the front door of this compartment. Auxiliary relays shall be mounted inside.

- **Control :**
  An interlock system shall be provided as follows (~~assume breaker numbering~~

7.2.3.11 TERMINAL BLOCKS

Terminal blocks shall be required for both P/H

7.2.3.12 CABLE TERMINATION

The switchgear shall be designed to facilitate PVC insulated and armoured cable entry from the rear bottom of the panel. Detachable gland plate of adequate thickness shall be provided to avoid sharp bending and easy connection. Compression type SIBG tinned brass cable gland shall be provided for all cable terminations. Crimping type tinned lugs for control and power cables up to 3 x 16 sq. mm PVC cables and 3 x 25 sq. mm and above that open close type soldering lugs (tinned copper) to be used for cable terminations. Suitable shrouds shall be provided to prevent accidental contact with live outgoing termination of other feeders while carrying out maintenance on one feeder.

7.2.3.13 LABELS

Name plates of approved design shall be provided to represent circuit designation for each feeder. Material for name plates shall be of PVC sheet with rear engraving. They shall be firmly secured with fasteners.

7.2.3.14 PAINTING

All metal surfaces shall be chemically cleaned, degreased and pickled in acid to produce a smooth clean surface, free of scale, grease and rust.
After cleaning, phosphating and passivation treatment, the surface shall be given two coats of zinc rich epoxy primer and baking in the oven.
After primer, it shall be given two coats of storing type enamel paint (shade as per IS – 5 shade 631).
Sufficient quantity of touch up paint shall be furnished for application at site.

7.2.3.15 TESTS

Equipment shall be tested as per the relevant IEC or applicable Indian Standards.

7.2.3.16 SPARE PARTS AND SPECIAL TOOLS

7.2.3.17 SPARE PARTS: ~~LIST AS PER SECTION 10~~ as per annexure 1

All spare parts shall be electrically and mechanically identical to corresponding parts of the equipment supplied and shall be suitably packed and clearly marked. All ready for long term indoor storage.

Contractor shall submit to a complete and distinct list of spare parts that the recommends be added to the above mentioned list and indicate the unit prices.
PSPCL reserves the right to purchase or not the spare parts appearing on the lists.
The spare parts that are purchased shall be delivered with the equipment specified in this specification.

7.2.3.18 SPECIAL TOOLS: ~~LIST AS PER SECTION 10~~ as per annexure 2

7.2.4 POWER AND CONTROL CABLES

7.2.4.1 SCOPE

All cables inside the power house shall be PVC cables,unarmoured Rodent proof, HRFR/FRLS type. Cables laid outside shall be pvc cables, armoured, Rodent proof and HRFR/FRLS type.

7.2.4.2 STANDARDS

The cables shall comply with the latest edition standards:

IS : 1554 (Part I)	PVC insulated (heavy duty) electric cables - Part I for working voltages up to and including 1 100 V.
IS : 7098 (Part II)	Cross-linked Polyethylene insulated PVC sheathed cables: Part II for working voltages for 12.7/22 kV.
IS : 8130	Conductors for insulated electric cables and flexible cords.
IS : 5831	PVC insulation and sheath of electric cables.
IS : 3975	Mild steel wires, strips and tapes for armouring of cables.
IS 2633	Methods of testing weight, thickness and uniformity of coating on hot dipped galvanized articles.
IS : 209	Specification for Zinc.
IS : 3961 (Part II)	Recommended current ratings for cables: Part-II PVC insulated and PVC sheathed heavy duty cables.
IS : 1753	Aluminum conductors for insulated cables.
BS : 2782 Part - I	Methods 141A, British Standard methods of testing Plastics - Part-I thermal properties.
IEC : 754-1 **OR** relevant IS	Test on gases evolved during combustion of electric cables Part I - Determination of the amount of halogen acid gas evolved during the combustion of polymeric materials taken from cables.
IEC : 60502 Series **OR** relevant IS	Extruded solid dielectric insulated power cables for rated voltages from 1 kV up to 30 kV.
IEC : 60811 & 60885 Series **OR** relevant IS	Test methods for insulation and sheaths of electric cables and cords.
IS : 9968 (Part-I)	Elastomer insulated cables - for working voltage up to and including 1100 V.

7.2.4.3 GENERAL CONSTRUCTION

7.2.4.4 GENERAL

The cables shall be brand new and in good condition. These shall be suitable for laying in trays, trenches, ducts, conduits and underground buried installation with uncontrolled backfield and possibility of flooding by water. The terminating and straight through joint kits for the cables shall be suitable for the type of cables offered and for storage without deterioration up to 40 °C ambient temperature.

7.2.4.5 PVC CABLES

Low voltage power cables shall be of aluminum and control cables shall be of copper. All conductor cable shall be of Stranded construction.

All power/control cables for use on low voltage systems shall be heavy duty type, 1100 V grade with aluminum/copper conductor, PVC insulated, inner sheathed, unarmoured, Rodent proof, HRFR/FRLS type and overall PVC sheathed as detailed below:

- The construction of the conductors shall be stranded for aluminum cables. Conductors of nominal area less than 25 sq. mm shall be circular only. Conductors of nominal area 25 sq. mm and above may be circular or shaped.

- The core insulation shall be with PVC compound applied over the conductor by extrusion and shall conform to the requirements of Type A compound of IS : 5831. Control cables having 6 cores and above shall be identified with prominent and indelible core nos. on the outer surface of the insulation. Color of the numbers shall be white with a spacing of maximum 500 mm between two consecutive numbers.

- The inner sheath shall be applied over the laid-up cores by extrusion and shall be of PVC conforming to the requirements of Type STI PVC compound of IS : 5831. The extruded inner sheath shall be of uniform thickness of size as per table -4 of IS 1554 (part-1).

  Taped inner sheath is not acceptable.

- All cables used for electronic circuit shall be of 0.5 mm2 copper twisted pair cables as per relevant IS.

- The outer sheath for the cable shall be applied by extrusion and shall be PVC compound conforming to the requirements of type ST1 compound IS: 5831. To protect the cables against rodent and termite attack, suitable chemicals shall be added into the PVC compound of the outer sheath.

- The dimensions of the insulation, armour, and outer sheath materials shall be governed by values given in Section VI of IS 1554 (Part-I).

compound of IS: 5831. To protect cable against rodent and termite attack, suitable chemicals shall be added into the PVC compound of the outer sheath.

The dimensions of insulation, armour, outer sheathing materials shall be governed by values given in Tables 1.3 and 4 of IS: 7098 Part -II.

7.2.4.7 CABLE ACCESSORIES

The termination for use on medium voltage system shall be suitable for the type of cables offered as per this specification. The termination shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fitting and consumable items. An installation instruction shall also be included in each kit. Makes of kits other than those specified may be considered by PSPCL if type test certificates accompany the offer. These kits are to be provided as back-up tools and are not to be used by Contractor. Joints are not permitted under any circumstances.

7.2.4.8 TERMINATING KITS

The terminating kits shall be suitable for termination of the cable in indoor switchgear or in a weather proof cable box of an outdoor mounted transformer/motor. The terminating kits shall preferably be one of the following types:

- "TAPEX" of M-SEAL make using non-linear resistance material for stress grading.
- "PUSH-ON" type of CCI make using factory moulded silicon rubber insulators.
- "TROPOLINK" type of CCI make.
- Heat - Shrink sleeve type of M/s Raychem.

For outdoor terminations, whether shields/sealing ends and any other accessories required shall also form part of the kit.

7.2.4.9 TESTING AND INSPECTION

7.2.4.10 GENERAL

The cables shall be tested and examined at the Contactor's works by the PSPCL. Contactor shall furnish all necessary information concerning the supply to PSPCL. The inspector shall have free access to the Contactor's works for the purpose of inspecting the process of manufacture in all its stages and he will have the power to reject any wire or other material which appears to him to be of unsuitable description or of unsatisfactory quality.

7.2.4.11 PVC ~~& XLPE~~ CABLES

After completion of cables and prior to dispatch, cables shall be subjected to type, routine, acceptance and special tests as detailed below. PSPCL reserves the right to witness all tests with sufficient advance notice from Bidder. The test reports for all cables shall be submitted for approval by the PSPCL

All cables where 5 core cables used, the size of neutral conductor should be 1.7 time of phase ~~contractor.~~ conductor

All routine tests, acceptance tests, type tests as well shall be carried out on cables as per relevant IS.

~~The inner and outer sheath of XLPE cables shall be subjected to all the tests applicable for PVC cables.~~ The test requirements for insulation and sheath of PVC cables shall be as per latest revision of IS: 5831.

In addition to above, the following special tests shall also be performed on the cables.
Accelerated water absorption test for insulation as per NEMA-WE-3.11.

Dielectric retention Test: The dielectric strength of the cable insulation tested in accordance with Cl. 6.7.4 of NEMA WE-5 at 75 +/- 1 ℃ shall not be less than 60% of the original dielectric strength.

Oxygen Index Test: The test shall be carried out as per ASTMD 2863 - 1974 and the minimum oxygen index number should be 30.

Test for rodent and termite repulsion property: Bidder shall furnish the test details to analyze the property to chemical method.

Medium voltage cables shall be subjected to hi-pot testing after installation and after completion of termination. First a 5 kV AC "MEGGER" test shall be done to establish cable soundness and note insulation resistance. Then a DC hi-pot test shall be conducted at a level of about 45 kV DC. Voltage shall be applied progressively in 10 steps with a 60-second wait at least in between. Test report shall be provided for approval of PSPCL.

7.2.4.12 CABLE ACCESSORIES

Type tests shall have to be carried out to prove the general qualities and design of a given type of termination/jointing system. The type test shall include the following tests conforming to the latest IEC 502-2, 466 **OR** relevant IS and VDE 0278 specifications. The type test certificates shall be submitted along with the offer.

- AC Voltage withstand dry test for 1 minute.
- Partial discharge test - Discharge magnitude shall be less than 20%.
- Impulse voltage withstand test with 10 impulses of each polarity.
- AC high voltage test following load cycling test with conductor temperature at 90 ℃.
- Partial discharge test - Discharge magnitude shall be less than 20%.
- Thermal short circuit test at 250 Deg. C for 1 second.
- Impulse voltage withstand test with 10 impulses of each polarity.
- DC Voltage withstand test for 30 minutes.
- Humidity test.
- Dynamic short circuit test.
- Salt fog test.
- Impact test.
- ~~ADD site testing.~~
- Megger testing of 1100 V cables.
- ~~HIPOT and Megger testing of 11/12.7/22 kV cables.~~

7.2.4.13 PACKING AND MARKING

Cable shall be dispatched in wooden drum of suitable barrel diameter, securely battened, with the take-off end fully protected against mechanical damage. The wood used for construction of the drum shall be properly seasoned, sound and free from defects. Wood preservatives shall be applied to the entire drum.
On flange of the drum necessary information such as manufacturer's name, type size voltage grade of cable, length of cable in meters, drum No., cable code, ISI

Certification mark, gross weight, etc. shall be printed. An arrow shall be printed on the drum with suitable instruction to show the direction of rotation of the drum.
Cables shall be supplied in drum lengths as follows:

- Low voltage power cables up to and including 6 sq. mm – 1000 M.
- Low voltage power cables from 10 sq. mm up to and including 300 sq. mm – 500 M.
- Control cables up to and including 27 cores – 1000 M.

7.2.4.15 Cable Trays and Fittings

7.2.4.16 SCOPE FOR EACH P/H

This section covers cable trays and fittings for installation.

7.2.4.17 STANDARDS

Cable troughs and fittings shall conform with the latest edition of the applicable IEC standards **OR** relevant IS

7.2.4.18 CHARACTERISTICS

The cable trays shall be ladder type with rung spacing of 300 mm. They shall be made of galvanized steel. Their sides shall be 114 mm high and their width shall be 300 mm, 600 mm or 750 mm as indicated in the bill of material. Rungs shall be welded to sides to provide optimum strength. The cable trays shall have the following tentative design characteristics/values:

Width	Design Support	Design Load
300 mm	6 m	67 kg/m
600 mm	6 m	67 kg/m
750 mm	6 m	112 kg/m

Horizontal and vertical elbows and tees shall have an inside turning radius of 600 or 900 mm ~~according to indication in the bill of material~~.

All the above elbows shall be factory performed to provide a single welded unit. Elbows made with short lengths of cable trays and flexible slotted straps shall not be accepted.

Adjustable horizontal elbows shall be provided only as indicated in the bill of materials for angles of less than 10 degrees.

Adjustable vertical elbows shall be provided only ~~as indicated in the bill of material~~ for angles of less than 6 degrees.

Connectors shall be supplied complete with the necessary bolts, nuts and lock washers. Expansion joints shall provide for expansion of plus or minus 25 mm and shall not reduce the rigidity of the installation.

The barrier strips shall be made of sturdy aluminum 90 mm high and shall be provided complete with a strip clamp for every meter of length.

7.2.4.19 TESTING

PSPCL shall require that a sample of cable trays be subjected to the Preece test detailed in ASTM A 239 standard.

7.2.5 Cabling, Earthing and Lightning Protection (for both P/H)

7.2.5.1. Cabling

i) Scope

The specification covers design, supply, insulation, testing and commissioning of cabling, earthing and lightning protection at the both power houses

The complete cable support system shall be supplied and installed for the entire project. The system shall enable proper laying of all power, control, instrumentation and telephone cables, and shall provide necessary mechanical protection, ventilation and segregation for them. All hardware and anchoring arrangement shall be included. All steel members shall be hot dip galvanized.

ii) Design

The contractor shall furnish detailed design, Drawing and calculation for approval.

iii) General requirements

No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant and switchyard areas.

Interplant cabling for main routes shall be laid along overhead trestles/duct banks/directly buried. However, from tap-offs, same can be through shallow trenches with approval of Owner. Directly buried cable, if essential, shall not have concentration of more than four (4) cables. However, cables in switchyard area shall not be buried. Cables from main plant to switchyard control room shall be laid in duct bank/cable trenches.

In switchyard area, cables shall be laid in RCC concrete trenches with.
Wherever false floors are envisaged for cabling, the cables can be directly laid on ground, neatly routed along grid spacing. The false floor shall be at least 1000 mm deep. False floor requirement shall be subject to Owner's approval.

Cable entry from outdoor underground/cable routes to the buildings, if any shall be above the finished floor level inside the building.

PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

Cable trays, support system and pipes.

a)	support system for cable trays	Prefabricated out of sheet steel and fully galvanized flexible type consisting of channels, cantilever arms and associated brackets & hardware, installed at site by bolting or clamping. These shall be rigid enough to withstand max. possible loads

Cable tray support system shall be made of 2.5 mm thick hot/cold rolled M.S. as per IS 1079 with zinc coating of min 75 microns/ 610 g.sq m.

b)	Type of cable trays	Ladder for power cables and perforated for control instrumentation cables, complete with all accessories, fittings and hardware.
c)	Material of cable trays	Rolled mild steel, min. 2 mm thick for trays and 3 mm thick for coupler plate.
d)	Finish of cable trays	Hot tip galvanized. Mass of Zn coating 610 g/sq m.
e)	Duct banks (if provided)	Heavy duty GI pipes/heavy duty PE pipes (10% spare of each size, subject to min 1) with suitable water-proof manholes. For corrosive areas, pipes shall have anti-corrosion Coating both inside & outside.
f)	Pipe size	Suitable with 40% fill criteria
	Junction and Pull boxes	Hot dip galvanized sheet steel of 2 mm thickness.
	Cable glands	Nickel chromium plated brass, heavy duty, and single compression type for unarmored and double compression type for armoured cables conforming to BS: 6121 **OR** relevant IS.
	Cable lugs	Solder less tinned copper crimping type. ~~For HT cables, lugs shall be as per DIN 46329. F~~or rest, it shall be as per relevant IS.
	~~HT cable terminations and joints~~	~~Proven design and type tested as per VDE 0278. Elastimold or equivalent fully insulated moulded terminations shall be preferred.~~

Cable Lying:

a)	Identification tags for cables	To be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray or buried run.
b)	Cable tray numbering	To be provided at every 10 m and at each end of cable way & branch connection.
c)	Joints	Joints for less than 250 m run of cable shall not be permitted.
d)	Buried cable protection	With concrete slabs; Route markers at every 20 m along the route & at every bend.
e)	Road crossings	Cables to pass through buried RCC Hume pipes.
f)	Transformer yard Handling area	RCC trenches to be filled with sand after cable laying.
g)	Separation	At least 300 mm between HT power & LT power cables, LT power & LT control/ instrumentation cables.
h)	Segregation	All cables associated with the unit shall be segregated from cables of other units. Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for ac drives and corresponding emergency ac or dc drives shall laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall

		be segregated from the other set. Segregation means physical isolation to prevent fire jumping or minimum one hour fire rating. In switchyard, control cables of each bay shall be laid on separate racks/trays.
i)	Cable clamping	To be suitably clamped/tied to the tray; For cables in trefoil fonnation, trefoil clamps as required.
j)	Fire protection	Fire proof cable penetration seals rated for one hour when cable passes through walls and/or floors. This shall be by suitable block system using individual blocks with suitable framework or by silicon RTV foaming system. In case foaming system is offered, damming board, if used, shall not be considered for fire rating criteria. Any of the system offered shall be of proven type as per BS: 476 (Part-8) or equivalent standard.

7.2.5.2 Earthing/Grounding/ Soil resistivity

Earthing system shall be designed as per IS: 3043 and IEEE: 80. Earthing system network/earth mat shall be interconnected mesh of mild steel rods buried in ground in the plant. All off-site areas shall be interconnected together by minimum two parallel conductors. The contractor shall furnish the detailed design and calculations for PSPCL approval.

Enclosures of all electrical equipment as well as all cabinets/boxes/ panels/etc. shall be earthed by two separate and distinct earth connections. Metallic pipes, conduits, cable tray section, etc. shall be bonded to ensure electrical continuity and earthed at regular intervals as well as at both ends. Metallic conduits, pipes, etc. shall not be used as earth continuity conductor. All hinged doors shall be earthed by flexible braids of adequate size.

All steel structures shall be duly earthed. Metallic sheaths and armour of all multi core cables shall also be earthed at both equipment and switchgear end. Earthing conductor shall be buried at least 2000 mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead. Earthing conductor embedded in the concrete floor shall have at least 50 mm concrete cover.

Earthing connections with equipment earthing pads shall be bolted type with at least two bolts, and joint surfaces shall be galvanised. The connections shall be painted with anti-corrosive paint after testing and checking.

Neutral of power transformers shall be directly connected to two rod electrodes in treated earth pits, which in turn shall be connected to station earthling grid.

The earthing terminal of surge arresters and voltage transformers, and lightning protection down conductors shall also be connected to station earthing grid through separate rod electrode.

Soil resistivity;- The Soil resistivity measurements shall be required to be taken at 20 locations at the two no. Power House site. These measurements shall require to be taken with ANALOG SOIL RESISTIVITY METER, ASHIDA make by four electrodes method with equal probe. The report must be declared satisfactory by PSPCL. It will be as guidance and actual measurements must be validated. Contractor to measure at site at min. 20 locations approved by Owner

7.2.5.3 Lightning Protection

The lightning protection system shall be designed as per IS:2309. It shall cover all buildings and structures in the plant, and switchyard areas. It shall comprise horizontal/vertical air terminations, down conductors, test links and earth connections to the station earthing grid. All conductors shall be of minimum 25x6 nun size and shall be of galvanised steel only.

The down conductors of lightning protection system shall have a test joint at about 1500 mm above ground level. Each down conductor shall be connected to a 40 mm dia, 3 m long mild steel earth electrode as well as station earthing grid.

The lightning protection system shall not be in direct contact with under ground metallic service ducts and cables, and shall not be connected above ground level to other earthing conductors. All joints in the down conductors shall be of welded type. Pulser system for lightning shall not be accepted.

Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths as per IEEE: 142.

Other requirements for earthing system.

a.	Standard Code	IEE – 80, IS:2390
b.	Earthing system life expectancy	40 years.
c.	System fault level	50 kV for one second
d.	Soil resistivity	Contractor to measure at site at min. 20 locations approved by Owner
e.	Min. steel corrosion rate	0.25 mm per year.
f.	Depth of burial of main earth conductor	600 mm below grade level: where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300 mm below them.
g.	Conductor Joints	By electric arc welding, with resistance of joint not less than that of the conductor. Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection.

The minimum conductor size for earthing system shall be as follows :

Equipment	Buried conductor	Conductor above ground & in trenches
Main station grid	40 mm dia MS rod	65x8 mm GS flat
Switchgear/MCC	--	65x8 mm GS flat
415 V distribution boards	--	50x6 mm GS flat
HT motors	--	50x6 mm GS flat
LT motors above 125 kW	--	50x6 mm GS flat
LT motors - 25 to 125 kW	--	25x6 mm GS flat
LT motors - 1 to 25 kW	--	25x3 mm GS flat
Fractional HP LT motors	--	8 SWG GS wire

Control panel & control desk	--	25x3 mm GS flat
Push button stn. & Junction box	--	8 SWG GS wire
Cable trays, cols. & structures	--	50x6 mm GS flat
Bus duct enclosures	--	50x6 mm GS flat
Rails & other metal parts	--	25x6 mm GS flat
Eqpt. earthing for switchyard	--	75x12mm GS flat and 50x6mm GS flat

model) PCs each with 500 GB hard disk, 4 GB SDRAM, 52 X DVD drive, pan drive, DVD writer, 17/19 inch colour LED monitor, key board, scroll mouse, 256 KBPS external modem, UPS for 30 min. power backup and A 4 size monochrome 20 PPM, 600/1200 DPI laser printer along with scanner and one AI size monochrome plotter.

This system shall be placed in a separate cabin in control room and shall be used to store all drawings, data, progress reports, minutes of meeting etc. Computers shall be provided with necessary soft-wares/ programs. Adequate furniture will also be supplied by the contractor for each system.

7.2.10 Lattice Structure with Ladder FOR BOTH P/H one each
For lighting repair work, Masts of adequate height shall have lattice structure with ladder, cage and top platform.

7.2.11 Welding Set: One No. for each P/H of rated capacity of 5 KVA, 50 Hz, 415V shall require being located in a separate room/cabin.

7.2.12 Diesel Generator set: One No. for each P/H of rated capacity of 500 KVA, 50 Hz, 415 V shall require being located in a separate room/cabin for the back-up of LT supply.

7.2.13 Ceiling Fans: Approximately 50 No. fans (1200 mm sweep) shall be required for each Power House where ventilation/air conditioner not provided.

7.2.14 Mechanical ventilator fans: Mechanical ventilator fans may be provided by the contractor in each power house as per site.

7.2.15 Wall handing fans: Wall hanging fans shall also be provided by the contractor in Power House where ceiling fans/air conditioners are not provided.

Electrical Workshop Equipment – AS PER LIST OF WORKSHOP EQUIPMENT.

7.2.17 Specification for Erection of Electrical Equipment

7.2.17.1 SCOPE

This specification covers the installation, testing and commissioning of all electrical equipment and accessories required for the power plant and substation for efficient and trouble free operation.

7.2.17.2 STANDARDS

The electrical installation work covered by this specification shall, unless otherwise stated, comply with the requirements of the latest edition of the following relevant Indian Standards, statutory regulations and Codes of practices.

• Indian Electricity Rules		
• Tariff advisory committee recommendations.		
• IS - 10018	:	Code of practice for selection, installation and maintenance of switchgear and control gear
• IS - 6600	:	Guide for loading of oil immersed transformers
• IS - 3043	:	Code of practice for earthing
• IS - 2309	:	Code of practice for protection of building and allied structures against lightning
• IS - 2274	:	Code of practice for electrical wiring installation

Representative. Contractor shall be responsible for final adjustment of relays, instruments, meters, breakers, etc. and also for submission of relay settings and calculations.

7.2.17.4 EQUIPMENT ERECTION

All the equipment shall be properly handled and erected as per the relevant codes of practice and Contactor's drawings and instruction manuals.

Handling equipment, sling ropes, etc. should be tested before erection and periodically for strength.

For cleaning the inside and outside of equipment, only clean, lint free rag or leather clothes shall be used.
Necessary Junction boxes (C/W terminal blocks) for CT's and PT's wherever applicable shall be supplied and installed. Marshalling boxes shall be provided where deemed necessary.

7.2.17.5 INSTALLATION CABLE RACKS, SUPPORTS

All cable trays and racks, cable rack supports and conduits shall be installed by the Contractor before installing cables.

7.2.17.6 POWER CABLES

Contractor's scope of work includes unloading, laying, fixing, jointing, bending and terminating of cables. The bending of power cables shall be made in accordance to the minimum bending radius recommended by the cable manufacturer and code requirement. Contractor shall also supply all the necessary hardware for jointing and terminating of cables. Cable shall be laid on cable racks, on cable trays and supports in conduits and ducts, etc.

Markers shall be installed at all road crossing positions. Their provision and installation shall be indicated in the areas.

All necessary care must be taken by Contractor for design and installation of cables.

Contractor shall install, test and commission the cable specified in accordance with the latest revisions of Indian Standards.

All cable work and the associated apparatus shall be designed and arranged to reduce the risk of fire and any damage that may result in the event of fire. Wherever cables pass through any floor or wall opening, suitable sealing compounds using fire resisting materials shall be used to prevent fire spreading.
Standard cable installation tools shall be utilized for cable pulling. Maximum pull tension shall not exceed the Contractor's recommended value. Cable grips, reels or pulleys used shall be properly lubricated. The lubricant shall not injure the overall covering and shall not set up undesirable conditions of electrostatic stress.
Sharp bending and kinking of cables shall be avoided. The bending radius for various types of cables shall not be less than those specified by manufacturer.
Power and control cables shall be laid in separate cable trays. The order of laying of various cable in trenches shall be as specified below:

- 11/12.7/22 kV cables on the top of the layers;
- 415 V cables;
- 220V DC cables;
- Control and instrumentation cables;
- Communication as the first bottom layer.

Where cables cross roads and water, oil, gas or sewerage pipes the cables shall be laid in reinforced concrete pipes. Cables shall be protected at all times from mechanical injury and from absorption of moisture. Cables that are not laid in cable trays shall be installed in continuous rigid steel galvanized conduits. Contractor shall provide all the required fittings and supports.

Some extra length shall be kept in each cable run at a suitable point to enable one or two straight through joints to be made at a later date, if any fault occurs.
Metal sheath and armour of the cable shall be bonded to the earthing system of the station.

Each cable shall be identified with its designation number as indicated in the drawings and cable schedule.

Cable clamps shall be of 3 mm thick galvanized M.S. spaced at 1.5 m interval.

Imbedded conduits shall be provided as required. Conduits shall be galvanized and rigid and be provided with threaded couplings. Embedded conduits will most likely be required for the field cables between the excitation and the generator.

Bidder shall indicate clearly in the Technical Data Sheets the extent to which these methods shall be used.

All welded joints, which have to be tight, shall be inspected or tested by dye penetration tests.

All major welds carried out on parts under hydraulic pressure shall be at least 10 radio-graphically and 100% ultrasonic examined. All welds on the skin-plates shall be additional dye penetration tested as directed by the Engineer.

The Contractor shall indicate in the corresponding drawings the type of non-destructive testing to be carried out during manufacture and at Site.

Defects and Repairs

Plates with laminations discovered after cutting shall be rejected unless the laminated portion is only local and can easily be repaired; such repairs shall require the consent of the Engineer.

Defects in welds, which are to be repaired, shall be chipped out to sound metal and the areas to be DP or ultrasonically tested to ensure that the defective material has been completely removed before repair of welding is carried out. Repairs shall be carried out in accordance with the relevant Standards and to the approval of the Engineer. The Contractor shall be fully responsible for the in-service performance of all welding work.

The Work shall be 100% inspected again by the method used first to determine such faulty work.

Heat Treatment

Heat treatment shall be performed on all fabricated parts which are stressed during service and are to be finish machined as per the approved heat treatment / weld procedure.

Heat treatment of field erection welding seams shall be performed according to the specifications for the welding procedure for the corresponding parts, which shall be submitted to the Engineer for approval.

1.7 PROTECTION OF MACHINED SURFACES

1.7.1 General

Machine-finished surfaces shall be thoroughly cleaned of foreign matter. Finished surfaces of large parts and other surfaces shall be protected with wooden pads or other suitable means. Unassembled pins or bolts shall be oiled or greased and wrapped with moisture-resistant paper or protected by other approved means.

1.7.2 Corrosion Protection

All ferrous metal work shall be provided with an effective painted or galvanized finish, applied in accordance with the best trade practice to protect from corrosion.

The Contractor's services shall cover the procurement of all materials,

and the preparation and application of the painting and other protective coats as specified. All costs of painting or galvanizing shall be included in the Tender Price.

The Contractor shall submit for the Engineer's approval full details of the preparation, type of materials, methods and sequences he proposes to use to comply with the requirements for the protection of the Works.

Painting

Surface Preparation

All surfaces to be painted shall be thoroughly cleaned by suitable means before application of paint. After cleaning the surfaces shall be rinsed in a manner that no residues will remain.

For removing rust and mill scale on structural steel, piping and other steel surfaces, particularly parts which will be in contact with water, exposed to heavy condensation and humidity or subjected to high temperature shall be sandblasted. Parts, which cannot be sandblasted, shall be cleaned of rust by power tool cleaning to the highest degree possible.

The sandblasted clean surfaces shall receive a shop coat with a quick-drying highly pigmented 2-pack zinc-rich primer, unless otherwise specified.

Primed surfaces contaminated with oil or grease shall be de-greased in a manner not affecting the quality of the primer. 2-component coatings older than six (6) months shall be roughened prior to the application of the next coat. Powder coating along with epoxy paint wherever applicable for various cubicles and other enclosures shall also be applicable.

Application Procedure

The most commonly used methods of application are painting by brush, roller, pressure and airless spraying equipment. Selection of the application method depends on the surface to be painted. The quality of the paint shall in no way be negatively influenced.

For all paints the surface temperature of the metal shall not be higher than +50℃ during the painting. Concerning special paints, the requirements set by the paint manufacturer shall be followed. All painting shall be free of cracks and blisters and all runs shall be brushed out immediately. After application of the last coat the paint system shall be free of pores.

Parts, which are embedded in concrete, shall be painted with cement base paints.

COATING

General

Unless otherwise specified, and insofar as possible, all of the Contractor's supply shall be shop painted according to the following specifications. Only touch-ups shall be done on site. The paint manufacturer's recommendations shall be followed for film thickness, drying time, application method moisture, temperature and other parameters. These recommendations shall be transmitted to Engineer for approval, before the start of the application of coating.

After painting, surfaces shall be protected from cold, moisture, dirt or new paint until they are completely dry.

For every planned field weld, an area 50 mm on either side of the weld shall not be painted. After the weld, the surface to be painted shall be considered a touch-up.

Unless otherwise specified, surface preparation shall be SSPC-SP6 "Commercial blast cleaning". Every surface preparation shall be inspected before painting and an inspection report shall be given to the Owner. SSPC Standards are published by the Society for Protective Coatings.

All surfaces destined to be embedded in concrete shall not be surface-prepared or painted.

There are no particular paint requirements for mass-produced standard components such as instruments, panels, cubicles, etc. However, exposed plain steel surfaces of these parts shall be supplied painted by the manufacturer, at the very least.

The protective coating shall be guaranteed with respect to materials and workmanship. This guarantee covers, among other things, the separation between the base and the coating.

Care shall be taken to protect workers against fumes and irritants, with the use of proper ventilation, masks, protective clothing, as specified in the respective MSDS instructions. The personnel assigned to the preparation of surfaces and application of paint shall be qualified for and experienced in this type of work, and be directed by an experienced supervisor.

Approximately 5% extra paint shall be provided to the Owner in sealed containers once the work is completed, for additional touch-ups at later times.

1.7.3 Requirements for Specific Components

- Piping:
  Carbon steel piping, including any interface with stainless steel, shall be painted with two coats of alkyd paint.
- Steel surfaces designed for permanent contact with water:
  Unless otherwise specified, two coats of polyamine epoxy paint shall be applied within four hours of SSPC-SP10 near white blast cleaning.
- Machined surfaces designed for contact (i.e. flanges or seal surfaces):
  No surface preparation and no paint shall be applied. However, surfaces shall be cleaned according to SSPC-SP1 "Solvent cleaning" and protected for shipping using an appropriate surface protector such as Cosmoline or Rustveto.
- Other steel surfaces, except for embedded surfaces:
  One coat of zinc rich primer and one coat of alkyd paint.

1.7.4 Touch-up Paint

Contractor shall touch-up all surfaces that have been burned, dented, welded, deeply scratched or have been damaged in any other way during site installation.

The surface preparation for the touch-ups shall be done according to SSPC-SP3 "Power Tool Cleaning". All touch-ups shall be done with the original paint system and thicknesses shall be as specified by the paint manufacturer.

The paint shall be inspected after any touch-ups and touched-up again if necessary

1.7.4 Colors

Unless otherwise specified, colors of the finishing coat shall be as below:

Turbine	:	Sky Blue
Generator	:	Sky Blue

Control panels	:	Grey (as per manufacturer's standard)
Oil components	:	Orange
Water piping	:	Sky Blue
Fire protection	:	Red
Compressed air	:	Yellow/Green

Galvanising

Hot-dip galvanized or electrolytically galvanized for the fasteners and steel structures including ladders, platforms, hand rails and the like and all exterior and interior steel surfaces of outdoor Works shall be provided as per usage requirements i.e. water protection etc.

For galvanizing, only original blast furnace raw zinc shall be applied, which shall have a purity of 98.5%.

The thickness of the zinc coat shall be:

For bolts and nuts of sizes above M36 approx. 60 micrometer and for sizes below M36, 25 micrometer.

- For all other parts, except for hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 50 micrometer
- For hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 100 micrometer.
- Cleaning: All material to be galvanized shall be cleaned carefully of rust, loose scale, dirt, oil, grease, and other foreign matters. Particular care shall be taken to clean slag from welded areas.
- Galvanising of hardware: Bolts, nuts, washers, locknuts and similar hardware shall be galvanised in accordance with the relevant standards.

- Straightening after galvanising: All plates and shapes, which have been warped by the galvanising process, shall be straightened by being re-rolled or pressed without injury to the protective coating. Materials that have been harmfully bent or warped in the process of fabrication or galvanising shall be rejected.

1.8 MANUFACTURER'S NAMEPLATES

- Each important part to be delivered under this Contract shall be equipped with permanent nameplate in readily visible locations. The nameplates shall be protected during erection and especially during painting.
- The following data shall be shown in accordance with the relevant standards:
  --Manufacturer's name
  - Work's serial number and year of manufacture
  - Main design data.
  As a general rule, standardised components, such as small or medium-sized electric motors, transformers, instruments, etc., may be delivered with the original manufacturer's standard nameplate.
- Items such as valves, which are subject to handling, shall be provided with an engraved chromium plated brass name plate or label with engraving filled with enamel.

- Nameplates or labels for outdoor equipment are to be of non-corrodible non-hygroscope material with lettering of a contrasting colour. Labels for indoor equipments shall be engraved with black letters on white traffolyte.

- The wording of all labels shall be to the approval of the Engineer prior to the shipment of the plant or equipment.

Data sheet - A

Of

Low Voltage Switchgear

(I) LOW VOLTAGE SWITCHGEAR

(A) SWITCHGEAR

1.0 SYSTEM DESIGN DATA

1.1	Design Ambient		:	50°C
1.2	Relative Humidity			
	a)	Average	:	85%
	b)	Maximum	:	100%
1.3	Max. system voltage for continuous operations		:	440 Volt
1.4	One-minute power frequency withstand voltage:			
	a)	Main circuit	:	2.5 KV rms.
	b)	Aux. circuit	:	2.0 KV rms.
1.5	DC System fault level (220 V)		:	20 KA
1.6	System Earthing		:	Solidly Earthing
1.7	Formula for calculating Full Load Current (FLC) of motors		:	For Uni-directional drives: $\frac{kW \times 1000}{\sqrt{3} \times V(line) \times PF \times Efficiency}$ For Bi-directional drives: Average load current of valves to be considered.

2.0 **APPLICABLE STANDARDS** :IS 8623, IS 13947, IS 2147 (latest revisions)

3.0 **CONSTRUCTIONAL FEATURES**

3.1 **GENERAL**

3.1.1	Operational Fronts	:	[ ] Double Front [√] Single Front [ ] Both as per BOM
3.1.2	a. Type of sheet steel	:	[ ] Hot rolled [√] Cold rolled
	b. Sheet metal thickness (Minimum)		

	a)	Non-load bearing covers	:	14 SWG
	b)	Non-load bearing partitions	:	14 SWG
	c)	Load bearing members	:	12 SWG
	d)	Frames (non load bearing)	:	12 SWG
	e)	Door	:	14 SWG
	f)	Withdrawable unit	:	14 SWG
3.1.3	Rating above which louvers are permitted		:	1600 Amp.
3.1.4	Degree of Protection of switchboards with modules in service and all doors closed.			
	a)	Without louvers	:	IP-54
	b)	With louvers	:	IP-42 (above 1600A)
3.1.5	Spare Modules		:	[√] As per BOM (load list) [ ] %

3.2 **DRAWOUT MODULES**

3.2.1	Type of execution of modules (functional unit)	:	
a)	Circuit breaker unit (Incoming & outgoing)	:	[√] Withdrawable [ ] Fixed
b)	MCCB unit (Incoming)	:	[√] Withdrawable [ ]
c)	Switch-Fuse & Contactor (Incoming)	:	[√] Withdrawable [ ] Fixed
d)	Switch or Switch-Fuse (Incoming)	:	[√] Withdrawable [ ] Fixed for DCDBs
e)	MCCB unit (Outgoing)	:	[√] Withdrawable [ ]
f)	Contactor starter unit (Outgoing)	:	[√] Withdrawable [ ] Fixed
g)	Switch-Fuse unit (Outgoing of DCDB)	:	[ ] Withdrawable [√] Fixed
h)	Incoming Voltage Transformer (VT)	:	[√] Withdrawable [ ] Fixed
i)	BUS VT	:	[√] Withdrawable [ ] Fixed
j)	Control Transformer (upto 5kVA)	:	[ ] Withdrawable [√] Fixed

k)	Space Heater	:	[ ] Withdrawable [√] Fixed	
l)	Alarm	:	[ ] Withdrawable [√] Fixed	
m)	DC Supply	:	[ ] Withdrawable [√] Fixed	
3.2.2	Rating upto which withdrawable units applicable, if specified in 3.2.1 b), d), e) and g) above.	:	400 Amp.	
3.2.3	Facility for functional testing of withdrawable modules required for :			
a)	Incomer units (PCC)	:	[√] YES	[ ] NO
b)	Incomer units (MCC)	:	[√] YES	[ ] NO
c)	Outgoing contactor starters	:	[√] YES	[ ] NO
d)	Bus - Couplers	:	[√] YES	[ ] NO

3.3 **BUSBARS & CONNECTIONS**

3.3.1	Busbar material		
a)	Phase	:	Aluminium for Horizontal busbar and copper for vertical dropper
b)	Earth	:	Copper busbar
3.3.2	Fault Level	:	40 kA
3.3.3	Short time current		
a)	for switchboards fed by ACB	:	40 KA ,1 sec.
b)	For switchboards fed thru MCCB	:	40 KA , 0.2 sec.
3.3.4	Temperature Rise (for Horizontal Busbar)		
a)	Design ambient	:	[ ] 45 [√] 50 °C
b)	Temp. rise for		
i.	Silver plated joints	:	[ ] 60 [√] 55 °C
ii.	Non-silver plated joints	:	[ ] 45 [√] 40 [ ] 35 °C

3.3.5	Whether HRPVC sleeving to be provided for horizontal busbar	:	[√] YES	[ ] NO
3.3.6	Whether Shrouds on busbar tap offs to be provided	:	[√] YES	[ ] NO
3.3.7	Applicable method of colour coding for black PVC sleeving	:	Bands as per Table 1 of IS:11353	
3.3.8	Busbar clearances in air (minimum)			
a)	Phase-Phase	:	25 mm	
b)	Phase-Earth	:	25 mm	

3.4 SECONDARY WIRING

3.4.1	Colour code of wires	:	
	CT Circuit		R,Y,B,Black
	Space Heater Circuit		Black
	PT Circuit		R,Y,B
	AC Control Circuit		Black
	DC Control Circuit		Grey
	Door Earthing		Green

3.4.2 Sizes of wires (minimum)

a)	CT leads & control circuit	:	2.5 mm^2	
b)	Other wires for voltage circuits	:	1.5 mm^2	

3.5 AUXILIARY BUSES

Provision of following shall have copper buses:

a)	AC Control Bus	:	[√] 230 V	[ ] 110 V
b)	DC Control Bus	:	[√] 220 V	[ ] 110 V
c)	24V AC Wdg. htg.Bus	:	[ ] YES	[√] NO
d)	240V AC Space htg. Bus/buswire	:	[√] YES	[ ] NO
e)	Alarm Bus/buswire	:	[ ] YES	[√] NO

3.6 CONTROLS, INDICATIONS & ALARMS

3.6.1	Means for simulation testing to be provided	:	[ ] YES	[√] NO
3.6.2	Scope of interposing relays for remote command	:	[ ] Mounting & wiring only [√] Supply, mounting & wiring interface	

3.7 CABLING AND TERMINATIONS

	a)	Cable Entry	:	[√] BOTTOM [ ] TOP [ ] REAR
	b)	Cable Sizes (tentative)	:	-
	c)	Type of Incoming connections from PCC/PMCC (Note: Also refer BOM for respective boards.)	:	through Cable

3.8 EARTHING

Size of earth bus	:	[√] Copper

4.0 SWITCHGEAR MAIN ASSEMBLIES

4.1 AIR CIRCUIT BREAKERS (conforming to IS 2516-1980)

4.1.1	Rated voltage	:	415 Volts
4.1.2	Rated frequency	:	50 Hz
4.1.3	Number of Poles	:	[√] Three [ ] Four
4.1.4	Symmetrical (RMS) Interrupting capacity at rated voltage.	:	40 KA.
4.1.5	Momentary making current	:	105 KA (peak)
4.1.6	Short circuit performance category	:	P-2
4.1.7	Short time rating		
	a) Current	:	40 KA
	b) Duration	:	1 sec.
4.1.8	Normal (continuous) current rating at specified design ambient (Amperes)	:	As specified in board-wise BOM / SLD
4.1.9	One minute power frequency withstand voltage (RMS)	:	2.5 KV.
4.1.10	Operating mechanism		
	a) Closing	:	[√] Motor wound spring
		:	[ ] Manual
		:	
	b) Tripping	:	[ ] Direct acting on incoming to MCC & outgoing circuit on PCCs to MCCs

[ ] Shunt trip
[√] Both of above

4.1.11 Operation counter required : [√] YES [ ] NO

4.1.12 Auxiliary voltage

a) Spring charging motor : [√]220 V DC [ ]230 V AC

b) Closing release coil : [√]220 V DC [ ]230 V AC

c) Shunt trip coil : [√]220 V DC [ ]230 V AC

4.1.13 No. of Auxiliary Contacts required (min.) for indicating breaker 'ON/OFF' status and for purchaser's use : 6 NO + 6 NC (Convertible from NO to NC and vice versa at site)

4.1.14 Type of release (where applicable) : Refer Cl. No.7.2.3.8 Page 34 of 68[SECTION – 7].

4.1.15 Whether Programmable Secondary isolating contact required : [√] YES [ ] NO

4.2 CONTACTOR STARTER UNITS (DIRECT-ON-LINE)

4.2.1 Max. motor rating upto which contactor starter can be applied. : BELOW 110KW

4.2.2 Type of short circuit device : [ ] HRC Fuse [√] MCCB

4.2.3 Locked rotor protection required : [ ] YES [√] NO

4.2.4 Type of co-ordination between SCPD & other starter components as per IS:8544. : TYPE-2

4.3 SWITCH-FUSE UNITS (N.A)

4.3.1 Breaking capacity : 3 times rated current

with conditions :

a) Voltage : 110 % rated voltage

b) Power Factor : 0.3

4.4 MOULDED CASE CIRCUIT BREAKERS (MCCB)

4.4.1 Auxiliary contacts 1NO+1 NC

4.4.2 Rated short circuit duty P-2

Further, refer Cl. No. 1.9.8 (Page 32 of 54 [SECTION – 1]) for details of MCCB.

5.0 SWITCHGEAR COMPONENTS

5.1 ISOLATING SWITCH

5.1.1	No. of poles	:	3/2
5.1.2	Utilization category for main contacts	:	AC 23(For Motor Feeder) AC 22(For Other Feeders) DC 22 (For DC)
5.1.3	Auxiliary contacts		
	a) Number	:	Mini.2 NO + 2 NC
	b) Rating	:	As per Requirements
5.1.4	Minimum thermal rating	:	16 Amp.

5.2 POWER CONTACTORS

5.2.1	Coil voltage (nominal)	:	[√] 230 V AC 50 Hz

The control circuit voltage shall be obtained from a 415/240 V isolating transformer with primary circuit breaker and secondary fuse.

5.2.2	No. of poles for main contactor	:	Three
5.2.3	Permissible supply voltage variation w.r.t. nominal coil voltage	:	85 – 110 %
5.2.4	Minimum thermal rating when used in power circuit	:	16 Amp.
5.2.5	Utilization category		
	I) AC		
	a) Reversible motor	:	AC 4 (class-III)
	b) Non-reversible motor	:	AC 3 (class-III)
	II) DC		
	a) Shunt Motor	:	DC2 (class-I)
	b) Series Motor	:	DC4
5.2.6	Type of hold-in mechanism	:	[√] Electrically held [ ] Mechanical latch-in

5.3 HIGH RUPTURING CAPACITY (HRC) FUSES

5.3.1 Max. prospective fault current to be interrupted

a) For main circuit : 40 KA

b) For Secondary circuit:

i. AC : 40 KA, 1 Sec.

ii. DC : 20 KA

5.4 THERMAL OVERLOAD RELAY

5.4.1 Range : 80-120%

5.4.2 Number of Contacts : 1 NO + 1 NC

5.4.3 Resetting : [√] Hand [ ] Self

5.4.4 Single phasing prevention feature provided : [√] YES [ ] NO

5.5 SINGLE PHASING PREVENTER (SPP)

5.5.1 Separate SPP required : [ ] YES [√] NO

If yes, applicable above motor rating : kW

5.5.2 Delay time : Variable upto 10 sec.

5.5.3 Number of Contacts : 1 NO + 1 NC

5.5.4 Resetting : [ ] Hand [ ] Self

5.6 INSTRUMENTS AND METERS

5.6.1 Indicating Instruments

a)	Function	:	VOLTMETER	AMMETER
b)	Type	:	Moving iron spring controlled	
c)	Shape	:	Square	Square
d)	size	:	96x96 mm	96x96 mm
e)	Accuracy class	:	1.0	1.0
f)	Current coil rating	:		1 Amps.
g)	Voltage coil rating	:	110 Volts	
h)	Angle of deflection	:	90 Deg.	90 Deg.

5.6.2	Energy Meters (if applicable)		:	
	a)	Type	:	Multifunction meter with RS485 port suitable for EDMS/DDCMIS interface
	b)	Accuracy class	:	0.5
	c)	Hours of operation	:	
	d)	Current coil rating	:	1 Amps.
	e)	Voltage coil rating	:	110Volts
5.6.3	Provision of ammeter for motor rating		:	above 7.5 kW
5.7	RELAYS			
5.7.1	Type		:	[ ] Static [ ] Electromagnetic [√] Numerical
5.7.2	Coil Rating :			
	a)	Current coil	:	[√] 1 Amp. [ ] 5Amp.
	b)	Voltage	:	110 V AC/220 V DC
5.7.3	Means for in-built testing required		:	[√] YES [ ] NO
5.7.4	Relaying Requirement			
	a)	Inverse time over current	:	[ ] YES [√] NO
	b)	Definite time over current	:	[√] YES [ ] NO
	c)	Motor protection	:	[√] YES [ ] NO
	d)	Inverse time earth fault	:	[√] YES [√] NO
	e)	Definite time earth fault	:	[√] YES [ ] NO
5.8	CURRENT TRANSFORMERS (AS PER IS: 2705)			
5.8.1	Type		:	CAST RESIN
5.8.2	Secondary Rating		:	[√] 1 Amp. [ ] 5 Amp.
5.8.3	Output		:	As per requirement
5.8.4	Accuracy class (metering)		:	1.0
5.8.5	Accuracy class (protection)		:	5P20 or better
5.8.6	Accuracy limit factor (ALF)		:	20

5.8.7	Primary current rating	:	(**As per Schemes**)	Amps.
5.8.8	Instrument security factor	:	Not More Than 5	
5.8.9	Specific data for CTs required for differential Protection	:	PS Class	
	a) Lead resistance	:	As per requirement of scheme	
	b) VA burden (of remote device)	:		
5.8.10	Short time rating	:	40 KA, 1sec.	
5.8.11	Dynamic Current	:	105 KA	
5.8.12	Power Frequency Withstand voltage	:	2.5 KV (r.m.s) for one minute	

5.9 VOLTAGE, CONTROL & WINDING HEATING TRANSFORMERS

5.9.1 Voltage Transformers

a)	Type	:	CAST RESIN
b)	System Earthing	:	[√] Effective [ ] Non-effective
c)	Secondary terminal voltage (phase-phase)	:	110 Volt
d)	Accuracy class	:	0.5 (Metering) 3P (Protection)
e)	Output	:	As per requirement
f)	Winding configuration	:	As per requirement
g)	Over voltage factor	:	As per requirement

5.9.2 Control Transformers (for contactor operation)

a)	Rated Primary voltage (Phase-Phase)	:	415 volts
b)	Taps	:	±5% in steps of 2.5%
c)	Minimum secondary terminal voltage (when primary voltage is minimum & transient current is maximum)	:	Not less than minimum pick up voltage of AC contactor
d)	Secondary terminal voltage	:	[ ] 110 V [√] 230 V AC

e)	Whether separate control transformer required for individual circuit	:	[ ] YES	[√] NO
5.9.3	24 V Winding Heating Transformer (If required as per item 5.14 below)	:	**N.A.**	
a)	Secondary terminal voltage	:	N.A.	
b)	Primary voltage	:	N.A.	
5.10	MINIATURE CIRCUIT BREAKER			
5.10.1	Application (Whether acceptable in lieu of fuses for secondary circuits) If yes,	:	[√] YES	[ ] NO
5.10.2	Rating	:	16 Amp.	
5.10.3	Short time rating	:	9 KA	
5.10.4	Thermal overload and magnetic short circuit protection required	:	YES	
5.11	CONTROL AND SELECTOR SWITCH			
5.11.1	Application	:	As per schemes	
5.11.2	Type			
a)	Control Switch	:	[ ] Stay put [√] Spring return [ ] Wing knob [√] Pistol grip	
b)	Selector switch	:	[√] Stay put [ ] Wing knob	
5.11.5	Lockability			
a)	Control Selector switch	:	[√] in each position [ ] with integral barrel lock & key	
b)	Control switch	:	[√] In each position [ ] With integral barrel lock & key in neutral position	

5.12 INDICATION LAMPS

5.12.1 Lens colour

a)	Breaker Closed	:	Red
b)	Breaker Open	:	Green
c)	Trip	:	Amber
d)	Service	:	Yellow
e)	Test	:	White
f)	Spring Charged	:	Blue
g)	Trip Circuit healthy	:	White
h)	Phases	:	Red, Yellow, Blue

5.12.2 Circuit voltage : [√] 230 V AC
[ ] 110 V DC
[ ] 220 V DC

5.13 PUSH BUTTONS

5.13.1 Voltage Grade : 415 Volt

5.13.2 No. of Contacts :

a)	NO	:	2
b)	NC	:	2

5.13.3 Contact rating **(As per application/schemes)**

a)	At 230V AC continuous	:	Amp.
b)	At 220V DC breaking	:	Amp.

5.13.4	Function	:	START	STOP	RESET
a)	Colour of actuator	:	Green	Red	Black
b)	Type of actuator head (S=Shrouded, M=Mushroom)	:	S	M	S
c)	Lockability (Y=Yes, N=No)	:	N	Y	N

5.14 ANTI-CONDENSATION HEATERS

5.14.2 Panel space heating

a)	Voltage	:	230 V AC	
b)	Thermostat required	:	[√] YES	[ ] NO
c)	If b) is yes, limit of adjustability of temp. within panel	:	30-50 deg.C	
d)	If b) is no, the min temp. to be maintained	:	N.A. oC	

5.15 GENERAL PURPOSE TIMERS
(Other than electromechanical or Electronic timers used on protection scheme)

5.15.1 Type : [√] Electronic [ ] Static

5.15.2 No. of contacts (As per requirements)

6.0 PAINTING

Refer cl. No. 7.2.3.14 **Page** 36 **of** 68 [SECTION – 7]

(II) LOCAL PUSHBUTTON STATION AND LOCAL STARTERS

1.	Requirement	:	[ ] Local starter
		:	[ ] Local Push Button Station
		:	[√] Both

2.0 TECHNICAL PARTICULARS FOR LOCAL STARTER

2.1	Voltage rating (V)	:	415V
	& frequency (Hz)	:	50 Hz
	Fault level (KA)	:	40 KA
2.2	***Motor rating(s) (KW)***	***:***	***REFER BOM***
2.3	Enclosure sheet Steel thickness (mm)	:	2.0 mm
2.4	Degree of protection of enclosure	:	IP-55
2.5	Cable entry	:	Bottom
2.6	COMPONENT RATINGS		**[As per requirements]**
2.6.1	Contactor	:	
2.6.1.1	Category of duty	:	AC3
2.6.1.2	Coil voltage (V)	:	230 V AC
2.6.1.3	Short time rating	:	40 KA
2.6.4	Power cable size	:	-----LATER-----

3.0 LOCAL PUSH BUTTON STATION

3.1	***Push button station type***	***:***	***Refer BOM***
3.2	***Stop push button type***	***:***	***-***
3.3	Push button station	:	Sheet Steel/ Die cast Aluminium
3.4	Thickness of enclosure	:	2 mm for Sheet Steel 3 mm for Die Cast aluminium
3.5	Aluminium alloy (for enclosure) grade	:	----------as per IS----------
3.7	Degree of protection of enclosure	:	IP-55 with canopy
3.8	Control cable size &		

	Number of cores	:	-----LATER-----
3.9	Cable entry	:	Bottom
4.0	COMMON REQUIREMENTS FOR LPBS & LOCAL STARTERS		
4.1	Design Ambient (ºC)	:	50º C
4.2	Environment	:	[√] Tropical [ ] Marine [ ] Hazardous
4.3	Designation List	:	---- LATER--
4.4	PAINTING Refer cl. No. 7.2.3.14 **Page** 36 **of** 68 [SECTION – 7]		
4.5	COMPONENT RATING		
4.5.1.2	Breaking current rating (A) at voltage (V)	:	10A at 230V
4.5.1.5	No. of contacts	:	2NO+2NC
4.5.1.6	Colour		
	Start P.B. Stop P.B.	: :	Green Red
4.5.3	**INDICATION LAMPS**		
4.5.3.1	Function & lens colour	:	ON—RED OFF--- GREEN
4.5.3.2	Working voltage (V)	:	230 V

DATA SHEET-A

1.0	Type of Cable	Flame Retardant Low Smoke Halogen (FR-LSH)	
2.0	Standard applicable in general (Latest amendment to be referred if any)	IS:1554 (Part-1), IS:8130, IS:5831, IS:10810, IS:3975, ASTMD:2843, ASTMD:2863, IEC-754-1, IEC:60332 (Part-1), IEC:60332-3-23, IEEE:60383, ASTMD 3137:81	
3.0	Voltage Grade	1.1kV	
4.0	Number of cores, cross sectional area of conductors and quantities	As per BOQ-Cum-Price Schedule	
5.0	**FAULT CHARACTERISTICS**		
	Fault Level	40kA RMS	
6.0	**CONDUCTOR**		
(a)	Material	Aluminium	Copper
	Grade and Class	Stranded, Compacted, H2 Grade	Stranded, plain annealed high conductivity, Class 2
(b)	Standard Applicable	IS: 8130	
(c)	Shape	Aluminium	Copper
		Circular/ Shaped – as per IS	Circular/ Shaped – as per IS
(d)	Min. number and diameter of strands for main and neutral conductor [Neutral conductor cross section w.r.t main conductor shall be as per Table-1 of IS:1554 (Part-1)]	As per Table-2 of IS: 8130	
7.0	**INSULATION**		
(a)	Material	Extruded PVC Type-A	
(b)	Standard Applicable	IS: 5831	
(c)	Continuous withstand temperature	70°C	
(d)	Short-circuit withstand temperature	160°C	
(e)	Method of application	By extrusion; sleeve extrusion not permitted	
(f)	Nominal Thickness of insulation	As per Table-2 of IS: 1554 (Part-1)	
8.0	**CORE IDENTIFICATION**	Colour coding as per IS 1554	
9.0	**INNER SHEATH**		
(a)	Material	Extruded PVC Type ST-1	
(b)	Standard Applicable	IS:1554 (Part-1), IS: 5831	
(c)	Colour	Black	
(d)	Whether FR-LSH	No	
(e)	Thickness of inner sheath	As per Table-4 of IS: 1554 (Part-1)	
(f)	Inner sheath applicable for single core cable	No	
(g)	Fillers	Acceptable	
(h)	Material of fillers (if permitted)	Same as inner sheath (Material of filler to be compatible with	

		that of inner sheath)
(i)	Method of application	
(1)	Multi-core cables:	
(i)	With fillers	Pressure/ Vacuum extruded
(ii)	Without fillers	Pressure extruded
(2)	Single-core cables:	**NOT APPLICABLE**
10.0	**ARMOUR**	
(a)	Applicable	NA
(b)	Material:	
(i)	Single core cables	
(ii)	Multi-core cables	
(iii)	Standard Applicable	
(c)	Minimum Coverage	
(d)	Gap between armour wires	
(e)	Breaking load of joint	
(f)	Paint on joint	
11.0	**OUTERSHEATH**	
(a)	Material	Extruded PVC Type ST-1 as per IS:5831
(b)	Colour	Black
(c)	Whether FR-LSH	Yes
(d)	Method of application	Extruded
(e)	Thickness of outer sheath	As per IS: 1554 (Part-1)
(f)	Marking	Cable size (cross section area and no. of cores), voltage grade and Reference IS @ 5m (by embossing) Word "PVC", "FR-LSH" @ 1m (by embossing) Manufacturer's name and/ or trade name, and year of manufacture @ 5m (by embossing) 'BHEL' and 'PSPCL' name @5m (by embossing) Progressive sequential marking of length of the cable in metres @ 1m (by embossing/ printing) The embossing shall be progressive, automatic, in line and marking shall be legible and indelible
12.0	**FR-LSH CHARACTERISTICS**	
(a)	Oxygen index	Min 29 (As per IS 1554-I /ASTMD 2863/IS 10810 part 58)
(b)	Temperature index	Min. 250°C (As per IS 1554-I /ASTMD 2863)
(c)	Acid gas generation	Max. 20% by weight (As per IS 1554-I /IEC-60754-1)
(d)	Smoke density rating	Max. 60% (As per IS 1554-I /ASTM D 2843)
(e)	**Flammability Test**	
(i)	Flammability test for single cable	YES As per IEC-60332 Part-1
(ii)	Flammability test for bunched cables	YES As per IEC-60332 Part-3-23, CAT-B
(iii)	Flammability test as per IEEE: 60383	YES
(iv)	As per Swedish Chimney test SEN-SS-424-1475-F3	YES

(f)	**Special Tests**	
I.	Hydrolytic Stability Test	No
II.	Ultraviolet Radiation Test	No
III.	Accelerated water absorption test for insulation as per NEMA-WE-3.11	Yes
IV.	Dielectric retention Test: The dielectric strength of the cable insulation tested in accordance with Cl. 6.7.4 of NEMA WE-5 at 75 +/- 1 °C shall not be less than 60% of the original dielectric strength	Yes
13.0	**Anti-rodent and Termite repulsion Test**	YES
14.0	**Anti-Fungal Test**	No
15.0	**TOLERANCE ON OUTER DIAMETER**	± 2mm
16.0	**MINIMUM BENDING RADIUS**	
(a)	Single core cables	15 x O.D.
(b)	Multi core cables	12 x O.D.
17.0	**SAFE PULLING FORCE**	
(a)	Aluminium conductor cable	30 N/ sq. mm.
(b)	Copper conductor cable	50 N/ sq. mm.
18.0	**CABLE DRUMS**	
(a)	Type of Drum	Wooden as per IS 10418
(b)	Standard drum length	500m (±) 5% / 1000m (±) 5%. (1. up to and including 6 sq. mm – 1000 M. 2. from 10 sq. mm up to and including 300 sq. mm – 500 M)

Other details of drum as specified at S. No. 7.2.4.13 Page **40** of **68 [SECTION – 7].**

A. SPECIFICATION & DATA SHEET FOR LT PVC CONTROL CABLE

S.No.	Particulars	Description
1	**Type of Cable**	Flame Retardant-Low Smoke (FR-LSH) LT CABLE
1.1	**Voltage Grade**	*1.1 KV*
2	**STANDARDS APPLICABLE**	
2.1	Standard applicable in general (Latest amendment to be referred if any)	IS:1554 (Part-1)
2.2	Current rating of cables conforms to	As per IS:3961 (P-2)
2.3	Short circuit rating conforms to	IEC 60949
3	**INSTALLATION CONDITIONS AT SITE**	
3.1	Ambient air temperature (deg. C)	50
3.2	Ground temperature (deg. C)	30
3.3	Depth of laying of cables buried in ground (cm)	90
3.4	Thermal resistivity of soil (K.m/W)	1.5
5	**CONDUCTOR**	
5.1	Applicable standard	IS: 8130
5.2	Material type	Electrolytic annealed bare copper (ABC)
5.3	Grade	Annealed high conductivity
5.4	Class	Class 2 (Stranded)
5.5	Shape	Circular
5.6	Strands	7 (min)
6	**PVC INSULATION**	
6.1	Material	Extruded PVC Type-A
6.2	Standard Applicable	IS: 5831
6.3	Continuous withstand temperature	70°C
6.4	Short-circuit withstand temperature	160°C
6.5	Method of application	By extrusion; sleeve extrusion not permitted.
6.6	Nominal thickness of insulation (mm)	As per Table-2 of IS: 1554 (Part-1)
7	**CORE IDENTIFICATION**	
7.1	Control Cables up to 5 core	Colour coding as per IS 1554 (Part-1)
7.2	Control Cables above 5 cores	By numbering as per IS 1554 (Part-1). Insulation to have black colour.
8	**INNERSHEATH**	
8.1	Standard Applicable	IS: 5831
8.2	Material	Extruded PVC Type ST-1
8.3	Colour	*Black*
8.4	Whether FR-LSH	NO
8.6	Fillers acceptable	Acceptable
8.7	Material of fillers (if permitted)	Same as inner sheath (Material of filler to be compatible with that of inner sheath)
8.8	Method of application	*Extrusion*
(1)	Multi-core cables:	
(i)	With fillers	Pressure/ Vacuum
(ii)	Without fillers	*Pressure extruded*
8.9	Thickness of inner sheath	As per IS 1554 (Part-1)
9	**ARMOUR**	
9.1	Standard Applicable	NA
9.2	Material (Multi core)	

9.3	Minimum Coverage	
9.4	Tolerance on formed wire dimension	
9.5	Gap between armour wire	
9.6	Breaking load of Joint	
9.7	Paint on joint	
9.8	Maximum resistivity of GS Round wire (Ohm-cm)	
10	**OUTERSHEATH**	
10.1	Standard Applicable	IS: 5831
10.2	Material	Extruded PVC Type ST1 as per IS: 5831.
10.3	Colour	Black
10.4	Whether FR-LSH	YES
10.5	Method of application	Extruded
10.6	Thickness of outer sheath	As per Table-7 of IS: 1554 (Part-1)
10.7	Marking/ Embossing on Outersheath	(i) Owner's name (PSPCL)
		(ii) Manufacturer's name and trade mark,
		(iii) Year of manufacture,
		(iv) Type of cable and voltage class,
		(v) Nominal cross section area of conductor and no. of cores,
		(vi) 'BHEL-PEM'.
		(vii) In addition to above, cable shall also be marked as having 'FRLSH' on outer sheath, at every 5 Meters. (The embossing shall be progressive, automatic, in line and marking shall be legible and indelible)
		(viii) Progressive Sequential length marking, @ 1M (by printing)
11	**FR-LSH CHARACTERISTICS**	
11.1	Oxygen index	Minimum 29 as per ASTMD 2863
11.2	Temperature index	Minimum 250°C as per ASTMD 2863
11.3	Acid gas generation	Maximum 20% by weight as per IEC-60754-1
11.4	Smoke density rating	Maximum 60% as per ASTMD 2843
13	**FLAMMABILITY**	
13.1	*Flammability test for single cable*	As per IS 7098 Part 1 (IS 10810 Part 53)
13.2	*Flammability test for bunched cables*	As per IEC 60332-3 Part 23 (Cat-B)
13.3	*Flammability test as per IEEE: 60383*	YES
13.4	*As per Swedish Chimney test SEN-SS-424-1475-F3*	YES
14	*Anti-rodent and Termite repulsion Test*	YES
16	Special Tests	
	Accelerated water absorption test for insulation as per NEMA-WE-3.11	*YES*
	Dielectric retention Test: The dielectric strength of the cable insulation tested in accordance with Cl. 6.7.4 of NEMA WE-5 at 75 +/- 1 °C shall not be less than 60% of the original dielectric strength	*YES*
17	**DIAMETERS**	
17.1	Tolerance on overall diameter ((±) mm)	(±) 2 mm. over the declared value
18	Minimum bending radius (x O.D.)	
18.1	Multi core cables	12 x O.D.
19	Safe pulling force (kg)	
19.1	Copper conductor cable	50 N/ sq. mm.

21	**CABLE DRUM DETAILS**	
21.1	*Type of Drum*	Wooden (as per IS 10418)
21.2	Outermost Layer	To be covered with water-proof polyethylene
21.4	Standard drum length	*1000 M*
21.5	Tolerance on drum length	(±) 5%
21.6	Details of marking on Drum	Refer CL. NO. 7.2.4.13 Page 40 of 68 [SECTION – 7]

	TECHNICAL SPECIFICATION SCREENED CONTROL CABLE	PE-TS-XXX-507-E005 Issue No: 01 Rev. No. 00 Date :

TECHNICAL DATA - PART - A			
SL.NO	**DESCRIPTION**	**UOM**	**DETAIL**
1.0	**DESIGN CODES & STANDARDS**		
1.1	Core identification		IS-8130 (1984)
1.2	Construction for screened control cable		IS: 1554 (Part-1) and IS:3975 (1999)
1.3	Insulating and sheathing compounds for cables		IS: 1554 (Part-1) & IS: 5831 (1984)
1.4	Test Method for Measuring the smoke density		ASTMD-2843
1.5	Test Method for Measuring the Minimum Oxygen Index		ASTMD-2863
1.6	Methods of test of cables		IS-10810 Part 62
1.7	Acid gas generation		IEC 754-1
1.8	Flammability Test		IEEE-383
1.9	Swedish Chimney Test		SEN-SS-424-1475
2.0	**DESIGN /SYSTEM PARAMETERS**		
2.1	Type of Cable		FRLS SCREENED CONTROL CABLES
2.2	Voltage Grade		1.1kV
2.3	Electrical parameters		
a	High voltage test		2kV RMS for 1 min (Core – Core), 0.5kV RMS for 1 min (Core- shield)
b	Resistance to direct current test		0.22kV DC for 240 hrs/ 10 days
2.4	C&I Parameter		For 0.5 mm2 (I & OS) type-F/ For 0.5 mm2 (OS) type-G
a	Mutual Capacitance (max.)at 0.8 kHz, nF/Km		120/100
b	Conductor Loop Resistance (max.), Ohm/Km		73.4 (Plain)/73.4 (Plain)
c	Insulation Resistance (min), M Ohm/ Km		100/100
d	Cross Talk Figure (min) at 0.8kHz, dB		60/60
e	Characteristic impedance(max.) at 1 kHz		320/340
f	Attenuation(max.) at 1 kHz db/Km		1.2/1.2
	Note:Cable parameters indicated above are at 20 degC (+/- 3 degC)		
3.0	**CONSTRUCTION FEATURES**		
3.1	**CONDUCTOR**		
a	Material type & Grade		High Conductivity Multistranded Annealed Tinned Electrolytic Copper
b	Standard applicable		IS: 8130
c	Min number of strands, Dia and cross sectional area		7, 0.3 mm (nom), 0.5 sq.mm
d	Maximum Conductor loop resistance/km (in ohm) at 20 degr		78 (tinned)
e	Continuous operation suitability		85 DEG. C
3.2	**INSULATION**		
a	Material		PVC Type-A
b	Application		Extruded
c	Insulation thickness Min./Max.		0.44 (minimum) / 0.6mm (nominal) (for 0.5 sq mm) as per IS-694
d	Volume Resistivity (Min.)		1x 10^{13} at 27 deg .C & 1x 10^{10} at 70 deg. C in ohm-cm
3.3	**LAYING OF CORES**		
a	Min. number of twist per Metre for paired cables.		20 (For 0.5 Sqmm)
b	Maximum lay of individual twisted pair		50 mm (For 0.5 Sqmm)

c	Cores of the pairs of a bunch provided		As per Annexure-B-I enclosed
d	Single Layer of Binder Tape on each pair is provided		YES
e	Unit Formation of four pair polyester binder tape for cables more than 4P is provided		YES
3.4	**CORE IDENTIFICATION**		Band marking
3.5	**INDIVIDUALLY SCREENED (F TYPE CABLE)**		
a	Material		Aluminium-Mylar tape
b	Coverage		100%
c	Overlap		Minimum 20%
d	Min thickness (Micron)		28
e	Binder		Polyester tape.
3.4	**OVERALL SCREENED (G TYPE CABLE)**		
a	Material		Aluminium-Mylar tape
b	Coverage		100%
c	Overlap		Minimum 20%
d	Min thickness (Micron)		55
e	Binder		Polyester tape.
3.5	**DRAIN WIRE (To be provided separately for individual pair shield (wherever applicable) and overall shield.)**		
a	Material		Multistranded Annealed Tin coated copper conductor
b	Min number of strands, Dia and cross sectional area		7, 0.3 mm (nom), 0.5 sq.mm
3.6	**ACCESSORIES (BEDDING, BINDER, TAPE REQ.)**		
a	Material		Mylar Tape
3.7	**INNERSHEATH DETAILS**		
a	Material:		Extruded PVC Type ST-1 as per IS:5831 (1984)
b	Thickness (Min)		As per Table-4 of IS: 1554 (Part-1)
c	Whether FRLS		NO
d	Fillers		Acceptable
e	Material of fillers		Same as inner sheath (With moisture resistant properties & Flame retardant-
f	Method of application		Pressure / Vacuum extruded
3.8	**ARMOUR**		
a	Applicable		NA
b	Material:		
c	Standard Applicable		
d	Minimum Coverage		
e	Gap between armour wires		
f	Breaking load of joint		
g	Method of jointing		
3.9	**OUTERSHEATH**		

a	Material		Extruded PVC Type ST1
b	Standard Applicable		IS: 1554 (Part-1) & IS: 5831
c	Thickness		As per IS: 1554 Part-1
d	Minimum Thickness at any point		1.24 mm
e	Nominal Thickness at any point		>1.8 mm
f	Application		Extruded
g	Colour		Grey for Overall screened cable (G type) & Grey' for Individual & overall screened cable (F type)
h	Whether FRLS		YES
i	Other		Resistant to water, oil, acid, alkali, fungus, termite & rodent attack.
j	Marking/ Embossing on Outer sheath		
1	At every 5 Meters		(i) Owner's Name (PSPCL) (ii) Manufacturer's name and trade mark (iii) Year of manufacture (iv) Type of cable and voltage class (v) Nominal cross section area of conductor and no. of cores (vi) 'BHEL-PEM' (vii) 'FRLS'/ FRLSH (viii) Drum no.
2	At every 1 Meters by printing		Progressive Sequential length
4.0	**FR-LSH CHARACTERISTICS**		
4.1	Oxygen index		29% Minimum as per ASTMD 2863
4.2	Temperature index		Min. 250 deg C at oxygen index value of 21 (As per ASTMD 2863)
4.3	Acid gas generation		less than 20% by weight (As per IEC 754-1)
4.4	Smoke density rating		Not more that 60% (As per ASTMD 2843) Defined as average area under curve when the results of smoke density plotted on a curve indicating light absorption v/s time as ASTMD 2843
4.5	Flammability Test		IEEE-383
4.6	Swedish Chimney Test		As SEN-SS-424-1475 Class F3
6.0	**PERFORMANCE PARAMETERS**		Not Applicable
6.0	**CABLE DRUM DETAILS**		
6.1	Type		Wooden
6.2	Standard drum length		1000m
6.3	Tolerance on drum length		(±) 5%

6.4	Details of marking on Drum		a) Manufacturer's name or trade make. b) Type of cable & voltage grade. c) Year of manufacture. d) Type of insulation. e) No. of core and sizes of cables. f) Cable code - FRLS. g) Single length of cable on drum. h) Direction of rotation, by arrow. i) Approx. gross mass.

TECHNICAL DATASHEET

1.0 GALVANIZED MS MATERIALS FOR ABOVE GROUND EARTHING AND LIGHTNING PROTECTION SYSTEMS

a) Material: Hot Rolled Mild Steel

b) Type: Hot-dip galvanized

3.0 SURFACE TREATMENT

Galvanising:

a) Pre-treatment	As per IS 2629 prior to galvanization
b) Type	Hot dip galvanization.
c) Applicable Standard	IS 2629

d) Minimum thickness:

i) MS flats 5mm thick & over	75 microns (minimum)
ii) MS flats under 5mm thickness	60 microns (minimum)
iii) Pipes/ conduits with thickness 5 mm & over.	75 microns (minimum)
iv) Pipes/ conduits with thickness under 5mm	60 microns (minimum)
v) GI Wire	20 Microns (Medium coated)

e) Min. weight:

i) MS flats 5mm thick & over	610 gms. / sq. mtr.
ii) MS flats under 5mm thickness	460 gms. / sq. mtr.
iii) Pipes/ conduits with thickness 5 mm & over.	610 gms. / sq. mtr
iv) Pipes/ conduits with thickness under 5mm.	460 gms. / sq. mtr
v) GI Wire	150 gms. / sq. mtr.

INSTRUCTION TO BIDDER
1. This data sheet shall be filled up on the basis of finally agreed points, bid clarifications and MOM with the bidder.
2. This Data Sheet shall be submitted by successful bidder after award of contract.

1.0 SYSTEM DESIGN DATA

1.1	Design Ambient	:		°C
1.2	Relative Humidity			
	a) Average	:		
	b) Maximum	:		
1.3	Max. System voltage for continuous operations	:		V
1.4	Rated frequency	:		Hz
1.5	One minute power frequency withstand voltage :			
	a) Main circuit	:		kV.
	b) Aux. circuit	:		kV.
1.6	DC System fault level (220 V)	:		kA

2.0 APPLICABLE STANDARDS

Compliance to the standards indicated in Annexure I of Data Sheet A confirmed unless specifically mentioned otherwise in "Schedule of Deviations"	:	[ ] YES	[ ] NO

3.0 CONSTRUCTIONAL FEATURES

3.1 GENERAL

3.1.1	Switchgear type designation of manufacturer	:	
3.1.2	Operational Fronts	:	[ ] Double Front [ ] Single Front [ ] Both as per BOM

3.1.3 Sheet metal type ROLLING THICKNESS

Name of Bidder/Sub-contractor				Project	
Revision Number	0	1	2	3	
Signature of Bidder/Sub-contractor/Authorised Representative					
Date					BIDDER'S SEAL

a)	Non-load bearing covers	:	[ ] Hot [ ] Cold		mm
b)	Non-load bearing partitions	:	[ ] Hot [ ] Cold		mm
c)	Load bearing members	:	[ ] Hot [ ] Cold		mm
d)	Frames	:	[ ] Hot [ ] Cold		mm
e)	Doors	:	[ ] Hot [ ] Cold		mm
f)	Withdrawable units	:	[ ] Hot [ ] Cold		mm

3.1.4 Rating above which louvers are provided : A

3.1.5 Degree of Protection of switchboards with modules in service and all doors closed.

a) Without louvers :

b) With louvers :

3.1.6 Method of power connection from busbars to module : [ ] Rigid busbars
[ ] Insulated conductor

3.1.7 Minimum size of primary power conductors

a) Copper : mm^2

b) Aluminium : mm^2

3.1.8 Spare modules considered as per Data Sheet A / BOM : [ ] YES [ ] NO

3.2 **DRAWOUT MODULES**

3.2.1 Type of execution of modules (functional unit)

a) Circuit breaker unit (Incoming & outgoing) : [ ] Withdrawable [ ] Fixed

b) MCCB unit (Incoming) : [ ] Withdrawable [ ] Fixed

c) Switch-Fuse & Contactor (Incoming) : [ ] Withdrawable [ ] Fixed

d)	Switch or Switch-Fuse (Incoming)	:	[ ] Withdrawable	[ ] Fixed
e)	MCCB unit (Outgoing)	:	[ ] Withdrawable	[ ] Fixed
f)	Contactor starter unit (Outgoing)	:	[ ] Withdrawable	[ ] Fixed
g)	Switch-Fuse unit (Outgoing)	:	[ ] Withdrawable	[ ] Fixed
h)	Incoming Voltage Transformer (VT)	:	[ ] Withdrawable	[ ] Fixed
i)	BUS VT	:	[ ] Withdrawable	[ ] Fixed
j)	Control Transformer	:	[ ] Withdrawable	[ ] Fixed
k)	Space Heater	:	[ ] Withdrawable	[ ] Fixed
l)	Alarm	:	[ ] Withdrawable	[ ] Fixed
m)	DC Supply	:	[ ] Withdrawable	[ ] Fixed

3.2.2 Rating upto which withdrawable units applicable, if specified in 3.2.1 b), d), e) and g) above. : A

3.2.3 Facility for functional testing of withdrawable modules provided for:

a)	Incomer Circuit Breaker	:	[ ] YES	[ ] NO
b)	Outgoing Circuit Breaker	:	[ ] YES	[ ] NO
c)	Contactor controlled units	:	[ ] YES	[ ] NO
d)	Bus - Couplers Circuit Bkr. Controlled	:	[ ] YES	[ ] NO

3.3 **BUSBARS & CONNECTIONS**

3.3.1 Busbar material

a) Phase & Neutral

i.	Material	:	[ ] Copper	[ ] Aluminium
ii.	Grade	:		

b) Earth

i.	Material	:	[ ] Copper	[ ] Aluminium

[ ] Galvanised MS

ii. Grade :

3.3.2 Support material :

3.3.3 Fault Level : kA

3.3.4 Max. temperature for short time rating : °C

3.3.5 Short time current

a) For switchboards fed thru ACB / MCCB : kA, sec.

b) For switchboards fed thru HRC Fuses : kA, sec.

3.3.6 Momentary rating : kA (peak)

3.3.7 Type of joints : [ ] Silver plated
[ ] Non-silver plated
[ ] Both

3.3.8 Temperature Rise

a) Design ambient : °C

b) Temp. rise (max.) for
i. Silver plated joints : °C

ii. Non-silver plated joints : °C

3.3.9 Whether HRPVC sleeving provided : [ ] YES [ ] NO

3.3.10 Whether shrouds on busbar tap offs provided : [ ] YES [ ] NO

3.3.11 Applicable method of colour coding for black PVC sleeving :

3.3.12 Busbar clearances in air (minimum)
a) Phase-Phase : mm
b) Phase-Earth : mm

3.3.13 Spacing between supports : mm

3.3.14 Spacing between busbars : mm

3.4 SECONDARY WIRING AND TERMINALS

3.4.1	Voltage grade of wires	:		V
3.4.2	Conductor material of wire			
	a) Power wiring	:		
	b) Control wiring	:		
3.4.3	Sizes of wires			
	a) Power wiring (min.)	:		mm^2
	b) CT leads	:		mm^2
	c) Other control wires	:		mm^2
3.4.4	Insulation material of wires	:		
3.4.5	Colour code of wires conforms to Section D	:	[ ] YES	[ ] NO
3.4.6	Type of lugs used for internal wiring	:		
3.4.7	Minimum current rating of terminal block	:		A
3.4.8	Is shrouding inherent feature for live parts of terminal block for -			
	a) Secondary isolating contacts	:	[ ] YES	[ ] NO
	b)	:	[ ] YES	[ ] NO
	c)	:	[ ] YES	[ ] NO
3.4.9	Number of ways per block of terminals	:		
3.4.10	Standard mounting of terminal blocks	:		
3.4.11	Whether terminals for CTs provided with shorting facility	:	[ ] YES	[ ] NO
3.4.12	Whether disconnectable link type short circuiting terminals provided for secondary injection	:	[ ] YES	[ ] NO
3.4.13	Spare terminals as percentage of total terminals	:		%

Name of Bidder/Sub-contractor				Project	
Revision Number	0	1	2	3	
Signature of Bidder/Sub-contractor/Authorised Representative					
Date					BIDDER'S SEAL

3.5 **AUXILIARY BUSES**

3.5.1 Provision of following as applicable to various switchboards

a)	AC Control Bus	:	[ ] 240 V	[ ] 110 V
b)	DC Control Bus	:	[ ] 220 V	[ ] 110 V
c)	24V AC Wdg. htg. Bus	:	[ ] YES	[ ] NO
d)	240V AC Space htg. Bus	:	[ ] YES	[ ] NO
e)	Alarm Bus	:	[ ] YES	[ ] NO

3.6 **CONTROLS, INDICATIONS & ALARMS**

3.6.1 Means for simulation testing provided : [ ] YES [ ] NO

3.6.2 Scope considered for interposing relays for remote command interface : [ ] Mounting & wiring only
[ ] Supply, mounting & wiring

3.6.3 No. of contacts and rating at 230 V AC (make & carry) and 220 V DC (breaking)

			NO + NC	RATING (A) (AC)	(DC)
a)	Air Circuit Breaker				
	i. Internal use	:			
	ii. Purchaser's use	:			
	iii. Releases				
	A. Overload	:			
	B. Short Circuit	:			
	C. Under Voltage	:			
	D. Earth Fault	:			
b)	MCCB	:			

c)	Switches	:	
d)	Power Contactors	:	
e)	Thermal Overload Relay	:	
f)	Single Phasing Preventer	:	
g)	Push Button	:	
h)	Miniature Circuit Bkr.	:	
i)	Control switches	:	
j)	Selector switch	:	
k)	Timer		
	i. ON delay	:	
	ii. OFF delay	:	
	iii. Instantaneous	:	

3.7 CABLING AND TERMINATIONS

a)	Cable Entry	:	[ ] BOTTOM [ ] TOP [ ] REAR
b)	Cable Sizes as per enclosed annexure II (Data Sheet A) considered	:	[ ] YES [ ] NO
c)	Type of incoming connections from transformer to PCC	:	[ ] Bus Trunking [ ] Cable [ ] Bus Duct

3.8 EARTHING

3.8.1	Size of earth bus (min.)	:	mm^2

3.9 **LABELING**

3.9.1	Inscriptions, material and locations as per specification confirmed, specifically mentioned otherwise in "Schedule of Deviations"	:	[ ] YES [ ] NO

3.9.2	Thickness of anodised aluminium sheet	:		mm
4.0	**SWITCHGEAR MAIN ASSEMBLIES**			
4.1	**AIR CIRCUIT BREAKERS**			
4.1.1	Rated voltage	:		V
4.1.2	Maximum voltage at which circuit-breaker can operate continuously	:		V
4.1.3	Number of Poles	:	[ ] Three	[ ] Four
4.1.4	No. of breaks per pole	:		
4.1.5	Clearances in air			
	a) Between phases	:		mm
	b) Live parts to earth	:		mm
4.1.6	Symmetrical (RMS) interrupting capacity at rated voltage.	:		kA
4.1.7	Rated breaking capacity at service voltage	:		MVA
4.1.8	Momentary making current	:		kA (peak)
4.1.9	Short time rating	:		kA, sec.
4.1.10	Short circuit performance category	:		
4.1.11	Derating factor for operation under site conditions	:		
4.1.12	Operating mechanism			
	a) Closing	:	[ ] Motor wound spring	
		:	[ ] Manual	
	b) Tripping	:	[ ] Direct acting	
			[ ] Shunt trip	
			[ ] Both of above	
4.1.13	Operation counter provided	:	[ ] YES	[ ] NO

4.1.14	Auxiliary voltage for			
	a)	Spring charging motor	:	V DC
	b)	Closing release coil	:	V DC
	c)	Shunt trip coil	:	V DC
4.1.15	Limits of voltage for satisfactory operation of the following devices as %age of normal voltage			
	a)	Spring charging motor	:	%
	b)	Closing release coil	:	%
	c)	Shunt trip coil	:	%
4.1.16	Spring charging motor details			
	a)	Rating	:	kW
	b)	Rated voltage	:	V
	c)	Rated current	:	A
	d)	Speed	:	r.p.m.
	e)	Insulation class	:	
	f)	Spring charging time	:	sec.
	g)	Max. temperature rise over specified ambient	:	°C
4.1.17	Maximum temp. of the main contacts with rated continuous current (After considering derating for site conditions)		:	°C
4.1.18	Type of main contacts		:	
4.1.19	Material of main contacts		:	
4.1.20	Type of arcing contacts		:	
4.1.21	Material of arcing contacts		:	
4.1.22	Whether contacts are silver plated		:	[ ] YES [ ] NO

If yes,

4.1.23	Thickness of silver plating	:		
4.1.24	Contact pressure	:		
4.1.25	Maximum number of auxiliary contacts that can be fitted	:		
4.1.26	Whether NO & NC contacts interchangeable at site	:	[ ] YES	[ ] NO
4.1.27	Maximum number of secondary isolating contacts that can be fitted	:		
4.1.28	Power required for closing at			
	a) Normal voltage	:		Watts/VA
	b) 80% normal voltage	:		Watts/VA
4.1.29	Power required for tripping			
	a) Normal voltage	:		Watts/VA
	b) 50% normal voltage	:		Watts/VA
	c) Trip circuit consumption (With supervision lamp)	:		Watts/VA
4.1.30	Are the circuit breakers trip free	:	[ ] YES	[ ] NO
4.1.31	Type of release (where applicable)	:	[ ] Static	[ ] Electromagnetic
4.1.32	Provision of releases for specified function			
	a) PCC incomer			
	i. Overload	:	[ ] YES	[ ] NO
	ii. Short Circuit	:	[ ] YES	[ ] NO
	If Yes, With timer	:	[ ] YES	[ ] NO

	iii.	Under Voltage	:	[ ] YES	[ ] NO
		If yes,			
		With timer	:	[ ] YES	[ ] NO
	iv.	Earth Fault	:	[ ] YES	[ ] NO
		If Yes,			
		With timer	:	[ ] YES	[ ] NO
b)	MCC incomer				
	i.	Overload	:	[ ] YES	[ ] NO
	ii.	Short Circuit	:	[ ] YES	[ ] NO
		If Yes,			
		With timer	:	[ ] YES	[ ] NO
	iii.	Under Voltage	:	[ ] YES	[ ] NO
		If yes,			
		With timer	:	[ ] YES	[ ] NO
	iv.	Earth Fault	:	[ ] YES	[ ] NO
		If Yes,			
		With timer	:	[ ] YES	[ ] NO
c)	Outgoing Feeder				
	i.	Overload	:	[ ] YES	[ ] NO
	ii.	Short Circuit	:	[ ] YES	[ ] NO
		If Yes,			
		With timer	:	[ ] YES	[ ] NO
	iii.	Under Voltage	:	[ ] YES	[ ] NO
		If yes,			
		With timer	:	[ ] YES	[ ] NO
	iv.	Earth Fault	:	[ ] YES	[ ] NO
		If Yes,			
		With timer	:	[ ] YES	[ ] NO
d)	Bus - Coupler				
	i.	Overload	:	[ ] YES	[ ] NO

	ii.	Short Circuit	:	[ ] YES	[ ] NO
		If Yes, With timer	:	[ ] YES	[ ] NO
	iii.	Under Voltage	:	[ ] YES	[ ] NO
		If yes, With timer	:	[ ] YES	[ ] NO
	iv.	Earth Fault	:	[ ] YES	[ ] NO
		If Yes, With timer	:	[ ] YES	[ ] NO

4.1.33 Release setting range

a)	Overload	:	%
b)	Short circuit	:	%
c)	Under Voltage	:	%
d)	Earth Fault	:	%

4.1.34 Release time delay

a)	Short circuit	:	sec.
b)	Under Voltage	:	sec.
c)	Earth Fault	:	sec.

4.1.35 Min. recommended grading time between consecutive circuit breakers fitted with

a)	Electromagnetic relays	:	msec.
b)	Solid state releases	:	msec.

4.1.36	Means provided for remote indication of individual function for above releases	: [ ] YES	[ ] NO
4.1.37	Whether following anti-pumping features provided		
	a) Mechanical	: [ ] YES	[ ] NO
	b) Electrical	: [ ] YES	[ ] NO
4.1.38	Whether programmable secondary isolating contact provided	: [ ] YES	[ ] NO

Name of Bidder/Sub-contractor				Project	
Revision Number	0	1	2	3	
Signature of Bidder/Sub-contractor/Authorised Representative					
Date					BIDDER'S SEAL

4.2 **CONTACTOR STARTER UNITS (DIRECT-ON-LINE)**

4.2.1	Max. Motor rating upto which contactor starter considered	:		kW
4.2.2	Type of short circuit device	:	[ ] HRC Fuse	[ ] MCCB
4.2.3	Locked rotor protection provided	:	[ ] YES	[ ] NO
4.2.4	Type of co-ordination between SCPD & other starter components as per IS: 8544.	:	[ ] a [ ] b	[ ] c
4.2.5	Whether secondary isolating contacts are self-isolating self-aligning type	:	[ ] YES	[ ] NO

4.3 **SWITCH-FUSE UNITS**

4.3.1	Breaking capacity at 110 % rated voltage and 0.3 power factor	:		
4.3.2	Short time rating	:		kA, sec.

4.4 **MOULDED CASE CIRCUIT BREAKERS (MCCB)**

4.4.1	Application				
	a)	Contactor Starter	:	[ ] YES	[ ] NO
	b)	Other circuits	:	[ ] YES	[ ] NO
	c)	If Yes for b) Provided for rating upto	:		A
4.4.2	Rated voltage		:		V
4.4.3	Number of poles		:		
4.4.4	Derating factor for site ambient conditions		:		
4.4.5	Minimum clearances in air				
	a)	Between poles	:		mm

	b)	Live parts to frame	:		mm
4.4.6	Construction materials of				
	a)	Frame	:		
	b)	Main contacts	:		
	c)	Arcing contacts	:		
4.4.7	Whether contacts are plated		:	[ ] YES	[ ] NO
	If yes,				
4.4.8	Material of plating		:		
4.4.9	Main contact pressure		:		
4.4.10	Maximum temperature rise over ambient for				
	a)	Main contacts	:		°C
	b)	Other moulded parts	:		°C
4.4.11	Short time rating		:		kA, sec.
4.4.12	Rated short circuit duty		:		
4.4.13	Rated breaking capacity (rms) at 415 V		:		kA
4.4.14	Rated making current		:		kA (peak)
4.4.15	On/Off operation				
	a)	Manual	:	[ ] YES	[ ] NO
	b)	Remote power operated	:	[ ] YES	[ ] NO
4.4.16	Releases provided				
	a)	Overload	:	[ ] YES	[ ] NO
	b)	Under voltage	:	[ ] YES	[ ] NO
	c)	Short circuit	:	[ ] YES	[ ] NO

4.4.17	Whether MCCBs are suitable for use without Short Circuit and/or Overload release without impairing its function in any way	:	[ ] YES [ ] NO
4.4.18	Whether comparison of I Vs T plot of MCCB and fuse will automatically ensure discrimination between the two in S/C and O/L region	:	[ ] YES [ ] NO
	If no,		
4.4.19	State the other consideration for achieving discrimination	:	
4.4.20	Type of coordination with the characteristics of other devices as per IS: 8544, when used as SCPD with contactor	:	[ ] a [ ] b [ ] c
4.4.21	Whether coordination indicated above verified by the test	:	[ ] YES [ ] NO
4.4.22	Whether MCCB is suitable for direct switching on to motor	:	[ ] YES [ ] NO
	If yes,		
4.4.23	Utilization category as per IS: 2959	:	
4.4.24	Whether shunt trip provided	:	[ ] YES [ ] NO
	If yes,		
	a) Nominal voltage	:	V [ ] AC [ ] DC
	b) Voltage variation range	:	%
	c) Energisation power	:	VA
4.4.25	Whether solenoid closing operation provided	:	[ ] YES [ ] NO
	If Yes,		
	a) Nominal voltage	:	V [ ] AC [ ] DC
	b) Voltage variation range	:	%
	c) Energisation power	:	VA

5.0 **SWITCHGEAR COMPONENTS**

5.1 **ISOLATING SWITCH**

5.1.1	Rated voltage	:	V

5.1.2	No. of poles	:		
5.1.3	Minimum thermal rating	:		A
5.1.4	Are switches suitable for breaking locked rotor current of the motor of maximum rating controlled by the switches	:	[ ] YES	[ ] NO
5.1.5	Derating factor for site ambient conditions	:		
5.1.6	Utilization category for main contacts	:		
5.1.7	Temperature rise over ambient for main contacts when carrying rated current for site condition	:		°C

5.2 **POWER CONTACTORS**

5.2.1	Short time rating	:		kA, sec.
5.2.2	Rated voltage of main contacts	:		V
5.2.3	Rated voltage of auxiliary			
	a) AC	:		V
	b) DC	:		V
5.2.4	Coil voltage (nominal)	:	[ ] 110 V AC 50 Hz [ ] 220/240 V AC 50 Hz [ ] 110 V DC [ ] 220 V DC	
5.2.5	Permissible supply voltage variation w.r.t. nominal coil voltage	:		%
5.2.6	Drop out voltage for coil	:		V
5.2.7	No. of poles for main contactor	:		
5.2.8	Insulation class for winding of electromagnet	:		
5.2.9	Temperature rise over ambient	:		°C

for coil winding

5.2.10 Minimum thermal rating when used in power circuit : A

5.2.11 Utilization category

a) Reversible motor :

b) Non-reversible motor :

5.2.12 Type of hold-in mechanism : [ ] Electrically held
[ ] Mechanical latch-in

5.3 HIGH RUPTURING CAPACITY (HRC) FUSES

5.3.1 Whether fuse mounted in the insulated carrier : [ ] YES [ ] NO

5.3.2 Rupturing capacity

a) AC : kA

b) Dc : kA

5.3.3 Temperature rise over ambient at rated current : °C

5.4 THERMAL OVERLOAD RELAY

5.4.1 Range : %

5.4.2 Resetting : [ ] Hand [ ] Self
[ ] Both with changeover facility

5.4.3 Whether ambient compensated : [ ] YES [ ] NO

If yes,
Compensated upto ambient of : °C

5.4.4 Single phasing prevention feature provided : [ ] YES [ ] NO

5.5 SINGLE PHASING PREVENTER (SPP)

(To be filled up where separate SPP is considered)

5.5.1	Applicable above motor rating	:		kW
5.5.2	Delay time	:		sec.
5.5.3	Setting (%age of FLC)	:		%
5.5.4	Resetting	:	[ ] Hand	[ ] Self

5.6 **INSTRUMENTS AND METERS**

5.6.1	Provision of ammeter for motor rating above	:		kW
5.6.2	Voltmeter			
	a) Shape	:		
	b) size	:		mm x mm
	c) Accuracy class	:		
	d) Voltage coil rating	:		V
	e) Angle of deflection	:		deg.
	f) Scale length	:		mm
5.6.3	Ammeter			
	a) Shape	:		
	b) size	:		mm x mm
	c) Accuracy class	:		
	d) Current coil rating	:		A
	e) Angle of deflection	:		deg.
	f) Scale length	:		mm
5.6.4	Energy Meters			
	a) Shape	:		

b)	size	:		mm x mm
c)	Accuracy class	:		
d)	Current coil rating	:		A
e)	Voltage coil rating	:		V
f)	Angle of deflection	:		deg.
g)	Scale length	:		mm
h)	Hours of operation	:		hours

5.7 **RELAYS**

5.7.1	Type	:	[ ] Static [ ] Electromagnetic
5.7.2	Coil Rating		
a)	Current coil	:	[ ] 1 A [ ] 5 A
b)	Voltage	:	V
5.7.3	Means for in-built testing provided	:	[ ] YES [ ] NO
5.7.4	Minimum grading time recommended between consecutive breakers fitted with the relays	:	msec.

5.8 **CURRENT TRANSFORMERS**

5.8.1	Secondary Rating	:	[ ] 1 A [ ] 5 A
5.8.2	Output	:	VA
5.8.3	Accuracy class (metering)	:	
5.8.4	Accuracy class (protection)	:	
5.8.5	Accuracy limit factor (ALF)	:	
5.8.6	Type of Primary winding	:	[ ] Bar [ ] Wound

Name of Bidder/Sub-contractor				Project	
Revision Number	0	1	2	3	
Signature of Bidder/Sub-contractor/Authorised Representative					
Date					BIDDER'S SEAL

5.8.7	Primary current rating		:		A
5.8.8	Instrument security factor		:		
5.8.9	Specific data for CTs required for differential Protection				
	a)	Knee point voltage (Vk)	:		V
	b)	Exciting current at Vk/2	:		A
	c)	Secondary resistance	:		ohms
5.8.10	Short time rating		:		kA, sec.
5.8.11	Momentary current		:		kA
5.8.12	Insulation material		:		
5.8.13	Class of insulation		:		
5.8.14	Max. temperature rise over ambient for the winding		:		^{o}C
5.8.15	Whether capable of carrying rated primary current for 1 minute with the secondary winding open circuited		:	[ ] YES	[ ] NO

5.9 VOLTAGE, CONTROL & WINDING HEATING TRANSFORMERS

5.9.1 Voltage Transformers

	a)	System Earthing considered	:	[ ] Effective	[ ] Non-effective
	b)	Secondary terminal voltage (phase-phase)	:		V
	c)	Insulation material	:		
	d)	Class of insulation	:		
	e)	Accuracy class	:		
	f)	Output	:		VA

g)	Winding configuration	:		[ ] 3, 1ϕ [ ] 3ϕ [ ]	V
h)	Over voltage factor				
	i. continuous	:			
	ii. 30 seconds	:			
i)	Max. temperature rise of winding over ambient	:			°C

5.9.2 Control Transformers (for contactor operation)

a)	Rated Primary voltage(Phase-Phase)	:		V
b)	Taps	:		%
c)	Minimum secondary terminal voltage (when primary voltage is minimum & transient current is maximum)	:		V
d)	Secondary terminal voltage	:	[ ] 110 V	[ ] 240 V
e)	Whether separate control transformer considered for individual circuit	:	[ ] YES	[ ] NO

5.9.3 24 V Winding Heating Transformer
(If applicable as per Data Sheet A)

a)	Secondary terminal voltage	:		V
b)	Primary voltage	:		V

5.10 **MINIATURE CIRCUIT BREAKER**

(Data to be filled up if applicable)

5.10.1	Breaking capacity	:		kA
5.10.2	Thermal overload and magnetic short circuit protection provided	:	[ ] YES	[ ] NO

5.11 **CONTROL AND SELECTOR SWITCH**

5.11.1 Control Switch

a) Type : [ ] Stay put
[ ] Spring return
[ ] Wing knob
[ ] Pistol grip

b) Voltage grade : V

c) No. of positions :

d) Lockability : [ ] In each position
[ ] with integral barrel lock & key in neutral position

e) No. of poles / ways :

f) Angular movement : deg.

5.11.2 Selector Switch

a) Type : [ ] Stay put
[ ] Wing knob

b) Voltage grade : V

c) No. of positions :

d) Lockability : [ ] in each position
[ ] with integral barrel lock & key

e) No. of poles/ ways :

f) Angular movement : deg.

5.12 **INDICATION LAMPS**

5.12.1 Voltage grade : V

5.12.2 Series resistor value used as economy ohms resistor or dropping resistor for supervision :

5.12.3 Circuit voltage : [ ] 220/240 V AC
[ ] 110 V DC
[ ] 220 V DC

5.12.4	Lens colour as per Data Sheet A.	:	[ ] YES	[ ] NO
5.12.5	Diameter of lamp	:		mm
5.12.6	Wattage consumption of lamp			
	a) With resistor	:		Watts
	b) Without resistor	:		Watts
5.13	PUSH BUTTONS			
5.13.1	Voltage Grade	:		V
5.13.2	No. of Contacts	:		(NO + NC)
5.13.3	Function	:	START	STOP RESET
	a) Colour of actuator	:		
	b) Type of actuator head (S=Shrouded, M=Mushroom)	:	S/M	S/M S/M
	c) Lockability (Y=Yes, N=No)	:	Y/N	Y/N Y/N

5.14 **ANTI-CONDENSATION HEATERS**

5.14.1	24 V motor winding heating		
	a) Applicable Rating(including & below)	:	kW
	b) Maximum space htg. current (%age of FLC) considered for the sizing of transformer	:	%
5.14.2	Panel space heating		
	a) Voltage	:	V AC
	b) Thermostat provided	:	[ ] YES [ ] NO
	c) If b) is yes, limit of adjustability of temp. within panel	:	°C

d) If b) is no, the min temp. to be maintained : °C

e) Separate provision for front and rear panels considered : [ ] YES [ ] NO

5.15 **GENERAL PURPOSE TIMERS**
(Other than electromechanical & Electronic timers used in protection)

5.15.1 Coil voltage rating (AC) : [ ] 220 V [ ] 110 V

5.15.2 Limits of voltage variation : %

5.15.3 Time delay range : sec.

5.15.4 Type of delay mechanism : [ ] Pneumatic
[ ] Electronic
[ ] Electromechanical

5.15.5 Repeat accuracy :

6.0 **PAINTING**

6.1 Shade

a) Interior : as per IS:5

b) Exterior : as per IS:5

6.2 Paint Finish

a) Interior : [ ] Matt [ ] Semi-glossy

b) Exterior : [ ] Semi-glossy [ ] Full-glossy

6.3 Paint thickness (min.) : microns

7.0 MAKE AND TYPE OF COMPONENTS

	EQUIPMENT	MAKE	TYPE DESIGNATION OF MANUFACTURER	No. OF YEARS IN SERVICE
1.	Air Circuit Breaker			

	2.	MCCB (AC)				
	3.	MCCB (DC)				
	4.	Isolating Switch				
	5.	AC Contactor				
	6.	DC Contactor				
	7.	HRC Fuse (base & link)				
	8.	Single Phasing Preventer				
	9.	Voltmeter				
	10.	Ammeter				
	11.	Energy meter				
	12.	Relays				
		i. Thermal O/L				
		ii. Inverse Time Over Current				
		iii. Definite Time Over Current				

Name of Bidder/Sub-contractor				Project	
Revision Number	0	1	2	3	
Signature of Bidder/Sub-contractor/Authorised Representative					
Date					BIDDER'S SEAL

		iv.	Motor Protection			
---						
		v.	Inverse Time Earth Fault			
---						
		vi.	Definite Time Earth Fault			
---		vii.	Interposing Relay			
---		viii.				

	13.	CT				
---	14.	VT				
---	15.	Control Transformer				

	16.	Winding Heating Transformer				

	17.	MCB				

	18.	Control Switch				
---	19.	Selector Switch				

	20.	Indicating Lamps				

	21.	Panel space Heater				
---	22.	Gen. Purpose Timer				

Name of Bidder/Sub-contractor				Project	
Revision Number	0	1	2	3	
Signature of Bidder/Sub-contractor/Authorised Representative					
Date					BIDDER'S SEAL

	23.	Push Buttons				
---	24.	Breaker operation counter				
---	25.	Breaker switch				
---	26.	Neutral link				
---	27.	Cable gland				
---	28.	Cable lugs				
---	29.	DC switch				
---	30.	Fixed terminals				
---	31.	Lighting switch				
---	32.	Limit switch				
---	33.	Sockets				
---	34.	Terminal drawouts				
---	35.	Thermostat				

8.0 SPARES

8.1 **O&M Spares**

a) Period for which O&M spares offered : years

Name of Bidder/Sub-contractor				Project	
Revision Number	0	1	2	3	
Signature of Bidder/Sub-contractor/Authorised Representative					
Date					BIDDER'S SEAL

b)	Whether additional O&M offered (other than those indicated)	:	[ ] YES	[ ] NO

8.2 Start-up spares

a)	Whether E & C spares offered	:	[ ] YES	[ ] NO
b)	Whether any additional start-up spares offered for purchaser's consideration	:	[ ] YES	[ ] NO

9.0 **DOCUMENTATION**

Whether following furnished as per clause 12.3 Section D.

a)	Typical sectional drawing	:	[ ] YES	[ ] NO
b)	Schematic drawings for each functional unit	:	[ ] YES	[ ] NO
c)	Wire routing, termination and numbering details	:	[ ] YES	[ ] NO
d)	Type test Certificates of switchboard, circuit-breakers and components	:	[ ] YES	[ ] NO
e)	Final Quality Plans with signatures and seal on each sheet	:	[ ] YES	[ ] NO
f)	Catalogues / Technical leaflets of switchboard and components	:	[ ] YES	[ ] NO
g)	Bar chart of activities and their schedules	:	[ ] YES	[ ] NO

The above documents shall be submitted in the form of Annexures - A to Annexure - G in the exact order listed above along with Data Sheet C.

Name of Bidder/Sub-contractor				Project	
Revision Number	0	1	2	3	
Signature of Bidder/Sub-contractor/Authorised Representative					
Date					BIDDER'S SEAL

DATASHEET C

GUARANTEED TECHNICAL PARTICULARS
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)

1.1	Name of manufacturer	:	
1.2	Place of Manufacture	:	
2.1	Current rating of cables conforms to	:	
2.2	Short circuit rating conforms to	:	
3.1	Formula for calculating short circuit current for different durations as per Clause-5 of Data Sheet-A	:	
	OR		
	Whether curve for short time current v/s time for different cables enclosed	:	

4.0 **INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE**

4.1	No. of cores x size		:	
4.2	Base current ratings (*) based on Clause 6.0 of Data Sheet-A			
	a)	In air	:	Amp
	b)	In ground	:	Amp
	c)	ducts	:	Amp
4.3	Short circuit rating		:	kA, sec.
4.4	a)	D.C. resistance of conductor at 20 deg. C	:	ohm/km
	b)	A.C. resistance of conductor at 70/85 deg. C	:	ohm/km
	c)	Reactance of cable at normal frequency	:	ohm/km

4.5 CONDUCTOR

a) Material type & grade :

b) Shape of conductor :

c) No & dia of wires in each core before stranding : no x mm

4.6 PVC INSULATION

a) Type :

b) Minimum & Nominal thickness of insulation : mm

4.7 PVC *ST1/ ST2* INNERSHEATH

a) Thickness (min.) : mm

b) Method of application

1) Multi-core cables
i) With fillers :

ii) With out fillers : Pressure Extruded

c) Type of fillers (if used) : PVC type *ST1/ ST2* as per IS 5831
Shape of fillers (if used) :

d) Colour :

4.8 ARMOUR

a) Material
i) Single core cables :
ii) Multi-core cables :

b) Size/ dimensions :

c) Minimum no. of wires :

d) Maximum resistivity of GS wire :

e) Maximum resistivity of Aluminium round wire :

4.9 PVC *ST1/ ST2* FRLS OUTERSHEATH

a) Minimum thickness of outer sheath : mm

b) Colour :

4.10 Diameters

a) Diameter of insulated conductor : mm

b) Cable diameter under armour : mm

c) Cable diameter over armour : mm

d) Overall diameter of cable : mm

4.11 Weight of cable : kg./km

4.12 Dimension of drum : mm

4.13 Shipping weight : kg.

(*) For single core cables, the continuous current rating shall be furnished separately for armour earthed at one end and at both ends.

DATASHEET C

GUARANTEED TECHNICAL PARTICULARS (TO BE SUBMITTED BY SUCCESSFUL BIDDER)

1.0	**GENERAL**		
1.1	Name of manufacturer	:	
1.2	Place of manufacture	:	
2.0	**STANDARDS APPLICABLE**		
2.1	**IS-1554 (Part-I)** For general specification of PVC cables	:	YES
2.2	**IS:8130** For conductor material	:	YES
2.3	**IS-5831** For material of insulation, innersheath & outersheath.	:	YES
2.4	**IS:3975/ IS:8130** For armour multi core/ single core cables)	:	YES/NO/NA
2.5	**IS:10810** For method of tests	:	YES
2.6	**IS:10418** For cable drums	:	YES
2.7	**ASTMD-2863** For oxygen index test	:	YES
2.8	**SS:424-14-75,** **IEC-332-Part-III (Category-B),** **IEEE 383/74** For flammability test	:	YES

2.9 **IEC-754-1** : YES
For acid gas generation test

2.10 **ASTMD-2843** : YES
For smoke generation test

2.11 **IS:5831** : YES

For heat shock test, loss of mass test and thermal heat stability test

2.12 Current rating of cables conforms to :

2.13 Short circuit rating conforms to :

3.0 **CABLE CONSTRUCTION**

3.1 **Conductor :**

Conductor material to IS:8130 (Class/Grade)

a) Control cables :

3.2 **Insulation**

a) Material :

b) Dielectric constant at normal frequency : KV/mm

c) Insulation resistance constant (min.)

i) at 27 deg. C : Mega-ohm km
ii) at 70/85 deg.C : Mega-ohm km

d) Minimum volume resistivity

i) at 27 deg. C : Mega-ohm km
ii) at 70/ 85 deg.C : Mega-ohm km

e) Minimum tensile strength : N/mm2

f) Minimum % Elongation at rupture :

g) Tolerance on thickness :

3.3 **Inner Sheath**

a)	PVC Type ST1 to IS: 5831	:	YES
b)	Whether FRLS	:	YES/NO
c)	Method of application		
i)	with filllers		
ii)	without fillers	:	Pressure extruded
d)	Type & shape of fillers (if used)	:	
e)	Colour		

3.4 **Armour**

a)	Galvanised steel wire/ formed wire conforming to IS:3975 for multi-core cables.	:	YES
b)	Hard drawn aluminium wire H4 grade conforming to IS:8130	:	YES/NA
c)	Method of joining	:	
d)	Breaking load of joint	:	

3.5 **Outer Sheath**

a)	PVC Type ST1 to IS: 5831	:	YES
b)	Whether FRLS	:	YES
c)	Method of application	:	
d)	Minimum Tensile strength	:	N/mm2
e)	Minimum % elongation at rupture	:	
f)	Colour		
g)	Tolerance on thickness	:	
h)	Whether progressive sequential length marking provided.	:	

4.0 **PERMISSIBLE VOLTAGE AND FREQUENCY VARIATION**

a)	Voltage	:	(±)	%
b)	Frequency	:	(±)	%
c)	Voltage-frequency combined combined	:	|ABS|	%

5.0 Permissible Conductor Temp. for

a)	Maximum Continuous Rating	:	°C
b)	Short Circuit	:	°C

6.0 Installation Conditions for specified current rating

a)	ambient air temperature in deg. C	:	°C
b)	ground temperature	:	°C
c)	depth of laying of cables buried in ground :	:	cm
d)	thermal resistivity of soil	:	°C cm/W
e)	thermal resistivity of insulation	:	°C cm/w

7.0 Formula for calculating short circuit current for different durations

8.0 **CHARACTERISTICS OF FRLS SHEATH**

a)	Oxygen index	:
b)	Temperature index	:
c)	Acid gas generation	:
d)	Smoke density rating	:

9.0 **CABLE DRUMS**

a)	Type & construction	:
b)	Standard drum length	:
c)	Tolerance on drum length	:

10.0 **DOCUMENTATION**

Whether following enclosed

a)	X-sectional drawing with construction details	:	YES
b)	BHEL's Quality Plan with seal of acceptance	:	YES
c)	Derating factors as stipulated in Section-D	:	YES
d)	Packing drawing	:	YES/NO

(TO BE FILLED IN FOR EACH SIZE OF CABLE IN THE FORM OF TABLE)

11.0	No. of cores x size	:	
12.0	Voltage grade	:	kV
13.0	Base current ratings (*) based on cl.5.0, cl.6.0		
	a) In air	:	Amp
	b) In ground	:	Amp
	c) In ducts	:	Amp
14.0	Short circuit rating	:	kA, sec.
15.0	a) D.C. resistance of conductor at 20 °C	:	ohm/km
	b) A.C. resistance of conductor at 70 °C/ 85 °C	:	ohm/km
	c) Reactance of cable at normal frequency	:	ohm/km
16.0	CONDUCTOR		
	a) Material, type & grade	:	
	b) No & dia of wires in each core before stranding	:	no x mm

c) Shape :

17.0 Nominal thickness of insulation : mm

18.0 Inner sheath thickness (min.) : mm

19.0 Sizes of armour : no x mm

20.0 Nominal thickness of outersheath : mm

21.0 DIAMETERS

a) i) Fictitious diameter of insulated conductor : mm

ii) Approximate cable diameter of insulated conductor : mm

b) i) Fictitious cable diameter of under armour/ over innersheath : mm

ii) Approximate cable diameter under armour/ over innersheath : mm

c) i) Fictitious cable diameter of under armour/ over innersheath : mm

ii) Approximate cable diameter over armour : mm

d) i) Fictitious overall diameter of cable : mm

ii) Approximate overall diameter of cable : mm

22.0 Tolerance on overall diameter : (±) mm.

23.0 Minimum bending radius : x O.D.

24.0 Safe pulling force : kg.

25.0 Weight of cable : kg./km

26.0 Dimension of drum : mm

27.0 Shipping weight : kg.

28.0 Identification mark on outersheath :

29.0 Identification marks on drum :

S.No.	Particulars	Unit	Description
1	Manufacturer's name	-	
2	Reference design standards	-	
3	Conductor size	sq. mm	
4	Rated Voltage	V	
5	Number of pairs	No.	
6	Cable suitable for both earthed & unearthed system	-	
7	Conductor		
	a) Material	-	
	b) Reference Standard	-	
	c) Grade	-	
	d) No. of strands	No.	
	e) Diameter of strands (nom.)	mm	
	f) Approx. dia of conductor	mm/	
	Cross Section area	sq. mm	
	g) Maximum conductor resistance per Km at 20°C	ohm	
8	Insulation		
	a) Reference Standard	-	
	b) Material composition	-	
	c) Minimum thickness	mm	
	d) Nom.Thickness	mm	
	e) Max. thickness	mm	
	f) Minimum volume resistivity as pre VDE-0207 Part-4	Ohm cm	
	g) Dielectric constant	-	
	h) The insulation will withstand conductor operating temp. of 70°C	-	
	i) Core diameter including insulation	mm	

S.No.	Particulars	Unit	Description
9	Core laying		
	a)Whether cores are twisted.	-	
	b) Maximum lay of twist	mm	
10	Individual Shield		
	a) Material	-	
	b) Thickness of tape	mm	
	c) Coverage/ Overlap	%	
	d) Noise interference better than	dB	
11	Drain wire for individual shield		
	a) Reference standard	-	
	b) Size/ No. of strands	sq. mm/ no.	
	c) Material	-	
	d) Resistance of drain wire per km at 20 deg.C	ohm	
12	Overall shield		
	a) Material	-	
	b) Thickness of tape	mm	
	c) Coverage/Overlap	%	
	d) Noise interference better than	dB	
13	Drain wire for overall shield		
	a) Reference standard	-	
	b) Size/ No.of strands	sq. mm/ no.	
	c) Material	-	
	d) Resistance per Km at 20°C	Ohm/ km	
14	Fillers if applicable		
15	Inner sheath		
	a) Material, type and standard	-	
	b) Whether FRLS	-	
	c) Colour	-	
	d) Method of application	-	
	e) Thickness (min)	mm	
16	Armour		
	a) Material,	-	
	b) Minimum Coverage	%	
	c) Method of jointing	-	
	d) Breaking load of joint	-	
	e) Size (approx.)	mm	
	f) Dia of armour	mm	
	g) No. of wires	mm	

S.No.	Particulars	Unit	Description
17	Outer sheath		
	a) Reference standard	-	
	b) Material	-	
	c) Minimum thickness of sheath	mm	
	d) Calculated dia under outersheath	mm	
	e) Oxygen index (as per ASTMD 2863)	-	
	f) Temperature index (in deg. C as per ASTMD 2863)	-	
	g) Maximum acid gas generation as per IEC754-1	%	
	h) Maximum smoke density rating as per ASTMD 2843	%	
	i) Colour of outer sheath	-	
18	Dia under armour	mm	
19	Overall diameter of cable	mm	
20	Tolerance on overall diameter	mm	
21	Weight of		
	conductor	Kgs. / km	
	PVC (insulation, sheath & fillers)	Kgs. / km	
	Armour	Kgs. / km	
	Cable (approx.)	Kgs. / km	
22	Cable parameters at 20°C(+/-3 deg. C)		
	a) Conductor resistance (max)	Ohm/ km	
	b) Insulation resistance (min)	M-Ohm	
	c) Mutual capacitance at 0.8KHz (max)	nF/ km	
	d) Cross talk at 0.8KHz (min)	dB	
	e) Attenuation at 1 KHz (max)	dB/ km	
	f) Characteristic impedence max.	Ohm	
23	Continuous operating temp. (deg.C)	deg. C	
24	Whether complete cable Flame retardant as per IEEE-383	-	
25	Whether complete cable passes Swedish Chimney test as per SEN 4241475 (F3)	-	
26	Identification		
	a) Length of cable marked at every mtr.	-	
	b) FRLS marked at every 5 mtrs	-	
	c) Each core of the pair numbered	-	
	d) Conductor identification details for pairs	-	
	e) Details of cable markings	-	

S.No.	Particulars	Unit	Description
27	Test voltage		
	a) High voltage test/ Dielectric Strength		
	i) Voltage (KV)	kV	
	ii) Duration	min	
	b) High Voltage test		
	i) Voltage (KV)	V	
	ii) Duration	min	
	c) Resistance to direct current test	-	
	as per VDE-0815		
	Voltage	V	
	Duration	hrs/days	
28	Min bending radius	mm	
29	Ovality at any cross section	mm	
30	Variation of dia through out cable length		
31	Cable cross-sectional drawings for each type of cable furnished		
32	i) Length of single coil in a drum	M	
	ii) Marking on drum	-	
	iii) Seasoned wood drum provided	-	
	iv) Both ends of cable to be sealed with PVC/ Rubber caps to prevent water/ moisture ingress		
	v) Gross weight (approx.)	kg.	
	vi) Net weight (approx.)	kg	
33	Type test procedures as per VDE 0472, IS 10810, VDE 0815, BHEL Technical Spec. and other relevant standards enclosed.		
34	Anti termite & rodent test		

Below sub vendor list comprises of BHEL approved sub vendors for cables, LT Switchgear, Cable Trays, Earthing material. The same shall be subjected to final approval by customer at contract stage without any technical / commercial implication to BHEL.

PACKAGE WISE BHEL PEM APPROVED SUPPLIER LIST

Sl No	Package Name	Supplier Name	Supplier Communication Address
1	LT SWITCHGEAR	ABB India Limited	Mr.Tommy Andreson/Mr.Naveen Maikhuri PLOT NO.79, STREET NO.17 VADODARA Phone- 9958188524 Pincode : 390013 Email : rizwan.siddiqui@in.abb.com
2	LT SWITCHGEAR	ALSTOM LTD.	Mr. Sanjeev Khetrapal Siège social: Immeuble Le Galilée - 51, esplanade du Général de Gaule,La Défense PARIS Phone- 2270500 Pincode : 92907 Email : parthsarathi.harichandan@alstom.com
3	LT SWITCHGEAR	C and S ELECTRIC LTD.	222, OKHLA INDUSTRIAL ESTATE, PHASE-II, NEW DELHI Phone- 9871799447 Pincode : 110020 Email : panel.marketing@cselectric.co.in
4	LT SWITCHGEAR	CONTROLS and SCHEMATICS LTD.	Mr. C.L. Narayana Street No.8, 3-6-584/G, Himayatngar HYDERABAD Phone- 9391006355 Pincode : 500029 Email : clnarayana@controlsandschematics.com
5	LT SWITCHGEAR	GE INDIA INDUSTRIAL PVT.LTD.	42/1 & 45/14, ELECTRONIC CITY, PHASE-II, HOSUR ROAD, BANGALORE Phone- 51113164/3115-7/3113 Pincode : 560008 Email : vijay.pal@ge.com
6	LT SWITCHGEAR	KMG ATOZ SYSTEMS PVT.LTD	Mr. Atter M Ram/Mr. S.P Goyal G-120, Sai Plaza,187-188, Sant Nagar,East of Kailash NEW DELHI Phone- 0120-4207920 Pincode : 110 065 Email : atoz@atoz.co.in
7	LT SWITCHGEAR	LARSEN and TOUBRO LTD.	Mr. Mohan Kumar L & T HOUSE, BALLARD ESTATE, P.O.BOX-278, MUMBAI Phone- 22618181/82 Pincode : 400001 Email : BAS@LNTECC.COM
8	LT SWITCHGEAR	SCHNEIDER ELECTRIC INDIA PVT. LTD.	A-29, MOHAN COOPERATIVE INDL ESTATE, MATHURA ROAD, NEW DELHI Phone- 51678010 Pincode : 110044 Email : aditya.bawa@schneider-electric.com
9	LT SWITCHGEAR	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com
10	LT SWITCHGEAR	SPACEAGE SWITCHGEARS LTD.	68, INDUSTRIAL DEVELOPMENT COLONY, MEHRAULI ROAD, GURGAON Phone- 2302711,2310123/4 Pincode : 122001 Email : info@spaceagegroup.org; at.soundar@spaceagegroup.org
11	LT SWITCHGEAR	TRICOLITE ELECTRICAL INDUSTRIES LTD	Mr. Abhishek Nangia/Mr. SK Raghav V- 325 Rajouri Garden NEW DELHI Phone- 9560376219 Pincode : 110027 Email : abhishek@tricoliteenergy.in
1	CABLE TRAYS & ACC.	ADVANCE POWER PRODUCTS LLP	Mr. Manmohan Damani 24A, Rabindra Sarani, Kolkata Phone- 033-22252463 Pincode : 700073 Email : sales@advancepowerproducts.in
2	CABLE TRAYS & ACC.	EROS METAL WORKS (P) LTD.	Mr. Amit N. Pande G-5, MIDC Industrial area Hingna Road Nagpur Phone- 9371490163 Pincode : 440028 Email : eemwpl@erosgroup.co.in;sohumpande@erosgroup.co.in
3	CABLE TRAYS & ACC.	INDUSTRIAL PERFORATION (I) PVT.LTD.	MR. A. K. SAHA 327, R.N.GUHA ROAD, DUM DUM KOLKATA Phone- 9830241788 Pincode : 700028 Email : mail@ipipl.co.in
4	CABLE TRAYS & ACC.	PARMAR METALS PVT.LTD.	MR. KIRIT PARMAR 28-A, BHAKTINAGAR INDL ESTATE RAJKOT Phone- 9925019998 Pincode : 360 002 Email : info@parmarmetal.com
5	CABLE TRAYS & ACC.	PATNY SYSTEMS (P) LTD	PATNY PLAZA 160 , SARDAR PATEL ROAD SEUNDRABAD SECUNDRABAD Phone- 040-27902451 Pincode : 500003 Email : mr.mkt@patnysystems.com

6	CABLE TRAYS & ACC.	PENTAX FERRO INCORPORATE	Mr. Rajeev Kandhari 801, 8th Floor, Palm Springs, Link road, Malad (W) Mumbai Phone- 09820088400 Pincode : 400064 Email : rajeev@jencogalva.com
7	CABLE TRAYS & ACC.	Pinax Steel Industries Pvt. Ltd.	Village - Deokuli, PO - Musepur, Bihta, Patna Phone- 9264477062 Pincode : 801103 Email : p.singh@pinaxgroup.in, kumar@pinaxgroup.in
8	CABLE TRAYS & ACC.	PREMIER POWER PRODUCTS (CAL) PVT. LTD.	Chatterjee International Centre, 33A, Jawaharlal Nehru Road, 6th Floor, Suit No. - 11A, Kolkata, Phone- 9331008739 Pincode : 700071 Email : pppdaga4@gmail.com;info@thepremierpower.com
9	CABLE TRAYS & ACC.	R.K. Engineering Works	W/87,Addl Ambernath Anandnagar,MIDC,Ambernath-East Thane Phone- 9923009696 Pincode : 421506 Email : salespune@rkenggwork
10	CABLE TRAYS & ACC.	RABI ENGINEERING WORKS PVT. LTD.	MR. TAPAN KUMAR SEN/MR. SIDDHARTHA 327, R.N. GUHA ROAD, DUM DUM, KOLKATA Phone- 9748753002 Pincode : 700028 Email : rabiengineering@gmail.com
11	CABLE TRAYS & ACC.	RATAN PROJECTS & ENGINEERING CO. PVT.LTD.	MR. G.D. SINGHEE/MR. MAHESH SINGHEE 26, P.K. TAGORE STREET, MAIN BUILDING KOLKATA Phone- 9830177331 Pincode : 700006 Email : mahesh@ratans.com
12	CABLE TRAYS & ACC.	RUKMANI ELECTRICAL & COMPONENTS PVT LTD	11A , MAHARISHI DEBENDRA ROAD 1ST FL , ROOM NO.4 KOLKATA Phone- Pincode : 700007 Email : maruthikabra@gmail.com
13	CABLE TRAYS & ACC.	Saral Industries	Mr. Y.K. Gupta L-1, L-2, Industrial Area-1 Sultanpur Road Rae Bareli Phone- 0535-2702474 Pincode : 229010 Email : saralindustries@gmail.com
14	CABLE TRAYS & ACC.	UNITECH FABRICATORS and ENGINEERS PVT LTD	INDRAPRASHTHA APARTMENT 24 , M.B.RAOD , BIRATI KALABAGAN KOLKATA KOLKATA Phone- 9836381647 Pincode : 700051 Email : ufepl@rediffmail.com;ufepl@vsnl.net;
1	CABLE TRAY SUPPORT SYSTEM - BOLTABLE	AM-TECH ENGG.SERVICES	Chinmay Patwardhan 305 ,UNIQUE CHAMBERS 925 B/1,FC ROAD PUNE Phone- 9822499078 Pincode : 410004 Email : amtech.aditya@amail.com
2	CABLE TRAY SUPPORT SYSTEM - BOLTABLE	INDUSTRIAL PERFORATION (I) PVT.LTD.	MR. A. K. SAHA 327, R.N.GUHA ROAD, DUM DUM KOLKATA Phone- 9830241788 Pincode : 700028 Email : mail@ipipl.co.in
3	CABLE TRAY SUPPORT SYSTEM - BOLTABLE	Maheshwari Electrical Mfrs. Pvt. Ltd.,	Mr. Abhishek Garg, 9999902481 A-59, Sector-5, Noida, Phone- 9811027324, Pincode : 201301, Email : memindia@gmail.com,
4	CABLE TRAY SUPPORT SYSTEM - BOLTABLE	PREMIER POWER PRODUCTS (CAL) PVT. LTD.	Chatterjee International Centre, 33A, Jawaharlal Nehru Road, 6th Floor, Suit No. - 11A, Kolkata, Phone- 9331008739 Pincode : 700071 Email : pppdaga4@gmail.com;info@thepremierpower.com
5	CABLE TRAY SUPPORT SYSTEM - BOLTABLE	RATAN PROJECTS & ENGINEERING CO. PVT.LTD.	MR. G.D. SINGHEE/MR. MAHESH SINGHEE 26, P.K. TAGORE STREET, MAIN BUILDING KOLKATA Phone- 9830177331 Pincode : 700006 Email : mahesh@ratans.com
1	LT PVC POWER CABLE	APAR INDUSTRIES LTD.	Mr. Vijay Kumar Bajaj 12/13,Jyoti Wire House,23-A,Shah Ind Est Off. Veera Desai Road, Andheri (West). Mumbai Phone- 022-26740001 Pincode : 400053 Email : info.cable@apar.com
2	LT PVC POWER CABLE	CHANDRESH CABLES LIMITED	Mr RK JAIN/MD, G-6 NEW MADHAVPURA MARKET, NEAR POLICE COMMI. OFFICE, SHAHIBAUG AHMEDABAD Phone- 9825136231 Pincode : 380004 Email : rkjain@avocab.com
3	LT PVC POWER CABLE	CMI LTD.	Mr.Munishvar Gaur, 501-503,New Delhi House, 27,Barakhamba Road New Delhi, Phone- 9599599244 Pincode : 110001 Email : mgaur@cmilimited.in

4	LT PVC POWER CABLE	CORDS CABLE INDUSTRIES LTD.	MR. NAVEEN SAWHNEY B-1/A-26, MOHAN CO-OPERATIVE INDUSTRIAL ESTATE, MATHURA ROAD, NEW DELHI Phone- 9818356799 Pincode : 110044 Email : sg@cordscable.com
5	LT PVC POWER CABLE	Dynamic Cables Limited	F-260 ,Road No. 13 V.K.I Area Jaipur Phone- 01412332388 Pincode : 302013 Email : info@dynamiccables.co.in
6	LT PVC POWER CABLE	GEMSCAB INDUSTRIES LTD.	Sh. A. N. Pathak, (GM/Business Develop.) 704-707, 7th Floor, Vikrant Tower 4, Rajendra Place NEW DELHI Phone- 09212560974 Pincode : 110008 Email : anpathak@gemscab.com
7	LT PVC POWER CABLE	Govind Cable Industries,	73/1, Cotton Street, Kolkata, Phone- 9331055614, Pincode : 700007, Email : govindcable2001@yahoo.com
8	LT PVC POWER CABLE	GUPTA POWER INFRASTRUCTURE LIMITED	Mr. NITISH KUMAR PARIDA ,502, 5th Floor, K M Trade Tower,Radisson Blu Complex, Sector-14, Kaushambi Ghaziabad Phone- 09861995978 Pincode : 201010 Email : info@guptapower.com
9	LT PVC POWER CABLE	Insucon Cables And Conductors Pvt. Ltd.	Mr. SUMIT NAHATA, 314-A, 3rd Floor, City Centre, Sansar Chand Road Jaipur Phone- 8290073333 Pincode : 302001 Email : info@insuconcables.com
10	LT PVC POWER CABLE	KEC INTERNATIONAL LIMITED	Mr. Radheshyam Singh CEAT MAHAL, 1ST FLOOR, 463, DR. ANNIE BESANT ROAD,WORLI, MUMBAI Phone- 9313244467 Pincode : 400 030 Email : powercables@kecrpg.com
11	LT PVC POWER CABLE	KEI INDUSTRIES LTD.	Mr. ANIL GUPTA D-90, OKHLA INDUSTRIAL AREA, PHASE-I, NEW DELHI Phone- 011-26818840 Pincode : 110020 Email : lalit.saxena@kei-ind.com
12	LT PVC POWER CABLE	LASER POWER & INFRA PVT. LTD.	Mr. Devesh Goel, Director 5A, Woodburn Central 5th Floor, Unit No. 502 & 503 Kolkata Phone- 9830623440 Pincode : 700020 Email : devesh@laserpowerinfra.com
13	LT PVC POWER CABLE	Lumino Industries Limited	Acropolis, 1858/1, 12th Floor, Rajdanga Main Road, KOLKATA Phone- 9711480487 Pincode : 700107 Email : northzone@luminoindustries.com
14	LT PVC POWER CABLE	Nangalwala Industries Pvt. Ltd.	F 151 to 154 M.I.A M.I.A Alwar Phone- 9928033029 Pincode : 301030 Email : registration@suncables.co
15	LT PVC POWER CABLE	PARAMOUNT COMMUNICATIONS LTD.	Mr. Sanjay Aggarwal C-125, Naraina Industrial Area, Phase-I, NEW DELHI Phone- 9650005915 Pincode : 110028 Email : jatan.singh@paramountcables.com
16	LT PVC POWER CABLE	POLYCAB INDIA LIMITED	HICO HOUSE, Ist FLOOR, 771, PANDIT SATWALEKAR MARG, MAHIM, MUMBAI Phone- 011-29841697 Pincode : 400016 Email : lnsingh@polycab.com
17	LT PVC POWER CABLE	Ravi Industries	Deepak Goyal, Proprietor Plot No. 451,EPIP,HSIIDC INDUSTRIAL AREA Sec-53, Phase 3, Kundli Sonipat Phone- 9810019276 Pincode : 131028 Email : deepakgoyal@deegeelitecables.com
18	LT PVC POWER CABLE	RAVIN CABLES LIMITED	MR.PRAKASH LAKHKAR 30,AKRUTI TRADE CENTRE, 3RD FL, ROAD NO.7 , MIDC ,MAROL,ANDHERI (E) MUMBAI Phone- 09324081733 Pincode : 400093 Email : surendra.rawat@ravingroup.com
19	LT PVC POWER CABLE	Sam Cables & Conductors (P) Ltd.,	6th Km. Rudrapur-kichha Road, Post-Lalpur, Rudrapur, Distt. Udham Singh Nagar , Uttrakhand, Phone- 9837766444, Pincode : 263148, Email : manpreet@samcables.com,
20	LT PVC POWER CABLE	SBEE CABLES (INDIA) LIMITED	Kishore Kumar .B, Director No.29, JCW Industrial Estate 11th Km Kanakapura Road Bangalore Phone- 08026662172 Pincode : 560062 Email : info@sbeecables.in

21	LT PVC POWER CABLE	SHIVPRIYA CABLES PVT. LTD.	Mr. AYUSH GUPTA,DIRECTOR B 15 / 23 GROUND FLOOR DLF CITY PHASE-I GURUGRAM Phone- 9810322001 Pincode : 122002 Email : info@shivpriyacables.com
22	LT PVC POWER CABLE	SPECIAL CABLES PVT. LTD.	MR.MUKUL KHANNA-VICE PRESIDENT B-II/12, Mohan Cooperative Industrial estate, Badarpur, Mathura Road NEW DELHI Phone- 9599186479 Pincode : 110044 Email : sales@specialcables.co.in
23	LT PVC POWER CABLE	SRIRAM CABLES PVT. LTD.	Anil Garg / Sunil Garg Flat No. 102, A 8A Rama Road, Adarsh Nagar Delhi Phone- 011-27670005 Pincode : 110033 Email : contact@sriramcables.com
24	LT PVC POWER CABLE	SUYOG ELECTRICALS LTD.	Mr.Bimal Y.Desai/Mr. Haresh Hansoti 1, Madhuvan Apartment,24 Arunoday Society,Alkapuri VADODARA Phone- 9227192737 Pincode : 390 007 Email : suyog@seplcables.com
25	LT PVC POWER CABLE	THERMO CABLES LTD.	Ms.UMA GHURKA/N.SRINIVASA RAO 28, NAGARJUNA HILLS, PUNJAGUTTA HYDERABAD Phone- 9397803596 Pincode : 500082 Email : isharma@thermocables.com
26	LT PVC POWER CABLE	TIRUPATI PLASTOMATICS PVT. LTD.	Mr. Ravi Gemini B-141 A, Road No. 9D V.K.I. Area Jaipur Phone- 0141-2330305 Pincode : 302013 Email : ravi.gemini@yahoo.com
27	LT PVC POWER CABLE	ULTRACAB INDIA LIMITED	SR NO 262 BH GALAXY BEARINGS LTD SHAPAR VERAVAL RAJKOT Phone- Pincode : 360024 Email : tenders@ultracab.in
28	LT PVC POWER CABLE	UNIVERSAL CABLES LTD.	MR. Y.S. LODHA/MR. AMITAVA ABOSE P.O. BIRLA VIKAS, SATNA SATNA Phone- +91 9584968066 Pincode : 485005 Email : amsingh@unistar.co.in
29	LT PVC POWER CABLE	V-MARC INDIA LIMITED	Mr. Vikas Garg, 203,Aditya Complex,Local Shopping Centre Sarita Vihar 110092 Phone- 8171169401 Pincode : New Delhi Email : sales@v-marc.in
30	LT PVC POWER CABLE	Zenium Cables Ltd.	H.O:102/103 Leena Heights,Opp.Thunga Hospital Mira Bhayander Road, Mira Road(E) Thane Phone- 02228114444 Pincode : 401107 Email : info@zeniumcables.com
1	LT PVC CONTROL CABLE	Advance Cable Technologies (P) Ltd.	Mr. Siddharth Jain G-1, Sunrise Serenity, No.1,40 Ft.Road, M.R. Garden,Geddalahhalli, Aswathnagar, Bangalore Phone- 9845326881 Pincode : 560094 Email : dbhat@advancecable.in
2	LT PVC CONTROL CABLE	CHANDRESH CABLES LIMITED	Mr RK JAIN/MD, G-6 NEW MADHAVPURA MARKET, NEAR POLICE COMMI. OFFICE, SHAHIBAUG AHMEDABAD Phone- 9825136231 Pincode : 380004 Email : rkjain@avocab.com
3	LT PVC CONTROL CABLE	CMI LTD.	Mr.Munishvar Gaur, 501-503,New Delhi House, 27,Barakhamba Road New Delhi, Phone- 9599599244 Pincode : 110001 Email : mgaur@cmilimited.in
4	LT PVC CONTROL CABLE	CORDS CABLE INDUSTRIES LTD.	MR. NAVEEN SAWHNEY B-1/A-26, MOHAN CO-OPERATIVE INDUSTRIAL ESTATE, MATHURA ROAD, NEW DELHI Phone- 9818356799 Pincode : 110044 Email : sg@cordscable.com
5	LT PVC CONTROL CABLE	DELTON CABLES LTD.	MR. V.K. GUPTA 4801, BHARAT RAM ROAD, 24, DARYA GANJ, NEW DELHI Phone- 9560866060 Pincode : 110002 Email : shashikumar@deltoncables.com
6	LT PVC CONTROL CABLE	Dynamic Cables Limited	F-260 ,Road No. 13 V.K.I Area Jaipur Phone- 01412332388 Pincode : 302013 Email : info@dynamiccables.co.in
7	LT PVC CONTROL CABLE	ELKAY TELELINKS LTD.	Mr. Vinod Dubey K.C.HOUSE,5/66, PADAM SINGH ROAD, KAROL BAGH, NEW DELHI Phone- 9899789830 Pincode : 110005 Email : projects@elkaygroup.net

8	LT PVC CONTROL CABLE	GEMSCAB INDUSTRIES LTD.	Sh. A. N. Pathak, (GM/Business Develop.) 704-707, 7th Floor, Vikrant Tower 4, Rajendra Place NEW DELHI Phone- 09212560974 Pincode : 110008 Email : anpathak@gemscab.com
9	LT PVC CONTROL CABLE	GUPTA POWER INFRASTRUCTURE LIMITED	Mr. NITISH KUMAR PARIDA ,502, 5th Floor, K M Trade Tower,Radisson Blu Complex, Sector-14, Kaushambi Ghaziabad Phone- 09861995978 Pincode : 201010 Email : info@guptapower.com
10	LT PVC CONTROL CABLE	Insucon Cables And Conductors Pvt. Ltd.	Mr. SUMIT NAHATA, 314-A, 3rd Floor, City Centre, Sansar Chand Road Jaipur Phone- 8290073333 Pincode : 302001 Email : info@insuconcables.com
11	LT PVC CONTROL CABLE	K C POWERTRACKS	Mr. SUDHAKAR GARG (CEO), S. NO. 185/1/1, PLOT NO. 7, DOKMARDI SILVASSA Phone- 9825264766 Pincode : 396230 Email : powertrackscable@gmail.com
12	LT PVC CONTROL CABLE	KEI INDUSTRIES LTD.	Mr. ANIL GUPTA D-90, OKHLA INDUSTRIAL AREA, PHASE-I, NEW DELHI Phone- 011-26818840 Pincode : 110020 Email : lalit.saxena@kei-ind.com
13	LT PVC CONTROL CABLE	Nangalwala Industries Pvt. Ltd.	F 151 to 154 M.I.A M.I.A Alwar Phone- 9928033029 Pincode : 301030 Email : registration@suncables.co
14	LT PVC CONTROL CABLE	PARAMOUNT COMMUNICATIONS LTD.	Mr. Sanjay Aggarwal C-125, Naraina Industrial Area, Phase-I, NEW DELHI Phone- 9650005915 Pincode : 110028 Email : jatan.singh@paramountcables.com
15	LT PVC CONTROL CABLE	POLYCAB INDIA LIMITED	HICO HOUSE, Ist FLOOR, 771, PANDIT SATWALEKAR MARG, MAHIM, MUMBAI Phone- 011-29841697 Pincode : 400016 Email : lnsingh@polycab.com
16	LT PVC CONTROL CABLE	PRESTIGE CABLE INDUSTRIES	Mr. ASHISH AGGARWAL, PARTNER M-15, BADLI INDUSTRIAL ESTATE, PHASE-1, DELHI Phone- 9350581279 Pincode : 110042 Email : prestigecable@gmail.com
17	LT PVC CONTROL CABLE	SBEE CABLES (INDIA) LIMITED	Kishore Kumar .B, Director No.29, JCW Industrial Estate 11th Km Kanakapura Road Bangalore Phone- 08026662172 Pincode : 560062 Email : info@sbeecables.in
18	LT PVC CONTROL CABLE	SPECIAL CABLES PVT. LTD.	MR.MUKUL KHANNA-VICE PRESIDENT B-II/12, Mohan Cooperative Industrial estate, Badarpur, Mathura Road NEW DELHI Phone- 9599186479 Pincode : 110044 Email : sales@specialcables.co.in
19	LT PVC CONTROL CABLE	SRIRAM CABLES PVT. LTD.	Anil Garg / Sunil Garg Flat No. 102, A 8A Rama Road, Adarsh Nagar Delhi Phone- 011-27670005 Pincode : 110033 Email : contact@sriramcables.com
20	LT PVC CONTROL CABLE	SUYOG ELECTRICALS LTD.	Mr.Bimal Y.Desai/Mr. Haresh Hansoti 1, Madhuvan Apartment,24 Arunoday Society,Alkapuri VADODARA Phone- 9227192737 Pincode : 390 007 Email : suyog@seplcables.com
21	LT PVC CONTROL CABLE	SVARN INFRATEL PVT. LTD.	Mr. Ajay Kumar Gupta/MD, Plot no.-1, Site no.1, 14/3, Mathura Road, Faridabad Phone- 9811142260 Pincode : 121003 Email : info@svarn.com
22	LT PVC CONTROL CABLE	THERMO CABLES LTD.	Ms.UMA GHURKA/N.SRINIVASA RAO 28, NAGARJUNA HILLS, PUNJAGUTTA HYDERABAD Phone- 9397803596 Pincode : 500082 Email : isharma@thermocables.com
23	LT PVC CONTROL CABLE	TIRUPATI PLASTOMATICS PVT. LTD.	Mr. Ravi Gemini B-141 A, Road No. 9D V.K.I. Area Jaipur Phone- 0141-2330305 Pincode : 302013 Email : ravi.gemini@yahoo.com
24	LT PVC CONTROL CABLE	UNIVERSAL CABLES LTD.	MR. Y.S. LODHA/MR. AMITAVA ABOSE P.O. BIRLA VIKAS, SATNA SATNA Phone- +91 9584968066 Pincode : 485005 Email : amsingh@unistar.co.in

25	LT PVC CONTROL CABLE	V-MARC INDIA LIMITED	Mr. Vikas Garg, 203,Aditya Complex,Local Shopping Centre Sarita Vihar 110092 Phone- 8171169401 Pincode : New Delhi Email : sales@v-marc.in
26	LT PVC CONTROL CABLE	Zenium Cables Ltd.	H.O:102/103 Leena Heights,Opp.Thunga Hospital Mira Bhayander Road, Mira Road(E) Thane Phone- 02228114444 Pincode : 401107 Email : info@zeniumcables.com
1	SCREENED CONTROL CABLES	Advance Cable Technologies (P) Ltd.	Mr. Siddharth Jain G-1, Sunrise Serenity, No.1,40 Ft.Road, M.R. Garden,Geddalahhalli, Aswathnagar, Bangalore Phone- 9845326881 Pincode : 560094 Email : dbhat@advancecable.in
2	SCREENED CONTROL CABLES	CMI LTD.	Mr.Munishvar Gaur, 501-503,New Delhi House, 27,Barakhamba Road New Delhi, Phone- 9599599244 Pincode : 110001 Email : mgaur@cmilimited.in
3	SCREENED CONTROL CABLES	CORDS CABLE INDUSTRIES LTD.	MR. NAVEEN SAWHNEY B-1/A-26, MOHAN CO-OPERATIVE INDUSTRIAL ESTATE, MATHURA ROAD, NEW DELHI Phone- 9818356799 Pincode : 110044 Email : sg@cordscable.com
4	SCREENED CONTROL CABLES	DELTON CABLES LTD.	MR. V.K. GUPTA 4801, BHARAT RAM ROAD, 24, DARYA GANJ, NEW DELHI Phone- 9560866060 Pincode : 110002 Email : shashikumar@deltoncables.com
5	SCREENED CONTROL CABLES	ELKAY TELELINKS LTD.	Mr. Vinod Dubey K.C.HOUSE,5/66, PADAM SINGH ROAD, KAROL BAGH, NEW DELHI Phone- 9899789830 Pincode : 110005 Email : projects@elkaygroup.net
6	SCREENED CONTROL CABLES	GUPTA POWER INFRASTRUCTURE LIMITED	Mr. NITISH KUMAR PARIDA ,502, 5th Floor, K M Trade Tower,Radisson Blu Complex, Sector-14, Kaushambi Ghaziabad Phone- 09861995978 Pincode : 201010 Email : info@guptapower.com
7	SCREENED CONTROL CABLES	KEI INDUSTRIES LTD.	Mr. ANIL GUPTA D-90, OKHLA INDUSTRIAL AREA, PHASE-I, NEW DELHI Phone- 011-26818840 Pincode : 110020 Email : lalit.saxena@kei-ind.com
8	SCREENED CONTROL CABLES	PARAMOUNT COMMUNICATIONS LTD.	Mr. Sanjay Aggarwal C-125, Naraina Industrial Area, Phase-I, NEW DELHI Phone- 9650005915 Pincode : 110028 Email : jatan.singh@paramountcables.com
9	SCREENED CONTROL CABLES	POLYCAB INDIA LIMITED	HICO HOUSE, Ist FLOOR, 771, PANDIT SATWALEKAR MARG, MAHIM, MUMBAI Phone- 011-29841697 Pincode : 400016 Email : lnsingh@polycab.com

10	SCREENED CONTROL CABLES	Shriram Telelink	46/4/1, Sahibabad Indl. Area, SITE IV SAHIBABAD, GHAZIABAD Phone- 9999909700 Pincode : 201010 Email : info@shriramtelelink.com
11	SCREENED CONTROL CABLES	SPECIAL CABLES PVT. LTD.	MR.MUKUL KHANNA-VICE PRESIDENT B-II/12, Mohan Cooperative Industrial estate, Badarpur, Mathura Road NEW DELHI Phone- 9599186479 Pincode : 110044 Email : sales@specialcables.co.in
12	SCREENED CONTROL CABLES	SUYOG ELECTRICALS LTD.	Mr.Bimal Y.Desai/Mr. Haresh Hansoti 1, Madhuvan Apartment,24 Arunoday Society,Alkapuri VADODARA Phone- 9227192737 Pincode : 390 007 Email : suyog@seplcables.com
13	SCREENED CONTROL CABLES	T C Communication Pvt. Ltd.	Mr. Ashok Bathwal 505, Vikas Deep, 18 Laxmi Nagar District Centre New Delhi Phone- 9810002411 Pincode : 110092 Email : ashok@technocab.in
14	SCREENED CONTROL CABLES	Tempsens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR Phone- 09352420069 Pincode : 313003 Email : info@tempsens.com
15	SCREENED CONTROL CABLES	THERMO CABLES LTD.	Ms.UMA GHURKA/N.SRINIVASA RAO 28, NAGARJUNA HILLS, PUNJAGUTTA HYDERABAD Phone- 9397803596 Pincode : 500082 Email : isharma@thermocables.com
1	ABOVE GROUND EARTHING MATERIALS	EROS INFRASTRUCTURES PVT. LTD.	Mr. Amit Pande MIDC Industrial Area, Butibori, G-97, Nagpur Phone- 0712-3205305 Pincode : 441103 Email : amitp@erosgroup.co.in
2	ABOVE GROUND EARTHING MATERIALS	INDUSTRIAL PERFORATION (I) PVT.LTD.	MR. A. K. SAHA 327, R.N.GUHA ROAD, DUM DUM KOLKATA Phone- 9830241788 Pincode : 700028 Email : mail@ipipl.co.in
3	ABOVE GROUND EARTHING MATERIALS	NAMDHARI INDUSTRIAL TRADERS PVT. LTD	Mr. Gurdeep Singh 515/5, Industrial Area-B, Overlock Road, Ludhiana Phone- 0161-2531398 Pincode : 141003 Email : namdhari_ind_traders@yahoo.com
4	ABOVE GROUND EARTHING MATERIALS	PATNY SYSTEMS (P) LTD	PATNY PLAZA 160 , SARDAR PATEL ROAD SEUNDRABAD SECUNDRABAD Phone- 040-27902451 Pincode : 500003 Email : mr.mkt@patnysystems.com
5	ABOVE GROUND EARTHING MATERIALS	PREMIER POWER PRODUCTS (CAL) PVT. LTD.	Chatterjee International Centre, 33A, Jawaharlal Nehru Road, 6th Floor, Suit No. - 11A, Kolkata, Phone- 9331008739 Pincode : 700071 Email : pppdaga4@gmail.com;info@thepremierpower.com
6	ABOVE GROUND EARTHING MATERIALS	RABI ENGINEERING WORKS PVT. LTD.	MR. TAPAN KUMAR SEN/MR. SIDDHARTHA 327, R.N. GUHA ROAD, DUM DUM, KOLKATA Phone- 9748753002 Pincode : 700028 Email : rabiengineering@gmail.com
7	ABOVE GROUND EARTHING MATERIALS	RAJASTHAN METAL SMELTING CO.	D-80, Road No. 7, V.K.I.A., Jaipur Phone- 9928966443 Pincode : 302013 Email : info@rmscoindia.com
8	ABOVE GROUND EARTHING MATERIALS	RATAN PROJECTS & ENGINEERING CO. PVT.LTD.	MR. G.D. SINGHEE/MR. MAHESH SINGHEE 26, P.K. TAGORE STREET, MAIN BUILDING KOLKATA Phone- 9830177331 Pincode : 700006 Email : mahesh@ratans.com
9	ABOVE GROUND EARTHING MATERIALS	RUKMANI ELECTRICAL & COMPONENTS PVT LTD	11A , MAHARISHI DEBENDRA ROAD 1ST FL , ROOM NO.4 KOLKATA Phone- Pincode : 700007 Email : maruthikabra@gmail.com
10	ABOVE GROUND EARTHING MATERIALS	Saral Industries	Mr. Y.K. Gupta L-1, L-2, Industrial Area-1 Sultanpur Road Rae Bareli Phone- 0535-2702474 Pincode : 229010 Email : saralindustries@gmail.com
11	ABOVE GROUND EARTHING MATERIALS	UNITECH FABRICATORS and ENGINEERS PVT LTD	INDRAPRASHTHA APARTMENT 24 , M.B.RAOD , BIRATI KALABAGAN KOLKATA KOLKATA Phone- 9836381647 Pincode : 700051 Email : ufepl@rediffmail.com;ufepl@vsnl.net;

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

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

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

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

	LOAD DATA (ELECTRICAL)	JOB NO.		ORIGINATING AGENCY		PEM (ELECTRICAL)
		PROJECT TITLE	SHAHPURKANDI HYDRO-ELECTRIC PROJECT (HEP) 206 MW	NAME		DATA FILLED UP ON
		SYSTEM / S	HVAC	SIGN.		DATA ENTERED ON
		DEPTT. / SECTION		SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO:	DATE:
		CUSTOMER:		QP NO.: PE-QP-999-506-E002, REV. 0	DATE: 27.02.2024
		PROJECT:		PO NO.:	DATE:
		ITEM: LT SWITCHGEAR	SYSTEM: LT SWITCHGEAR	SECTION: II	SHEET 1 of 10

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK (6)		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY (10)				REMARKS
										D *	M **	B	C	
(1)	(2)	(3)	(4)	(5)	M	B/C	(7)	(8)	(9)					(11)
1	**RAW MATERIAL**													
1.1	Angles, Channels & Sheet Steel for Fabrication (CR/HR)	Thickness	MA	Meas.	1 sample of each type & size per Lot	-	Approved Drawing/ IS-513, IS-1079, IS 2062	Approved Drawing/ IS-513, IS-1079, IS 2062	QC record		P	-	-	
		Surface finish & check for waviness / flatness	MA	Visual	-do-	-	IS-513, IS-1079, IS 2062	IS-513, IS-1079, IS 2062	QC record		P	-	-	
		Bending Test	MA	Mech.	Sample	-	Approved Drawing/ IS-513-1994	Approved Drawing/ IS-513-1994	MTC		V	-	-	
1.2	Bus Bar – Copper/ Aluminum	Dimension	MA	Meas.	1 sample of each type & size per Lot	-	IS- 5082 (Al.)/ IS-1897 (CU)/ Approved Drawing	IS- 5082 (Al.)/ IS-1897 (CU)/ Approved Drawing	QC record		P	-	-	
		Surface Finish	MA	Visual	-do-	-	IS- 5082 (Al.)/ IS-1897 (CU)	IS- 5082 (Al.)/ IS-1897 (CU)	QC record		P	-	-	
		Conductivity	MA	Elec.	10% SAMPLE	-	As per IS- 5082/ IS-1897	As per IS- 5082/ IS-1897	MTC		P	-	-	
2	**BOUGHT OUT ITEMS**													
2.1	Air Circuit Breaker	Type & Rating	MA	Visual	100%	-	Approved Drawing/ Data sheet/ IEC-60947-2	Approved Drawing/ Data sheet/ IEC-60947-2	QC RECORD		P	-	-	
		All Routine test	CR	Test	-do-	-	Approved Drawing/ Data sheet/ IEC-60947-2	Approved Drawing/ Data sheet/ IEC-60947-2	MTC	✓	V	V	V	
2.2	CT's	Overall dimensions & mounting arrangement	MA	Meas.	10% of each type & rating per lot	-	Manufacturing Drawing	Manufacturing Drawing	QC Record		P	-	-	
		Make, Type & Rating	MA	Visual	-do-	-	Approved Drawing/ Data sheet	Approved Drawing/ Data sheet	QC Record		P	-	-	
		All routine tests	CR	Elec.	100%	10%	IS-2705	IS-2705	MTC	✓	V	V	V	

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:		MEGHA/ NARENDRA NATH JAJWARE	Checked by:		KUNDAN PRASAD			Reviewed by:			
Reviewed by:		SANDEEP LODH	Reviewed by:		HARISH KUMAR			Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO	DATE:
		CUSTOMER:		QP NO.: PE-QP-999-506-E002, REV. 0	DATE: 27.02.2024
		PROJECT:		PO NO.:	DATE:
		ITEM: LT SWITCHGEAR	SYSTEM: LT SWITCHGEAR	SECTION: II	SHEET 2 of 10

S. NO	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK (6)		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY (10)			REMARKS
					M	B/C				D *	M **	B	C
(1)	(2)	(3)	(4)	(5)			(7)	(8)	(9)				(11)
2.3	PT's	Overall dimensions & mounting arrangement	MA	Meas.	10% of each type & rating per lot	-	Manufacturing Drawing	Manufacturing Drawing	QC Record		P	-	-
		Make, Type & Rating	MA	Visual	-do-	-	Approved Drawing/ Data sheet	Approved Drawing/ Data sheet	QC Record		P	-	-
		All routine tests	CR	Elec.	100%	10%	IS-3156	IS-3156	MTC	✓	V	V	V
2.4	Air Break Switch, Fuse, MCCB, MPCB, Push Button, MCB, Control & Selector Switches AC/DC, Power & aux. Contactor, Timers, OLR, Coupling Relays, Indicating Lamp	Make, Type & Rating	MA	Visual	1 sample of each type & rating per lot	-	Approved Drawing/ Data sheet	Approved Drawing/ Data sheet	QC RECORD		P	-	-
2.5	Indicating Instruments	Make, Type & Rating	MA	Visual	10% of each make, type & rating per lot	-	Approved Drawing/ Data sheet	Approved Drawing/ Data sheet	MTC		P	-	-
		All routine tests	MA	Elec.	100%	10%	IS-1248	IS-1248	MTC	✓	V	V	V
2.6	Transducer	Make, Type & Rating	MA	Visual	10% of each make, type & rating per lot	-	Approved Drawing/ Data sheet	Approved Drawing/ Data sheet	QC RECORD		P	-	-
		All routine tests including calibration & accuracy test reports	MA	Elec.	100%	10%	IEC 60688/ Approved Drawing/ Data sheet	IEC 60688/ Approved Drawing/ Data sheet	MTC	✓	V	V	V

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:		MEGHA/ NARENDRA NATH JAJWARE	Checked by:		KUNDAN PRASAD		
Reviewed by:		SANDEEP LODH	Reviewed by:		HARISH KUMAR		

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-999-506-E002, REV. 0	DATE: 27.02.2024
	PROJECT:		PO NO.:	DATE:
	ITEM: LT SWITCHGEAR	SYSTEM: LT SWITCHGEAR	SECTION: II	SHEET 3 of 10

S. NO	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK (6)		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY (10)				REMARKS
					M	B/C				D	M	B	C	
(1)	(2)	(3)	(4)	(5)			(7)	(8)	(9)					(11)
2.7	MFM & IMC	Make, Type & Rating	MA	Visual	10% of each make, type & rating per lot	-	Approved Drawing/ Data sheet	Approved Drawing/ Data sheet	QC RECORD		P	-	-	
		All routine tests including accuracy test Reports	MA	Elec.	100%	10%	IEC 62052 & IEC 60947/ Approved Drawing/ Data sheet	IEC 62052 & IEC 60947/ Approved Drawing/ Data sheet	MTC	✓	V	V	V	
2.8	Control Transformer	Make, Type & Rating	MA	Visual	100%	-	Approved drawing	Approved drawing	QC RECORD		P	-	-	
		Voltage ratio	MA	Elec.	100%	-	Approved drawing	Approved drawing	QC RECORD		P	-	-	
		All routine tests	MA	Elec.	100%	10%	IS 12021	IS 12021	MTC		V	V	V	
2.9	Numerical Relay	Make, Type & Rating	MA	Visual	100%	-	Approved drawing	Approved drawing	QC RECORD		V	-	-	
		Routine test report	MA	Elec.	100%	100%	IEC-60255/IEC-61850	IEC-60255/IEC-61850	MTC	✓	V	V	V	
		Numerical Relay Testing	MA	Elec.	10% of each type & rating per lot	10% of each type & rating per lot	Approved FAT Test Procedure	Approved Test FAT Procedure		✓	P	W	W	Only for NTPC project.
2.10	Synthetic rubber Gasket/ Neoprene rubber gasket	Visual & Dimension, Profile, shore hardness, Elongation at break & ageing & compression Test, Ozone Resistance Test	MA	Review of Document	10%	-	Approved Drawing/ Manufacturer's Standard	Approved Drawing/ Manufacturer's Standard	QC RECORD/ COC		P	V	V	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by		MEGHA/ NARENDRA NATH JAJWARE	Checked by:		KUNDAN PRASAD		
Reviewed by:		SANDEEP LODH	Reviewed by:		HARISH KUMAR		

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-999-506-E002, REV. 0	DATE: 27.02.2024
		PROJECT:		PO NO.:	DATE:
		ITEM: LT SWITCHGEAR	SYSTEM: LT SWITCHGEAR	SECTION: II	SHEET 4 of 10

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK (6)		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY (10)				REMARKS
										D *	M **	B	C	
(1)	(2)	(3)	(4)	(5)	M	B/C	(7)	(8)	(9)					(11)
2.11	PVC wire	Verify size, color & properties	MA	Visual	1 sample of each type & size per lot	-	IS-694	IS-694	QC RECORD/ MTC		P	-	-	
2.12	Space heater, Thermostat, 3-pin socket, hooter, terminal block	Make & Type	MA	Visual	1 sample of each type per lot	-	Manufacturer's Standard	Manufacturer's Standard	QC RECORD		P	-	-	
2.13	ACB Handling trolley	Functional Checks	MA	Test	1 sample of each type & rating of first lot	-	Manufacturer's Standard	Manufacturer's Standard	QC RECORD		P	V		Subsequent lots will be cleared based on COC
3	IN PROCESS INSPECTION													
3.1	Panel Fabrication	Cutting, punching, shearing & bending	MA	Meas.	Mfr. Practice	-	Manufacturer's Standard	Manufacturer's Standard	QC RECORD		P	-	-	
		Panel front door cut-outs punching	MA	Meas.	-do-	-	Approved drawing	Approved drawing	QC RECORD		P	-	-	
3.2	Paint Check	Pre- Treatment of sheet	MA	Process	-do-	-	Manufacturer's Standard practice, IS-6005	Manufacturer's Standard practice, IS-6005	QC RECORD		P	-	-	
		Paint Shade	MA	Visual	1 sample per lot	-	Approved drawing	Approved drawing	QC RECORD		P	-	-	
		Paint Thickness & Adhesion	MA	Test	Mfr. Practice	-	Approved drawing	Approved drawing	QC RECORD		P	-	-	Cross hatch method using adhesive tape
3.3	Panel Assembly	Panel shell assembly, Top & back cover assembly, Panel door assembly, hinge fitting & door knob fitting etc.	MA	Process	100%	-	Manufacturer's Internal drawing made to meet Approved drawing	Manufacturer's Internal drawing made to meet Approved drawing	QC Records		P	-	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:		MEGHA/ NARENDRA NATH JAJWARE	Checked by:		KUNDAN PRASAD		
Reviewed by:		SANDEEP LODH	Reviewed by:		HARISH KUMAR		

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-999-506-E002, REV. 0	DATE: 27.02.2024
		PROJECT:		PO NO.:	DATE:
		ITEM: LT SWITCHGEAR	SYSTEM: LT SWITCHGEAR	SECTION: II	SHEET 5 of 10

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK (6)		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY (10)				REMARKS
										D *	M **	B	C	
(1)	(2)	(3)	(4)	(5)	M	B/C	(7)	(8)	(9)					(11)
		Size of busbar & busbar finish	MA	Process	100%	-	-do-	-do-	QC RECORD		P	-	-	
		Colour coding of busbar	MA	Visual	100%	-	-do-	-do-	QC RECORD		P	-	-	
		Insulator type & mounting	MA	Process	100%	-	Manufacturer's Internal drawing made to meet Approved drawing	Manufacturer's Internal drawing made to meet Approved drawing	QC RECORD		P	-	-	
		Busbar support distance & tightness of bolts for Main bus bars and bus bar joints	MA	Process	100%	-	Manufacturer's Standard	Manufacturer's Standard	QC RECORD		P	-	-	
		Main , Control & Auxiliary Busbar Clearances	MA	Process	100%	-	Manufacturer's Internal drawing made to meet Approved drawing	Manufacturer's Internal drawing made to meet Approved drawing	QC Records		P	-	-	
		CT / PT mounting arrangement & tightness	MA	Process	100%	-	-do-	-do-	QC Records		P	-	-	
		Termination for power & control circuits	MA	Process	100%	-	-do-	-do-	QC Records		P	-	-	
		Lug size & crimping quality	MA	Process	100%	-	-do-	-do-	QC Records		P	-	-	
		Earthing busbar size & continuity; Earthing of panel & doors	MA	Process	100%	-	-do-	-do-	QC Records		P	-	-	
		Breaker safety shutter operation	MA	Process	100%	-	-do-	-do-	QC Records		P	-	-	
		Spring loaded power and control contact alignment	MA	Process	100%	_	-do-	-do-	QC Records		P			

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:		MEGHA/ NARENDRA NATH JAJWARE	Checked by:		KUNDAN PRASAD			Reviewed by:			
Reviewed by:		SANDEEP LODH	Reviewed by:		HARISH KUMAR			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO:	DATE:
	CUSTOMER:		QP NO.: PE-QP-999-506-E002, REV. 0	DATE: 27.02.2024
	PROJECT:		PO NO.:	DATE:
	ITEM: LT SWITCHGEAR	SYSTEM: LT SWITCHGEAR	SECTION: II	SHEET 6 of 10

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK (6)		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY (10)			REMARKS
					M	B/C				D	M	B	C
(1)	(2)	(3)	(4)	(5)			(7)	(8)	(9)				(11)
		Tin / silver plating/ bimetallic strip between Cu & Al joints	MA	Process	100%	–	-do-	-do-	QC Records		P			
3.4	Module assembly	Component identification	MA	Process	100%	-	Manufacturer's Internal drawing made to meet Approved drawing	Manufacturer's Internal drawing made to meet Approved drawing	QC Records		P	-	-	
		Component layout, mounting & dimensions	MA	Process	100%	-	-do-	-do-	QC Records		P	-	-	
		Incoming & outgoing power & control contacts assembly & Alignment	MA	Process	100%	-	-do-	-do-	QC Records		P	-	-	
		Power circuit wire / strip termination & clearances	MA	Process	100%	-	-do-	-do-	QC Records		P	-	-	
		Busbar joints	MA	Process	100%	-	-do-	-do-	QC Records		P	-	-	
		Functional Checks	MA	Process	100%	-	-do-	-do-	QC Records		P	-	-	
3.5	Control Wiring	Wire Size & lug size & Color of wire	MI	Visual	100%	-	Approved Wiring drawing	Approved Wiring drawing	QC Records		P	-	-	
		Proper wire Clamping & Ferruling	MI	Visual	100%	-	Manufacturer's Standard	Manufacturer's Standard	QC Records		P	-	-	
		Continuity as per wiring drawing	CR	Test	Sample	-	Approved drawing	Approved drawing	QC Records		P	-	-	
		Tightness of termination & crimping check	MA	Test	100%	-	Manufacturer's Standard	Manufacturer's Standard	QC Records		P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		MEGHA/ NARENDRA NATH JAJWARE	Checked by:		KUNDAN PRASAD
Reviewed by:		SANDEEP LODH	Reviewed by:		HARISH KUMAR

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-999-506-E002, REV. 0	DATE: 27.02.2024
		PROJECT:		PO NO.:	DATE:
		ITEM: LT SWITCHGEAR	SYSTEM: LT SWITCHGEAR	SECTION: II	SHEET 7 of 10

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK (6)		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY (10)				REMARKS
					M	B/C				D *	M **	B	C	
(1)	(2)	(3)	(4)	(5)			(7)	(8)	(9)					(11)
4	FINAL INSPECTION & TESTING													
		1. Overall visual check for aesthetics, verticality of panels and alignment between two transport sections	MA	Visual	100%	10%	Approved GA drawing	Approved GA drawing	QC Records	✓	P	W	W	
		2. Verification of overall dimensions including sheet steel thickness	MA	Meas.	100%	1 sample of each type of panel per lot	Approved GA drawing	Approved GA drawing	QC RECORD	✓	P	W	W	
		3. Busduct interface, phase sequence, flange dimensions & clearances	MA	Visual	100%	100%	Approved GA drawing	Approved GA drawing	QC RECORD	✓	P	W	W	
		4. Busbar (Main horizontal) - clearances, color coding, phase sequence, identification for each transport unit	CR	Meas. & Visual	100%	10%	Approved drawing	Approved drawing	QC RECORD	✓	P	W	W	
		5. Verification of tightness of busbar joints by torque wrench	CR	Mech.	100%	10%	Manufacturer's Standard	Manufacturer's Standard	QC RECORD	✓	P	W	W	
		6. CT /PT fixing & mounting arrangement	MA	Visual	100%	10%	Manufacturer's Standard	Manufacturer's Standard	QC RECORD	✓	P	W	W	
		7. Check shrouding of accessible live parts, Cable supports and tool falling shroud in cable alley and application of PVC sleeves on busbars	MA	Visual	100%	10%	Technical Specification	Technical Specification	QC RECORD	✓	P	W	W	

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:		MEGHA/ NARENDRA NATH JAJWARE	Checked by:		KUNDAN PRASAD			Reviewed by:			
Reviewed by:		SANDEEP LODH	Reviewed by:		HARISH KUMAR			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO:	DATE:
	CUSTOMER:		QP NO.: PE-QP-999-506-E002, REV. 0	DATE: 27.02.2024
	PROJECT:		PO NO.:	DATE:
	ITEM: LT SWITCHGEAR	SYSTEM: LT SWITCHGEAR	SECTION: II	SHEET 8 of 10

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK (6)		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY (10)				REMARKS
										D *	M **	B	C	
(1)	(2)	(3)	(4)	(5)	M	B/C	(7)	(8)	(9)					(11)
		8. Verification of Components for make, type, rating & layout	MA	Visual	100%	10% of each type of module per lot	Approved drawing/ Make's List	Approved drawing/ Make's List	QC RECORD	✓	P	W	W	
		9. Check control wiring / terminal arrangement & ferruling	MA	Visual	100%	10% Same as above	Approved drawing	Approved drawing	QC RECORD	✓	P	W	W	
		10. Safety Shutters operation check	CR	Elec.	100%	10% Same as above	Technical Specification	Technical Specification	QC RECORD	✓	P	W	W	
		11. Check door interlock & defeat interlock feature	MA	Elec.	100%	10% Same as above	Technical Specification	Technical Specification	QC RECORD	✓	P	W	W	
		12. Mech. operation test for ACB	CR	Elec.	100%	10% Same as above	IEC 60947-2	IEC 60947-2	QC RECORD	✓	P	W	W	
		13. Breaker operation at service , test & isolate position	CR	Elec.	100%	100%	Technical Specification	Technical Specification	QC RECORD	✓	P	W	W	
		14. Power & control draw-out contacts alignment check	MA	Elec.	100%	10% of each type of module per lot	Technical Specification	Technical Specification	QC RECORD	✓	P	W	W	
		15. Check for Breaker Anti-pumping & trip free feature	MA	Elec.	100%	100%	Technical Specification	Technical Specification	QC RECORD	✓	P	W	W	
		16. Earthing of ACB Cradle	MA	Visual	100%	100%	Technical Specification	Technical Specification	QC RECORD	✓	P	W	W	
		17. Interlocks & operation check - Elect. / Mech. open, close: under test, service & isolation position	CR	Elec.	100%	10% of each type of module per lot	Approved drawing	Approved drawing	QC RECORD	✓	P	W	W	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:		MEGHA/ NARENDRA NATH JAJWARE	Checked by:		KUNDAN PRASAD		
Reviewed by:		SANDEEP LODH	Reviewed by:		HARISH KUMAR		

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-999-506-E002, REV. 0	DATE: 27.02.2024
	PROJECT:	PO NO.:	DATE:
	ITEM: LT SWITCHGEAR / SYSTEM: LT SWITCHGEAR	SECTION: II	SHEET 9 of 10

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK (6)		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY (10)				REMARKS
					M	B/C				D *	M **	B	C	
(1)	(2)	(3)	(4)	(5)			(7)	(8)	(9)					(11)
		18. Interchangeability check for draw-out modules	MA	Mech.	100%	10%	Technical Specification	Technical Specification	QC RECORD	✓	P	W	W	
		19. Earth bus dimensions, Earthing of draw-out modules, door etc.	MA	Elec.	100%	10% of each type of module per lot	Approved drawing	Approved drawing	QC RECORD	✓	P	W	W	
		20. Check Paint shade, thickness, Adhesion & finish	MA	Visual/ Test	100% for shade & finish; 2-3 samples/lot for thickness & adhesion check	2 - 3 samples/ board	Approved drawing	Approved drawing	QC RECORD	✓	P	W	W	
		21. Bus bar support arrangement: centre to centre distance between supports	MA	Meas.	100%	10%	TTR	TTR	QC RECORD	✓	P	W	W	
		22. Overlapping of bus bar joints	MA	Meas.	100%	10%	Approved drawing	Approved drawing	QC RECORD	✓	P	W	W	
		23. Degree of protection check, check profile & fixing of gaskets	MA	Visual	2 - 5 samples at gasketted joints per board	2-5 samples at gasketted joints per board	Approved drawing/ Technical Specification	No insertion possible from openings & gasketted joints	QC RECORD	✓	P	W	W	Paper insertion method - IP5X Comp. & 1 mm wire insertion method - IP4X Comp.
		24. IR Test before & after the HV Test	MA	Elec.	100%	100%	IS/ IEC 61439	IS/ IEC 61439	QC RECORD	✓	P	W	W	
		25. HV test on Power circuit	CR	Elec.	100%	100%	IS/ IEC 61439	IS/ IEC 61439	QC RECORD	✓	P	W	W	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:		MEGHA/ NARENDRA NATH JAJWARE	Checked by:		KUNDAN PRASAD		
Reviewed by:		SANDEEP LODH	Reviewed by:		HARISH KUMAR		

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-999-506-E002, REV. 0	DATE: 27.02.2024
	PROJECT:		PO NO.:	DATE:
	ITEM: LT SWITCHGEAR	SYSTEM: LT SWITCHGEAR	SECTION: II	SHEET 10 of 10

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK (6)		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY (10)				REMARKS
										D *	M **	B	C	
(1)	(2)	(3)	(4)	(5)	M	B/C	(7)	(8)	(9)					(11)
		26. Functional Test of each type of draw-out feeders	MA	Functional	100%	10%	Approved drawing	Approved drawing	QC RECORD	✓	P	W	W	
5	Packing	Soundness of packing, Loading etc.	MA	Verify	100%	100%	Manufacturer's Standard	Manufacturer's Standard			P	-	-	

LEGENDS:

*Records, identified with "Tick"(√) shall be essentially included by supplier in QA documentation.
** **M**: Supplier/ Manufacturer/ Sub-Supplier, **B**: Main Supplier/ BHEL/ Third Party Inspection Agency, **C**: Customer.
P: Perform, **W**: Witness, **V**: Verification, as appropriate.
MA: Major, **MI**: Minor, **CR**: Critical, **D**: Documentation

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:		MEGHA/ NARENDRA NATH JAJWARE	Checked by:		KUNDAN PRASAD		
Reviewed by:		SANDEEP LODH	Reviewed by:		HARISH KUMAR		

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-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 1 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	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	B/C				D	M	B	C	
1.0	**RAW MATERIALS**													
1.1	**Aluminium /Copper Rods (Conductor/ Armour Wire)**	a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	V	V	-	
		b) Grade	MA	-do-	-do-	-do-	IS:8130 (Al), IS:613 (Cu)	IS:8130 (Al), IS:613 (Cu)	-do-	✓	V	V	-	
		c) Resistivity	MA	Electrical Tests	Manufacturer std.	Manufacturer std.	IS:613 (Cu), IS:5082 (Al)	IS:613 (Cu), IS:5082 (Al)	-do-	✓	P	V	-	
1.2	**PVC Compound for insulation**													
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✔	V	V	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL		
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:	Harish Kumar	HARISH KUMAR		

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-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 2 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	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	B/C				D	M	B	C	
		b) Type/ Grade	MA	-do-	-do-	-do-	Approved Datasheet	Approved Datasheet	-do-	✓	V	V	-	
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	Compound mfg std	Compound mfg std	-do-	✓	V	V	-	
1.3	**Fillers (if applicable)**	1. Make/ Type/ Grade	MA	Verify	Manufacturer standard	Manufacturer standard	Manufacturer approved source & Approved datasheet	Manufacturer approved source & Approved datasheet	Test Cert.	✓	P	V	-	Fillers material chosen shall be compatible with the temperature rating of the cable and shall have no deleterious effect on any other component of cable)
		2. Flame retardant & moisture	CR	Chemical / Environ.	-do-	-do-	Appd. Data Sheet	Appd. Data Sheet	-do-	✔	P	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:	Harish Kumar	HARISH KUMAR

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-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 3 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	B/C				D	M	B	C	
1	2	3	4	5	6		7	8	9	*	**			
		resistant. (As applicable)												
1.4	**Galvanised steel wire/strip for Armour (as applicable)**	**GENERAL:**												
		1. Make	MA	Verify	Manufacturer std.	Manufacturer std.	Manufacturer approved source	Manufacturer approved source	Inspection report / Test Cert.	✓	P	V	-	
		2. Dimension	MA	Measurement	1 sample each size	1 sample each size	Appd. Data Sheet	Appd. Data Sheet	-do-	✓	P/V	V	-	
		3. Phy. and Elec. Properties	MA	Physical & Electrical Tests	Sample*	Sample*	IS 3975	IS 3975	-do-	✓	P/V	V	-	* Sample from each armour size/Batch

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:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL			Reviewed by:			
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:	Harish Kumar	HARISH KUMAR			Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 4 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	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	B/C				D	M	B	C	
		4.Galvanization Quality (Acceptance test as per IS 3975)	MA	Galv.Tests	-do-	-do-	IS 3975	IS 3975	-do-	✓	P/V	V	-	
1.5	**PVC Compound (for sheath)**													
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	Inspection report / Test Cert.	✓	V	V	-	
		b) Type/ Grade	MA	-do-	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✓	V	V	-	
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	✓	V	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:	Harish Kumar	HARISH KUMAR

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-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 5 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	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	B/C				D	M	B	C	
1.6	**Wooden Drum if applicable as per approved data sheet**	1. Phy. & Constructional checks	MA	Visual	Mfr's Plant Std.	Mfr's Plant Std.	IS 10418	IS 10418	Inspection report / Test Cert.	✓	P	V	-	
		2. Anti termite treatment	MA	Chem.	-do-	-do-	Mfr's Plant Std.	Mfr's Plant Std.	-do-	✓	P	V	-	
1.7	**Steel Drum #**	1. Dimension	MA	Meas.	Mfr's Plant Std.	Mfr's Plant Std.	Approved drg **of steel drum**	Approved drg **of steel drum**	Inspection report / Test Cert.	✓	P	V	-	**# If required, as per spec./ mentioned in approved data sheet**
		2. Surface finish	MA	Visual	-do-	-do-	Surface shall be smooth	Surface shall be smooth	-do-	✓	P	V	-	
2.0	**IN PROCESS**													

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:	Harish Kumar	HARISH KUMAR

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-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 6 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	B/C				D	M	B	C	
1	2	3	4	5	6		7	8	9	*	**			
2.1	**Wire Drawing**	1. Size	MA	Dimensional	Plant Mfg. Std.	Plant Mfg. Std.	Approved datasheet	Approved datasheet	Inspection Report/ Test report	✓	P	V	-	
		2. Surface finish	MA	Visual	-do-	-do-	Surface shall be smooth	Surface shall be smooth	-do-	✓	P	V	-	
		3. % of Elongation	MA	Mechanical	-do-	-do-	IS 8130	IS 8130	-do-	✓	P	V	-	
2.2	**Tinning**	1. Size	MA	Dimensional	Plant Mfg. Std.	Plant Mfg. Std.	Mfrs Std	Mfrs Std	-do-	✓	P	V	-	(Applicable only for tin-coated Copper conductor)
		2. Chemical test for tinning	CR	Chemical	-do-	-do-	IS 10810 Pt-4	Is-8130	-do-	✓	P	V	-	
2.3	**Stranding of wires**	1. No. of wires	MA	Counting	One Sample of each size	One Sample of each size	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:	Harish Kumar	HARISH KUMAR

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-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 7 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	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	B/C					M	B	C	
		2. Resistance (DC)	CR	Electrical	-do-	-	-do-	-do-	-do-	-do-	P	-	-	
		3. Sequence, lay length & Direction	MA	Visual, Measurement	One Sample of each size	-	Mfrs Std. / Appd. Datasheet	Mfrs Std. / Appd. Datasheet	-do-		P	-	-	
		4. Surface Finish	MA	Visual	100%	-	Surface shall be smooth	Surface shall be smooth	-do-		P	-	-	
		5. Dimension	MA	Measurement	One Sample of each size	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
2.4	**Core Insulation** (No repair permitted)													
		1. Surface finish	MA	Visual	100%	100%	Free from bulging, burnt particles, lumps, cuts	Free from bulging, burnt particles, lumps, cuts & scratches	Inspection Report/ Test report	✓	P	V	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL		
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:	Harish Kumar	HARISH KUMAR		

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-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 8 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	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	B/C				D	M	B	C	
							& scratches							
		2. Insulation Thickness	CR	Measurement	-do- One Sample of each size	-	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	-	-	
		3. Concentricity # Eccentricity & Ovality $	CR	Measurement	One Sample of each size	One Sample of each size	Mnfr's Std / Approved data sheet	Mnfr's Std / Approved data sheet	-do-	✓	P	V	-	# To be checked at starting & finish end of extruded length $ To be checked for PVC/HRPVC Power Cable
		4. Dia over insulation	MA	Measurement	-do-	-	-do-	-do-	-do-	✓	P	-	-	
		5. Core Identification	MA	Visual	100%	-	Approved Data Sheet	Approved Data Sheet	-do-	✓	P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:	Harish Kumar	HARISH KUMAR

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-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 9 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	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	B/C				D	M	B	C	
		6. TS & % Elongation	MA	Mechanical	100%	-	IS:1554-I, IS:5831	IS:1554-I, IS:5831	-do-	✓	P	-	-	
		7. Spark Test or Water immersion test	CR	Electrical	100%	-	Mnfr's Std	Mnfr's Std	-do-	✓	P	-	-	
2.5	**Core Laying**	1. Dia over laid up core	MA	Measurement	One Sample of each size	-	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	-	-	
		2. Sequence of lay & lay length & direction of laid up core	MA	Visual & Measurement	-do-	-	IS 1554-pt-1	IS 1554-pt-1	-do-	✓	P	-	-	
2.6	**Inner Sheath Extrusion (if applicable)**	1. Surface finish	MA	Visual	100%	-	Surface shall be smooth	Surface shall be smooth	Inspection Report/ Test report	✓	P	-	-	
		2. Thickness	CR	Measurement	One Sample of each size	-	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:	Harish Kumar	HARISH KUMAR

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-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 10 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	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	B/C				D	M	B	C	
		3. Dia over inner sheath	MA	-do-	-do-	-	-do-	-do-	-do-	✓	P	-	-	
		4. Colour	MA	Visual	-do-	-	-do-	-do-	-do-	✓	P	-	-	
2.7	**Armour (as applicable)**	1. No. of wires/Strips	MA	Counting	At the start of the process	-	Mnfr's Std	Mnfr's Std	Inspection Report/ Test report	✓	P	-	-	
		3. Lay length / Direction	MA	Visual & Meas.	-do-	-	IS 1554 P-1	IS 1554 P-1	-do-	✓	P	-	-	
		4. Coverage	MA	Measurement	-do-	-	-do-	-do-	-do-	✓	P	-	-	
		5. Dia over armouring	MA	Measurement	-do-	-	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	-	-	
2.8	**Outer Sheath Extrusion**	1. Surface finish	MA	Visual	100%	-	Surface shall be smooth	Surface shall be smooth	Inspection Repo	✓	P	-	-	

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:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL			Reviewed by:			
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:	Harish Kumar	HARISH KUMAR			Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 11 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	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	B/C				D	M	B	C	
	(No repair permitted)								rt/ Test report					
		2. Sheath Thickness	CR	Measurement	One Sample of each size	-	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	-	-	
		3. Dia over outer sheath	MA	-do-	-do-	-	-do-	-do-	-do-	✓	P	-	-	
		4. Colour Embossing/ Sequential Marking	MA	Visual	100%	-	Approved data sheet	Approved data sheet	-do-	✓	P	-	-	
3.0	**Final Inspection (INTERNAL)**	**1. Routine Test**	CR	Electrical Tests & Measurement	100%	100%	#	#	-do-	✓	P	V	V	#: Refer Annexure-A & Annexure-B to QP.

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY					Doc No:			
	Sign & Date	Name		Sign & Date	Name	Sign & Date			Sign & Date	Name	Seal
Prepared by:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL	Seal		Reviewed by:			
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:	Harish Kumar	HARISH KUMAR			Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 12 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	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	B/C				D	M	B	C	
4.0	**Final Inspection (EXTERNAL)**	**1. Finish & Length (Cable & cable drum)**	MA	Visual	One drum	One drum	Appd. Datasheet	Free from Porosity, Bulging, Burnt particles, lumps, cuts & scratches	Inspection Report/ Test report	✓	P	W	W	
		2. Dimension	MA	-do-	IS 1554-I	IS 1554-1	Appd. Data sheet	Appd. Data sheet	-do-	✓	P	W	W	
		3. Armouring - Coverage & No.of Wires/Strips	MA	Visual & Meas.	-do-	-do-	-do-	-do-	-do-	✓	P	W	W	
		4. Marking & Colour Coding	MA	Visual	-do-	-do-	-do-	-do-	-do-	✓	P	W	W	
		5. Acceptance Tests	CR	Phy, Elect. Tests & FRLS Tests	Sample #	Sample #	#	#	-do-	✓	P	W	W	#: Refer Annexure-A & Annexure-B to QP.

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:	Harish Kumar	HARISH KUMAR

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-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 13 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	B/C				D	M	B	C	
1	2	3	4	5	6		7	8	9	*	**			
		6. Type & FRLS Tests	CR	Measurement	Sample #	Sample #	#	#	-do-	✓	P	W / V	W / V	Witness required for conduction of Type test; else 'Verification' of type test(s) reports to be done. #: Refer Annexure-A & Annexure-B to QP. .
5.0	**Packing**	**End sealing / Polythene wrapping**	MA	Visual	100%	100%	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	V		

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:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL			Reviewed by:			
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:		HARISH KUMAR			Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-02	
		PROJECT:		PO NO.:	
		ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 14 OF 14

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	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	B/C				D	M	B	C	

NOTES:

A. For lists of routine tests, acceptance tests & type tests refer Annexure-A to SQP.
B. For project specific tests (if any); refer Annexure-B to SQP.
C. Cable manufacturer to maintain records to show co-relation of raw materials to finished cables i.e. raw material batch no. should be traceable to the final cable drum number or batch no.
D. Cable manufacturer to maintain all quality records identified as per all QP stages enumerated above whether it is identified for BHEL verification or witness or not.
E. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*RECORDS, IDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **B:** MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C:** CUSTOMER

P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE

MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

D: DOCUMENTATION

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	Devendra Singh	Priyanka Gupta / Devendra Singh	Checked by:	Suman Nakwal	SUMAN NAKWAL
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:		HARISH KUMAR

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

TYPE/ ACCEPTANCE/ ROUTINE TEST REQUIREMENTS

A. Type Test Conduction:

1. Tests for which "T" is indicated in the 'Test Conduction Required As' column below shall be conducted as Type Test.

2. Sampling:
   a) Type test to be conducted on one size for each type (Al/Cu conductor) of cable.
   b) FRLS & Flammability Test to be conducted only on one sample.

3. Repeat type test(s) are not required, in case the requirements of note no. 2, clause no. 2.2 of IS 1554-1 (as per amendment no. 5 of 2012) are met.

B. Acceptance Test Conduction:

1. Tests for which "A" is indicated in the 'Test Conduction Required As' column below shall be conducted as Acceptance tests.

2. Sampling:
   Sampling for acceptance tests shall be as per Appendix-B of IS: 1554 Part-I.

3. Flammability Test to be conducted only on one sample.

C. Routine Test Conduction:

1. Tests for which "R" is indicated in the 'Test Conduction Required As' column below shall be conducted as Routine tests.

D. Tests listed in S. No-7.0 & 8.0 shall be conducted only on one sample.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
1.0	**Tests for Conductor**				
I.	Annealing test	For copper conductor only	**T, A**	IS 10810 Pt 1	Internal in process Test Report to be furnished for to inspector at the time of inspection
II.	Tensile test	For aluminium conductor only (Not applicable for compacted circular or shaped conductor)	**T, A**	IS 10810 Pt 2	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	Devendra Singh	Priyanka Gupta/ Devendra Singh	Checked by:		SUMAN NAKWAL
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:		HARISH KUMAR

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
III.	Wrapping test	For aluminium conductor only (Not applicable for compacted circular or shaped conductor)	T, A	IS 10810 Pt 3	
IV.	Resistance test	For Al/Cu	T, A, R	IS 10810 Pt 5	
2.0	Tests for Armour Wires/Strips				
I.	Measurement of dimensions	Applicable for Aluminium wire & GS wire/Strip	T	IS 10810 Pt 36	
II.	Tensile test	Applicable for Aluminium wire & GS wire/Strip	T	IS 10810 Pt 37	
III.	Elongation at break test	Applicable for GS wire/Strip only	T	IS 10810 Pt 37	
IV.	Torsion test	For GS round wire only	T	IS 10810 Pt 38	
V.	Winding / Adhesion Test	For GS strip only	T	IS 10810 Pt 39	
VI.	Resistivity test	Applicable for Aluminium wire & GS wire	T	IS 10810 Pt 42	
VII.	Uniformity of Zinc coating test	For G. S. wires/Strip only	T	IS 10810 Pt 40	
VIII.	Mass of Zinc coating test	For G. S. wires/Strip only	T	IS 10810 Pt 41	
IX.	Wrapping Test	Applicable for Aluminium wire & GS wire	A	IS 10810 Pt 3	
3.0	Physical Tests for PVC Insulation & PVC sheath				
I.	Test for thickness	Applicable for PVC insulation, PVC inner sheath & PVC outer sheath	T, A	IS 10810 Pt 6	
II.	Tensile strength and elongation test at break	Applicable for PVC insulation & PVC outer sheath			
(a)	Before ageing		T, A	IS 10810 Pt 7	
(b)	After ageing		T, A	IS 10810 Pt 7	
III.	Ageing in air oven	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 11	
IV.	Loss of mass in air oven test	For PVC outer sheath only	T	IS 10810 Pt 10	
V.	Hot deformation test	For PVC outer sheath only	T	IS 10810 Pt 15	
VI.	Heat shock test	For PVC outer sheath only	T	IS 10810 Pt 14	
VII.	Shrinkage test	For PVC insulation & PVC outer sheath only	T	IS 10810 Pt 12	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	Devendra Singh (Digitally signed by Devendra Singh DN: cn=Devendra Singh, o=BHEL, ou=PEM, email=devendrasingh@bhel.in, c=IN Date: 2024.02.27 18:36:07 +05'30')	Priyanka Gupta/ Devendra Singh	Checked by:		SUMAN NAKWAL
Reviewed by:	Ayan Saha (Digitally signed by Ayan Saha DN: cn=Ayan Saha, o=BHEL, ou=PEM, email=ayansaha@bhel.in, c=IN Date: 2024.02.27 19:10:11 +05'30')	AYAN SAHA	Reviewed by:		HARISH KUMAR

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

BHEL	ANNEXURE-A TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER:
		BIDDER/VENDOR:	QUALITY PLAN NUMBER: PE-QP-999-507-E003, R02	SPECIFICATION TITLE:
	SHEET 3 OF 4	SYSTEM: CABLE	ITEM: 1. LT PVC CONTROL CABLE 2. LT PVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
VIII.	Thermal stability test	For PVC insulation & PVC outer sheath only	T	IS 10810 Pt 60	
4.0	Improved Fire performance (FR-LSH) Tests				
I.	Oxygen index test	*For outer sheath only*	T, A	IS 10810 Pt 58 / ASTMD 2863/	Applicable for Inner Sheath also, if the same is indicated in Datasheet-A
II.	Smoke density test	*For outer sheath only*	T	IS 10810 Pt 63 / ASTMD 2843	
III.	Acid gas generation test	*For outer sheath only*	T, A	IS 10810 Pt 59 / IEC-754-1	
IV.	Temperature Index Test	*For outer sheath only*	T	IS 10810 Pt 64 / ASTMD 2863	
5.0	Flammability Tests				
I.	Flammability test for bunched cables	For complete cable	T	IS 10810 Pt 62/ IEC-60332 (Part-3-23-Cat-B	Test & Category applicable as indicated in Technical Datasheet
II.	Flammability test for single cable	For complete cable	T, A	IS: 10810 Pt 61 / IEC:60332 Part-1	
III.	Swedish chimney test	For complete cable	A	SEN SS 424 1475 (Class F3)	
IV.	Flammability test	For complete cable	A	IEEE: 60383	
6.0	Electrical Tests				
I.	High Voltage Test (Water immersion test)	On cores	T, A, R	IS 10810 Pt 45	
II.	High Voltage Test at room temperature	For complete cable	T, A, R	IS 10810 Pt 45	
III.	Insulation Resistance Test (Volume resistivity method)	For complete cable	T, A	IS 10810 Pt 43	
7.0	Anti-rodent and Termite Repulsion test	For PVC outer sheath only	A	Refer Note	Test applicable if indicated in Technical Datasheet-A
8.0	Anti-Fungal Test	For PVC outer sheath only	A	Self-certification by vendor for anti-fungal property.	
9.0	Special Tests				

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	Devendra Singh	Priyanka Gupta/ Devendra Singh	Checked by:		SUMAN NAKWAL
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:		HARISH KUMAR

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

	ANNEXURE-A TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER:
		BIDDER/VENDOR:	QUALITY PLAN NUMBER: PE-QP-999-507-E003, R02	SPECIFICATION TITLE:
	SHEET 4 OF 4	SYSTEM: CABLE	ITEM: 1. LT PVC CONTROL CABLE 2. LT PVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
I.	Hydrolytic Stability Test	For complete cable	**	ASTM D 3137:81	Test applicable if indicated in Technical Datasheet
II.	Ultraviolet Radiation Test	For complete cable	**	BS EN ISO 4892-2	

***** These tests shall be conducted on one sample for the entire contract and duration of these tests shall be 14 days.***

Note: A few chipping of the PVC compound is slowly ignited on a porcelain dish or cubicle in a muffle furnace at about 60-degree C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). Place a drop of aqueous sodium sulphide solution on a thick filter paper and allow soaking. Touch the spot with a drop of above extract. A black spot indicates the presence of lead, the anti-termite and rodent compound.

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	Devendra Singh	Priyanka Gupta/ Devendra Singh	Checked by:		SUMAN NAKWAL
Reviewed by:	Ayan Saha	AYAN SAHA	Reviewed by:		HARISH KUMAR

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

Annexure “B” to Standard Quality Plan

PROJECT SPECIFIC REQUIREMENT

PROJECT:

PACKAGE: (1) LT PVC CONTROL CABLE, (2) LT HRPVC CONTROL CABLE, (3) LT PVC POWER CABLE, (4) LT HRPVC POWER CABLE

S. No.	TEST	APPLICABLE	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
1.	Accelerated water absorption test for insulation	as per NEMA-WE-3.11.			
2.	Dielectric retention Test: The dielectric strength of the cable insulation			tested in accordance with Cl. 6.7.4 of	
	NEMA WE-5 at 75 +/- 1 °C shall not be less than 60% of the original dielectric strength.				
3. Test for rodent and termite repulsion property					

PREPARED BY	CHECKED BY	REVIEWED BY	APPROVED BY
NAME: DESIGNATION:	NAME: DESIGNATION:	NAME: DESIGNATION:	NAME: DESIGNATION:

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 03.	
	PROJECT:			
	ITEM: SCREENED CONTROL CABLES	SYSTEM: CABLE		SHEET 1 OF 8

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			REMARK
1	2	3	4	5	6		7	8	9	*	**			
					M	B/C				D	M	B	C	
INSTRUCTIONS														
1	RAW MATERIALS & BOUGHT OUT ITEMS													
1.1	Copper Rods/ Wires (For Conductor & drain wire)	a) Make	MA	Physical verification	Sample/Batch	Sample/Batch	Manufacturer approved source	Manufacturer approved source	Test Cert.	✔	V	V	-	
		b) Type/ Grade	MA	-do-	100%	100%	IS 613	IS 613	-do-	✔	V	V	-	
		d) Resistivity	MA	Electrical Tests	Manufacturer std.	Manufacturer std.	IS 613	IS 613	-do-	✔	P	V	-	
1.2	PVC Compound (for insulation)	a) Make	MA	Physical verification	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✔	V	V	-	
		b) Type/ Grade	MA	-do-	100%	100%	Approved datasheet	Approved datasheet	-do-	✔	V	V	-	
		c) Shelf life/ Storage condition	MA	-do-	100%	100%	Compound Manufacturer std.	Compound Manufacturer std.	-do-	✔	V	V	-	
1.3	Screen / Tapes/ Binders	1. Make	MA	Physical verification	100%	100%	Manufacturer approved source	Manufacturer approved source	Inspection Report/ Test Cert	✔	V	V	-	
		2. Dimension	MA	Measurement	Manufacturer std.	Manufacturer std.	Manufacturer datasheet/ Approved datasheet	Manufacturer datasheet/ Approved datasheet	Inspection Report/ Test Cert	✔	V	V	-	
		4. Chem. & Phys. Properties	MA	Chemical & Physical Tests	-do-	do-	Manufacturer std.	Manufacturer std.	-do-	✔	P	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	2/12/24	khushbu agrawal	Checked by:	27.02.24	Suman
Reviewed by:	27/2/24	Hema kushwaha	Reviewed by:	27.2.24	Harish

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 03.	
		PROJECT:			
		ITEM: SCREENED CONTROL CABLES	SYSTEM: CABLE		SHEET 2 OF 8

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			REMARK
1	2	3	4	5	6		7	8	9	*	**			
					M	B/C				D	M	B	C	
1.4	Fillers (as applicable)	1. Make/ Type/ Grade	MA	Physical verification	Manufacturer standard	Manufacturer standard	Manufacturer approved source & Approved datasheet	Manufacturer approved source & Approved datasheet	Test certificate	✔	P/V	V	-	Fillers material chosen shall be compatible with the temperature rating of the cable and shall have no deleterious effect on any other comp. of cable)
1.5	Galvanised steel wire/strip for Armour (if applicable)	1. Make	MA	Physical verification	Manufacturer std.	Manufacturer std	Manufacturer approved source	Manufacturer approved source	Inspection Report/ Test Cert.	✔	P	V	-	
		2. Dimension	MA	Measurement	1 sample each size/ lot	1 sample each size/ lot	Appd. Data Sheet	Appd. Data Sheet	-do-	✔	P/V	V	-	
		3. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample*	Sample*	IS 3975	IS 3975	-do-	✔	P/V	V	-	*: SAMPLE FROM EACH ARMOUR SIZE/ BATCH /LOT
		4 Galvanization Quality (Acceptance test as per IS 3975)	MA	Test as per IS 3975	-do-	-do-	IS 3975	IS 3975	-do-	✔	P/V	V	-	
1.6	PVC compound for Sheath	a) Physical properties	MA	Physical Tests	Sample/ Batch	Sample/ Batch	IS 5831	IS 5831	Test Cert.	✔	P/V	V		
		b) Elec. Properties	MA	Electrical Tests	-do-	-do-	-do-	-do-	-do-	✔	P/V	V		
		c) FRLS Properties (as applicable)	CR	Chemical/ Environ.	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✔	P/V	V		
		d) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	Inspection Report/ Test Cert.	✔	V	V	-	
		e) Type/ Grade	MA	-do-	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✔	V	V	-	
		f) Shelf life/ Storage condition	MA	-do-	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	✔	V	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	29/2/24	khushbu agrawal	Checked by:	27.02.24	Suman
Reviewed by:	27/2/24	Hema kushwaha	Reviewed by:	27/2/24	Harish

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN	SPEC. NO :	DATE:
	CUSTOMER :	QP NO.: PE-QP-999-507-E004, REV 03.	
	PROJECT:		
	ITEM: SCREENED CONTROL CABLES — SYSTEM: CABLE		SHEET 3 OF 8

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD	AGENCY			REMARK
1	2	3	4	5	6		7	8	9	*	**		
					M	B/C				D	M	B	C
1.7	Wooden drum	1. Phy. & Constructional checks	MA	Measurement	Manufacturer std.	Manufacturer std.	IS 10418	IS 10418	Inspection Report	✔	P	V	-	
		2. Anti-termite treatment	MA	Chem.	-do-	-do-	Manufacturer std.	Manufacturer std.	Inspection Report	✔	P	V	-	
1.8	Steel drum (if applicable as per approved data sheet)	1. Dimension	MA	Measurement	Manufacturer std.	Manufacturer std.	Approved drg. of steel drum	Approved drg. of steel drum	Inspection Report	✔	P	V	-	
		2. Surface finish	MA	Visual	-do-	-do-	-	Surface shall be smooth	Inspection Report	✔	P	V	-	
2	IN PROCESS												-	
2.1	Wire Drawing	1. Size	MA	Dimensional	Manufacturer std.	Manufacturer std.	Approved datasheet	Approved datasheet	Inspection Report/ Test Report	✔	P	V	-	
		2. Surface finish	MA	Visual	-do-	-do-	Surface shall be smooth	Surface shall be smooth	-do-	✔	P	V	-	
		% of Elongation	MA	Mechnical	-do-	-do-	IS 8130	IS 8130	-do-	✔	P	V		
2.2	Tinning (Conductor or drain wire)	1. Size	MA	Dimensional	Manufacturer std.	Manufacturer std.	Manufacturer std.	Manufacturer std.	-do-	✔	P	V	-	
		2. Chemical test for tinning	CR	Chemical	-do-	-do-	IS 10810 - 4	IS 8130	-do-	✔	P	V	-	

BHEL

ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/24	khushbu agrawal	Checked by:	27.02.24	Suman
Reviewed by:	27/2/24	Hema kushwaha	Reviewed by:	27/2/24	Manish

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 03.	
		PROJECT:			SHEET 4 OF 8
		ITEM: SCREENED CONTROL CABLES	SYSTEM: CABLE		

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			REMARK
					6					*	**			
1	2	3	4	5	M	B/C	7	8	9	D	M	B	C	
2.3	Stranding of wires	1. No. of wires	MA	Counting	one Sample each	one Sample each	Approved datasheet	Approved datasheet	-do-	✔	P	V	-	
		2. Resistance (DC)	CR	Electrical	-do-	-	-do-	-do-	-do-	✔	P	-	-	
		3. Sequence, lay length & Direction	MA	Visual, Measurement	one Sample each size/lot	-	Manufacturer std.	Manufacturer std.	-do-		P	-	-	
		4. Surface Finish	MA	Visual	100%	-	Surface shall be smooth	Surface shall be smooth	-do-		P	-	-	
		5. Dimension	MA	Measurement	one Sample each size/lot	-	Approved datasheet	Approved datasheet	-do-		P	-	-	
2.4	Core Insulation (No repair permitted)	1. Surface finish	MA	Visual	100%	100%	Free from bulging burnt particles lumps, cuts & Scratches.	Free from bulging burnt particles lumps, cuts & Scratches.	Inspection Report / Test Report	✔	P	V	-	
		2 Insulation thickness (Min./ Max.)	CR	Measurement	one Sample of each size/lot		Appd. data sheet	Appd.data sheet	-do-	✔	P	-	-	
		3. Concentricity #	CR	Measurement	-do-	-do-	Mfr's Std. / Appd. Data sheet	Mfr's Std. / Appd. Data sheet	-do-	✔	P	V	-	# To be checked at starting & finish end of extruded length
		4 Dia over insulation	MA	Measurement	-do-	Manufacturer standard / Approved data sheet	Appd.data sheet	Appd.data sheet	-do-	✔	P	-	-	
		5. Core identification	MA	Visual	100%	-	Appd.data sheet	Appd.data sheet	-do-	✔	P	-	-	
		6. T S & % Elongation	MA	Mechanical	100%	-	IS-1554/IS-5831	IS-1554/IS-5831	-do-	✔	P	-	-	
		7. Spark Test	CR	Electrical	100%	-	Mfr's Std.	Mfr's Std.	-do-	✔	P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/12/24	khushbu agrawal	Checked by:	27.12.24	Suman
Reviewed by:	27/12/24	Hema kushwaha	Reviewed by:	27/12/24	Harish

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 03.	
		PROJECT:			
		ITEM: SCREENED CONTROL CABLES	SYSTEM: CABLE		SHEET 5 OF 8

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			REMARK
1	2	3	4	5	6		7	8	9	*	**			
					M	B/C				D	M	B	C	
2.5	Core pairing, screening (provision of drain wire & laying)	1. Pair identification	MA	Visual	100%	100%	Appd. Data Sheet	Appd. Data Sheet	Inspection Report	✔	P	-	-	
		2.Wire size & tape size	MA	Measurement	100%	100%	-do-	-do-	-do-	✔	P	-	-	
		3.Test for capacitance	CR	Elect. Test	100%	100%	-do-	-do-	-do-	✔	P	-	-	
		4. Sequence of lay and lay length	MA	Visual & Measurement	one Sample of each size/lot	one Sample of each size/lot	Appd. Data Sheet	Appd. Data Sheet	-do-	✔	P	-	-	
		5. Screen overlap & coverage	MA	Measurement	-do-	-do-	-do-	-do-	-do-	✔	P	-	-	
		6. Dia over laid up core	MA	Measurement	-do-	-do-	-do-	-do-	-do-	✔	P	-	-	
		7. Continuity of drain & drain wire with Screen	MA	Elect. Test	100%	100%	<--------No Discontinuity ---------->		-do-	✔	P		-	
2.6	Inner Sheath Extrusion (if applicable)	1. Surface finish	MA	Visual	100%	100%	Free from bulging, burnt particles, lumps, cuts & Scratch.	Free from bulging, burnt particles, lumps, cuts & Scratch	-do-	✔	P	-	-	
		2. Sheath thickness	CR	Measurement	One sample of each size/lot	One sample of each size/lot	Approved Data sheet	Approved Data sheet	-do-	✔	P	-	-	
		3.Dia over inner sheath	MA	Measurement	-do-	-do-	Appd. Data Sheet	Appd. Data Sheet	-do-	✔	P	-	-	
		4. Colour	MA	Visual	-do-		Appd. Data Sheet	Appd. Data Sheet	Appd. Data Sheet	✔	P	-	-	

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:	27/2/24	khushbu agrawal	Checked by:	27.02.24	Suman			Reviewed by:			
Reviewed by:	27/2/24	Hema kushwaha	Reviewed by:	27/2/24	Harish			Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 03.	
		PROJECT:			
		ITEM: SCREENED CONTROL CABLES	SYSTEM: CABLE		SHEET 6 OF 8

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			REMARK
1	2	3	4	5	6		7	8	9	*	**			
					M	B/C				D	M	B	C	
2.7	Armouring (if applicable)	1. No.of wires/Strips	MA	Counting	At the start of the process	At the start of the process	Mftr's Std	Mftr's Std	-do-	✔	P	-	-	
		2. Size of wire/ Strip	MA	Measurement	-do-	-do-	Appd. Data Sheet	Appd. Data Sheet	-do-	✔	P	-	-	
		4. Lay Length/Lay Direction	MA	Visual, Meas.	At the start of the process	At the start of the process	IS-1554	IS-1554	-do-	✔	P	-	-	
		5. Coverage	MA	Measurement	-do-	-do-	IS-1554	IS-1554	-do-	✔	P	-	-	
		6. Dia over armour	MA	Measurement	-do-	-do-	Appd. Data Sheet	Appd. Data Sheet	-do-	✔	P	-	-	
2.8	Outer Sheath Extrusion (No repair permitted)	1. Surface Finish	MA	Visual	100%	-	Surface shall be smooth	Surface shall be smooth	Inspection Report/ Test report	✔	P	-	-	
		2.Sheath thickness	CR	Measurement	One sample of ech size/lot	-	Appd. Data Sheet	Approved Data sheet	-do-	✔	P	-	-	
		3. Dia over outer sheath	MA	Measurement	-do-	-	Appd. Data Sheet	Appd. Data Sheet	-do-	✔	P	-	-	
		4. Colour / Embossing / Sequential Marking	MA	Visual	100%	-	Appd. Data Sheet	Appd. Data Sheet	-do-	✔	P	-	-	Sequencing be done by printing/marking
		5. TS & % Elongation	MA	Mechanical	100%	100%	IS 5831/-IS 10810 part 7	IS 5831	-do-	✔	P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/24	khushbu agrawal	Checked by:	27.02.24	Suman
Reviewed by:	27/2/24	Hema kushwaha	Reviewed by:	27/2/24	Harish

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN	SPEC. NO :	DATE:
		CUSTOMER :	QP NO.: PE-QP-999-507-E004, REV 03.	
		PROJECT:		
		ITEM: SCREENED CONTROL CABLES	SYSTEM: CABLE	SHEET 7 OF 8

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			REMARK
1	2	3	4	5	6		7	8	9	*	**			
					M	B/C				D	M	B	C	
3	Final Inspection (Internal)	Routine Test	CR	Electrical test & Measurement	100%	100%	#	#	-do-	✔	P	V	V	# Refer Annexure-A to QP
4	Final Inspection (External)	1. Finish & Length (Cable & cable drum)	MA	Visual, Measurement	One drum in each lot	One drum in each lot	Appd. Data Sheet	Free from Bulging, Burnt particles, lumps, cuts & scratches/ Approved data sheet	Inspection Report / Test Report	✔	P	W	W	
		2. Dimensions	MA	Measurement	IS-1554-1	IS-1554-1	Appd. Data sheet	Appd. Data sheet	Inspection Report	✔	P	W	W	
		3. Armouring - Coverage	MA	Measurement	-do-	-do-	-do-	-do-	-do-	✔	P	W	W	
		4. Marking/Colour/ pair identification (Cable & cable drum)	MA	Visual	-do-	-do-	-do-	-do-	-do-	✔	P	W	W	
		5. Acceptance Tests	CR	Phy & Elect. Tests	#	#	#	-do-	-do-	✔	P	W	W	# Refer Annexure-A to QP
		6. Type Tests	CR	Measurement	#	#	#	Appd. Data sheet	-do-	✔	P	W	W	Check for applicability of conduction of test(s) as per approved datasheet. #: Refer Annexure-A to QP.
5	Packing	End sealing / Polythene wrapping	MA	Visual	100%	100%	Appd. Data sheet	Appd. Data sheet	-	✔	P	W		
		CABLE DRUMS	MA	Visual	100%	100%	Appd. Data sheet	Appd. Data sheet	-	✔	P	W		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/24	khushbu agrawal	Checked by:	27.2.24	SUMAN
Reviewed by:	27/2/24	Hema kushwaha	Reviewed by:	27/2/24	Harish

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 03.	
		PROJECT:			SHEET 8 OF 8
		ITEM: SCREENED CONTROL CABLES	SYSTEM: CABLE		

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			REMARK
					6				*		**			
					M	B/C				D	M	B	C	
1	2	3	4	5			7	8	9					

NOTES:

A) For lists of routine tests, acceptance tests & type tests refer Annexure-A to SQP.
B) For project specific tests (if any): refer Annexure-B to SQP
C) Cable manufacturer to maintain records to show co-relation of raw materials to finished cables i.e. raw material batch/ lot no. should be traceable to the final cable drum number or batch no. witness or not.
D) Cable manufacturer to maintain all quality records identified as per all QP stages enumerated above whether it is identified for BHEL verification or witness or not.
F) Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*Records, identified with "Tick"(√) shall be essentially included by supplier in QA documentation.
** M: Supplier/ Manufacturer/ Sub-Supplier, B: Main Supplier/ BHEL/ Third Party Inspection Agency, C: Customer
P: Perform, W: Witness, V: Verification, as appropriate
MA: Major, MI: Minor, CR: Critical, D: Documentation

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/24	Khushbu agrawal	Checked by:	27.02.24	Suman
Reviewed by:	27/2/24	Hema Kushwaha	Reviewed by:	27/2/24	Harish

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

Annexure "A" to Standard Quality Plan

TYPE/ ACCEPTANCE/ ROUTINE TEST REQUIREMENTS

A. Type Test Conduction:

1. Tests for which "T" is indicated in the 'Test Conduction Required As' column below shall be conducted as Type Test
2. Sampling:
   a) Type test (except for Sl. no. b & c below) to be conducted on one size (preferably highest size.) of each type (F or G type)
   b) Electrical & C&I tests to be conducted on one size of each type of cables
   c) FRLS & Flammability Test to be conducted only on one sample

B. Acceptance Test Conduction:

1. Tests for which "A" is indicated in the 'Test Conduction Required As' column below shall be conducted as Acceptance tests.
2. Sampling:
   a) Acceptance tests (except for Sl. no. b & c below) for every lot shall be as per Appendix-B (Clause 15.22) of IS: 1554
   b) Electrical & C&I tests to be conducted on each size of each type of cables
   c) FRI-S & Flammability tests to be conducted only on one sample irrespective of size/type.

C. Routine Test Conduction:

1. Tests for which "R" is indicated in the 'Test Conduction Required As' column below shall be conducted as Routine tests.
2. Sampling: Routine tests shall be conducted on 100% cable drums

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
1.0	**Tests for Conductor**				
I.	Annealing test	For copper conductor only	T, A	IS 10810 Pt 1	***Internal in process Test Report to be furnished for to inspector at the time of inspection***
II.	Tin coating test (for tinned copper)	For copper conductor only	T, A	IS 10810 Pt 4	
III.	Resistance test	For Al/Cu	T, A,R	IS 10810 Pt 5	
2.0	**Tests for Armour Wires/Strips**				

22/2/24

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
I.	Measurement of dimensions	Applicable for Aluminium wire & GS wire/Strip	T	IS 10810 Pt 36	
II.	Tensile test	Applicable for Aluminium wire & GS wire/Strip	T, A	IS 10810 Pt 37	
III.	Elongation at break test	Applicable for GS wire/Strip only	T, A	IS 10810 Pt 37	
IV.	Torsion test	For GS round wire only	T, A	IS 10810 Pt 38	
V.	Winding / Adhesion Test	For GS strip only	T, A	IS 10810 Pt 39	
VI.	Resistivity test	Applicable for Aluminium wire & GS wire	T, A	IS 10810 Pt 42	
VII.	Uniformity of Zinc coating test	For G. S. wires/Strip only	T, A	IS 10810 Pt 40	
VIII.	Mass of Zinc coating test	For G. S. wires/Strip only	T, A	IS 10810 Pt 41	
IX.	Wrapping Test	Applicable for Aluminium wire & GS wire	A	IS 10810 Pt 3	
3.0	**Physical Tests for PVC Insulation & PVC sheath**				
I.	Test for thickness	Applicable for PVC insulation, PVC inner sheath & PVC outer sheath	T, A	IS 10810 Pt 6	
II.	Tensile strength and elongation test at break	Applicable for PVC insulation & PVC outer sheath	T, A		
(a)	Before ageing		T, A	IS 10810 Pt 7	
(b)	After ageing		T, A	IS 10810 Pt 7	
III.	Ageing in air oven	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 11	
IV.	Loss of mass in air oven test	For PVC outer sheath only	T	IS 10810 Pt 10	
V.	Hot deformation test	For PVC outer sheath only	T	IS 10810 Pt 15	
VI.	Heat shock test	For PVC outer sheath only	T	IS 10810 Pt 14	
VII.	Shrinkage test	For PVC insulation & PVC outer sheath only	T	IS 10810 Pt 12	
VIII.	Thermal stability test	For PVC insulation & PVC outer sheath only	T	IS 10810 Pt 60	
IX	Bleeding & Blooming test	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 19	For testing color of core In low temperature siff cable SAME ABOVE FOR DIA ABOVE 12.5 MM
X	Cold bend test	For PVC insulation & PVC outer & Inner sheath	T	IS 10810 Pt 20	
XI	Cold impact test	For PVC insulation & PVC outer & Inner sheath	T	IS 10810 Pt 21	
XII	Colour fastness to water	For PVC insulation & PVC outer sheath	T	IS 10810 Pt 18, Appendix-A of IS: 5831	

27/2/24

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
4.0	**Tests for Al-Mylar Shield**				
I	Continuity test	For Al-Mylar shield		Plant Standad	
II	Shield thickness	For Al-Mylar shield		ADS	
III	Overlap test	For Al-Mylar shield		ADS	
IV	Constructional details, dimensions	For Al-Mylar shield		ADS	
V	Visual, surface finish+	For Al-Mylar shield		Plant Standard	
VI	Overall coverage	For Al-Mylar shield		Plant Standard	
VII	Noise interference test.	For Al-Mylar shield		ADS	
5.0	**Tests for Drain Wire**				
	Annealing test	For copper conductor only		IS 10810 Pt 1	In process records shall be furnished to inspector at the time of inspection.
	Tin coating test (for tinned copper)	For copper conductor only		IS 10810 Pt 4	
	Resistance test	For Cu Conductor		IS 10810 Pt 5	
	Diameter test	For conductor		ADS	
6.0	**Improved Fire performance (FR-LSH) Tests**				
I.	Oxygen index test	*For outer sheath only*	T, A	IS 10810 Pt 58 / ASTMD 2863/	**Test applicable as indicated in Project specific Annexure-B**
II.	Smoke density test	*For outer sheath only*	T	IS 10810 Pt 63 / ASTMD 2843	
III.	Acid gas generation test	*For outer sheath only*	T, A	IS 10810 Pt 59 / IEC-754-1	
IV.	Temperature Index Test	*For outer sheath only*	T	IS 10810 Pt 64 / ASTMD 2863	
7.0	**Flammability Tests**				
I.	Flammability test for bunched cables	For complete cable	T	IS 10810 Pt 62/ IEC-60332 (Part-3-23-Cat-B	**Test applicable as indicated in Project specific Annexure-B**
II.	Flammability test for single cable	For complete cable	T, A	IS: 10810 Pt 61 / IEC:60332 Part-1	
III.	Swedish chimney test	For complete cable	A	SEN SS 424 1475 (Class F3)	
IV.	Flammability test	For complete cable	A	IEEE: 60383	
8.0	**Electrical Tests**				
I.	High Voltage Test (Water immersion test)	On cores	T, A, R	IS 10810 Pt 45	

21/12/24

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
II.	High Voltage Test at room temperature	For complete cable	T, A, R	IS 10810 Pt 45	
III.	Insulation Resistance Test (Volume resistivity method)	For complete cable	T, A,R	IS 10810 Pt 43	
IV.	L/R Ratio	For complete cable	A,R	BS:5308 Part II	
V.	Spark Test	Online Process during Extrusion of Insulation	ONLINE	BS:5308 Part II	
VI.	Thermal ageing test	For complete cable	T	IS-1554 Pt-1	Not applicable for screen cable as per IS
VII	Bending Test		T	IS 10810 Pt 50	
9.0	**C&I Tests**				
	Cross talk	For complete cable	T,A		
	Attenuation	For complete cable	T,A		
	Characteristic Impedance	For complete cable	T,A		
	Mutual capacitance	For complete cable	T,A,R		
	Noise interference	For complete cable	T,A		
10.0	**Anti-rodent and Termite Repulsion test**	For PVC outer sheath only	A	Refer Note	**Test applicable as indicated in Project specific Annexure-B**
11.0	**Anti-Fungal Test**	For PVC outer sheath only	A	Self-certification by vendor for anti-fungal property.	
12.0	**Special Tests**				
I.	Hydrolytic Stability Test	For complete cable	**	ASTM D 3137:81	**Test applicable as indicated in Project specific Annexure-B**
II.	Ultraviolet Radiation Test	For complete cable	**	BS EN ISO 4892-2	

***** These tests shall be conducted on one sample for the entire contract and duration of these tests shall be 14 days.***

Note: A few chipping of the PVC compound is slowly ignited on a porcelain dish or cubicle in a muffle furnace at about 60-degree C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). Place a drop of aqueous sodium sulphide solution on a thick filter paper and allow soaking. Touch the spot with a drop of above extract. A black spot indicates the presence of lead, the anti-termite and rodent compound.

In addition to above, the following special tests shall also be performed on the cables.

Accelerated water absorption test for insulation as per NEMA-WE-3.11.

Dielectric retention Test: The dielectric strength of the cable insulation tested in accordance with Cl. 6.7.4 of NEMA WE-5 at 75 +/- 1 °C shall not be less than 60% of the original dielectric strength.

Test for rodent and termite repulsion property: B

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO	DATE:
	CUSTOMER : -NA-		QP NO.: PE-QP-999-507-E005, REV. 04	DATE: 04.01.2024
	PROJECT: -NA-		PO NO.:	DATE:
	ITEM: CABLE TRAYS & ACCESSORIES	SYSTEM: CABLING		SHEET 1 of 3

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	B	C	
					M	B								
1.0 RAW MATERIAL														
1.1	HOT ROLLED CARBON STEEL SHEET	1 CHEM & PHY PROPERTIES	MA	VERIFICATION OF TC'S	100%	100%	IS -1079	IS -1079	TC	√	P/V	V	-	
		2 DIMENSIONS	MA	MEASUREMENT	100%	-	IS-1730	IS-1730	QC RECORD		P	-	-	
		3 SURFACE FINISH	MA	VISUAL	100%	-	IS-1079	IS-1079	QC RECORD		P	-	-	
1.2	ZINC	CHEM COMP.	MA	CHEM TEST	EACH HEAT	EACH HEAT	IS-209	IS-209	TC	√	P/V	V	-	
2.0 IN-PROCESS														
2.1	FABRICATION	1 DIMENSIONS	MA	MEASUREMENT	100%	100%	APPD DOCUMENT	APPD DOCUMENT	QC RECORD	√	P	V		
		2 WELDING QUALITY	MA	VISUAL	100%	100%	ASME SEC. IX	ASME SEC. IX	QC RECORD	√	P	V		Welding is to be done by qualified welders in accordance with ASME SEC. IX article III. WPS, PQR & WPQ to be reviewed during inspection.
		3 SURFACE FINISH	MA	VISUAL	100%	100%	FREE FROM DEFECTS & SLAG	FREE FROM DEFECTS & SLAG	QC RECORD	√	P	V	-	
2.2	SURFACE PREPARATION	1 CLEANING, PICKLING & RINSING & FLUXING	MA	VISUAL	100%	-	IS 2629	IS 2629	QC RECORD		P/V	-	-	
		2. SURFACE FINISH	MA	VISUAL	100%	-	IS 2629	IS 2629	QC RECORD		P/V	-	-	

BIDDER/SUPPLIER	
Sign & Date	
Seal	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Checked by:	Manj	MANJU MEENA	Checked by:	Mintoo	Mintoo
Reviewed by:	Hem	HEMA KUMAWAT	Reviewed by:	22/2/24	Hemant

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 : -NA-		QP NO.: PE-QP-999-507-E005, REV. 04	DATE: 04.01.2024
	PROJECT: -NA-		PO NO.:	DATE:
	ITEM: CABLE TRAYS & ACCESSORIES	SYSTEM: CABLING		SHEET 2 of 3

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	B					M	B	C	
2.3	GALVANISING	1.TEMPERATURE OF ZINC BATH	MA	MEASUREMENT	CONTINUOUS	-	IS-2629	IS-2629	QC RECORD		P/V	-	-	Galvanization is to be done at galvanization plant listed in Annexure-1 to quality plan.
		2.DROSS	MA	VISUAL	PERIODIC	-	IS-2629	IS-2629	QC RECORD		P/V	-	-	
		3.RATE OF IMMERSION	MA	VISUAL	100%	-	IS 2629	IS 2629	QC RECORD		P/V	-	-	
		4. SURFACE FINISH	MA	VISUAL	100%	-	IS 2629	FREE FROM BURRS, ROUGHNESS, SLAG FLUX, STAIN ETC.	QC RECORD		P/V	-	-	
3.0 FINISHED ITEMS														
3.1	(CABLE TRAY, ACCESSORIES &)	1. DIMENSIONS	MA	MEASUREMENT	IS-2500 (PART 1) LEVEL S-4	IS-2500 (PART 1) LEVEL S-4	APPD.DRG	APPD. DOCUMENT	INSP.REPORT	√	P	W	-	
		2. SURFACE FINISH	MA	VISUAL	IS-2500 (PART 1) LEVEL S-4	IS-2500 (PART 1) LEVEL S-4	APPD. DRG	FREE FROM BURRS, SLAG, ROUGHNESS,FLUX, STAIN ETC.	INSP.REPORT	√	P	W	-	
		3.RIGIDITY (FOR TRAYS)	MA	DEFLECTION TEST	05 No./ LOT/	05 No./ LOT/	APPD. DRG	APPD. DOCUMENT	INSP.REPORT	√	P	W	-	600MM wide Ladder & perforated cable tray to be tested. Maximum deflection shall not exceed 7MM on mid span on uniform loading of 100KG/M.

BIDDER/SUPPLIER	
Sign &Date	
Seal	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Checked by:		MANOJ MEENA	Checked by:		
Reviewed by:		HEMA KUSHWAHA	Reviewed by:	20/2/24	

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 : -NA-		QP NO.: PE-QP-999-507-E005, REV. 04	DATE: 04.01.2024
	PROJECT: -NA-		PO NO.:	DATE:
	ITEM: CABLE TRAYS & ACCESSORIES	SYSTEM: CABLING		SHEET 3 of 3

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	B	C	
					M	B								
3.0 FINISHED ITEMS														
		4 MASS OF ZINC COATING	MA	CHEM. TEST	IS-4759	IS-4759	IS-6745	APPD DOCUMENT	INSP REPORT	√	P	W	-	
		5 UNIFORMITY OF ZINC COATING	MA	CHEM. TEST	IS-4759	IS-4759	IS-2633	IS-2633	INSP REPORT	√	P	W	-	
		6 THICKNESS OF ZINC COATING	MA	PHYSICAL TEST	IS-4759	IS-4759	APPD DOCUMENT	APPD DOCUMENT	INSP REPORT	√	P	W	-	
		7 ADHESION	MA	MECH TEST	IS-4759	IS-4759	IS-2629	IS-2629	INSP REPORT	√	P	W	-	
		8 COUPLER PLATE	MA	VISUAL	100%	100%	APPD DOCUMENT	APPD DOCUMENT	INSP REPORT	√	P	W	-	Inspector to mention the total number of bags/bundles of coupler plates, nuts, bolts & washer in the inspection report.
		9 NUT & BOLT	MA	VISUAL	100%	100%	APPD DOCUMENT	APPD DOCUMENT	INSP REPORT	√	P	W	-	
		10 WASHER	MA	VISUAL	100%	100%	APPD DOCUMENT	APPD DOCUMENT	INSP REPORT	√	P	W	-	further manufacturer shall attach the detail of total number of bags/bundles of the respective items with packing list.
		11 PACKING	MA	VISUAL	100%	100%	APPD DOCUMENT	APPD DOCUMENT	INSP REPORT	√	P	V	-	

NOTES:

1. LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ASME/IEC ETC) INDICATED IN QP SHALL BE REFERRED.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. **D**: DOCUMENTATION.

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **B**: BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER.

P: PERFORM, **W**: WITNESS, **V**: VERIFICATION, AS APPROPRIATE **MA**: MAJOR, **MI**: MINOR, **CR**: CRITICAL.

BIDDER/SUPPLIER	
Sign & Date	
Seal	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Checked by:			Checked by:		
Reviewed by:			Reviewed by:		

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

MANUFACTURER/ BIDDER / SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-TS-XXX-507-E013	DATE:
	CUSTOMER : -NA-		QP NO.: PE-QP-999-507-013, REV. 03	DATE: 04.01.2024
	PROJECT: -NA-		PO NO.: -NA-	DATE:
	ITEM: CABLE TRAY SUPPORT SYSTEM -BOLTABLE	SYSTEM: CABLING		SHEET 1 OF 4

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 B	7	8	9	D	M	B	C	
1.0 RAW MATERIAL														
1.1	ROLLED CARBON STEEL SHEET	1.CHEM & PHY. PROPERTIES	MA	VERIFICATION OF TC'S	100%	-	IS1079 (for hot rolled) IS-513 (for cold rolled)	IS1079 (for hot rolled) IS-513 (for cold rolled)	TC		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	IS-1730/	IS-1730	QC RECORD		P	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	IS1079 (for hot rolled) IS-513 (for cold rolled)	IS1079 (for hot rolled) IS-513 (for cold rolled)	QC RECORD		P	-	-	
1.2	ZINC	CHEM.COMP.	MA	CHEM. TEST	EACH HEAT	-	IS-209	IS-209	QC RECORD	√	P/V	V	-	
2.0 IN-PROCESS														
2.1	FABRICATION	1.DIMENSIONS	MA	MEASUREMENT	100%	-	APPD.DRG	APPD.DRG	QC RECORD	√	P	V	-	
		2.WELDING QUALITY	MA	VISUAL	100%	-	ASME SEC. IX	ASME SEC. IX	QC RECORD	√	P	V	-	Welding is to be done by qualified welders in accordance with ASME Sec IX article III. WPS, PQR and WPQ to be reviewed during inspection

BIDDER/SUPPLIER	
Sign & Date	
Seal	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Checked by:		MANOJ MEENA	Checked by:		M° Mintoo
Reviewed by:		HEERA KUSHWAHA	Reviewed by:	22/2/24	Harish

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

MANUFACTURER/ BIDDER / SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-TS-XXX-507-E013	DATE:
	CUSTOMER : -NA-		QP NO.: PE-QP-999-507-013, REV. 03	DATE: 04.01.2024
	PROJECT: -NA-		PO NO.: -NA-	DATE:
	ITEM: CABLE TRAY SUPPORT SYSTEM -BOLTABLE	SYSTEM: CABLING		SHEET 2 OF 4

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	B				D	M	B	C	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM DEFECTS & SLAG	FREE FROM DEFECTS & SLAG	QC RECORD	√	P	V	-	
2.2	SURFACE PREPARATION	1.CLEANING, PICKLING & RINSING & FLUXING	MA	MEASUREMENT	PERIODIC IN EACH SHIFT	-	IS:2629	IS:2629	QC RECORD		P	-	-	
		2. SURFACE FINISH	MA	VISUAL	100%	-	IS:2629	IS:2629	QC RECORD		P	-	-	
2.3	GALVANISING	1.TEMPERATURE OF BATH	MA	MEASUREMENT	CONTINUOUS	-	IS-2629	IS-2629	QC RECORD		P/V	-	-	Galvanization is to be done at galvanization plant listed in Annexure-I to quality plan.
		2.DROSS	MA	VISUAL	PERIODIC	-	IS-2629	IS-2629	QC RECORD		P/V	-	-	
		3.RATE OF IMMERSION	MA	VISUAL	100%	-	IS 2629	IS 2629	QC RECORD		P/V	-	-	
		4. SURFACE FINISH	MA	VISUAL	100%	-	IS 2629	FREE FROM BURRS, SLAG, ROUGHNESS, FLUX, STAIN ETC.	QC RECORD		P/V	-	-	

BIDDER/SUPPLIER	
Sign &Date	
Seal	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Checked by:		MANOJ MEENA	Checked by:		MINTOO
Reviewed by:		HEMA KUSHWAHA	Reviewed by:	22/2/24	

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

MANUFACTURER/ BIDDER / SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-TS-XXX-507-E013	DATE:
	CUSTOMER : -NA-		QP NO.: PE-QP-999-507-013, REV. 03	DATE: 04.01.2024
	PROJECT: -NA-		PO NO.: -NA-	DATE:
	ITEM: CABLE TRAY SUPPORT SYSTEM -BOLTABLE	SYSTEM: CABLING		SHEET 3 OF 4

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	B				D	M	B	C	
3.0 FINISHED ITEMS														
3.1	SINGLE / DOUBLE CHANNELS, CANTILEVER ARMS, CLAMPS	1 DIMENSIONS	MA	MEASUREMENT	IS-2500 (PART-1) LEVEL S-4	IS-2500 (PART-1) LEVEL S-4	APPD.DRG	APPD.DRG	INSP.REPORT	√	P	W	-	
		2 SURFACE FINISH	MA	VISUAL	IS-2500 (PART-1) LEVEL S-4	IS-2500 (PART-1) LEVEL S-4	APPD.DRG	FREE FROM BURRS, SLAG, ROUGHNESS, FLUX, STAIN ETC.	INSP.REPORT	√	P	W	-	
		3.MASS OF ZINC COATING	MA	CHEM. TEST	IS-4759	IS-4759	IS-6745/ APPD.DRG	APPD.DRG	INSP.REPORT	√	P	W	-	
		4 UNIFORMITY OF ZINC COATING	MA	CHEM. TEST	IS-4759	IS-4759	IS-2633	IS-2633	INSP.REPORT	√	P	W	-	
		5 THICKNESS OF ZINC COATING	MA	MEASUREMENT	IS-4759	IS-4759	APPD.DRG	APPD.DRG	INSP.REPORT	√	P	W	-	
		6 ADHESION	MA	MECH.TEST	IS-4759	IS-4759	IS-2629	IS-2629	INSP.REPORT	√	P	W	-	
3.1.1	TYPE TESTING	PHYSICAL	CR	TEST	1 SAMPLE*	1 SAMPLE*	APPD. TYPE TEST PROCEDURE	APPD. TYPE TEST PROCEDURE	INSP.REPORT	√	P	W	-	*1 sample per / offered quantity

BIDDER/SUPPLIER		BHEL							FOR CUSTOMER REVIEW & APPROVAL			
Sign & Date Seal		ENGINEERING	Sign & Date	Name		QUALITY	Sign & Date	Name	Doc No:	Sign & Date	Name	Seal
		Checked by:		MANOJ MEENA		Checked by:			Reviewed by:			
		Reviewed by:		HEMA KUSHWAHA		Reviewed by:	22/2/24		Approved by:			

MANUFACTURER/ BIDDER / SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-TS-XXX-507-E013	DATE:
	CUSTOMER : -NA-		QP NO.: PE-QP-999-507-013, REV. 03	DATE: 04.01.2024
	PROJECT: -NA-		PO NO.: -NA-	DATE:
	ITEM: CABLE TRAY SUPPORT SYSTEM -BOLTABLE	SYSTEM: CABLING		SHEET 4 OF 4

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	B				D	M	B	C	
3.1.2	WELD INTEGRITY TEST	SOUNDNESS	CR	MAGNETIC PARTICLE INSPECTION (MPI) DIE-PENETRATION (DP)	SAMPLE TESTD DURING TYPE TESTING	SAMPLE TESTED DURING TYPE TESTING	APPD. TYPE TEST PROCEDURE.	NO DEFECT	INSP.REPORT	√	P	W	-	AFTER CARRYING OUT TYPE TEST, WELD INTEGRITY TEST TO CHECK THE WELD SOUNDNESS/ ACCEPTANCE SHALL BE DONE BY MANUFACTURER
4.0	PACKING	SEALING IDENTIFICATION	MA	VISUAL	100%	100%	BHEL APPD. DOCUMENT	BHEL APPD. DOCUMENT	INSP.REPORT	√	P	W	-	

NOTES:

1. LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ASME/IEC ETC.) INDICATED IN QP SHALL BE REFERRED.

LEGENDS:

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

BIDDER/SUPPLIER	
Sign & Date	
Seal	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Checked by:		MANOJ MEENA	Checked by:		
Reviewed by:		HEMA KUSHWAHA	Reviewed by:	22/2/24	

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:
बीएचईएल BHEL		CUSTOMER:		QP NO.: PE-QP-999-509-E001, R3	DATE:
		PROJECT:		PO NO.:	DATE:
		ITEM: ABOVE GROUND EARTHING MATERIALS	SYSTEM: EARTHING		SHEET 1 OF 2

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
					6		7	8	9	*	**			
					M	B				D	M	B	C	
1	2	3	4	5										
1.0	**RAW MATERIAL:**													
1.1	MILD STEEL (FLATS & RODS) AS PER SPECIFICATION	1.CHEMICAL & PHYSICAL PROPERTIES	MA	VERIFICATION OF TC'S	100%	-	IS 2062	IS 2062	MILL TC	✓	P	V	-	REFER REMARKS AT SL. NO. 3.1
		2. DIMENSIONS	MA	MEASUREMENT	100%	-	IS 1730	IS 1730	QC RECORD	✓	P		-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	IS 1079	IS 1079	QC RECORD	✓	P		-	
1.2	ZINC	1.CHEMICAL COMP.	MA	CHEM. TEST	SAMPLE	-	IS 209	IS 209	QC RECORD	✓	P	V	-	
2.0	**IN PROCESS:**													
2.1	CUTTING, DRILLING	1.DIMENSIONS	MA	MEASUREMENT	100%	-	IS 1730	IS 1730	QC RECORD	✓	P	V	-	
2.2	SURFACE PREPARATION	1. CLEANING, PICKLING, RINSING & FLUXING	MA	VISUAL	100%	-	IS 2629	IS 2629	QC RECORD	✓	P	-	-	
		2. SURFACE FINISH	MA	VISUAL	100%	-	IS 2629	IS 2629	QC RECORD	✓	P	-	-	
2.3	GALVANISING	1.TEMPERATURE OF BATH	MA	MEASUREMENT	CONTINUOUS	-	IS 2629	IS 2629	QC RECORD	✓	P	-	-	GALVANIZATION IS TO BE DONE AT GALVANIZATION PLANT LISTED IN ANNEXURE-1 TO QUALITY PLAN.
		2. DROSS	MA	VISUAL	PERIODIC	-	IS 2629	IS 2629	QC RECORD	✓	P	-	-	
		3.RATE OF IMMERSION	MA	VISUAL/ MEASUREMENT	100%	-	IS 2629	IS 2629	QC RECORD	✓	P	-	-	
		4. SURFACE FINISH	MA	VISUAL	100%	-	IS 2629	FREE FROM BURRS, ROUGHNESS, SLAG, FLUX, STAIN	QC RECORD	✓	P	-	-	
3.0	**FINISHED ITEMS:**													.
3.1	MS FLATS	1. CHEMICAL COMP.	MA	CHEM. TEST	1 No./LOT/SIZE	-	IS 2026	IS 2026	LAB TC	✓	P	V	-	NOTE: SAMPLE FOR CHEMICAL TEST SHALL BE SELECTED BY BHEL& TESTING SHALL BE DONE AT NABL/ GOVT. APPD. LAB
		2. DIMENSIONS	MA	MEASUREMENT	IS 2500 (PART 1) LEVEL S-4	IS 2500 (PART 1) LEVEL S-4	IS 1730	IS 1730	INSPECTION REPORT	✓	P	W		

BIDDER/SUPPLIER	
Sign &Date	
Seal	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Checked by:		MANOJ MEENA	Checked by:		Suman
Reviewed by:		Sandeep Gupta	Reviewed by:	22.2.24	Hari

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-999-509-E001, R3	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: ABOVE GROUND EARTHING MATERIALS	SYSTEM: EARTHING		SHEET 2 OF 2

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6		7	8	9	*	**			
1	2	3	4	5	M	B				D	M	B	C	
		3. SURFACE FINISH	MA	VISUAL	IS 2500 (PART 1) LEVEL S-4	IS 2500 (PART 1) LEVEL S-4	-	FREE FROM BURRS, ROUGHNESS, SLAG, FLUX, STAIN ETC.	QC RECORD	✓	P	W		
		4.MASS OF ZINC COATING	MA	CHEM. TEST	IS 4759	IS 4759	IS-6745	FLATS 5 MM THICK AND OVER 610 GM/SQ.M. FLATS UNDER 5 MM, BUT NOT LESS 2 MM 460 GM/SQ.M.	INSP. REPORT	✓	P	W	-	
		5.UNIFORMITY OF ZINC COATING	MA	CHEM. TEST	IS-4759	IS-4759	IS-2633	IS-2633	INSP. REPORT	✓	P	W	-	
		6. THICKNESS OF ZINC COATING	MA	MEASUREMENT	IS-4759	IS-4759	IS-4759	FLATS 5 MM THICK AND OVER=AVG 86 MICRON AND MINIMUM 75 MICRON. FLATS UNDER 5 MM THICK, BUT NOT LESS 2 MM =AVG 65 MICRON	INSP. REPORT	✓	P	W	-	
		7. ADHESION	MA	MECH. TEST	IS-4759	IS-4759	IS 2629	IS 2629	INSP. REPORT	✓	P	W	-	
	NOTE: ITEMS LIKE PIPES/ FLEXIBLE COPPER BRAID/ GI WIRE/ GS ROD/ SHIELDING MAST/ TEST LINK WILL BE CLEARED BASED ON COC (CERTIFICATE OF COMPLIANCE)													
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	BHEL APPROVED DOC	BHEL APPROVED DOC	INSPC. REPORT	✓	P	V	-	

NOTES:

1. LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ASME/IEC ETC.) INDICATED IN QP SHALL BE REFERRED.

LEGENDS:

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

BIDDER/SUPPLIER	
Sign &Date	
Seal	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Checked by:		MANOJ MEENA	Checked by:		Suman
Reviewed by:		Sandeep Lodhi	Reviewed by:	23.2.24	Harish

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

SECTION: I

SUB-SECTION: C4

TECHNCIAL SPECIFICATION

(C&I PORTION)

Specific Technical Requirements (C&I)

1. Complete Field Instrumentation for Control and Operation of Ventilation system for Phase-I & II shall be provided by Vendor.
2. Control for Ventilation system shall be PLC based. PLC system, in Vendor's scope, shall have provision for soft connectivity with plant SCADA for monitoring purpose. Vendor to provide separate PLC system for Phase-I & II taking into consideration the requirements mentioned elsewhere in the specification.
3. Local control panel shall also be provided for operation of Ventilation system.
4. The quantity of instruments for the system shall be as per P &ID of Ventilation system.
5. Control & Instrumentation cable for complete Ventilation system shall be in vendor's scope.
6. PLC control system as defined in the enclosed specification shall be in bidder scope. The PLC system shall comprise of PLC based local panel along with HMI.
7. PLC shall have the facility to synchronize its time with Plant master clock system using IRIG-B signals. Necessary Hardware (IRIG-B port) for same at PLC end to be provided by vendor. The cable connecting PLC and plant master clock system shall also be in bidder scope.
8. PLC shall be connected to Plant SCADA through redundant bidirectional serial link with OPC Compliant connectivity for monitoring using Fibre Optic link. The necessary hardware/software including LIU (Light Interface unit) at both (PLC as well as SCADA) end shall be in Vendor's scope. Repeaters if required for interfacing shall also be provided by the Vendor.
9. Vendor shall provide at least 20% spare channels as hot on rail spares in each configured I / O modules. In addition to this 10% or minimum one number, whichever is higher, extra assigned complete spare I / O modules mounted on rails in sub racks as hot on rail spare for each category of installed I / O modules shall also be provided. Spare channel and modules shall be fully wired up to termination cabinets.
10. Provision for input fire signal from fire alarm system to be ensured in the PLC panel for opening/ closing of the motor operated fire dampers to be supplied by vendor.
11. Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.
12. Provision for earthing of the panel to be provided by vendor.
13. All instruments/drives shall be terminated on Junction Boxes/Panel in Bidder scope of supply. 20% Spare terminals shall be provided in each Junction Box.
14. Vendor to delegate/depute their person/experts as per owner/consultant requirements.
15. 415 V AC Power supply shall be provided at a single point, further distribution to various instruments/equipment of the system shall be in bidder scope. Vendor to include necessary power distribution board/change over switch in his scope. Any power supply other than the above, if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Vendor to submit the power requirement along with the bid.

16. Root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold, junction boxes and all other accessories required for erection of local / remote instruments shall be provided by Vendor.

Instrumentation And Control Equipment Design Criteria

All components shall be of an approved and reliable design. The highest extent of uniformity and interchangeability shall be reached. The design shall facilitate maintenance and repair of the components.

• The Works shall be pre-assembled to the highest extent in the Contractor's or Sub Contractor's workshop, e.g., shop welding of thermometer wells and other connections, wiring of boards, desks, etc., including internal wiring and installation of devices shall be carried out. Fragile instruments shall be removed for transportation to site.

• All components shall be suitable for continuous operation under site conditions.

• Materials for instrumentation and control equipment, including piping material, which are exposed to the measured media, shall be selected accordingly.

• All components shall be compatible with other electrical, electronic and mechanical Works.

• All instrumentation and control functions shall be shown on the piping and instrumentation diagrams. The symbols to be used shall be in accordance with ISO standard. The identification system (tag numbers) shall be in accordance with the Works identification system and is subject to approval by the Engineer. All measurements and alarms shall be listed in a measuring list of a standard form subject to Approval by the Engineer. For remote controls, a schedule of interlocks shall be provided. The features of automatic controls shall be shown in block diagrams.

• Shielded cables shall be provided for the control and supervisory equipment where required. Sizes of Indicators, Recorders, etc.

• The meters, instruments and recorders shall be of standard size, to be selected to guarantee unique appearance of switchgears, control panels, control desks, etc. The front glasses shall be of the anti-glare type. The scales shall be 90 degrees type for local control panels but must be 240 degrees type for control room instrumentation.

Tests

• The single components and pre-erected assemblies shall undergo functional and routine tests in the Contractor or Sub-Contractor's workshop. The ready mounted control and supervisory system shall undergo functional tests on Site prior to commissioning of the power Works.

• Calibration tests shall be made on all-important pressure gauges and other instruments as required by the Engineer.

Measuring Systems

• Electric measuring signals of 4-20 mA shall be transmitted to the control room for essential or regulating circuits. In this case the absence of live zero signal shall lead to a warning signal. Measuring signals for indicating purposes will be 4-20 mA.

• The components shall quickly respond to any changes of the measured magnitudes. Measuring ranges of indicators, transducers, etc. shall be selected in such a way that the rated value of the measured magnitude covers approx. 75% of the range.

• All local instruments shall, as far as practicable, be mounted vibration free to allow good reading. Wherever required, damping elements shall be used.

• Corresponding systems shall be grouped together in local panels.
• The binary sensors shall be fused separately and supplied with 24 V D.C.

Temperature Measurement

• Resistance thermometers and thermocouples shall be equipped with waterproof connection heads. The temperature sensors shall be selected in such a way to minimise the number of different spare inserts.
• Resistance thermometers shall be used as far as possible and shall generally be of type Pt 100.
• The use of dial-type contact thermometers shall be restricted to bearing metal and oil temperature measuring.

Pressure Measurements

• Pressure gauges shall be shock and vibration-proof (preferably by filling with glycerine) and shall be equipped with toothed wheels and toothed segments of the machined type. They shall completely be made of stainless steel.
• The error for pressure transmitters shall be limited to ±0.5%.
• Each gauge, pressure switch and transmitter for absolute or differential pressure shall be equipped with a pressure gauge isolating valve including a test connection of the screwed type M20 x 1.7 mm so that such device can be removed without any disturbance of the plant operation.
If the pressure is pulsating, the devices concerned shall be connected via flexible tubes or other pulse-absorbing means.
• The adjustment of the pointer shall be possible by means of an adjustment device without removing the pointer from its axle.
• All casings shall be dust and watertight and be made of stainless steel. 1.10.3 Level Measurements The liquid level measurements in reservoirs and tanks with atmospheric pressure shall be made by means of displacement-type transmitters, float-disc-transmitters or capacitance measurement type. The errors shall not exceed ± 1.0% of the total measuring range. Level switches shall be of the externally mounted float or displacement operated type.

Position Measurements

Position transmitters for continuous position indication and measuring transducers shall have an output current of 4-20 mA and aux. supply voltage (if required) 48 V D.C.

Electrical Measurements

• All Electrical instruments shall be of flush mounted design, dust and moisture-proof. A.C. ammeters and voltmeters shall have digital type system of not less than 1.7 accuracy class for connection to the secondary side of instrument transformers. D.C. measuring instruments shall have digital type systems of the same accuracy. The energy meters shall be digital /load analyzer type. Wattmeters/energy meters shall have electro-dynamic measuring mechanisms if fed by transmitters. Wattmeters shall be suitable for unbalanced systems and accuracy of energy meters should be of 0.2 % accuracy class.

• All indicating instruments shall generally withstand without damage a continuous overload of 20% referred to the rated output value of the corresponding instrument transformers. Ammeters shall not be damaged by fault-currents within the rating and fault duration time of the associated switchgear via the primaries of their corresponding instrument transformers.
• All instruments and apparatus shall be capable of carrying their full load currents without undue heating. All instruments and apparatus shall be rear connected, and the enclosures shall be earthed. Means shall be provided for zero adjustment of instruments without dismantling.
• When more than one measured value is indicated on the same instrument, a measuring point selector switch shall be provided next to the instrument and shall be engraved with a legend specifying each selected measuring point.
• Scales shall be arranged in such a way that the normal working indication is between 50-75% of full scale reading permitting an accurate reading. CT connected Ammeters provided for indication of motor currents shall be provided with suppressed overload scales of 2 times full scale. The dials of such ammeters shall include a red mark to indicate the full load current of the motor.
• All instruments mounted on the same panel shall be of same style and appearance.
• All metering circuits shall be terminated in marked terminal blocks for remote metering purposes.

Contact Devices

Contacts of level switches, pressure switches, temperature switches, limit switches, and of all other devices shall be of the snap action type (SPDT). Contact devices for interlocking systems shall be separate, i.e., contact devices serving commonly for interlocking and other purposes will not be accepted.

Protection Systems

• Electrical/Mechanical Protection and Interlocking Systems shall be provided for all works components and individual systems to ensure a safe and reliable operation and to limit harm and damage to personnel and works to an utmost extent.
• The primary functions of these facilities shall be to disconnect selectively faulty sections of the systems prior to influence or damage to other works and to maintain operative systems as far as possible.
• Moreover, these devices shall facilitate the duty of the operation staff and prevent maloperation.

Terminal Blocks

• All terminal blocks shall be mounted in an accessible position with the spacing between adjacent blocks not less than 100 mm and space between the bottom blocks and the cable gland plate being a minimum of 200 mm. sufficient terminals shall be provided to allow for the connection of all incoming and outgoing cables, including spare conductors and drain wires. In addition, 20 percent spare terminals shall be provided. In enclosed cubicles, the terminal blocks shall be inclined toward the door for facilitating terminations.

• Terminals shall be of the channel mounting type and shall comprise a system of individual terminals so that terminal blocks can be formed for easy and convenient cabling consistent with the high reliability required of the circuits.
• Terminal blocks shall be provided with shorting links and paralleling links where applicable and mounting identification numbers and/or letters.
• Terminal blocks shall conform to the applicable standards. The smallest size to be used shall be designated for 2.5 Sq mm FRLS wire and not more than two conductors shall be connected under one terminal clamp.
• Terminal identification shall be provided corresponding to wire number of connected leads.
• Circuit terminals for 415 V AC shall be segregated from other terminals and shall be equipped with non-inflammable, transparent covers to prevent contact with live parts. Warning labels with red lettering shall be mounted thereon in a conspicuous position.
• For the wiring inside control cubicles and junction boxes, Contractor shall use copper electrical wire insulated with fluoropolymer, or equivalent, 600 V, 150 °C. Each wire shall be clearly identified at both ends with cable markers. No splice joints shall be permitted and connections shall be made on terminal blocks. Particular care shall be taken not to damage conductors from which insulation has been removed.

Cubicles and Control Panels

Cubicles and control panel enclosures shall be of sheet steel with minimum thickness of 2.5 mm, of rigid, self-supporting construction and supplied with channel bases.

Cubicles shall be fitted with close fitting, gasketted, hinged, lift-off doors capable of being opened through 180 deg. The doors shall be provided with integral lock and master key.

Cubicles and panels shall be vermin proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. The cables and wiring shall enter from bottom or top as approved or directed by the Engineer.

The cubicles and panels shall be adequately ventilated, if required, by vents or louvers. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.

Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.

Unless stated otherwise, all cubicles and panels shall be provided with a ground bus with 40mm copper bar extending throughout the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120mm2.

All instruments, control knobs and indicating lamps shall be flush mounted on the panels. Relays and other devices sensitive to vibration shall not be installed on doors or hinged panels, and no equipment shall be installed on rear access doors.

The instrument and control wiring, including all electrical interlocks and all interconnecting wiring between sections, shall be completely installed and connected to terminal blocks by the manufacturer.
The arrangement of control and protection devices on the panels and the exterior finish of the panels shall be subject to the approval of the Engineer. The interior of all cubicles and panels shall have a mat white finish unless specified otherwise.
Switched interior light and socket outlets shall be provided for all cubicles and control panels.
All cubicles and control panels shall be provided with nameplates, identifying the purpose of the panel and all of its components.
Control panels shall have a door with a lock and be manoeuvrable from the floor. No holes shall be cut in the panels for incoming or outgoing conduits. The panels shall include removable sealed plates on the top and bottom.

Junction Box

Doors for these boxes shall have neoprene gaskets. Unless otherwise specified, the boxes shall be equipped with a copper grounding strip installed at the bottom, having a length of 90% of the length of the box. This bar shall be 6 mm x 25 mm, tapped M5 every 25 mm. A connector for copper cable shall be supplied for connection to the main grounding system. Grounding through a metal piece (frame or other) will not be accepted. All connections shall be properly identified.

Drawings & Documents to be Submitted by Successful Bidder after Award of Contract along with Submission Schedule		
Sl. No.	**DOCUMENT TITLE**	**SUBMISSION SCHEDULE**
1	TECHNICAL DATASHEETS OF TRANSMITTERS, INDICATORS, SWITCHES, VALVES, DAMPERS, JBS, ETC.	
2	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM WITH SET POINTS	
3	CABLE SCHEDULE & INTERCONNECTION (IN EXCEL FORMAT)	
4	INSTRUMENTS INSTALLATION DIAGRAM	
5	LOCAL CONTROL PANEL GA & DATASHEET	
6	PLC LOGIC SCHEME	
7	PLC I/O LIST & CONFIGURATION DRAWING	
8	PLC PANEL GA (INTERNAL & EXTERNAL) DRAWING	

PLC SPECIFICATION

Compliance

Requirement specific to programmable controllers: Functional characteristics, Immunity, Resistance, Safety etc.: IEC / EN 61131-2 and IEC / EN 61010-2-201
IEC-61131-3 [Programming Language Standard] / IEC-61804 [Standard for EDDL] / IEC-61499
ISA S 71.01 [Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity]
ISA S 71.01 [Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity]

System Requirements

1. Control system shall provide safe operation under all plant disturbances and on component failure so that under no condition the safety of plant, personnel or equipment is jeopardized.
2. It shall be possible to remove / replace online, various modules (like Controller, I/O module, interface module, etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack.
3.The system design shall be modular and scalable to facilitate easy system expansion. Further it shall ensure that no single failure in the system results in loss of system operation

I/O racks and modules

Modular design. All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply. In general, all Output cards shall be sourcing type and Input cards shall be sinking type.

Analog Signal Conditioning

1. Galvanic isolation of input and output signals for which power supply source is derived from source external to the control system power supply.
2. Transmitter power supply with per point current limiting or fuse protection for loop powered transmitters.
3. Monitor sensor wire break/open circuit/short circuit and take suitable actions in logic/loop. (This will include blocking of trip signals in case of RTD failure).
4. All analog outputs shall be short circuit proof.

Isolation between I/P, O/P and controller

1.5 KV with opto couplers.

Processor

The microprocessor shall be 32 bit. An authorized forcing facility shall be provided for changing the status of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements. The cycle time for input scanning, execution of logics,

overheads and output scan shall not exceed 120 m sec. The processor & memory shall be loaded up to 50% at normal conditions and maximum up to 60% under worst loading conditions. The memories shall be field expandable. Memory capacity shall be sufficient for complete system operation and have a capability for at least 20% expansion in future.

Diagnostics & Indication

1. Channel Level Diagnostics (with reverse polarity, wire break, shortcircuit & optical /galvanic isolation) for DI / DO, AI & AO shall be provided. Each individual Channel healthiness shall be monitored at workstation / GUI level.
2. Individual signal status of each Input / Output, power supply status shall be indicated on the module faceplates.

Fail safe mode

1. On power supply failure / both PLCs failure / communication failure etc. the output shall be automatically switched over to fail safe mode.
2. In case of such failures, operating drives / equipment shall be tripped or kept running as per a pre-determined programmable requirement finalized during detailed engineering.

Fusing philosophy

Individual fuses with blown fuse indicator for each output. Individual fuses for each input/ group of inputs, keeping in view of system availability.

Switching Capacity

Output modules shall be rated to switch on/off coupling relays of 3VA at 24V DC and solenoid valves at 110 V AC

Data Communication Sub-System

The communication sub-system shall be a digital communication bus, based on standard Ethernet technology as its infrastructure backbone that provides a high speed data transfer rapidly and reliably between the operator station, process I/O devices and other devices connected to it. Based on existing IEEE 802.3 Ethernet standards, the network system shall be compatible with commercial off-the-shelf Ethernet products. HMI network between controllers and HMI devices shall be a minimum 100 Mbps redundant Ethernet control network (based on TCP/IP) to ensure high availability. Similarly, the redundant I/O bus / ring network shall be based on Ethernet technology (TCP/IP) with minimum 100 Mbps data transmission speed using suitable protocols to ensure 50 ms or better recovery time.

Integration with SCADA

1. The PLC system shall be OPC compliant and shall be provided with necessary hardware and software for successfully establishing dual redundant fiber optic

connectivity with SCADA using bidirectional OPC communication through OPC DA / UA protocol.
2. Suitable OPC server and client software and sufficient no. of licenses shall be procured by the contractor for fully meeting the intent as stated above.

Time Synchronization system

The PLC processor should be capable of receiving clock signals from Master Slave Clock system of the Owner in either NTP, DCF77 or IRIGB format.

HMIS (Human Machine Interface System)

1. Operator shall be able to access all control / information related data under all operating conditions including a single processor / computer failure in the HMIS.
2. The operator functions for each OWS shall as a minimum include Control System operation (A/M selection, raise/lower, set point/bias change, on/off, open/close operation, mode/device selection, bypassing criteria, sequence auto, start/stop selection, drive auto selection, local remote/ other multi-position selection etc.); alarm acknowledge; and any other functions required for smooth operation, control & management of information as finalized during detailed engineering.

Software license & Upgrades

1. The Contractor shall provide software license for all software being used in PLC based control system including HMI. The software licenses shall be provided for the project and shall not be hardware/machine specific. All licenses shall be valid for the continuous service life of the plant.
2. As a customer support the Contractor shall periodically inform the designated officer of the Employer about the software upgrades / new releases that would be taking place after the system is commissioned and in service, so that, if required, same can be procured and installed at site.

PEM :: C&I

STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-I036___**
VOLUME IIB
SECTION D
REV. NO. 01 DATE: 24.08.2007
SHEET 1 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records P	Agency $			Remarks
										W	V	
1.0	**Materials /Components**											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visua l	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2 2		1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visua l	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2 2		1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visua l	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2 2		1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection • Identification Labels • Physical Damages • Quantity • Spare Capacity	MA	Visua l	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2 2		1	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL 2 - Vendor 3 - Sub-vendor

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records P	Agency $			Remarks
										W	V	
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2 2		1	

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL 2 - Vendor 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-I036___**
VOLUME IIB
SECTION D
REV. NO. 01 DATE: 24.08.2007
SHEET 3 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records P	Agency $			Remarks
										W	V	
2.0 Ass embly												
2.1	Functional Test for HMI/OWS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2 1		1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2 2		1	
2.3 Po	wering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2 1		1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100% F	AT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2 2		1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

$ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records P	Agency $			Remarks
										W	V	
3.0	**Factory Acceptance Test (FAT)**											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Eletrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2 1		1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

$ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

a) Technical Specification of PLC.

b) PLC System Configuration

c) General Assembly Drawings.

d) Panel Wiring Diagrams.

e) Bill of Quantity for PLC System.

f) Logic Diagram.

g) HMI Schematics.

h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, to the inspecting agency, his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. Check online replacement of cards, processors, power supply etc.

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

i) Redundancy

ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.
Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

4. Communication System Verification

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

5. Diagnostic Verification

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

6. Control Panel /Desk Verification

i) PLC driven annunc iation system should be checked by alar m signal simulation.

ii) Push Button and sele ctor switch operation should be checked by verification of corresponding change of status of Data Base point.

iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

i). Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes

ii). Engineering features:-
a) Online changing of parameters, set points.
b) Online modification in Control Logic Diagrams.
c) Online configuration of Graphics, Trends, Logs, HSR.

iii). HMI features:-
Check for configuration & ope ration of Graphics, Trends, Logs, HSR and Alarms, in the for m of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

Electronic equipment s shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

ii) 48 hours test period shall be divided into 4 equal time segment of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.

LOCAL CONTROL PANEL SPECIFICATION

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-1248:2003 : 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 for Electrical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps/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 or folded construction by sheet metal formation depending upon the 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
Panel Height: Not less than 2365 mm (Refer data sheet-A (No. PES-145A-DS1-0)
Gland plate thickness: 3.0mm
Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at minimum three places. The door width shall not be more than 550mm.The doors shall be provided with suitable stiffeners to prevent buckling. The handle shall be on the right side of the door. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings / documents. Double door shall be provided with suitable glass windows, as per the requirement.

3.1.6 Suitable neoprene gasket shall be provided on all 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 surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-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. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.
No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.

3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.

3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm2 size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.

3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm2 to 2.5mm2 external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (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 shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.

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

3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte

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

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

3.2 Hazardous Area Panel Requirement

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.

3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

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

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

3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring devices

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

3.3.2 Alarm Annunciator System

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.

3.3.3 Relays

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

3.3.4 Timers

The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.

3.3.5 Control / Selector Switches

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

3.3.6 Push Buttons / Indicating Lights

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

RED	Motor OFF / Valve CLOSE	YELLOW	Alarm acknowledge	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.

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

4.3.1 Routine Tests

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

4.3.2 Type Tests

1. Enclosure Class Test

बी एच ई एल BHEL	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						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
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		

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

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
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		

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		7	8	9	D	**			
					M	C/N					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:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

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 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			

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:			

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	*	**			
					M	C/N				D	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		

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/4/2020	CHETAN MALIK	Checked by:	14/04/2020	KUNDAN PRASAD		
Reviewed by:	14/4/2020	RK RAINA	Reviewed by:	14/4/2020	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 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		**			
					M	C/N				D	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						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
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		

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 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	D	**			
					M	C/N					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		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
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

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 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:	14/2/2020	CHETAN MALIK	Checked by:	14/2/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	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 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		

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

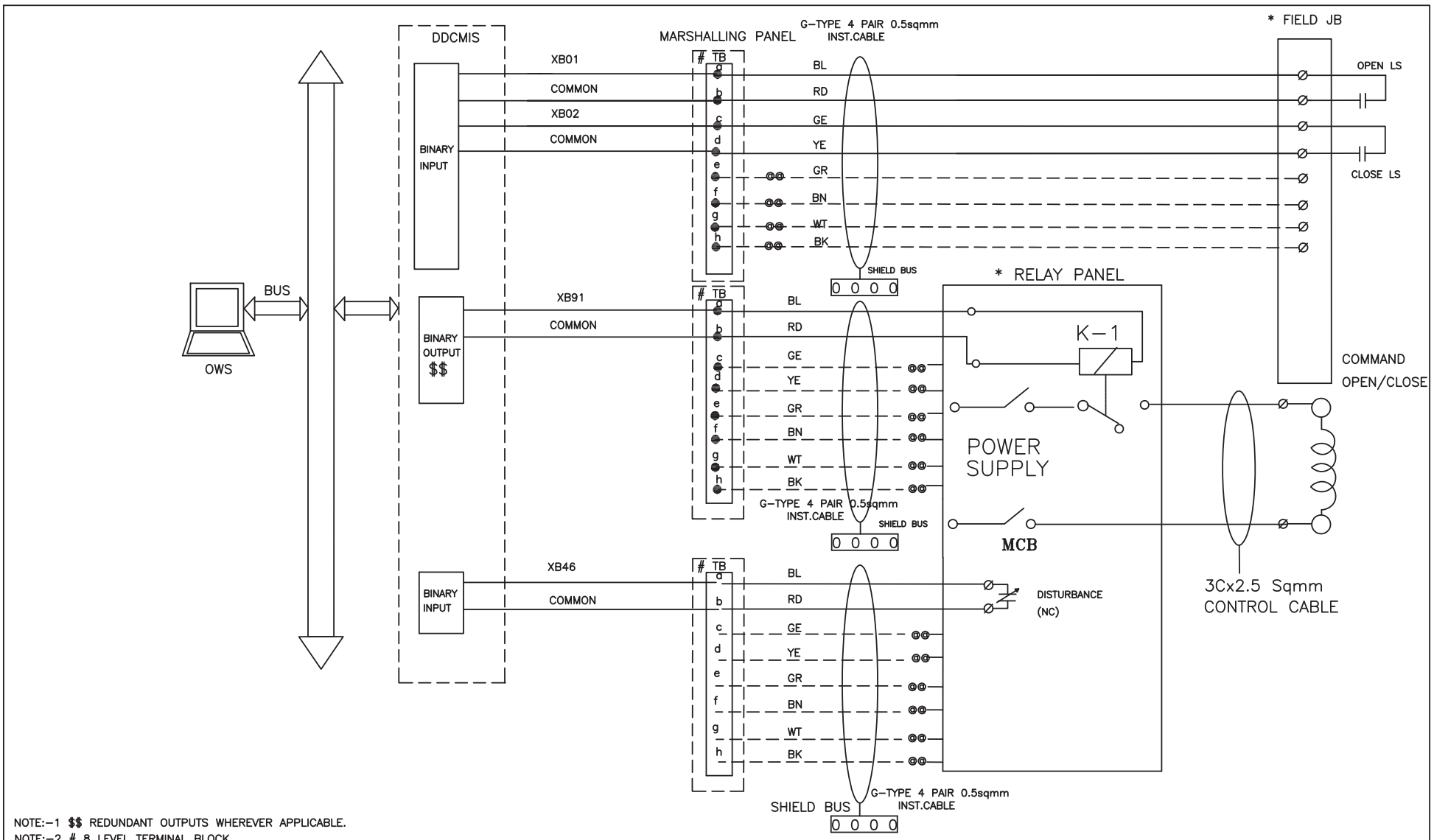
BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/12/2020	CHETAN MALIK	Checked by:	14/12/2020	KUNDAN PRASAD
Reviewed by:	14/12/2020	RK RAINA	Reviewed by:	14/12/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

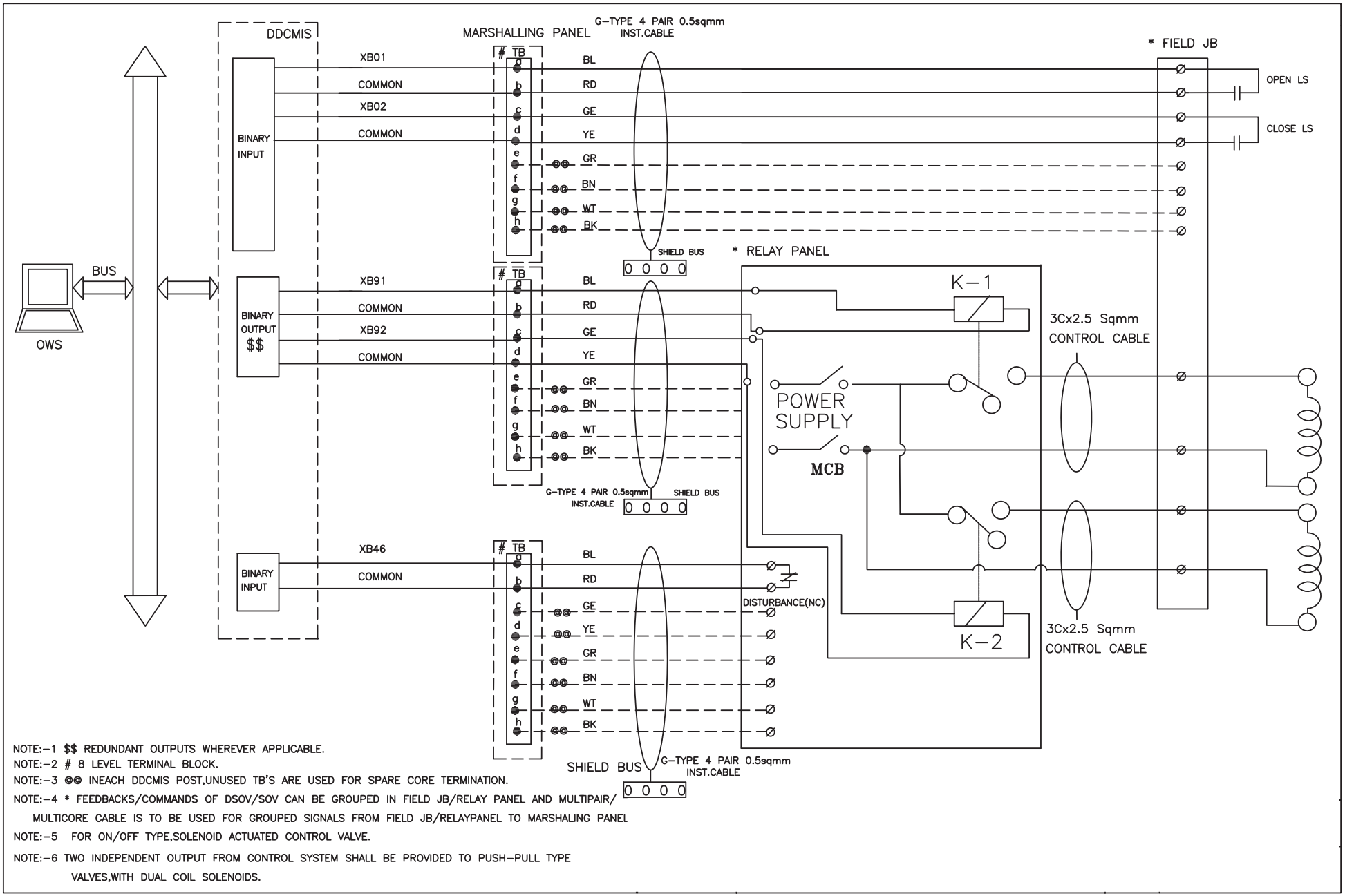
DRIVE CONTROL PHILOSOPHY

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



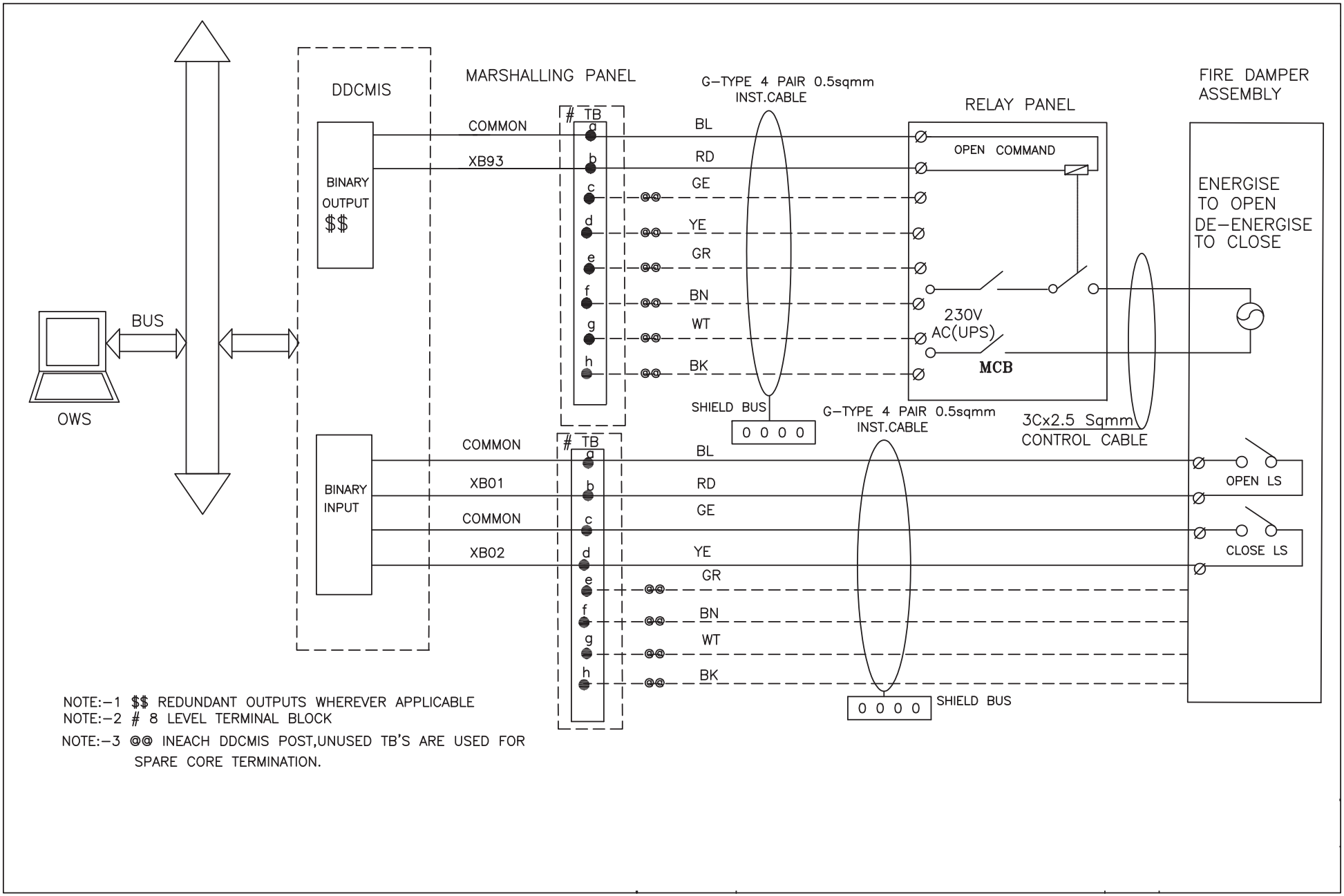
NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.
NOTE:-2 # 8 LEVEL TERMINAL BLOCK.
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/ MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS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

DDCMIS INTERFACE WITH DUAL COIL SOLENOID (DSOV/L)



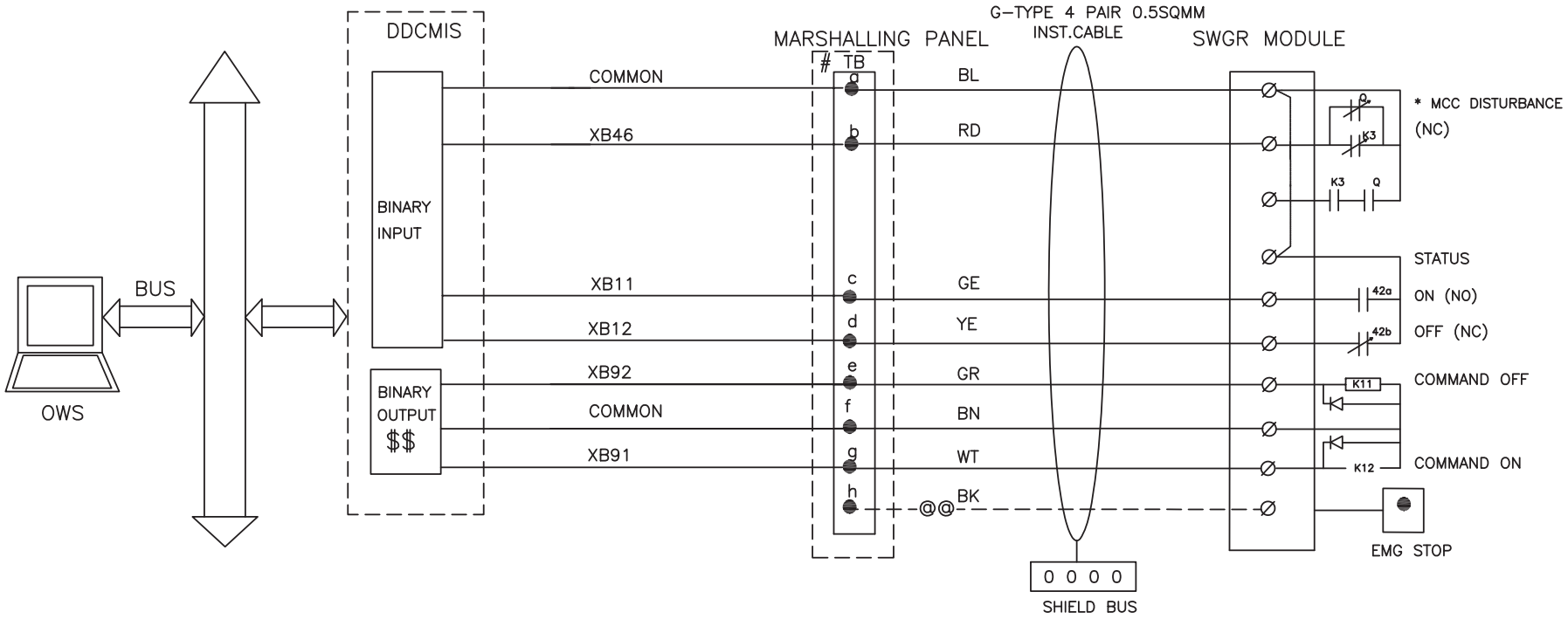
NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE.
NOTE:-2 # 8 LEVEL TERMINAL BLOCK.
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.
NOTE:-4 * FEEDBACKS/COMMANDS OF DSOV/SOV CAN BE GROUPED IN FIELD JB/RELAY PANEL AND MULTIPAIR/ MULTICORE CABLE IS TO BE USED FOR GROUPED SIGNALS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

DDCMIS INTERFACE WITH FIRE DAMPERS OF AC &VENT SYS(BID-FD)



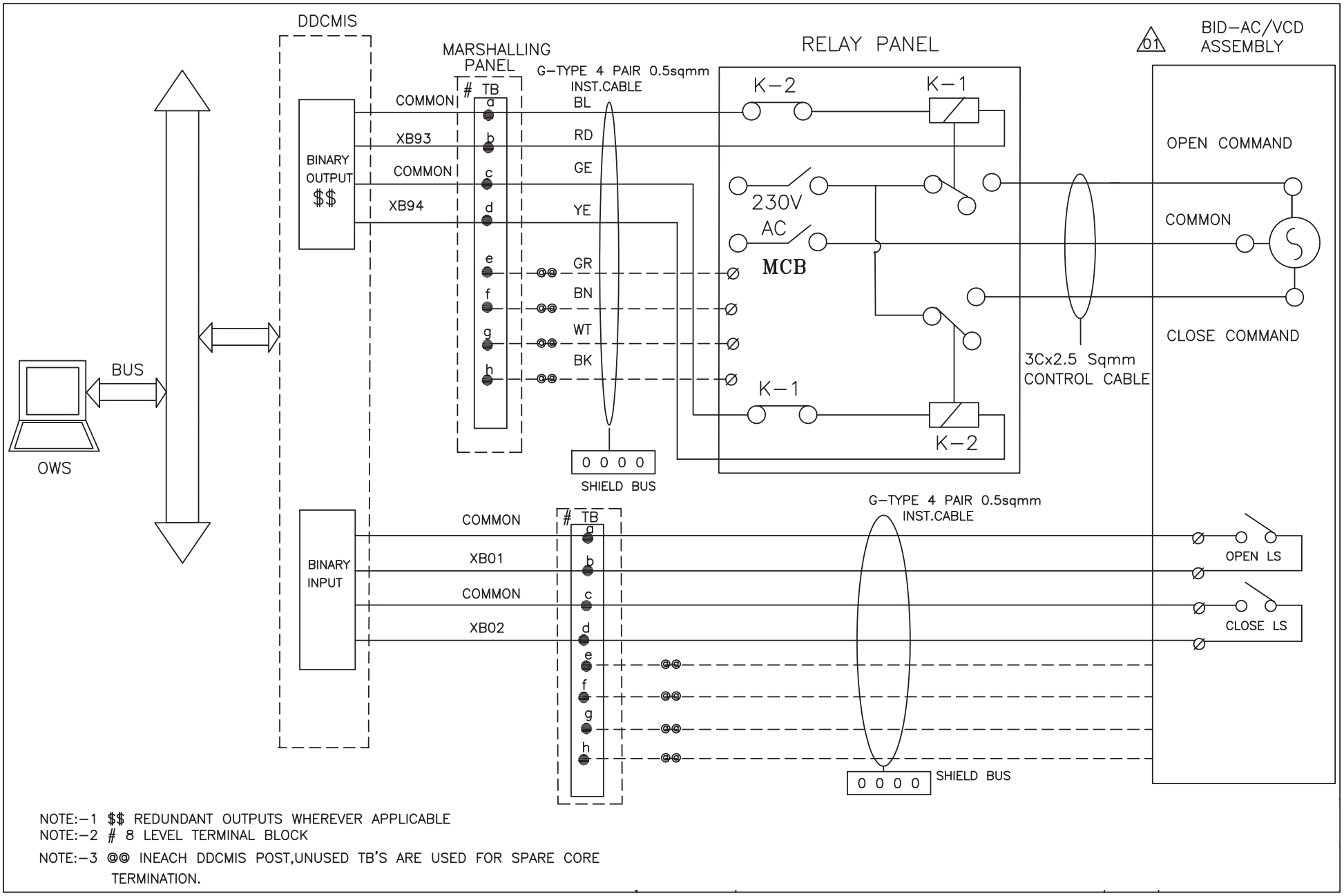
NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

DDCMIS INTERFACE WITH LT MCC (LT)



NOTE:–1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:–2 # 8 LEVEL TERMINAL BLOCK
NOTE:–3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION SEQUENTIALLY.
NOTE:–4 * MCC DISTURBED= THERMAL O/L OPT/CONT SUPP FAIL/EPB OPTD /DRIVE POWER SUPPLY OFF

DDCMIS INTERFACE WITH MOTORISED OPERATED VALVE OF AC &VENT SYS(BID-AC/BID VCD/)



NOTE:-1 $$ REDUNDANT OUTPUTS WHEREVER APPLICABLE
NOTE:-2 # 8 LEVEL TERMINAL BLOCK
NOTE:-3 @@ INEACH DDCMIS POST,UNUSED TB'S ARE USED FOR SPARE CORE TERMINATION.

INSTRUMENT INSTALLATION DIAGRAM

NOTES :–

1. IMPULSE PIPES SHALL BE OF SEAMLESS AND ANNEALED CONFORMING TO ANSI B36.10 IN LINE WITH THE MAIN PIPE MATERIAL.
2. PIPE FITTINGS SHALL BE OF FORGED MATERIAL CONFORMING TO ANSI B16.11–1991.
3. SNUBBER SHALL BE PROVIDED FOR PUMP DISCHARGE PRESS MEASUREMENTS.
4. IN CASE OF STEAM SERVICE SYPHON SHALL BE MADE BY BENDING THE TUBE OR PIPE.
5. VALVE MANIFOLDS & SNUBBER SHALL BE OF FORGED SS–316.
6. FOR SEA WATER APPLICATION SS316L FITTINGS TO BE PROVIDED.
7. 25NB x 15NB WELDED REDUCER SHALL BE USED FOR ROOT VALVE OF 25NB SIZE.
8. ROOT VALVES SHALL BE AS FOLLOWS:

   i) FOR PRESS <40 ATA & TEMP <425 DEG C, ONE(1) NO. 15Nb, ROOT VALVE OF SUITABLE CLASS SHALL BE USED.
   ii) FOR PRESS >40 ATA & TEMP <425 DEG C, TWO(2) NO. 15Nb, ROOT VALVE OF SUITABLE CLASS SHALL BE USED.
   iii) FOR PRESS >40 ATA & TEMP >425 DEG C, TWO(2) NO. 25Nb, ROOT VALVES OF SUITABLE CLASS SHALL BE USED.

9. HORIZONTAL PIPE RUNS SHOULD HAVE A SLOPE IN THE DIRECTION  SHOWN OF 1:20 AS MINIMUM.
10. FOR PRESSURISED STEAM & WATER SERVICE THE ASSOCIATED INSTRUMENT SHOULD BE MOUNTED BELOW THE TAPPING POINT. FOR VACUUM/AIR/GAS SERVICE, THE ASSOCIATED INSTRUMENT SHOULD BE MOUNTED ABOVE THE TAPPING POINT.
11. SEAMLESS PIPE/SEAMLESS TUBE/CAPILLARY LENGTH SHALL BE SUCH THAT THE GAUGES/TRANSMITTERS/SWITCHES ARE MOUNTED IN ACCESSIBLE AREA.

LEGEND :–

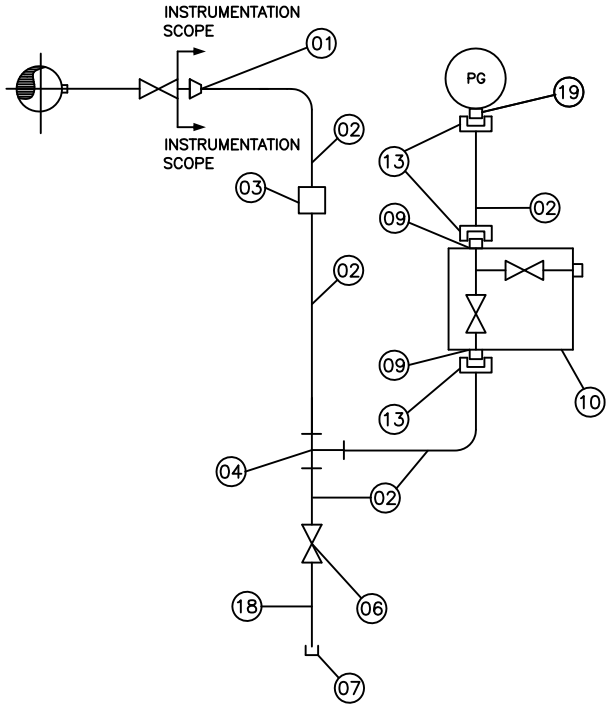
A/R – AS REQUIRED

NPTF – NATIONAL PIPE THREAD FEMALE

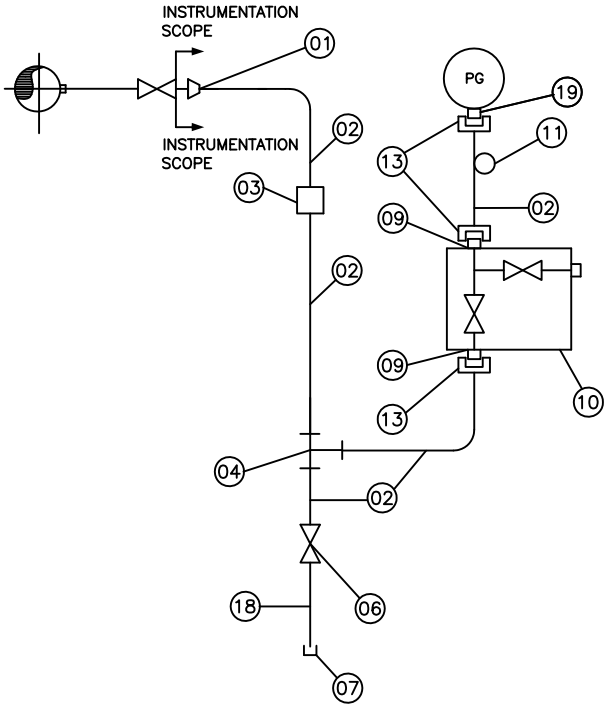
NPTM – NATIONAL PIPE THREAD MALE

SW – SOCKET WELD

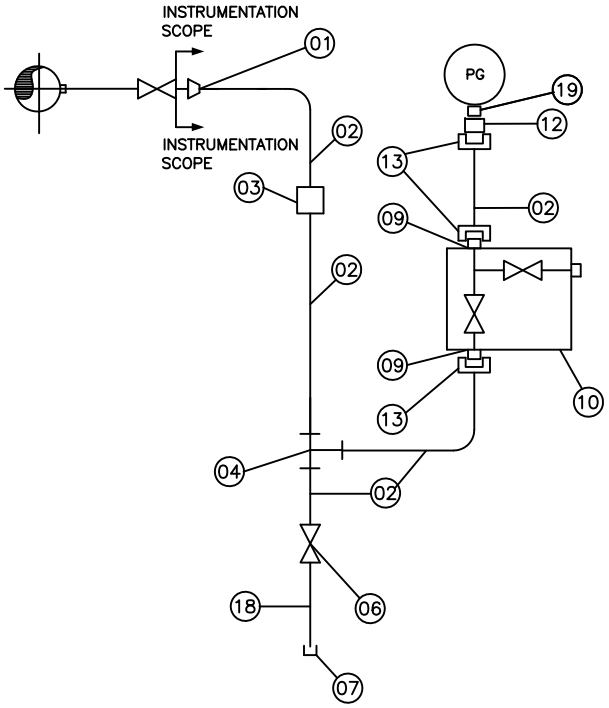
BHEL	TITLE :– INSTRUMENT INSTALLATION DIAGRAM NOTES	DRG. NO.	PE–DG–999–145–IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	2 OF 9	



WATER SERVICE

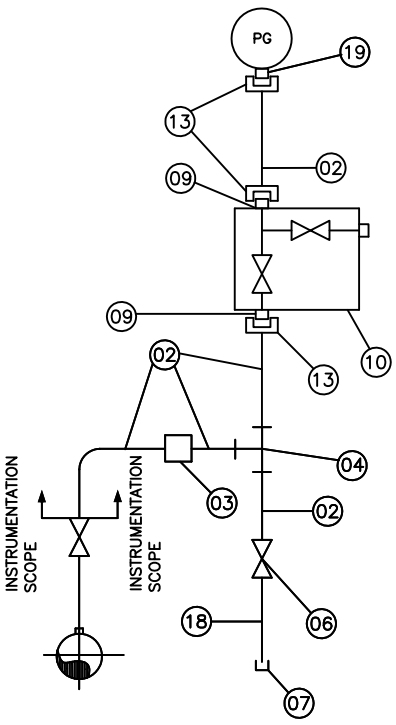


STEAM SERVICE

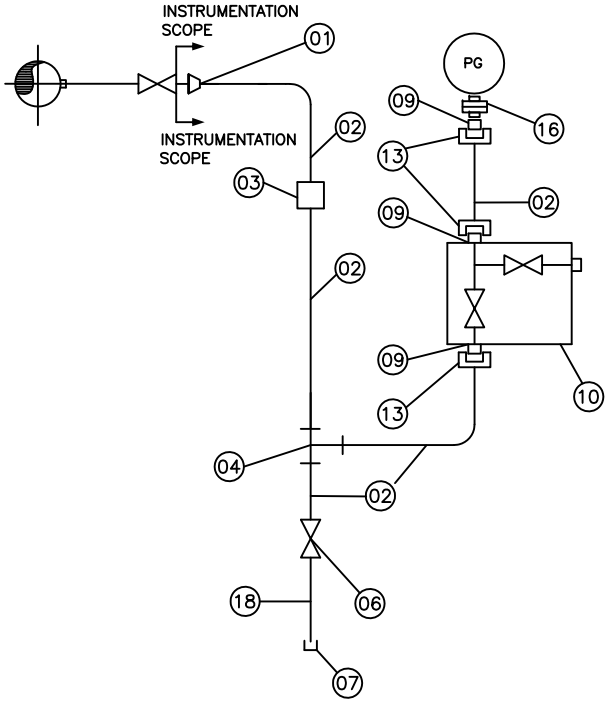


PULSATING SERVICE

TITLE :- INSTRUMENT INSTALLATION DIAGRAM PRESSURE GAUGES	DRG. NO.	PE-DG-999-145-IXXX		
	REV. NO.	00	DATE	05.11.13
	SHT	3 OF 9		



AIR SERVICE

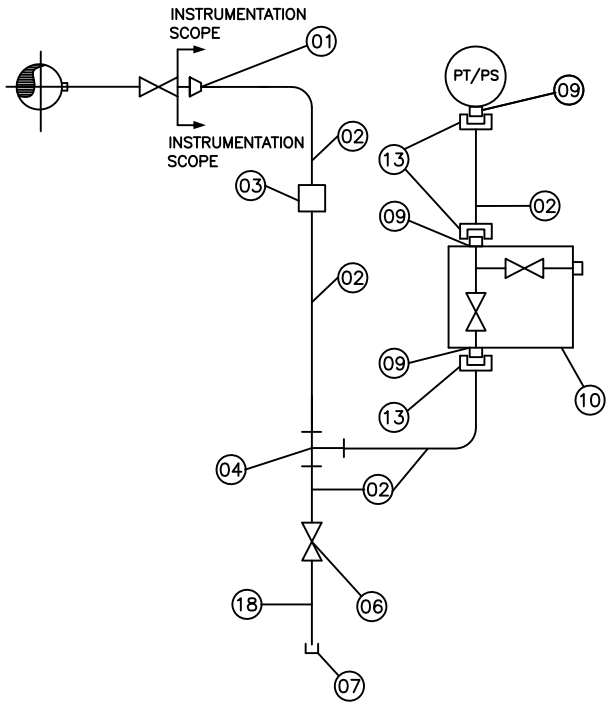


WITH CHEMICAL SEAL

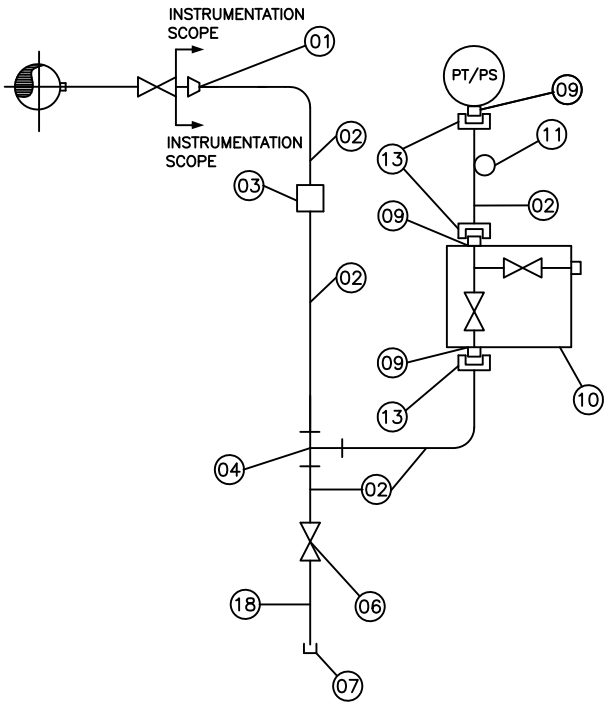
(FOR VISCOUS NON–CORROSIVE FLUID ONLY)

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY				
				WATER	STEAM	PULSATING	AIR	CHEMICAL
01	REDUCER (IF APPLICABLE)	SAME AS MAIN PIPE	1" X 1/2"SW	01	01	01	00	01
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R	A/R	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R	A/R	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	01	01	01	01	01
09	ADAPTER – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02	02	02	03
10	TWO VALVE 3 WAY MANIFOLD WITH VENT PLUG	SS316	1/2" NPTF	01	01	01	01	01
11	SYPHON	SS316	1/2" SW	00	01	00	00	00
12	SNUBBER	SS316	M20X1.5M X M20X1.5F	00	00	01	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	03	03	03	03	03
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00	00	00	01
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	01	01	01	01	01
19	ADAPTER – M TO F	SS316	M20X1.5M X 1/2" NPTF	01	01	01	01	00

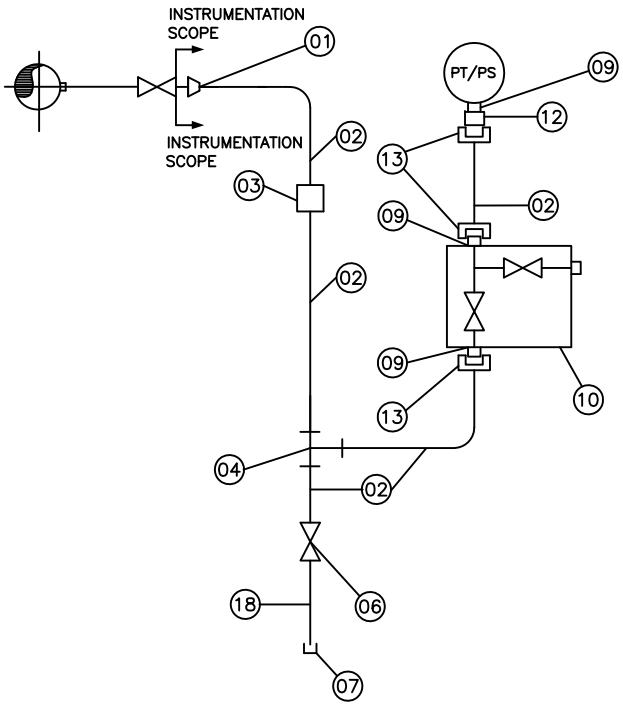
BHEL	TITLE :– INSTRUMENT INSTALLATION DIAGRAM PRESSURE GAUGES	DRG. NO.	PE–DG–999–145–IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	4 OF 9	



WATER SERVICE

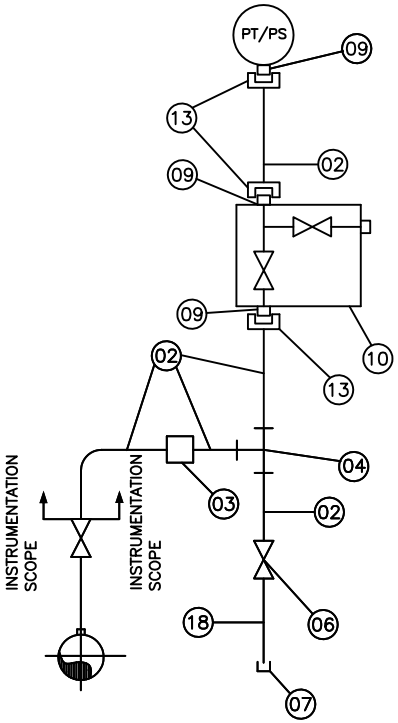


STEAM SERVICE

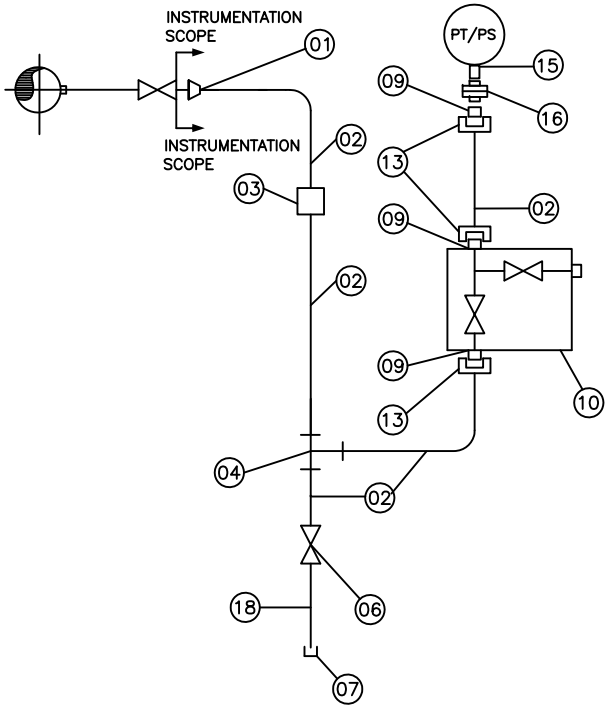


PULSATING SERVICE

	TITLE :- INSTRUMENT INSTALLATION DIAGRAM PRESSURE SWITCHES/TRANSMITTERS	DRG. NO.	PE-DG-999-145-IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	5 OF 9	



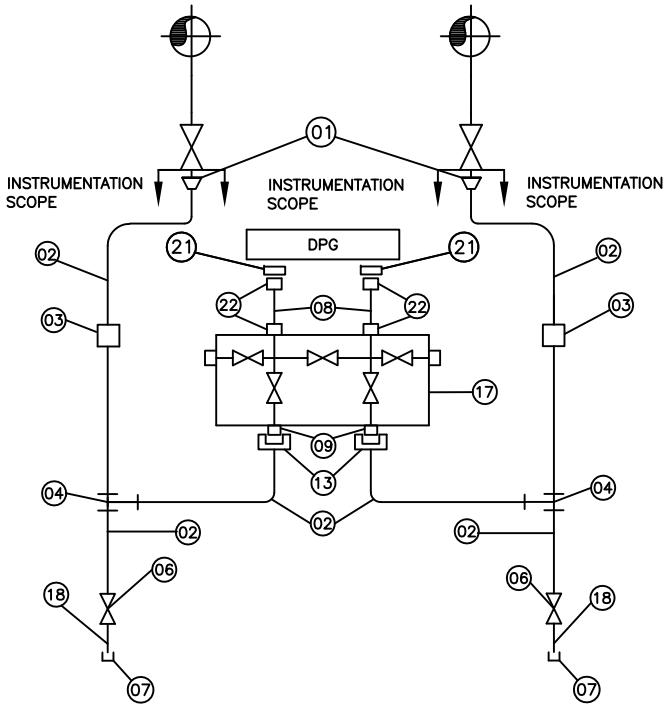
AIR SERVICE



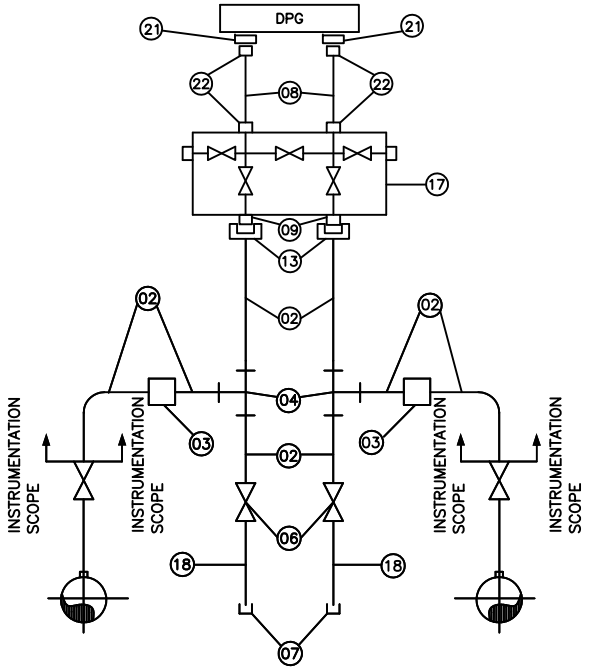
WITH CHEMICAL SEAL
(FOR VISCOUS NON–CORROSIVE FLUID ONLY)

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY				
				WATER	STEAM	PULSATING	AIR	CHEMICAL
01	REDUCER (IF APPLICABLE)	SAME AS MAIN PIPE	1" X 1/2"SW	01	01	01	00	01
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R	A/R	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R	A/R	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	01	01	01	01	01
09	ADAPTOR – M TO M	SS316	M20X1.5M X 1/2" NPTM	03	03	03	03	03
10	TWO VALVE 3 WAY MANIFOLD WITH VENT PLUG	SS316	1/2" NPTF	01	01	01	01	01
11	SYPHON	CS	1/2" SW	00	01	00	00	00
12	SNUBBER	SS316	M20X1.5M X M20X1.5F	00	00	01	00	00
15	CONNECTOR – M TO M	SS316	1/2" NPTM X 1/2" NPTM	00	00	00	00	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00	00	00	01
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	03	03	03	03	03
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	01	01	01	01	01

BHEL	TITLE :– INSTRUMENT INSTALLATION DIAGRAM PRESSURE SWITCHES/TRANSMITTERS	DRG. NO.	PE–DG–999–145–IXXX
		REV. NO.	00 DATE 05.11.13
		SHT	6 OF 9



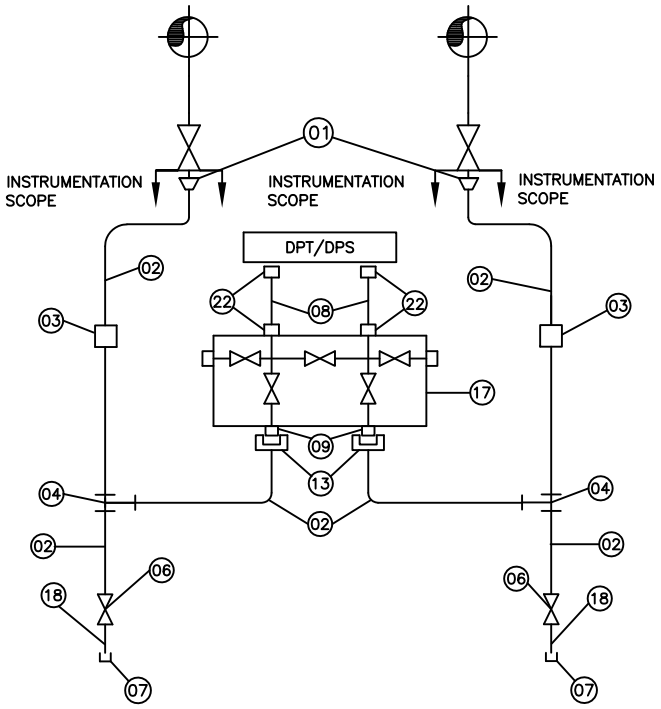
WATER SERVICE



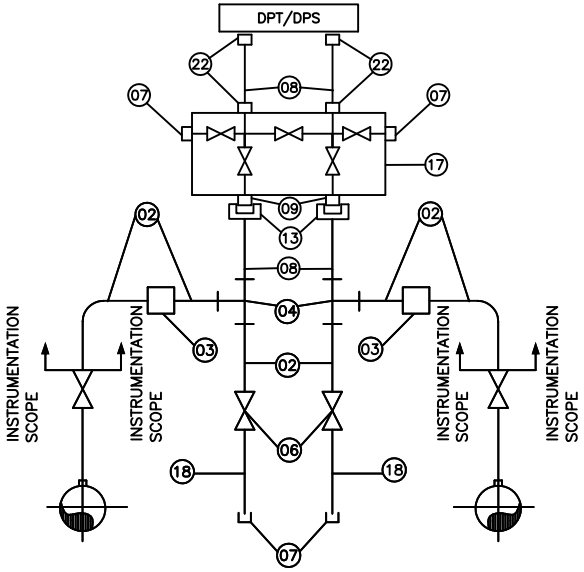
AIR SERVICE

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				WATER	AIR
01	REDUCER (IF APPLICABLE)	SS316	1" X 1/2"SW	02	00
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	02	02
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	02	02
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	02	02
08	SEAMLESS TUBE	SS316	1/2" OD	A/R	A/R
09	ADAPTOR – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02
17	FIVE VALVE MANIFOLD WITH DRAIN PLUG	SS316	1/2" NPTF	01	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	02	02
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	02	02
22	TUBE FITTING DFDC	SS316	1/2" NPTM X 1/2"OD TUBE	04	04
21	CONNECTOR – F TO F	SS316	1/2" NPTF X 1/2" NPTF	02	02

BHEL	TITLE :- INSTRUMENT INSTALLATION DIAGRAM DIFFERENTIAL PRESSURE GAUGES	DRG. NO.	PE-DG-999-145-IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	7 OF 9	



WATER SERVICE

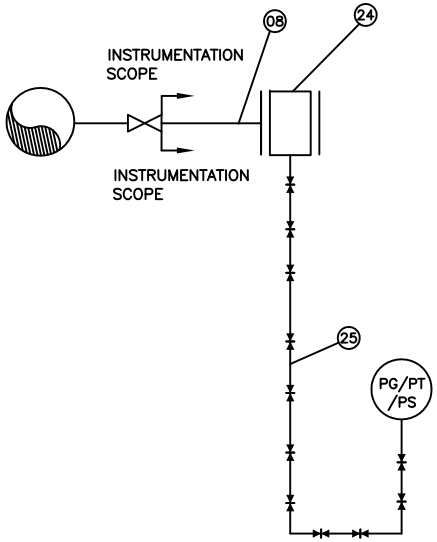


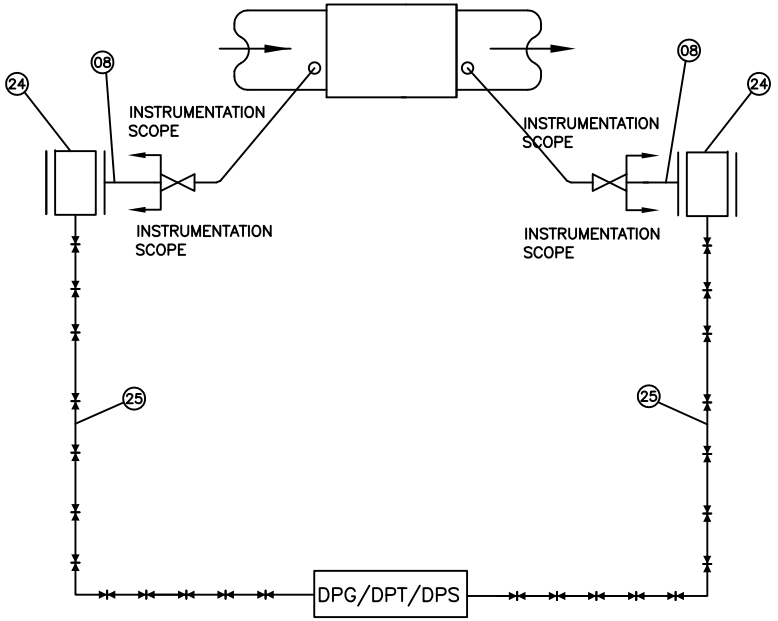
AIR SERVICE

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				WATER	AIR
01	REDUCER (IF APPLICABLE)	SS316	1" X 1/2"SW	02	00
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R
04	FORGED TEE	SS316	1/2" SW	02	02
06	FORGED GLOBE VALVE	SS316	1/2" SW	02	02
07	CAP	CS	1/2" NPTF	02	02
08	SEAMLESS TUBE	SS316	1/2" OD	A/R	A/R
09	ADAPTER – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02
17	FIVE VALVE MANIFOLD WITH DRAIN PLUG	SS316	1/2" NPTF	01	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00
15	CONNECTOR – M TO M	SS316	1/2" NPTM X 1/2" NPTM	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	02	02
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	02	02
21	CONNECTOR – F TO F	SS316	1/2" NPTF X 1/2" NPTF	00	00
22	TUBE FITTING DFDC	SS316	1/2" NPTM X 1/2"OD TUBE	04	04

BHEL	TITLE :- INSTRUMENT INSTALLATION DIAGRAM DIFFERENTIAL PRESSURE SWITCHES/TRANSMITTERS	DRG. NO.	PE-DG-999-145-IXXX	
		REV. NO.	00	DATE 05.11.13
		SHT	8 OF 9	

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				PG/PS/PT	DPG/DPS/DPT
24	FLANGE SUPPLIED WITH PG/PS PT/DPG/DPS/DPT TO SUIT 1/2" OR 1" NB PIPE	SAME AS MAIN PIPE	1/2" SW	01	02
08	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
25	SS ARMORED CAPILLARY TUBE (MINIMUM 5M IN LENGTH)	SS316	–	A/R	A/R





BHEL	TITLE :- INSTRUMENT INSTALLATION DIAGRAM WITH CAPILLARY TUBES	DRG. NO.	PE-DG-999-145-IXXX
		REV. NO.	00 DATE 05.11.13
		SHT	9 OF 9

SPECIFCATION for Instruments

Pressure Transmitter

01. Working Principle : Smart (HART Compatible)
02. Type: 2 - Wire
03. Output Signal : 4-20 mA DC.
04. Signal Processing: Silicon solid state electronic circuitry
05. Measuring Element: Capsule / Diaphragm
06. Element material: AISI-316 (Stainless Steel) or better
07. Static Pressure: 150 % of maximum span continuously, without affecting the calibration.
08. Turn-down ratio: 60: 1.
09. Span and Zero: Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span
10. Enclosure Class: IP-65
11. Output Indicator: LCD
12. Nameplate: Tag number, service engraved in SS tag plate
13. Body: Forged Carbon Steel for air and flue gas application and SS for other application.
14. Operating Voltage: 16 - 48 Volts D.C.
15. Load: 600 Ohms (min.) at 24 Volts D.C.
16. Ambient Temperature: 0 - 50 OC
17. Performance:
i) Accuracy: ± 0.1% of Span or better
ii) Repeatability: ± 0.05% of Span or better
iii) Response time: 100 msec or better
18. Sealing/Isolation: Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
19. Accessories: a) Universal mounting bracket suitable for 2” pipe mounting.
b) High tensile carbon steel U- bolts.
c) Siphon for steam and hot water services.
d) ½” NPT 2-valve stainless steel manifold, constructed from SS316 bar stock.
e) Companion flange with nuts, bolts and gaskets.
f) ½” NPT cable gland

Pressure Gauge and Differential Pressure Gauge

01. Type: Bourdon/Bellows/Diaphragm
02. Sensing & Socket: AISI-316 SS
03. Movement Material: AISI-304 SS
04. Case Material: Stainless steel. IP-65.
05. Dial Size: Generally, 150 mm
06. Scale: Black lettering on white in 270 O arc.
07. Window: Shatterproof glass
08. Range Selection: Normal process pressure: 50~70 % of range
09. Over-range Protection: 125% of maximum range by internal stop. External stop at zero.
10. Adjustment: Micrometer screw for zero. Internal micrometer screw for range.
11. Element Connection: Argon welding
12. Process Connection: 1/2" NPT (M) Bottom for local, back for panel mounting.
13. Performance: Accuracy of ± 1.0 % of span or better.
14. Operating ambient: 0 - 50 OC
15. Safety Feature: Blow out disc /diaphragm at the back
16. Accessories: a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge.
b) Stainless steel Diaphragm seals for viscous fluids.
c) 3-Way SS316 Gauge cock for pressure gauges.

d) 5-valve SS316 manifold from barstock for differential pressure gauge.
e) Siphons for steam and hot water services.
17. Applicable standard: IS-3624 / 1996
18. Nameplate: Tag number, service engraved in stainless steel tag plate

Differential Pressure Switch

01. Type: Bellows / Diaphragm / Piston actuated
02. Sensing element material: AISI SS-316. For all other wetted part SS 316
03. Case Material: Die-cast aluminum alloy with neoprene gasket.
04. Setter Scale: Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment
05. Over range: Static pressure on any one side, the other side being open to atmosphere.
06. Adjustments: a) Internal set point adjustment b) Differential adjustment
07. Process Connection: 1/2" NPT (M) bottom / back connected.
08. Switch configuration: Two SPDT
09. Switch rating: 240V, 5A AC/220V, 0.5A DC.
10. Switch type: Snap acting type contacts, shock and vibration proof.
11. Terminal Blocks: Suitable for full ring lugs for cable connection.
12. Cable Connection: ½" NPT conduit connection or compression gland.
13. Performance: a) Repeat accuracy ± 1.0% b) Accuracy of set point Indication: ±1.5%
14. Operating Ambient: 0 - 50 OC (Maximum Continuous)
15. Enclosure: IP-65
16. Accessories: a) Snubbers for pulsating fluid application.
b) Syphons for steam and hot water services.
c) Retention ring and screws for surface mounting.
d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock
e) 1/2" NPT Cable gland
17. Nameplate: Tag number, service engraved in stainless steel tag plate
18. Remote Seal type for special application: a) Silicone oil / fluorolube filled remote diaphragm seal for dirty / viscous /corrosive fluid.
b) SS armoured capillary at least 3 meters each.
c) Adapter flanges with nuts, bolts and gasket

Level Switch

01. Type: External cage float operated. Magnetically coupled.
02. Float Material: AISI-316 stainless steel or better
03. Other wetted parts: AISI-316 stainless steel or better
04. External Cage: Carbon steel / Stainless steel as per process requirements, welded type / flanged construction. Cage pressure rating shall equal or exceed the rating of the main vessel.
05. External cage mounting: Side-Side.
06. External cage connection: 25 NB socket welded.
07. Switch housing: Epoxy coated die-cast aluminium alloy with neoprene gasket conforming to IP-65.
08. Type of switch configuration: 2 SPDT (two nos.)
09. Contact rating: 5A, 240V/AC, 0.25A, 220V DC
10. Accessories: a) Counter flange, nuts & bolts, suitable gasket etc.
b) Steel globe type drain valve.

c) ½" NPT cable gland
d) Stainless steel nameplate with alphanumeric engraved for service and tag.
11. Preferred feature: Switch operating point marked on cage
12. Mounting : On standpipe

Resistance Temperature Detector

01. Type: Platinum (Duplex), Ungrounded
02. Resistance: 100 ohm at 0 OC
03. Base: Wound on ceramic (anti-inductive)
04. Wiring: 3 /4 Wire
05. Protecting Tube:
i) O.D.: 8 mm
ii) Material: SS-316, Seamless
iii) Filling: Magnesium oxide (Purity above 99.4%).
06. Response time: a) < 20 seconds for measurement. b) < 10 seconds for control.
07. Calibration: DIN 43760
08. Accuracy: ± 0.5%
09. Head: i) Type: IP-65 universal screwed type.
ii) Material: Die cast aluminum or better
iii) Terminal blocks: Nickel plated Brass-screw type / silver plated
iv) Cable connection: ½" NPT gland and grommet.
v) Others: Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells
10. Accessories: a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection
b) Compression fittings/unions
c) Flanges etc. (for flanged connections only)
d) Forged/barstock thermowell as per ASME PTC code. Process connection M33X2 (M).
Material of construction of Thermowell:
SS 316: In general Inconel: For flue gas application Tungsten carbide: For coal mill application.
11. Nameplate: Tag number, service engraved in stainless steel tag plate

Temperature Gauge

01. Type: Bimetallic or gas filled.
02. Sensing Element Material: Bourdon - AISI-316 SS
03. Capillary Armouring: Stainless steel flexible
04. Movement Material: AISI 304 SS
05. Bulb / Stem Diameter: 12 mm
06. Bulb / Stem Material: AISI 316
07. Capillary: Stainless Steel
08. Connection to well: ½" NPT
09. Case Material: Stainless steel
10. Dial Size: 150 mm in general
11. Scale: Black lettering on white in 270 O arc.
12. Mounting: Surface/Panel
13. Over range Protection: 125 % of range or more

14. Instrument connection: Bottom for local and back for panel mounting.
15. Range: Normal temperature–50~70% of range.
16. Zero adjuster: Micrometer screw adjustable from front.
17. Window Shatterproof glass.
18. Accuracy: ± 1 % or better
19. Enclosure Class: IP-65
20. Capillary: 5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel
21. Compensation: Capillary and Case Compensation
22. Accessories: a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of Thermowell: SS 316
23. Nameplate: Tag number, service engraved in stainless steel tag plate

SECTION: I

SUB-SECTION: C5

TECHNCIAL SPECIFICATION

(MH PORTION)

MATERIAL HANDLING EQUIPMENT

MANUAL HOIST (CHAIN PULLEY BLOCK)

1.0 MANUAL HOIST (CHAIN PULLEY BLOCK)

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

Manual hoists (hand operated) shall be as per IS 3832. Duty shall be class II.

The stipulations of all statutory codes like Indian Electricity Act, Indian Electricity Rules, Factory Acts, Local Municipality act etc. shall however prevail over the specification requirements, in case any conflict arises between this specification and the statutory codes.

Maintenance tools and tackles shall be as per data sheet attached.

DESIGN CRITERIA

1.0.0 Capacity of manual (Chain pulley block) hoists shall be decided keeping 25% margin over equipment to be handled.

Chain pulley block (Manual hoist) - 300kg to <2T, wherever feasible, considering layout constraints.

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/ manual hoist with the help of floor operated pendant

MINIMUM LIFTING REQUIREMENT

S.N.	AREA DESCRIPTION	QTY (nos.)	CAPACITY (T)	TYPE
1	LIST TO BE MENTIONED AS APPLICABLE			
2				
3				

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 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 MANUAL HOIST with accessories as per the details given elsewhere in the specification.

Any equipment / accessories not specified in the specification but required to make the 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 Services to be provided by the bidder: Packing suitable to avoid transit/storage damage, forwarding and transportation to site, storage and handling at site.

2.2.0 Erection and Commissioning

2.3.0 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 enclosed reference quality plan and as per IS 3832 (latest revision). Equipment supplied shall be strictly in accordance with nomenclature & technical specification. Any additional testing requirement/ CHP (Customer Hold Point) at any stage of inspection deemed necessary by Consultant/ end Customer during detailed engineering shall be carried out without any commercial or technical implication.

4.0 Works Excluded

Supply of ISMB monorail, as applicable.

5.0 PAINTING SPECIFICATION

As per painting details specified elsewhere in specification.

6.0 PACKING

In general packing shall be wooden box packing.

7.0 TESTING AT VENDOR'S WORKS

Hoist along with accessories shall be demonstrated for the rated capacity for the service conditions specified as specified in QAP 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. (Refer Annexure-I)

9.0 TESTING AT SITE

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) 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) i) ii) iii)	Load Chain Type Material Conforms to (Std./Code)	 Link type As per relevant standard IS: 6216 / ISO 3077/
d) i) ii) iii)	Hand Chain Type Material Conform to Std.	 Link type Mild steel Grade 30 IS:2429 Part 1 / 2
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) ii)	Type Material Type of Bearing	Spur Alloy steel / carbon steel/ High graded cast iron Antifriction ball bearing / Roller
g)	Sprockets: Type of bearings used	 Antifriction ball bearing / Roller
i)	Method of lubrication Bearings Gearing & Pinions Sprocket	 Grease Grease Grease
h)	Brakes Type	Screw and friction disc type
5.0	**Trolley and Bridge drive**	
a) i) ii)	Trolley Type Material of frame	 Geared (Manually operated) Mild steel (IS:2062 Grade A or B)
b) i) ii) iii)	Drive Chain Type Material Design of drive chain	 Link type Steel Gr.30 IS : 2429 Part 1/2
c) i) ii) iii) iv)	Wheel Number of pairs of wheel Flange Type of bearings need Wheel material	 Two in each trolley/bridge Single flanged Antifriction As per IS 3832
d) i) ii) iii)	Gears Type Material Type of bearings used	 Spur / helical Cast iron/EN8 Antifriction
e) i) ii)	Method of lubrication for Bearings General	 Grease Grease

iii)	Sprockets	Grease
6.0	**Painting**	As per manufacturer's standard

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	1 Set
2	Complete set of screwdrivers (Min. 6 nos. of suitable sizes)	1 Set
3	Adjustable Spanner	1 No.
4	Insulated pliers	1 No.
5	Wrench spanner	1 No.
6	Grease Gun	1 No.
7	Oil Gun	1 No.
8	Hand Lamp	1 No.
9	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) MANUAL HOIST (CHAIN PULLEY BLOCK):

Sl. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-414-553-A200	Manufacturing Quality Plan
2	PE-V0-414-553-A201	GA Drawing for Chain Pulley Block with detail BOM with painting details
3	PE-V0-414-553-A202	O & M Manual

A typical MQP is enclosed for the reference. Bidder to submit project specific MQP for BHEL/Customer approval.

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order.

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. 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.

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 purchaser's 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.

13.0 MANDATORY SPARES:

MANDATORY SPARES FOR MANUAL HOIST (AS APPLICABLE)

Refer Suggestive format

ANNEXURE I: MAKES AND SUB VENDOR LIST

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 CPB.

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.

PAINTING SPECIFICATION

1. Painting specification for steel structures:

Surface preparation: De greasing and Mechanical cleaning with wire brush or blasting according to SIS 055900, Grade 2 ½.

Primer : HB Zn Phosphate - 2 coat, Minimum DFT 80 µ per coat.

Finish Coat : HB MIO epoxy - 1 coat, Minimum DFT 120 µ per coat

Total DFT : 260 µm

2. Painting specification for Indoor components.

Surface preparation: blasting according to SIS 055900, Grade 2 ½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Primer : Zinc phosphate epoxy - 2 coat, Total DFT 80 µm.

Finish Coat : Chlorinated rubber paint- 2 coats, Total DFT 80 µm for indoor and 100 µm for outdoor.

Total DFT : 160 µm for indoor and 180 µm for outdoor.

3. Colour Shade (as applicable):

SL. No.	Item Description	Colour Shade
1	Crane Structure	Golden Yellow Shade 356 as per IS-5
2	Trolley and hook	Crimson Shade 540 as per IS-5

The painting schedule shall be submitted to BHEL/Customer for approval.

MANUFACTURER'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN** **ITEM:** Chain Pulley Block **(Manual Hoist)** **QP No.:** **REV**.:0, **Date.: , PAGE**: 1 OF 4	**PROJECT:** 206 MW Shahpurkandi HEP **PACKAGE: CHAIN PULLEY BLOCK**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	10.			11.
1	**RAW MATERIAL & B/OUT ITEMS:**												
1.1	HOOKS	CHEMICAL & MECH	MA	LAB ANALYSIS	ONE SAMPLE PER HEAT		MATERIAL SPECIFICATION AS PER APPROVED DRAWINGS.		MTC. ✓	P	V	V	
		MARK & IDENTIFICATION	MA	VISUAL	100%		HOOK TC FROM COMPETENT AUTHORITY		TC ✓	P	V	V	
		INTERNAL DEFECTS	MA	UT	100%		ASTM A-388	(REFER NOTE I)	IR ✓	P	V	V	ON SHANK PORTION
		PROOF LOAD TEST	MA	REVIEW	100%		IS 15560		TC ✓	P	V	V	
		NDT AFTER PROOF LOAD TEST	MA	DPT	100%		ASTM E-165	NO RELEVANT INDICATTION	TC ✓	P	V	V	
1.2	LOAD CHAIN	- DIMENSIONS	MA	MEASUREMENT	100%		APPD. DRGS	APPD. DRGS.	IR ✓	P	V	V	
		- BREAKING STR & % ELONGATION	MA	-TENSILE TEST	1/LOT		-DO-	-DO-	MTC ✓	P	V	V	
		- PROOF LOAD -HEAT TREATMENT	MA	-TENSILE TEST	100%		-DO-	-DO-	MTC ✓	P	V	V	
			MA	REVIEW	100%		-DO-	-DO-	HT CHRT ✓	P	V	V	
		-GRADE	MA	REVIEW	1/BATCH		-DO-	-DO-	MTC ✓	P	V	V	

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

भेल BHEL	MANUFACTURER'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN** **ITEM:** Chain Pulley Block **(Manual Hoist)** **QP No.:** **REV**.:0, **Date.: , PAGE**: 2 OF 4	**PROJECT:** 206 MW Shahpurkandi HEP **PACKAGE: CHAIN PULLEY BLOCK**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.		10.			11.
1.3	RAW MATL. (BAR /FORGING) FOR GEAR BLANKS/SHAFTS/ PINIONS/AXLE/ RATCHET PAWL / RATCHET WHEEL & PLATES FOR FABRICATION ETC	CHEMICAL COMPOSITION	MA	Review	ONE SAMPLE PER HEAT		Material specification as per approved drawings.		MFR'S TC	✓	P	V	V	TC or inspection report for components shall be given.
		MECHANICAL	MA	Review						✓	P	V	V	
		INTERNAL DEFECTS	MA	UT	100%		ASTM A-388 REFER NOTE 1		IR	✓	P	V	V	For rounds ≥50mm and plates ≥25 mm.
		NDT AFTER MACHINING	MA	DPT	100%		ASTM E-165 NO RELEVANT INDICATION		TC	✓	P	V	V	
1.4.	LOAD CHAIN WHEELS	- CHEMICAL & MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT		APPD. DRG.	APPD. DRG.	MTC	✓	P	V	V	
1.5	BEARINGS	MAKE, TYPE, CATALOUGE 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	

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

भेल BHEL	MANUFACTURER'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN** **ITEM:** Chain Pulley Block **(Manual Hoist)** **QP No.:** **REV**.:0, **Date.: , PAGE**: 3 OF 4	**PROJECT:** 206 MW Shahpurkandi HEP **PACKAGE: CHAIN PULLEY BLOCK**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	10.			11.
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	
		-SURFACE CRACK	MA	DPT	100 %		ASTM E165	NO DEFECT	IR	✓	P	V	V	
2.2	COMPONENTS AFTER HARDFACING & MACHINING	HEAT TREATMENT	MA	HT CHART	100%		IS 1875/IS 4367/IS 3832		IR	✓	P	V	V	
		SURFACE HARDNESS	MA	HARDNESS	10%		--DO--		IR	✓	P	V	V	
		SURFACE CRACK	MA	DPT FOR SURFACE CRACK	100%		ASTM E 165	NO DEFECT	IR	✓	P	V	V	
		DIMENSION	MA	MEASURE	10%		IS 3832		IR	✓	P	V	V	
3.0	**FINAL INSPECTION**													
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION	CR	MEASUREMENT	100 %		IS:3832 /APPD DRG	IS:3832 /APPD DRG	IR	✓	P	W	V	
		ENDURANCE TYPE TEST	MA	TYPE TEST	1 PER SIZE		IS 3832	IS 3832	TC	✓	P	V	V	
		OPERATIONAL PROOF LOAD & LIGHT LOAD TEST, EFFORT.	CR	LOAD TEST	100%		-DO-	-DO-	IR	✓	P	W	V	
		HEIGHT OF LIFT	MA	VISUAL	100 %		-DO-	-DO-	IR	✓	P	W	V	
		SWIVELING OF HOOK	MA	VISUAL	100%		APPROVED	APPROVED	IR	✓				

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

भेल BHEL	MANUFACTURER'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN** **ITEM:** Chain Pulley Block **(Manual Hoist)** **QP No.:** **REV**.:0, **Date.: , PAGE**: 4 OF 4	**PROJECT:** 206 MW Shahpurkandi HEP **PACKAGE: CHAIN PULLEY BLOCK**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.		10.			11.
		EFFORT	MA	PULL ON CHAIN	100%		DRG -DO-	DRG -DO-	IR	✓	P	W	V	
3.2	PAINTING	-CLEANING - SHADE & DFT OF PAINT	MA MI	VISUAL VISUAL	AT RANDOM AT RANDOM		APPROVED DRAWING/ **SPECIFICATION**	APPROVED DRAWING/ **SPECIFICATION**	IR IR		P - p	--- W	-- ---	
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: WHEN BACK WALL ECHO (BWE) IS SET AT 100% OF FULL SCREEN HEIGHT (FSH) IN DEFECT FREE AREA THEN
(A) DEFECT ECHO SHALL NOT EXCEED 20% OF FSH &
(B) BWE SHOULD BE MINIMUM 80% OF FSH IN ANY AREA.
NOTE 2: RECORDS IDENTIFIED WITH TICK SHALL BE ESSENTIALLY INLCUDED IN QA DOCUMENTATION.

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

SECTION: I

SUB-SECTION: D

STANDARD TECHNICAL SPECIFICATIONS

STANDARD TECHNICAL SPECIFICATION FOR AIR WASHER

1. GENERAL

1.1.1 This specification covers the design, manufacture, construction features, installation, commissioning and conducting performance test at site.

2. CODES AND STANDARDS

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

2.1.1 IS:277: Galvanised steel sheets

2.1.2 IS:1239: Mild steel tubes

2.1.3 IS: 2062:

3. DESIGN/CONSTRUCTION FEATURES

3.1 GENERAL

3.1.1 The air washer shall be designed for max. air velocity of 2.8M/sec. Circulating water quantity shall be 1.0 CMH for every 1000 CMH of air flow, unless otherwise stated in data sheet A. The minimum saturating efficiency of air washer shall not be less than 90% Minimum length of air washer shall be 2500 mm.

3.2 TANK (SUMP)

3.2.1 The air washer tank shall either be masonry or metallic construction as specified in data sheet A. Masonry tank shall be provided by purchaser whereas metallic tank shall be of welded construction, fabricated from not less than 6mm thick MS plates, and inside, outside surfaces shall be provided with anti corrosive paint (Zinc sprayed to coating thickness of 75 micron min.).

3.2.2 The air washer tank shall have a minimum depth of 600mm and tank construction shall be such that the suction screen can be replaced while the air washer is under operation. The inlet and outlet ends of tank shall be suitably constructed to accommodate distribution plates and eliminator plates.

3.3 DISTRIBUTION PLATE

3.3.1 The distribution plate shall be fabricated from minimum 18 gauge thick GSS and shall have minimum 50% free area. The angles used for supports shall be galvanised.

3.3.2 The distribution plate shall be built up of number of sections for easy handling.

3.4 HEADERS AND STAND PIPE

3.4.1 The air washer shall be of two bank construction (one cross flow and other unit flow). The piping up to and including 100mm dia meter shall be of galvanised steel and above 100mm dia shall be black steel (subsequently spray galvanized to coating thickness as per approved TDS). All piping shall be adequately supported.

3.5 SPRAY NOZZLES

3.5.1 Spray nozzles shall be made of HDP (High density polyethylene) and shall be self cleaning type. The nozzles shall be designed to produce fine atomised spray and shall be spaced to give, uniform coverage of the air washer section. The pressure drop through the nozzle shall be in the range of 1.4 kg/cm2 g to 2.4 Kg/cm2g

3.6 ELIMINATOR PLATE

3.6.1 Eliminator plate shall be fabricated from 22 gauge thick GSS (Zinc coating thickness as per approved TDS).The eliminator section shall have minimum 6 bends. Spacer bars, tie rods and supports shall be of galvanised steel construction. Eliminator box shall be complete with suitable drop tray and drain pipe.

3.7 SUCTION SCREENS

3.7.1 Suitable no. of suction screens shall be provided by vendor and one set of spare screens shall be furnished along with each air washer.

3.8 INSPECTION DOOR AND MARINE LIGHT

3.8.1 Air tight inspection door of 600x700mm, metallic construction shall be provided. The air washer shall be equipped with marine light as required.

3.9 MAKE UP, DRAIN AND QUICK FILL CONNECTION

3.9.1 The air washer shall be provided with quick fill and make up connection. The quick fill valve shall be a globe valve. Float valve for making connection shall be backed up by a gate valve. Drain connections complete with isolating valves shall be provided for both suction and main tank. Over-flow pipe shall be provided for main tank and shall be connected to drain pipe, before the isolating valve or drain. In case of masonry tanks suitable pipe pieces with stiffener plates shall be provided by Vendor for use during casting of masonry tank.

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

4.1.1 Performance curve for air washer

4.1.2 GA drg.

4.1.3 Foundation drag. weight, dynamic loading etc.

4.1.4 O&M manual

S.No.	DESCRIPTION	DETAILS
	GENERAL	
1.	Designation	Air washers for power house building.
2.	Nos. required	Refer Section-C of Specific Technical Requirement
3.	Service	Evaporative Cooling of TG Hall & electrical bay
4.	Location	As per section-C/ Tender Layout Drg.
DESIGN DATA		
5.	Type	Sheet metal type, as per schedule of Ventilation system.
6.	Capacity M3/hr	Refer Section-C of Specific Technical Requirement
7.	Inlet air temperature	(Refer design data.)
8. (min).	Saturation Efficiency	To achieve saturation efficiency of 90%
9.	Allowable Pressure drop through Spray nozzle	2.4 Kg/cm2 (g) max.
9.	Pressure drop across Spray chamber	15 to 20 mm WG.
MATERIALS		
11.	Moisture Eliminators plates	24 SWG Galvanized Sheet (Vertical and brake type)./ 100% Virgin PVC of minimum finished thickness of 2 mm.
12.	Moisture Eliminators Frame	22 SWG G.I. Sheets.
13.	Distribution plates	18 G GSS to have 50% free area.
14.	Tank	MS
15.	Casing	Black M.S. (10 SWG min.)
16.	Louvers	20 G GSS sheet & frame of 18 G galvanized steel angle. Louvers with Bird screen of galvanized wire mesh of 10 mm square.
17.	Piping	MS Heavy Class Galvanized to IS: 1239 Part I, OR IS –3589 depending upon size.

18.	Suction Screen Water	Brass (40 mesh size 2 nos for each air washer)
19.	Spray nozzles	Brass/Bronze with chrome plating or suitable plastic material (Nylon/Polymer) and shall be self cleaning type.
20.	Flooding Nozzles	Nylon/Polymer.
21.	Banks	Two spray banks each connected to individual header

EQUIPMENT SELECTION CRITERIA

22.	Face Velocity through louver.	Not to exceed 2.5 m/s
23.	Max. Pressure drop	Not to exceed 6.5 mm Wg when clean
24.	Saturation efficiency	Not less than 90%.
25.	Face velocity of air through spray chamber.	Not to exceed 2.5 m/s.
26.	Allowable pressure drop for washing chamber.	15 to 20 mm Wg.

NOTE:

1) All parts coming in contact with moisture for air washer shall be spray galvanized/epoxy painted
(2 coat of rust preventing epoxy primer & 2 coat of finished paint from both sides.)
2) Moisture eliminator shall have bends at 30 Degree with the direction of air flow & shall have
effectively hooked edges for traping the water.

STANDARD TECHNICAL SPECIFICATION FOR VENTILATION FANS

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.

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.

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

No.	Particulars	Data
1	**General Information**	
1.1	Fan Designation/application. system/	Refer schedule of Ventilation Air washers & UAF Units.
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 Air Washer and SISW for UAF
2.2	Type of blades	backward curved
2.3	Arrangement	To suit application as per layout.
2.4	Discharge direction	To suit application as per layout.
2.5	Duty	Continuous
2.6	Capacity at site (Cubic Meter/hr) & static pressure.	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	Fire resistant type plastic impregnated canvas with MS Flanges and cleats (3mm thick).
3.9	V Belt	ISI marked (Reinforced rubber section to IS: 4776)
3.10	V Pulley	Cast Iron multi groove to grade FG 20 as per IS: 210. Having taper lock type
3.11	Slide rails	M.S./C.I.
3.12	Connection pieces	G.I. according to supplier's design
3.13	Bolts & nuts	M.S. Galvanized / Epoxy painted.
3.14	Vibration isolating pads, washers and spring if any.	Hard synthetic rubber

4.0 **ACCESSORIES**

4.1	Common base plate	Required.
4.2	Anchor bolts	-do-
4.3	Vibration Isolators	Hard synthetic rubber
4.4	V-belt pulleys	-do-
4.5	V-belts	Reinforced rubber of appropriate section
4.6	Belt guard	Required.
4.7	Outlet damper	Required(M.S. Heavy Gauge)
4.8	Inlet guard	Required.
4.9	Inlet Vane (variable)	Not required.
4.10	Drain valve	Required.
4.11	Acoustic silencers	Not required.

5.0 **Motor**

5.1	Motor by	Bidder

5.2	Starter by	BHEL
6.0	Painting of fans including base frame	Galvanized / epoxy painting (as per Section-C & painting specifications)

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).

General Information

1)	Designation	Roof extractor Units for areas as per schedule of ventilation system.
2)	Nos. required	As per schedule.
3)	Service	Continuous
4)	Location	Roof of respective areas.
5)	Area	As per schedule

Design Data

6)	Type	axial flow type.
7)	Air delivery capacity	as per schedule of ventilation system.
8)	Fluid	Atmospheric Air.
9)	Temperature	50 Deg. C
10)	Static Pressure required	As per Section'C' schedule of ventilation system.
11)	Outlet air velocity	Not more than 12 m/sec.

Materials

12)	Casing/cowl/hood	M.S. Sheet to IS: 2062 /IS: 1079/Eq.
13)	Impeller	Cast A1uminium alloy to A-6M IS-617 Grade LM6
14)	Support frame and structure.	M.S. of adequate thickness (IS-2062).

ACCESSORIES

15)	Vibration isolating pads	Yes.
16)	Base frame for mounting	Yes.
17)	Wire Guard at inlet.	Yes.
18)	Disconnect switch	Yes.

19)	Gravity damper at outlet	Yes
	Motor	
20)	Motor by	Bidder
21)	Starter by	Bidder
22)	Type of motor	Conforming to IS: 325 latest/as per specification.
23)	Free delivery test	Yes.
24)	Performance test at specified duty point.	Yes
25)	Speed	Not more than 1500 RPM

NOTE:

1. Motors shall have 15% on duty power Point.

No.	Particulars	Data
	General Information	
1)	Designation	Supply/Exhaust Fans.
2)	Nos. required in	Refer schedule of Ventilation system section-C under specific technical requirement.
3)	Service air.	To exhaust warm air/to supply fresh
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 system.	As per schedule of ventilation
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 617)	Cast A1uminium. (Alloy A-6M, IS-
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.

Motor

21)	Motor by	Bidder
22)	Starter by	BHEL

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.

STANDARD TECHNICAL SPECIFICATION FOR LOW PRESSURE AIR DISTRIBUTION SYSTEM

1. GENERAL

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

2. CODES AND STANDARDS

2.1.1 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.

2.1.2 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

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

3.1.2 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 IS 277 Gr. 275 / as specified in Data Sheet A.

3.1.3 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

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

4.1 RECTANGULAR DUCTS

4.1.1

S.No.	Max Side	Sheet 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	0.80	S-drive, 25mm pocket or	25x25x3 mm MS

		(24G)		25mm bar slips or flanged joints on 2.5m centres	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				

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

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

4.1.4 The flanges used for transverse joints shall be joined together with GI bolts (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

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

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

4.2 ROUND DUCTS

4.2.1

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

4.2.2 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.

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

4.3 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.

4.4 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 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.

4.5 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.

4.6 CAULKING

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

4.7 EASEMENT

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

4.8 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.

4.9 DAMPERS AND SPLITTERS

4.9.1 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.

4.9.2 Fire Dampers

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

4.9.3 Gravity operated back draft dampers shall be provided to ensure pressurisation of rooms as specified. These dampers shall be designed such as not to allow infiltration of outside air while forced exit of air shall be achieved through this damper. The louvres shall be freely mounted on spindles to allow the dampers to open with the pressure developed by the fan. The dampers shall be provided with flange at inlet.

4.9.4 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.

4.9.5 Flashing

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

4.10 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.

4.11 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.

4.12 ACCOUSTIC LINING

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

4.13 PAINTING

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

4.14 THERMAL INSULATION

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

5. INSPECTION AND TESTING

5.1 INSPECTION & TESTING DURING FABRICATION–BY MAIN VENDOR

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.- visual inspection by Main Vendor.

5.1.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating –review of TC by BHEL/Customer

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.

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.

1)	General (List of areas)	As per schedule/tender drgs of Ventilation system.
2)	i) GSS Duct Work	
	a) Type	Zinc coating (Refer Section-C of Specific Technical Requirement)
	b) 1.25 mm thk ducting	Bidder to estimate as per Drawings/sketch
	c) 1.0 mm thk ducting	Separately for Ventilation system.
	d) Any other size	(area wise)
	e) Battery Room ducting.	MS with epoxy painting on both sides.
3)	Special painting epoxy	MS Ducts in Battery Room to be painted. Both interior & exterior)
4)	Thermal Insulation	Required in duct for vent. System exposed to Sun only (furnished by Cement sand plaster)
5)	SA grilles (for each size) (SQ.M) schedule/tender	To suit airflow as per drgs.
6)	Exhaust Gravity/Manual relief dampers (for each size & to maintain a slight positive pressure inside.)	-do-
	a) Frame	1.6mm M.S.
	b) Louver	0.8mm Al.

NOTE:

1) Ducting shall be as per IS-655 standard.

2) Opposed blade type volume control damper (gang operated) shall be provided at each supply air grilles.

3) Bidder to provide suitable gasketing at each duct flange.(Asbestos shall not be used).

4) Supply Air Grills shall have 2 (two) set of adjustable louvres.

5) Bidder to indicate unit rates for variable items like ducting, grilles with & without volume control damper, gravity damper, thermal insulation, etc.

6) Grilles, frames & louvres shall be of at least 18 SWG sheet and 20 SWG MS respectively.

6) Fire damper shall be solenoid operated in accordance with NFPA. The solenoid shall be charged during open condition and shall be de-energising to close.

7) Access door in ducting system shall be provided as required.

8) MS Angle (painted) shall be used only as duct supports.

9) Velocity thru duct shall not exceed 12 M/sec for Ventilation system.

10) All exhaust/return air grilles shall have one set of louvres in the front or thick rat-proof wire net guards.

STANDARD TECHNICAL SPECIFICATION
FOR
CENTRIFUGAL PUMPS

1.0 **GENERAL**

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

2.0 **CODES AND STANDARDS**

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

a) IS-1520 :Horizontal centrifugal pumps for clear, cold and fresh water
b) IS-5120 :Technical requirements - Rotodynamic special purpose pump
c) IS-1710 :Vertical turbine pumps for clear, cold and fresh water
d) Hydraulic Institute Standards of USA
e) BS - 599 :Method of testing Pumps
f) PTC - '6' :Centrifugal Pumps Power test code
g) API - 610

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

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

3.0 **DESIGN REQUIREMENTS**

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

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

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

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

4.0 **CONSTRUCTIONAL FEATURES**

4.1 **Pump Casing**

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

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

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

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

4.2 **Impeller**

Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity.

4.3 **Wearing Ring**

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

4.4 **Shaft**

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

4.5 **Bearings**

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

4.6 **Stuffing Boxes**

Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer.

4.7 **Shaft Couplings**

The pumps shall be directly coupled to their drives through heavy duty flexible coupling. Suitable coupling guards shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.

4.8 **Base Plate and sole Plate**

Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided.

If required in the data specification sheet, steel sole plates shall be provided, below the base plate.

4.9 **Prime Mover**

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

4.10 **Lifting arrangement**

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

5.0 **Performance Requirements**

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

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

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

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

6.0 **Drive Rating**

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

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

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

7.0 SCOPE OF INSPECTION AND TESTING

7.1 Castings

7.1.1 Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers.

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

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

7.1.4 Verification of neat treatment charts (as applicable)

Note: Casting effects shall not be filled by any method until an unless approved by BHEL/their customer

7.2 Forgings and

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

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

7.3 Fabricated items

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

7.3.2 Approval of welding procedure specifications and qualifications of weld procedures and personnel.

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

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

7.3.5 Hydro test as per para 7.5.1 below.

Note: For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating test certificates are not available, material shall be identified by BHEL and physical tests conducted by the supplier in the presence of BHEL

7.4 **In process Inspection and Testing**

7.4.1 Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. No defect shall be permitted on moving parts. On static parts acceptance norms are as per ASME Sec.III NB 2546.

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

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

a) Cracks, flakes, seams and laps

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

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

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

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

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

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

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

7.5 **Performance Test**

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

Capacity V/s Head

Capacity V/s Power absorbed by pump

Capacity V/s pump efficiency

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

7.5.2 NPSH test in case specifically mentioned elsewhere

7.5.3 Vibration and noise level measurement. Acceptance norms shall be as per manufacturers standards.

7.5.4 Overall dimensions as per GA drawings

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

7.5.6 Painting and packing as per technical specification.

7.6 **Test at site**

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

7.7 **Performance Guarantee**

The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification.

The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head.

8.0 **CLEANING, PROTECTION & PAINTING**

Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard shall be done to remove all dirts, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as necessary. Flanges, inlet and outlet pipe, etc shall be protected.

9.0 DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL

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

i) Foundation base plate and sole plate details as applicable

ii) Civil foundation and anchor bolts details and loading data

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

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

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

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

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

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

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

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

10.0 DRAWINGS AND DATA AFTER AWARD OF CONTRACT

The vendor shall furnish the drawings and other technical documents as required in Data Sheet-C enclosed with this specification

10.1 MANUFACTURERS NAME AND TAG. PLATES

Each pump shall have a permanently attached brass/metal tag on the body indicating the following information both in Hindi and English.

a) Manufacturer's name and trade mark
b) Design Capacity and Head
c) Design
d) Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

11.0 DRAWINGS/DOCUMENTS TO BE FURNISHED BY VENDOR AFTER THE 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.

S.No.	DESCRIPTION	DETAILS
1)	Designation	Air washer Pumps.
2)	Type	Horizontal Centrifugal Type.
3)	Quantity	As per section-C
4)	Installation	On floating type foundation inside Air Washer Room
5)	Fluid to be handled	Filtered Water.
6)	Temperature of Fluid	To suit.
7)	Capacity Cum/Hr TDH at	To suit system requirements however head shall Not be less than 35 MWC.
8)	Duty	————Continuous (24Hr./day)————-
9)	Suction condition	————Flooded————-
10)	Type of drive	Direct (flexible coupling)
11)	Type of prime mover	LV Ac Motor.
12)	Maximum speed	Not more than 1500 RPM
13)	Type of lubrication	Grease Lubrication

MATERIALS OF CONSTRUCTION

S.No.	DESCRIPTION	DETAILS
a)	Impeller	Bronze
b)	Pump Shaft	Carbon Steel C-45, IS-1570 or class-IV, IS-1875
c)	Casing	Cast Iron, grade-20, IS- 210
d)	Wearing ring	Bronze
e)	Shaft Sleeve	Bronze
f)	Base Plate/frame	Cast Iron to Grade FG-200 IS-210/fabricated Mild steel

g)	Counter Flanges	Mild Steel
h)	Stuffing box bush	Deep Bronze packing to be renewable with Case.
i)	Stuffing box gland	Flexible graphite or PTFE (Asbestos shall not be used)
j)	Pump Motor Coupling	Pin & Bush type (Flexible)
k)	Bolt and Nuts	MS

15) **ACCESSORIES REQUIRED**

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

a)	Priming funnel	Yes
b)	Drain piping upto Common drain point.	Yes
c)	Vent	Yes
d)	Suction & Discharge Pressure gauges	Yes
e)	Companion flanges	Yes
f)	Common base plate	Yes
g)	Suction strainer.	Yes
h)	Isolating valve.	Yes
i)	NRV at pump outlet at inlet/outlet	Yes
j)	Any special requirements	Yes
k)	Inspection & Testing	Yes

STANDARD TECHNICAL SPECIFICATION FOR AIR FILTER

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 ABSOLUTE FILTERS (HEPA)

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.

3.5 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:

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

4.1.1 Dimensional inspection of frame & filter media – TC from Manufacturer- review by BHEL/Customer.

4.1.2 Witnessing by BHEL/Customer 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.

4.1.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet) - by BHEL/Customer

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

5.1.1 GA Drawing

5.1.2 Drawing showing material/construction detail

5.1.3 Installation and\service manual

5.1.4 Rating curves/charts

5.1.5 Test certificates

Elect. diagrams (when automatic cleaning type)

	AIR FILTER	**VOLUME II-B**
	DATA SHEET - A	**SECTION D**
		REV 00 / **DATE NOV 2012**
		SHEET 1 OF 1

Description		**Data**
1)	**General**	
1.1	Service	Ventilation system .
1.2	Location	Main power house bldg. & Blower room of both the unit.
1.3	Nos.	Refer Section 'C' of Specification.
1.4	Total air flow/type	Refer Section 'C' of Specification.
1.5	Temperature	As per project information.
1.6	Relative Humidity	100%
1.7	Gas Composition	Atmospheric Air (Dusty) as prevalent in power station.
1.8	Filter Media	Synthetic non woven
1.9	Efficiency	Average arrestance efficiency of 65-80 % for Dry panel filter (pre-filters) and average arrestance efficiency of 80-90 % for fine filters.
1.10	Allowable pressure drop	2.5 mm & 6.5 mm in clean and dirty condition respectively for **dry panel filters** (pre filters). 12 mm in clean condition for fine filters.
1.11	Frame Work	18 G, GSS.
1.12	Mounting	Ladder Type M.S Angles (galvanised)
1.13	Size	600 x 600 mm

Note:-

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

STANDARD TECHNICAL SPECIFICATION
FOR
THERMAL INSULATION FOR COLD SURFACES

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 :-

2.1.1 IS:3069 : Glossary of terms & symbols & units relating to thermal insulation materials.

2.1.2 IS:4671 : Expanded polystyrene for thermal insulation purposes.

2.1.3 IS:3677 : Mineral wool for thermal insulation

2.1.4 IS:8183 : Resin bonded mineral wool

2.1.5 IS:702

3. DESIGN REQUIREMENTS

3.1.1 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.

3.1.2 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.

3.1.3 The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.

4. APPLICATION DETAILS

4.1.1 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.

4.1.2 A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.

4.1.3 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.

4.1.4 Insulation in the form of pipe sections/rolls slabs of specified density & thickness shall be stuck to the coated surface with joints staggered & well butted & secured. The adjoining sections shall be tightly pressed together. All the joints shall be sealed with bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.

4.1.5 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.

5.4.4 3mm (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.

6. INSULATION OF PUMPS & VALVES

For all inspection covers & hatches on equipment, pump casing & valve bodies, flanges etc. the insulation shall be applied such as to facilitate removal with minimum damage to the insulation. This shall be achieved by encasing the insulation in 22 gauge 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.

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)

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

8.1.1 Pipe work having insulation & cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.

8.1.2 Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.

8.1.3 All painting for insulated surfaces shall conform to the requirement specified elsewhere.

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1.1 Final version of data sheet 'B' incorporating changes if any along with design data.

9.1.2 Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following :-

i) Thermal conductivity test

ii) Sound absorption coefficient test

iii) Corrosion test

iv) Sulphur content, moisture content, shot content, moisture absorption etc.

v) Compressive strength & cross breaking strength test.

9.1.3 Sketches/technical literature/sectional drgs. indicating insulation materials finish and method of application etc.

9.1.4 Manual dealing with safety aspects & instructions for combating fire arising out of insulation work

9.1.5 Instructions on maintenance of insulation work.

INSULATION MATERIAL :

Insulation	Code	Thermal Conductivity MW/cm ^{0}C	Density Kg/m^3
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 ^{0}C	At least 24 (For Thermal Insulation) 48 for Acoustic insulation
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 ^{0}C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 50^{0}C	At least 15

TYPE OF INSULATION :

S.No.	Surface	Insulation Material	Insulation Form	Thickness (mm)
i)	Supply & Return air duct for air-conditioning system	Resin bonded Glass Wool (IS:8183)	Roll / Slab	50
ii)	Refrigerant Piping	a) Expanded Polystyrene	Pipe Section	75
		or		
		b) Mineral Wool	Pipe Section	75
iii)	AHU drain pipe (Suction & Liquid line)	a) Expanded Polystyrene	Pipe Section	25
		or		
		b) Mineral Wool	Pipe Section	25
iv)	AHU casing and condensate pan	a) Expanded Polystyrene	Slabs	25
		or		
		b) Mineral Wool	Slabs	25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene	Pipe Section	75
		or		
		b) Mineral Wool	Pipe Section	75
vi)	Chiller	a) Expanded Polystyrene	Slabs	100
		or		
		b) Mineral Wool	Slabs	100
vii)	Chilled Water Pumps	a) Expanded Polystyrene	Slabs	50
		or		
		b) Mineral Wool	Slabs	50
viii)	Expansion tank with pipe	a) Expanded Polystyrene	Slabs/Pipe Section	50
		or		
		b) Mineral Wool	Slabs/Pipe Section	50

ix)	Acoustic insulation of Duct	Glass Wool	Slab	25

SECTION: I

SUB-SECTION: E

LIST OF ANNEXURES

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
(206 MW PSPCL SHAHPURKANDI HYDRO ELECTRIC PROJECT
HVAC SYSTEM)

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
2	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP
3	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
4	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
5	INSULTATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
6	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
7	PIPING - ERW	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
8	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS
9	LEVEL GAUGE	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR/ BLISS ANAND
10	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
11	TEMPERATURE SWITCH	INDFOSS/ SEIMENS / DANFOSS/ DK INSTRUMENTS/ SOR INC / VASU / DRESSER / TOSHNIWAL / SWITZER
12	FLOW SWITCH	SWITZER / LEVCON / DK INSTRUMENT / SBEM / V. AUTOMATE/ SIEMENS
13	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
14	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
15	SIGHT FLOW INDICATORS	SIGMA / LEVCON /V AUTOMAT / TELLACE /EUREKA / TATA HONEYWELL/BLISS ANAND/ SCIENTIFIC

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(206 MW PSPCL SHAHPURKANDI HYDRO ELECTRIC PROJECT
HVAC SYSTEM)

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
		DEVICES/ BK EQUIPMENTS/ INSTRUMENTATION ENGINEERS
16	FLOW ELEMENT	BRISTOL BABCOCK / BALIGA /LIGHTING EQUIP /ENGINEERING SPECIALITIES /IL / MINCO/ MICRO PRECISION / STAR MECH
17	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
18	FLOW METER	EUREKA / INSTRUMENTATION ENGINEERS PVT LTD / PLACKA /TRAC / FLOW STAR/ SCIENTIFIC DEVICE
19	RH SENSOR/TEMP SENSOR	HONEY WELL /JOHNSON /SIEMENS / GENERAL INSTRUMENTS
20	PLC BASED PANEL	SIEMENS / SCHENIEDER / ROCKWELL / GE INTELLIGENT / HONEYWELL AUTOMATION / ABB/ MITSUBISHI ELECTRIC
21	OWS / PC	HP / COMPAQ / DELL / HCL / IBM / LENOVO
22	PRINTER	HP / CANON / EPSON / XEROX / IBM / LEXMARK
23	UPS	HITACHI-HIREL / APC / DELTA / EMERSON / DB POWER / APLAB
24	FIBRE OPTIC CABLE	BIRLA ERICSON / FINOLEX / AKSH FIBRE
25	ANNUNCIATOR FOR PANEL	ICC / PECON/ PROCON
26	LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR	CONTROL DEVICE / SYSTEM POWER CONTROL / JACKSON / UNILEC / ELECTRIC ALLIED PRODUCT
27	METERING PUMP	SHAPO TOOLS / VK PUMPS
28	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE / DOSI ION
29	PRESSURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL / FUJI
30	TEMPERATURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL
31	ROTAMETER	CHEMTROLS SAMIL / EUREKA IND / IL / TRANSDUCERS AND CONTROL
32	BATTERY CHARGER	AMARARAJA/ CHHABI ELECTRICAL / DUBAS ENGG. / HBL POWER SYSTEM / STATCON / CALDYNE
33	BATTERY (NI -Cd)	HBL POWER / AMCO SAFT / SAFT
NOTE		

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(206 MW PSPCL SHAHPURKANDI HYDRO ELECTRIC PROJECT
HVAC SYSTEM)

	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
(206 MW PSPCL SHAHPURKANDI HYDRO ELECTRIC PROJECT
HVAC SYSTEM)

S.No.	Description	Makes
1.	**AIR WASHER & UAF***	HYDERABAD POLUTION CONTROL / SK SYSTEM / ADVANCE VENTILATION / DRAFT AIR / BLUE STAR / VOLTAS / STERLING WILSON & ROOTS COOLING SYSTEM / C.DOCTOR
2.	**AIR HANDLING UNITS**	
3.	**CENTRIFUGAL FAN**	FLAKT / KRUGGER / DRAFT AIR / HYDERABAD POLUTION CONTROL / ADVANCE VENTILATION / PATEL AIR / NICOTRA/ SK SYSTEM / MARATHON / CB DOCTOR / SARLA
4.	**AXIAL FLOW FANS/RE UNITS**	HYDERABAD POLLUTION/ SK SYSTEM / ADVANCE VENTILATION / KRUGER / NICOTRA / MARATHON / FLAKT / CB DOCTOR/ PATEL AIR /SITAL
5.	**FAN**	FLAKT WOODS/ KRUGER/ ANDREW YULE/ AEROTHERM/ DUVENT/ SIWENT (SARLA)/ S.R PRAYAVARAN/ GEC(Alstom)
6.	**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
7.	**INDUCTION MOTORS (LT)**	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP/ KIRLOSKAR/ G.E.C.
8.	**AIR FILTER**	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER /SPECTRUM / AIR TECH / PUROMATIC/ CHEMFARM/ KIRLOAKAR/ CLEAR AIR PUROFIL/ DYNA
9.	**INSULTATION MATERIAL**	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
10.	**RESIN BOUNDED FIBRE GLASS**	UP TWIGA/ CLYOL/ COOLINE
11.	**FIRE DAMPER**	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
12.	**BUTTERFLY VALVE**	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE
13.	**NON RETURN VALVE**	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
14.	**GATE/GLOBE VALVES**	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
15.	**PIPING - ERW**	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
16.	**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
17.	**HUMID STAT**	JHONSON CONTROL / HONEYWELL / PENN
18.	**GRILLES/ DIFFUSERS**	MOOSA HAJI/ NUTECH/ COSMOS/ OPELLA/ CARYAIRE
19.	**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
20.	**THERMOSTATS**	H.GURU/ FIEBIG/ JAPSIN/ MICA/ PENN/ HONEYWELL

VENTILATION SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLIACBLE
(206 MW PSPCL SHAHPURKANDI HYDRO ELECTRIC PROJECT
HVAC SYSTEM)

21.	**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
22.	**LEVEL GAUGE**	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR/ BLISS ANAND
23.	**PRESSURE SWITCH / DP SWITCHES**	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT/ KASTURBA UDYOG/ BARKSDALE/ PRECISION MASS/ MITTAL REFRIGERATION
24.	**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
25.	**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
26.	**CONTROL PANEL**	INDUSTRIAL CONTROL & APPLIANCE/ PYROTECH /POSITRONICS / CONTROL & SWITCHGEAR /SIEMENS / L&T /GE POWER /RITTAL / HOFFMAN
27.	**SWITCHGEAR**	(MCCB, CROMPTON/ SIEMENS/ ABB/ L&T CONTRACTORS ETC.)
28.	**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 AFTER ORDERING WITH NO COMMERCIAL/DELIVERY IMPACT ON 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
(REFER SUGGESTIVE FORMAT)

SECTION-I

SUB-SECTION-E

ANNEXURE-III

LIST OF TOOLS & TACKLES
AND
LIST OF COMMISSIONING SPARES
(REFER SUGGESTIVE FORMAT)

SECTION-I

SUB-SECTION-E

ANNEXURE-IV

DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE

1.3.5.2 Drawings

All the drawings shall be worked out on computers using latest version of AutoCAD on maximum A-l size. All electrical drawings including schematic drawings block diagrams, flow diagrams, terminal details, panel outline drawings, circuit diagrams etc. shall be worked out on A-3 size. All drawings shall have a uniform title-block as approved by the Engineer. Beginning with the very first submittal to the Engineer, the Contractor's drawings shall bear a serial number corresponding to a drawing classification plan to be agreed upon by the Contractor and the Engineer. The drawings of bought out items shall also be preferred in AUTOCAD version, however, their scanned version will be allowed. Catalogue sheets, illustrations, printed specifications, etc., shall be checked and prepared by the Contractor in such a way that the figures, statements and data valid for the delivered sizes and types of the works concerned are clearly marked. These documents also shall be scanned and stored on CD.

Four sets of hard copies of the, drawings shall be submitted to the Engineer for comments / approval. The comments shall be marked on one set of hard copy and returned to Contractor for necessary correction in original drawings. Corrected drawings replacing previously submitted drawings should be marked accordingly. The final approved drawings shall be submitted on CD with eight sets of hard copies in product wise folders.

If the Engineer feels it necessary to give any comment on a drawing submitted "For Information Only", the same shall be entertained by the Contractor as “Drawing for Approval".

If any revision is required in the approved drawings by Contractor or the engineer, the same shall be got approved again and revised drawing shall bear revision number.

Drawings in respect of the following shall be supplied:

Foundation Drawings

If a piece of Works requires its own foundation or needs a special area for installation, the Contractor shall submit drawings indicating all pertinent dimensions, static and dynamic loads, etc. They shall include all essential details required for proper design and construction of the foundations and/or buildings.

In addition, they shall include openings, sleeves, and details of conduits, slopes and the arrangement of any supporting structure, i.e. base-frames or other steel constructions for permanent fixing or erection purposes.

Arrangement and Layout Drawings

All arrangement and layout drawings shall be drawn to scale. The General Arrangement Drawings shall show the physical arrangement of Works and their layout in the Power House, switchyard and appurtenances.

Assembly and sub-Assembly Drawings

The assembly drawings shall show all elements and the main dimensions of individual components in plan view, cross-section, side and top views. The assembly drawings shall include erection drawings, piping diagrams and piping arrangement drawings, etc., showing the dimensions, design and data of all constructions, apparatus and Works to be furnished under this Contract.

These drawings shall show:

- Assembly of the Works in plan, elevation and detail views with main dimensions
- Sub-assembly of the principal components of the Works which shall require dismantling, assembly and adjustments at site for maintenance, giving overall dimensions, adjustment, clearances and fitting tolerances
- Sub-assemblies in which the Contractor proposes to ship the Works
- Instructions for heat treatment, pressure tests, surface preparation and anticorrosive protection
- Full details of parts for which adjustment is provided or which are subject to wear
- Method and sequence of installation, field joints, erection and lifting devices, jacks, grout plugs, anchoring details, etc., if not shown on foundation drawings.

Block Diagrams

The Block Diagrams shall be used to show in a simplified manner the main inter-relationships between the elements of a system by means of symbols, block symbols and pictures without necessarily showing all the connections. The symbols used for the individual kinds of components, e.g. servomotors, computing modules, etc., shall clearly be explained on the diagram or on an attached legend.

Logic Diagrams

The Logic or Functional Diagrams shall be used for representation of logic and sequence controls and inter locking by showing only binary logic elements and their effect on the various process equipment disregarding their electrical realization. Logic function elements (AND, OR, NOR, NAND, STORAGE, etc.) shall be used for processing and combining binary signals.

Terminal Diagrams

- Such diagrams shall be prepared for any type of terminal box, marshalling rack, control cubicle, switchboard, etc., and shall show the terminals (properly numbered) and the internal and/or external conductors (wires or cables) connected to them.
- The terminal diagram of each individual switchboard, terminal box, panel, etc., shall contain, but not be limited to the following information:
- Terminal number of terminal board with targets (terminal number and current path) of incoming and outgoing cables and wires
- - Cable designation

- - Type of cable
- - Number and cross-section of conductors

1.3.6 Lists and Schedules

Following lists and schedules shall be supplied:

i) Cable Lists / Interconnection Lists

- The Cable Lists shall include for each individual cable the following as a minimum: - Cable number, in accordance with Identification System.- Cable type
  - Rated voltage
  - Number and size of conductors
  -Overall diameter
  - Cable termination at each end.
  - Connection point at each end with cubicle/Works identification and terminal numbers
  - Cable routing

In case interconnecting cubicles are used, the lists shall be prepared to show:

- Cable termination for incoming and out coming cables
- Interconnection wiring

ii) Alarm Lists

These lists shall indicate all alarms and shall contain at least:

- Description and denomination of alarm
- Data of alarm detector (contact) referring to applicable circuit diagram.
- Data of alarm annunciator (location and clear text abeling)

List of Final Control Elements

This list shall indicate all control actuators and control valves and shall contain at least:

- Data of pipe and valve connections
- Data of valve layout
- Maximal required and rated power

1.3.7. Calculations

In addition to the drawings or whenever the contractual documents do so require, the Contractor shall submit to the Engineer for checking, the appropriate calculations for determining the main sizes, stress levels, dimensions and operational characteristics, safety factors, clearly indicating the principles on which the calculations were based. The calculations shall include the formulae, standards, test results, basic assumptions, etc. Submission of computer calculations without baseline information such as derivation of the calculation method, applied formulas, definition of variables and constants, explanation of abbreviations etc., will not be accepted.

Short-Circuit Calculations

The short-circuit calculations shall be performed in accordance with VDE Standard 0102; part I/ IEEE 242 and 399.

1.3.8 Operation and Maintenance Manuals

The Operation and Maintenance Manuals shall be prepared in latest version of MS Word with enclosures in the form of computerized drawings and

scanned figures. They shall be supplied on CD along with Ten (10) hard copies in properly bound form. The O& M manuals shall contain the following information in sufficient detail to enable the Owner to maintain, dismantle, reassemble, adjust and operate the Works with all its items of Works and installations:

a) Table of Contents
b) List of Illustrations
c) Introduction
d) Detailed Description

Detailed description shall contain a complete and accurate description of the Works, all components and ancillaries, their assembling and dismantling. An accurate list stating clearances, tolerances, temperatures, fits, etc. shall be included.

e) Operating Principles and Characteristics

A brief summary of the technical operating principles of the Works, including diagrams, circuit diagrams, sequence diagrams, piping, etc.

f) Operating Instructions

The instructions shall contain the sequence of individual manipulations required for operation. Tables, lists and graphic presentations should be used whenever possible for making the description readily understandable. An appropriate trouble-shooting list shall be included in this chapter.

g) Testing and Adjustment

The entire testing and adjustment procedure required for the Works after overhauls and during operation shall be described.

h) Maintenance Instructions

This section is divided into five paragraphs:

hl) Preventive maintenance, indicating the inspections required at regular intervals, the routine cleaning and lubricating operations, the regular safety checks and similar steps.

The maintenance instructions shall include a tabular summary of the required activities sorted according to

- Daily
- Weekly
- Monthly
- Quarterly
- Yearly

(Or other) cycles as applicable.

h2) Repair and adjustment procedures including fault tracing

h3) Spare part lists, containing all the necessary data for ordering spare parts. These lists shall include all spare parts, those to be supplied and those not to be supplied under the present Contract. *Detailed drawing for each item of spare parts shall be supplied.* The above list should include minimum and maximum quantities of spares to be

maintained by the project.

h4) Tool lists, containing all necessary data for identification of tools to be delivered under the present Contract.

h5) List of Contractors of bought out items and their addresses.

j) As-built drawings

1.3.9 Installation and Commissioning Manuals

The Manuals of Installation and Commissioning Procedures shall be prepared in latest version of MS Word with enclosures in the form of computerized drawings and scanned figures. They shall be supplied on CD along with 10 (Ten) hard copies in properly bound form. These manuals shall contain the following information in detail:

Installation Procedures

The installations procedures shall describe in sequential steps the erection of major equipment and shall contain sufficient details such as equipment preparation on erection bay, handling of large and heavy pieces, levelling, anchoring, site welding, site painting, erection checks, site pressure tests, site flushing and cleaning of hydraulic systems, alignment and run out checks to allow the Engineer /Owner to plan and supervise the Works at site, if required. The manuals shall contain the 'Log Sheets for taking measurements during installation.

Pre-Commissioning Tests and Procedures

Pre-commissioning tests and procedures shall be described in sequential steps for the pre-commissioning of all electrical and mechanical equipments and shall also contain sufficient details viz. checking of installations, ratings, cable terminal checking and operation test of all auxiliary equipments etc. necessary Log Sheets shall be annexed to facilitate proper recording of test results.

Commissioning Procedures

The commissioning procedures shall sequentially and in sufficient detail describe activities and tests for all systems covered by the Contract Document.

1.3.10 Progress Reports during Design and Manufacturing

During design and manufacturing the Contractor shall quarterly submit four (4) copies of the progress reports in a format acceptable to the Engineer, detailing the progress of the work during the preceding period. The report shall contain (but not be limited to) the following information:

- A general description of the Works performed during the reporting period on each main activity, and include any notable problems, which were encountered.
- The total overall percentages of design and manufacturing works completed, with reference to the CPM programme. Appropriate comments shall explain any differences.
- The percentages of each main work activity completed during the

reported quarter with reference versus the scheduled programme. Appropriate comments shall explain any differences.

- A list of activities scheduled to be started within the next period of two (2) months, with expected starting and completion dates. If the expected starting and/or completion dates are different from those shown on the CPM programme, an explanation shall be given.

1.3.11 Progress Reports during Installation at Site

During erection the Contractor shall, before the tenth (10th) day of each calendar month, submit four (4) copies of the monthly progress reports in a format acceptable to the Engineer, detailing the progress of the work during the preceding month. The report shall contain (but not be limited to) the following information:

- A general description of the Works performed during the reporting period on each main activity, and include any notable problems, which were encountered.

- The total overall percentages of erection works completed, with reference to the CPM programme. Appropriate comments shall explain any differences.

- The percentages of each main work activity completed during the reported month with reference versus the scheduled programme. Appropriate comments shall explain any differences.

- A list of activities scheduled to be started within the next period of two (2) months, with expected starting and completion dates. If the expected starting and/or completion dates are different from those shown on the CPM programme, an explanation shall be given.

- A list of local manpower (by trade classification) employed during the reporting period.
- A list of expatriate personnel (by position) employed during the reporting period.
- A list of the Contractor's Equipment and materials presently located at the Site.

- Progress photographs of significant events. The Engineer may direct the inclusion of specific photographs if deemed necessary.

- A statement detailing the status of progress on the overall programme and how to regain any lost time or setbacks which may have occurred.
- A list of inoperable temporary equipment, and the estimated date when the repair will be completed.
- A statement concerning potential problems and recommendations on how they could be resolved.

1.3.12 Quality Assurance Plan for Manufacturing Works

Four copies of 'Quality Assurance Plan giving details of inspection, tests and customer witness / hold points shall be submitted with the bids. The quality plan shall contain the details of inspection and tests to be carried out' for

each major component of each functional assembly as recommended by the manufacturer as per their standard practice. The tests will include material composition and its properties, NDT, X-ray, hydraulic tests, leakage tests, insulation, high voltage tests and functional tests etc. along with the applicable standards and acceptance criteria.

The Contractor shall get the quality plans finalized and approved after the award of the Contract . The approved quality plan shall form the basis for inspection and acceptance of the equipment. The Engineer shall have the right to ask for more relevant tests if the same could not be included in the quality assurance plan at the time of their approval due to non availability of final design drawings.

1.3.13 Quality Assurance Plan for Site Installation & Commissioning

Four copies of Quality Assurance Plan giving details of stage inspection during installation, pre-commissioning and commissioning tests and customer witness / hold points shall be submitted with the bids. The quality plan shall contain the details of inspection and tests to be carried out for each major component of each functional assembly as recommended by the manufacturer as per their standard practice. Test Procedure shall be specified giving for each test item (kind of test) a description, test method / standards, used instruments, sample/routine test, test judgment.

The tests will necessarily include NDT, X-ray, hydraulic tests, leakage tests, insulation, high voltage tests and functional tests etc. along with the applicable standards and acceptance criteria.

The Contractor shall get the quality plans finalised and approved after the award of the Contract. The approved quality plan shall form the basis for inspection and acceptance of the equipment at site. The Engineer shall have the right to ask for more relevant tests if the same could not be included in the quality assurance plan at the time of their approval due to oversight and/or non availability of final design drawings.

1.4.1 SPARE PARTS, TOOLS AND SITE CONSUMABLES

1.4.1.1 Spare Parts

All spare parts to be supplied shall be interchangeable with the corresponding parts of all the Works supplied under these Specifications and shall be of the same material and workmanship. They shall be replaceable without cutting or destruction of adjacent components.

All spare parts shall be protected against corrosion and shall be marked with identification labels. The identification scheme for spares shall be sent for Owner's approval before dispatch of any spare.

All spare parts, tools and materials shall be delivered in marked boxes of sufficient sturdy construction to withstand long term storage.

Spare parts supplied under this contract shall not be given to the Contractor for use during erection and commissioning for replacing the defective or damaged original components of his supplies of works. The Contractor will arrange the spares required during the erection and guarantee period at his own.

The required list of spare parts has been given in Technical Specifications of respective equipment/works. The Bidders will give a separate list of spares

SECTION-I

SUB-SECTION-E

ANNEXURE-V

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

S. NO.	BHEL DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
1	PE-V0-406-571-11000-A001**	INSPECTION CATEGORIZATION AND SUBVENDOR LIST FOR HVAC SYSTEM*	04
2	PE-V0-406-571-11000-A002	QUALITY PLAN FOR VENTILATION SYSTEM (HVAC)	16
3	PE-V0-406-571-11000-A003	QUALITY PLAN FOR HORIZONTAL CENTRIFUGAL PUMP	17
4	PE-V0-406-571-11000-A005	QUALITY PLAN OF AHU	16
5	PE-V0-406-571-11000-A006	QUALITY PLAN OF CENTRIFUGAL FANS	14
6	PE-V0-406-571-11000-A007	QUALITY PLAN OF AXIAL FANS	16
7	PE-V0-406-571-11000-A008	QUALITY PLAN FOR LT MOTOR	18
8	PE-V0-406-571-11000-A009	QUALITY PLAN FOR LT SWITCHGEAR	18
9	PE-V0-406-571-11000-A010	MANUFACTURING QUALITY PLAN FOR LT CONTROL CABLE	18
10	PE-V0-406-571-11000-A011	QAP for Pipes	20
11	PE-V0-406-571-11000-A012	QUALITY PLAN FOR BUTTERFLY VALVE CI/CCS/CSS CONSTRUCTION(UPTO PN10 & SUBJECT TO LIFE CYCLE TEST)	18
12	PE-V0-406-571-11000-A013	QUALITY PLAN FOR STRAINER / FILTER	16
13	PE-V0-406-571-11000-A101**	HEAT LOAD CALCULATION FOR AC AREAS	04
14	PE-V0-406-571-11000-A102**	OPERATION AND CONTROL PHILOSOPHY FOR HVAC SYSTEM	06
15	PE-V0-406-571-11000-A103**	PRESSURE DROP CALCULATION FOR CIRCULATING WATER PIPING AHU(Evaporative)	14
16	PE-V0-406-571-11000-A104	VENTILATION FAN SCHEDULE.	24
17	PE-V0-406-571-11000-A105	SPLIT AC SCHEDULE	19
18	PE-V0-406-571-11000-A203	DATA SHEET & GA FOR PUMPS WITH FOUNDATION DETAILS.	19
19	PE-V0-406-571-11000-A204	DATA SHEET & GA FOR AHU WITH FOUNDATION DETAILS.	19
20	PE-V0-406-571-11000-A206	DATA SHEET & GA FOR WINDOW / SPLIT AC	16
21	PE-V0-406-571-11000-A207	DATA SHEET & GA FOR CENTRIFUGAL FANS	16

22	PE-V0-406-571-11000-A208	DATA SHEET & GA FOR AXIAL AND PROPELLAR FANS	16
23	PE-V0-406-571-11000-A210	DATA SHEET & GA FOR VALVES AND STRAINER.	13
24	PE-V0-406-571-11000-A212	DATA SHEET FOR INSULATION (THERMAL AND ACCOUSTIC).	16
25	PE-V0-406-571-11000-A213	DATA SHEET & GA FIRE DAMPER WITH ACTUATOR.	14
26	PE-V0-406-571-11000-A214	DATA SHEET FOR INSTRUMENTS (PRESSURE GAUGE, TEMP GAUGE, LEVEL GAUGE, PRESSURE SWITCH, LEVEL SWITCH, TRANSMITTERS ETC).	16
27	PE-V0-406-571-11000-A215	DATA SHEET OF PIPE.	9
28	PE-V0-406-571-11000-A216	DATA SHEET OF GI AND MS SHEET.	9
29	PE-V0-406-571-11000-A217	DATA SHEET & GA FOR PRE AND FINE FILTERS.	14
30	PE-V0-406-571-11000-A218	DATA SHEET & GA FOR MOTORS (Fan, pumps, Supply and Exhaust axial fans)	19
31	PE-V0-406-571-11000-A219	DATA SHEET & GA FOR HEATERS	10
32	PE-V0-406-571-11000-A221	TECHNICAL DATA SHEET & G.A. DRAWING OF PAN HUMIDIFIER	12
33	PE-V0-406-571-11000-A222	GA OF AIR TERMINALS LIKE SUPPLY/RETURN AIR DIFFUSER / GRILL / BACK DRAFT DAMPER / INTAKE LOUVER ETC FOR HVAC SYSTEM	18
34	PE-V0-406-571-11000-A501**	PID FOR AC SYSTEM	04
35	PE-V0-406-571-11000-A502**	SCHEME FOR AIR DISTRIBUTION IN TG BUILDING.	10
36	PE-V0-406-571-11000-A503**	PID FOR VENTILATION SYSTEM	04
37	PE-V0-406-571-11000-A504	TYPICAL Details- DUCT FABRICATION DRAWING / SUPPORT / ERECTION. INSULATION OF DUCTING / PIPING & EQUIPMENTS, PIPE ERECTION	10
38	PE-V0-406-571-11000-A505**	OUTDOOR AND INDOOR UNIT OF SPLIT AC LAYOUT PLAN IN CONTROL ROOM	08
39	PE-V0-406-571-11000-A507**	VENTILATION ROOM & VENTILATION DUCT LAYOUT FOR ALL THE FLOOR FOR POWER HOUSE ALONGWITH FOUNDATION DETAIL OF VENTILATION EQUIPMENT	06

40	PE-V0-406-571-11000-A508	VENT. ARRANGEMENT FOR BATTERY ROOM ALONGWITH FAN FIXING DETAIL.	16
41	PE-V0-406-571-11000-A509	VENT. ARRANGEMENT FOR VARIOUS AUXILIARY BUILDING ALONGWITH FAN FIXING DETAIL.	25
42	PE-V0-406-571-11000-A701**	ELECTRICAL PANEL DRAWING INCULDING SLD	10
43	PE-V0-406-571-11000-A702**	TDS OF CONTROL PANEL / PLC WITH CONFIGURATION DIAGRAM, BILL OF MATERIAL, GA &INTERNAL WIRING DIAGRAM, LOGIC FLOW DIAGRAM, IO WIRING DIAGRAM , PLC ROOM LAYOUT	12
44	PE-V0-406-571-11000-A703**	ELECTRICAL FEEDER LIST.	22
45	PE-V0-406-571-11000-A704	CABLE SCHEDULE	12
46	PE-V0-406-571-11000-A705	TDS FOR POWER AND CONTROL CABLES-TYPE TEST CERTIFICATE FOR CALES, TYPE TEST PROCEDUE, CROSS SECTION	22
47	PE-V0-406-571-11000-A706	TDS AND GA FOR ELECTRICAL PANEL-SCHEME, SLD, BILL OF MATERIAL	22
48	PE-V0-406-571-11000-A707	TDS And layout FOR CABLING-CABLE TRAY, CABLE SUPPORT, TYPE TEST CERTIFICATE, JOINTING KITS, TRIFOIL CLAMPS, ABOVE GROUND EARTHING	25
49	PE-V0-406-571-11000-A708	DRIVE LIST FOR HVAC SYSTEM	20
50	PE-V0-406-571-11000-A709**	I/O LIST FOR HVAC SYSTEM	12
51	PE-V0-406-571-11000-A710**	LOGIC DRAWING FOR HVAC SYSTEM	12
52	PE-V0-406-571-11000-A711	TECHNICAL DATASHEET & GA , TYPE TEST OF JUNCTION BOX FOR HVAC SYSTEM	20
53	PE-V0-406-571-11000-A712	INSTRUMENT SCHEDULE WITH TAG NUMBER FOR HVAC SYSTEM	24
54	PE-V0-406-571-11000-A713	INTERCONNECTION OF FIELD INSTRUMENTS UPTO JUNCTION BOX FOR HVAC SYSTEM	24
55	PE-V0-406-571-11000-A901	PERFORMANCE / DEMONSTRATION TEST PROCEDURE.	20
56	PE-V0-406-571-11000-A902	O & M MANUAL.	30

BHEL Drawing / Document indicated with ** are basic engineering documents.

Notes:

1. 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.
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-VII

SITE STORAGE AND PRESERVATION

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

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



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

1 SCOPE OF THE DOCUMENT

2 PURPOSE OF STORAGE & PRESERVATION

3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION

- a) GENERAL STORAGE REQUIREMENTS
- b) GENERAL PRESERVATION REQUIREMENTS
- c) GENERAL INSPECTION REQUIREMENTS

4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT

5. CONCLUSION

6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

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

2. PURPOSE OF STORAGE & PRESERVATION

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

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

a) GENERAL STORAGE REQUIREMENTS

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

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

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

b) GENERAL PRESERVATION REQUIREMENTS

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

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
    a. Rust preventive fluid (RPF)
    b. Rust protective paints
    c. Tarpaulin covers, in case of outdoor storage
    d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
    - Ingress of moisture and corrosion damages.
    - Damage to protective coating.
    - Open ends in pipes, vessels and equipment -
        - In case any open ends are noticed, same shall be capped.

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

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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



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

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





iii Open storage (O)

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

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

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



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

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

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

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

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

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

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

5. CONCLUSION

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

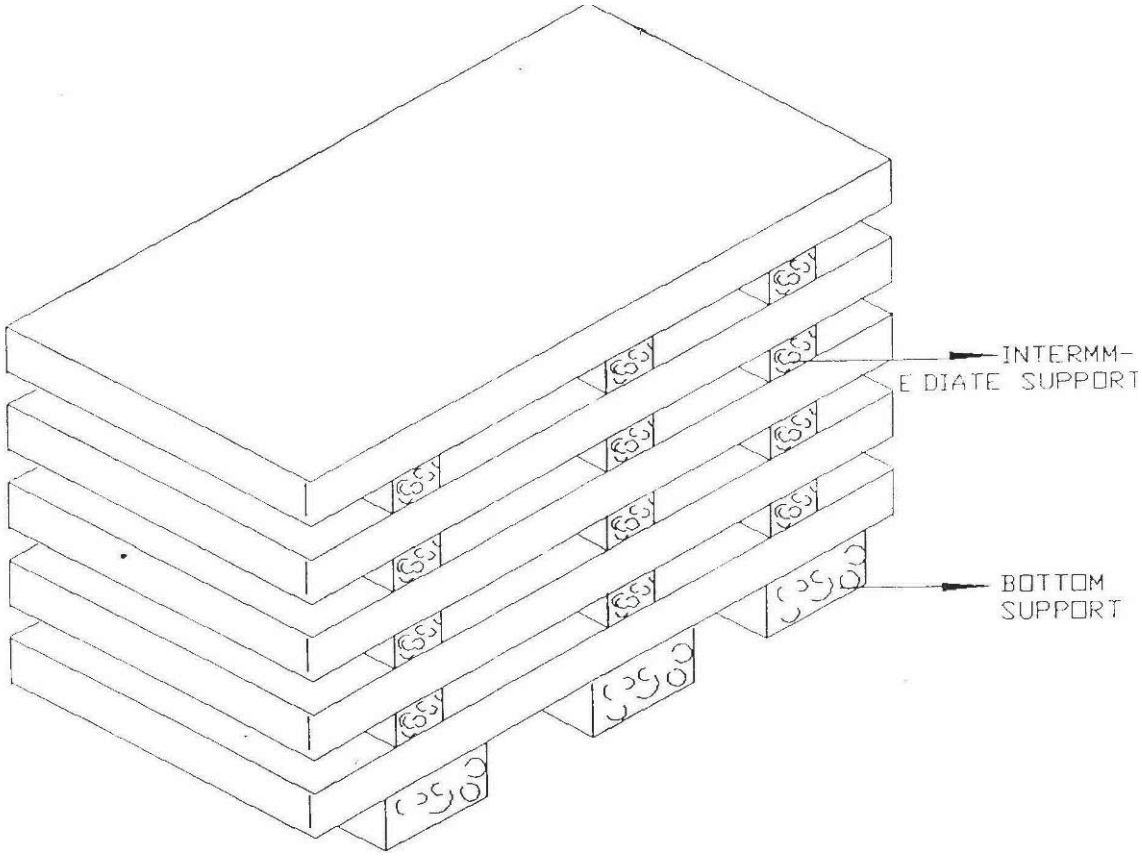


Figure – 1 – PLATE STACKING ARRANGEMENT

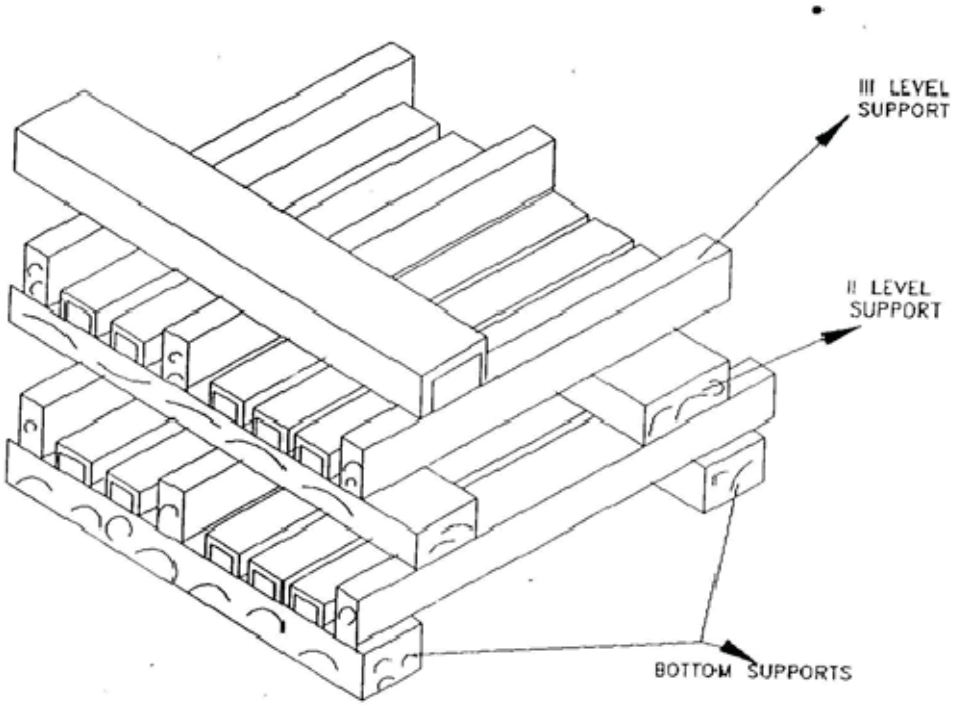


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

SECTION-I

SUB SECTION E

ANNEXURE-VIII

PAINTING SPECIFICATION & COLOUR SCHEME (COVERED UNDER SECTION C2-B)

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

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	Vendor

SECTION: II

SUB SECTION: 2

LIST OF DOCUMENTS TO BE SUBMITTED WITH BID

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

1. Compliance cum confirmation certificate
2. Unpriced format for Main package, mandatory spares, tools and tackles and commissioning spares on BHEL e-procurement portal.
3. Pre-bid clarification schedule and signed copy of technical corrigenda, if any.
4. PQR Qualification documents

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

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: _____

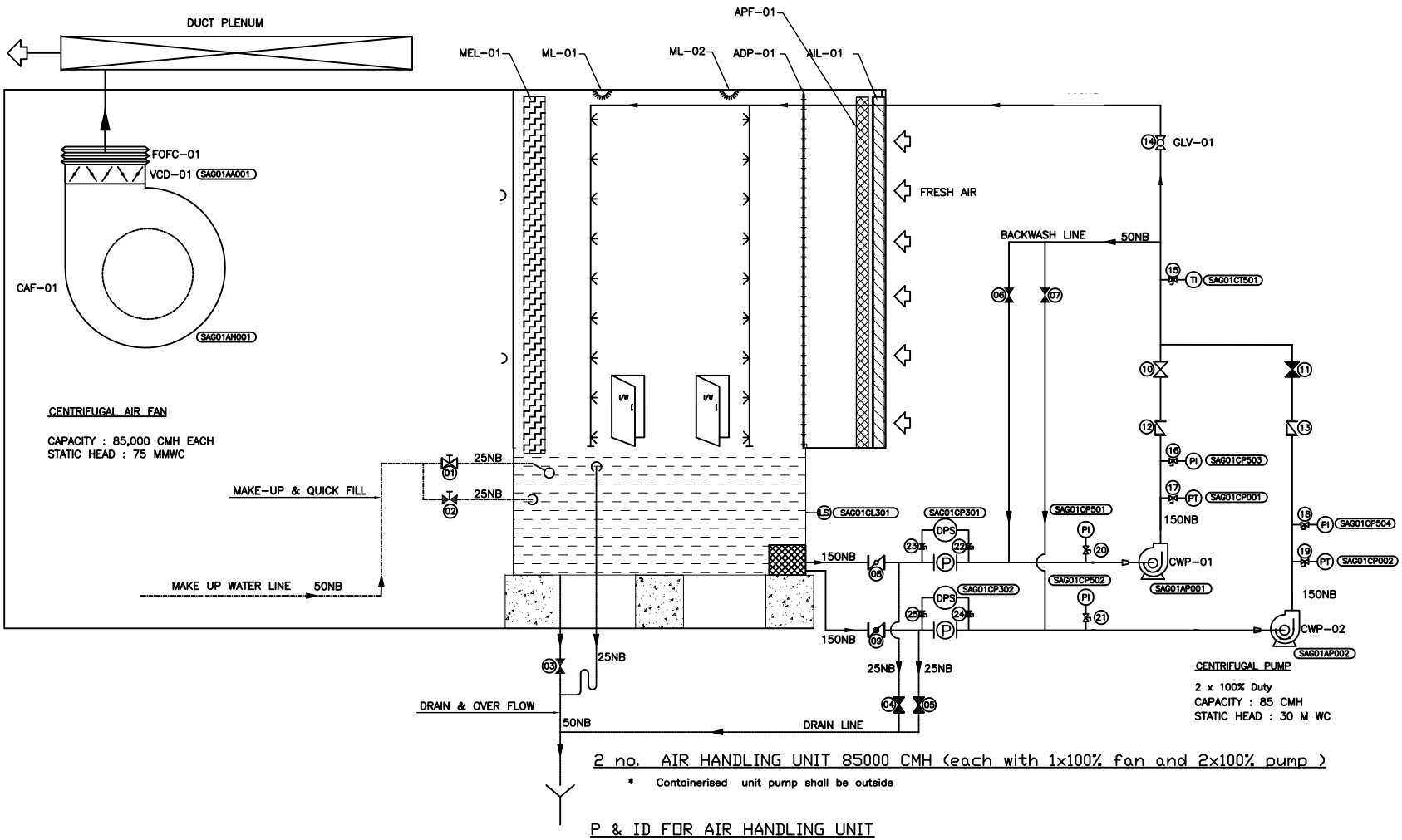
Date: _____

Company Seal

SECTION: II

SUB SECTION: 6

TENDER DRAWINGS



2 no. AIR HANDLING UNIT 85000 CMH (each with 1x100% fan and 2x100% pump)

* Containerised unit pump shall be outside

P & ID FOR AIR HANDLING UNIT

REFERENCE DOCUMENTS / DRAWINGS

DOCUMENT / DRAWING NO	DOCUMENT / DRAWING TITLE

NOTES :

1. LINE SIZE/INTRUMENT ARE INDICATIVE SHALL BE FINALIZED DURING DETAIL ENGG.
2. DRAIN PIPE SHALL BE ROUTED NEAREST DRAIN POINT .
3. ALL WATER PIPING SHALL BE AS PER TECHANICAL SPECIFICATIONS. FOR ALARM / TRIP.
4. SATURATION EFFICIENCY OF THE AIR HANDLING UNIT SHALL BE 90%.
5. IN THE AIR HANDLING TANK LOW LEVEL SWITCH SHALL BE PROVIDED

LINE LEGENDS

- MAKE-UP QUICKFILL LINE
- DRAIN & OVER FLOW LINE
- CIRCULATING WATER LINE

S.N	LEGEND	DESCRIPTION	TAG NO	QTY/ HANDLING UNIT
01		CENTRIFUGAL AIR FAN	CAF-01	01 Nos
02		VOLUME CONTROL DAMPER	VCD-01	01 Nos
03		FAN OUTLET (Non-Asbestos) FLEXIBLE CONNECTION	FOFC-01	01 Nos
04		AIR INTAKE LOUVER WITH BIRDMESH	AIL-01	01 SET
05		MIST ELIMINATOR	MEL-01	01 SET
06		AIR PRE FILTER	APF-01	01 SET
07		AIR DISTRIBUTION PLATE	ADP-01	01 SET
08		GLOBE VALVE OPEN	GLV-01	01 No
09		BUTTER FLY VALVE OPEN/CLOSE	BFV-01 TO 04	04 Nos
10		GATE VALVE OPEN/CLOSE	GTV-01 TO 07	07 Nos
11		DIFFERENTIAL PRESSURE SWITCH	DPS-01 TO 02	02 Nos
12		COOLING WATER CENTRIFUGAL PUMP	CWP-01 TO 02	02 Nos
13		NON RETURN VALVE	NRV-01 TO 02	02 Nos
14		PRESSURE INDICATOR WITH ISOLATION VALVE	PI-01 TO PI-04	04 Nos
15		PRESSURE TRANSMETER	PT-01 to 02	02 Nos
16		LEVEL SWITCH	LS-01	01 Nos
17		MARRINE LIGHT	ML-01 TO 02	02 Nos
18	TI	TEMPERATURE INDICATOR WITH ISOLATION VALVE	TI-01	01 No
19		POT STRAINER	PSTR-01 TO 02	02 Nos

Note
2x make up water pumps with applicable valves piping, instruments and strainers etc also to be provided for pumping of make up water to make up water tank.

VALVES KKS NUMBERING FOR AWU-1			
S. NO	DESCRIPTION	SIZE	KKS
01.	Gate Valve	25 NB	SAG01AA501
02.	Gate Valve	25 NB	SAG01AA502
03.	Gate Valve	25 NB	SAG01AA503
04.	Gate Valve	25 NB	SAG01AA504
05.	Gate Valve	25 NB	SAG01AA505
06.	Gate Valve	25 NB	SAG01AA506
07.	Gate Valve	25 NB	SAG01AA507
08.	Butter Fly Valve	150 NB	SAG01AA508
09.	Butter Fly Valve	150 NB	SAG01AA509
10.	Gate Valve	150 NB	SAG01AA510
11.	Gate Valve	150 NB	SAG01AA511
12.	Non Return Valve	150 NB	SAG01AA401
13.	Non Return Valve	150 NB	SAG01AA401
14.	Globe Valve	150 NB	SAG01AA601

VALVES KKS NUMBERING FOR AWU-1			
S. NO	DESCRIPTION	SIZE	KKS
15.	Ball Valve	15 NB	SAG01AA551
16.	Ball Valve	15 NB	SAG01AA552
17.	Ball Valve	15 NB	SAG01AA553
18.	Ball Valve	15 NB	SAG01AA554
19.	Ball Valve	15 NB	SAG01AA555
20.	Ball Valve	15 NB	SAG01AA556
21.	Ball Valve	15 NB	SAG01AA557
22.	Ball Valve	15 NB	SAG01AA558
23.	Ball Valve	15 NB	SAG01AA559
24.	Ball Valve	15 NB	SAG01AA560
25.	Ball Valve	15 NB	SAG01AA561

EQUIPMENT CAPACITY			
S. NO	DESCRIPTION	QTY.	CAPACITY
01.	Centrifugal Fan	2 nos.	85,000 CMH
02.	Pump	4 nos.	85

1) Bidder to note that the P&ID shows only the bare minimum requirement of valves and instruments. Any instrumentation & valves as required for the completion of the system in line with technical specification shall be provided by bidder during detailed engineering without any commercial implication.

PROJECT:	3x33MW + 1x8+3x33MW 206MW SHAHPURKANDI HEP
OWNER:	PSPCL
CONSULTANT:	WAPCOS Ltd
EPC CONTRACTOR:	BHARAT HEAVY ELECTRICALS LTD.

JOB NO. 406
STATUS CONTRACT
DISTRIBUTION

REV.	DATE	ALTD	CHD	APPD

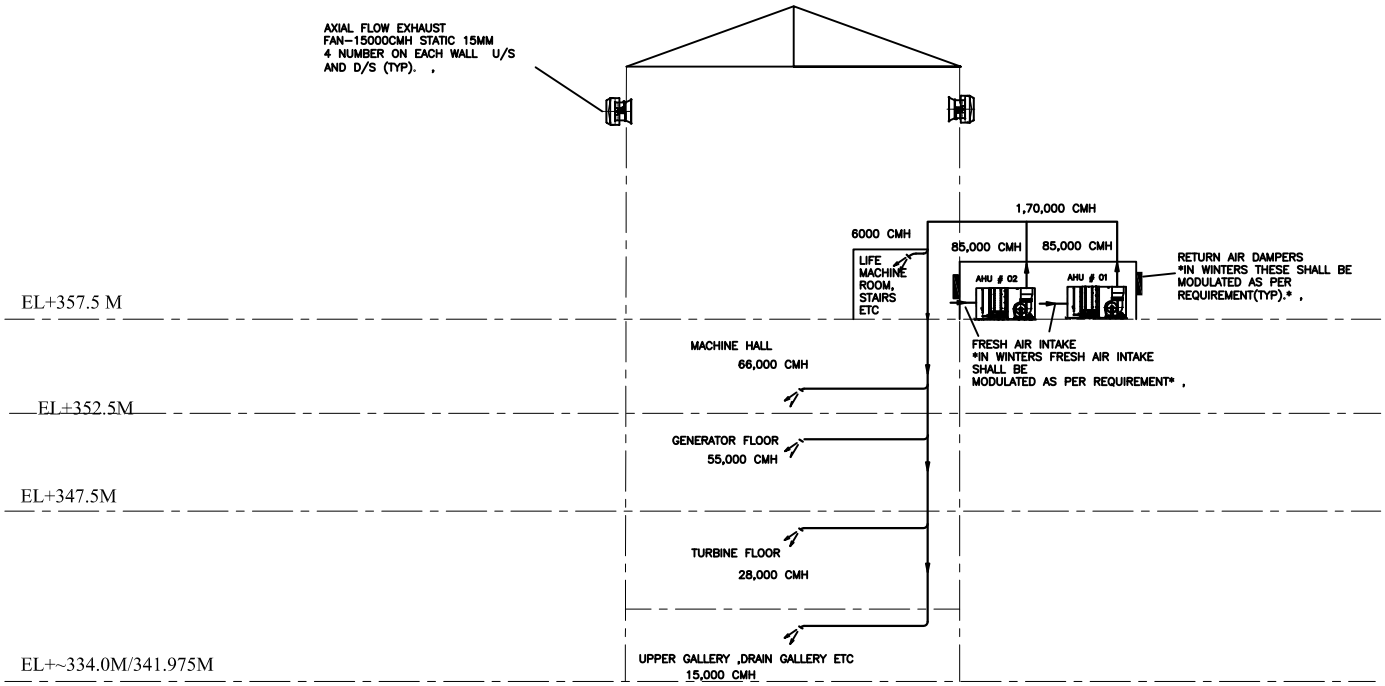
BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT.	DESIGN	CHECK	DATE
M			11.06.2020
			11.06.2020
	APPD.	LJ	11.06.2020

TITLE SINGLE LINE FLOW DIAGRAM FOR AHU FOR POWER HOUSE BUILDING

DRAWING NO. PE-YD-106-XXX-A602

CONTENTS ARE COPYRIGHT. It must not be used directly or indirectly by any BHEL/BHEL UNIT. It must not be used directly or indirectly by any unauthorised party for any purpose without the written consent of the company.



TENTATIVE AIR DISTRIBUTION IN POWER HOUSE

NTPC REFERENCE DOCUMENTS / DRAWINGS

DOCUMENT / DRAWING NO	DOCUMENT / DRAWING TITLE

NOTES

1) VALUES SHOWN IN AIR DISTRIBUTION SHEET ARE TENTATIVE AND MAY CHANGE DURING DETAILED ENGG

2) DURING SUMMERS 100% FRESH AIR SHALL BE COOLED THROUGH EVAPORATIVE TYPE AIR HANDLING UNIT AND RETURN AIR
AIR DAMPER SHALL BE KEPT CLOSED/USED AS PER REQUIREMENT.

3) DURING WINTER FRESH AIR SUPPLY SHALL BE ADJUSTED ACCORDING TO REQUIREMENT AND RETURN AIR DAMPER SHALL BE OPENED.

PROJECT	3X33+1X8+ 3X33MW - 206MW SHAHPURKANDI HEP
OWNER	PSPCL
PROJECT CONSULTANT	WAPCOS LIMITED
PACKAGE	HVAC SYSTEM
CONTRACTOR	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECTS ENGINEERING MANAGEMENT NOIDA
TITLE	AIR DISTRIBUTION IN POWER HOUSE

DRN.	CHD.	APPD.	DATE	SCALE	
UTK	UTK	LJ	14.08.2020	-	BHEL DRG. NO : PE-V0-406-XXX-A602 SHEET : 1 OF 1 REV-0

DRAWING SIZE : A2

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 12000019354 REV.

NOTES:-

1) LAYOUT SHOWS THE OVERALL DIMENSIONS OF POWER HOUSE
2) ALL CIVIL DESIGN INCLUDING CONCRETE THICKNESS OF FLOORS, SIZE OF COLUMN AND BEAMS ETC. TO BE DECIDED/DEVELOPED BY CIVIL DESIGN/AGENCY.
3) SUPER STRUCTURE, STAIRWAY, RAILINGS ETC TO BE DEVELOPED BY CIVIL DESIGN AGENCY
4) THE LAYOUT OF EACH FLOOR IS TENTATIVE AND SHALL BE FINALIZED DURING DETAIL ENGG.
5) STAGES OF CONCRETE SHOWN IS TENTATIVE .
6) DIMENSIONS/APPROACHES SHOWN FOR EOT CRANE ARE TENTATIVE AND SHALL BE FINALIZED AFTER EOT CRANE DESIGN.
7) ALL THE DIMENSIONS ARE IN MM AND ELEVATIONS IN METER.
8) ANY EQUIPMENT NOT MARKED IN THE LAYOUT DRAWING BUT REQUIRED FOR THE COMPLETENESS OF THE WORK SHALL BE SUPPLIED BY THE BHEL AS PER THE PROVISIONS OF THE CONTRACT
9) ALL THE HATCHES SHALL BE COVERED WITH GRATINGS AND RAILINGS (TO BE PROVIDED BY CIVIL AGENCY).
10) TO REMOVE AMBIGUITY WHICH MAY ARISE DUE TO SEPARATE DRAWINGS, STATION LAYOUT & CIVIL GUIDELINE DRAWINGS HAS BEEN COMBINED.
11) SURFACE DRAIN ARRANGEMENT OF FLOORS SHALL BE IN CIVIL SCOPE.
12) STATION LAYOUT CUM CIVIL GUIDELINES ARE SHOWN TENTATIVELY ON REQUEST OF CIVIL AGENCY, HOWEVER FINAL CUT-OUTS ETC SHOULD BE AS PER INDIVIDUAL SYSTEM/EQUIPMENT DRAWINGS.
13) DETAILS OF COLUMNS/BEAMS/WALL/STAIRS/TOILETS ETC ARE TO BE FINALIZED BY CIVIL AGENCY.

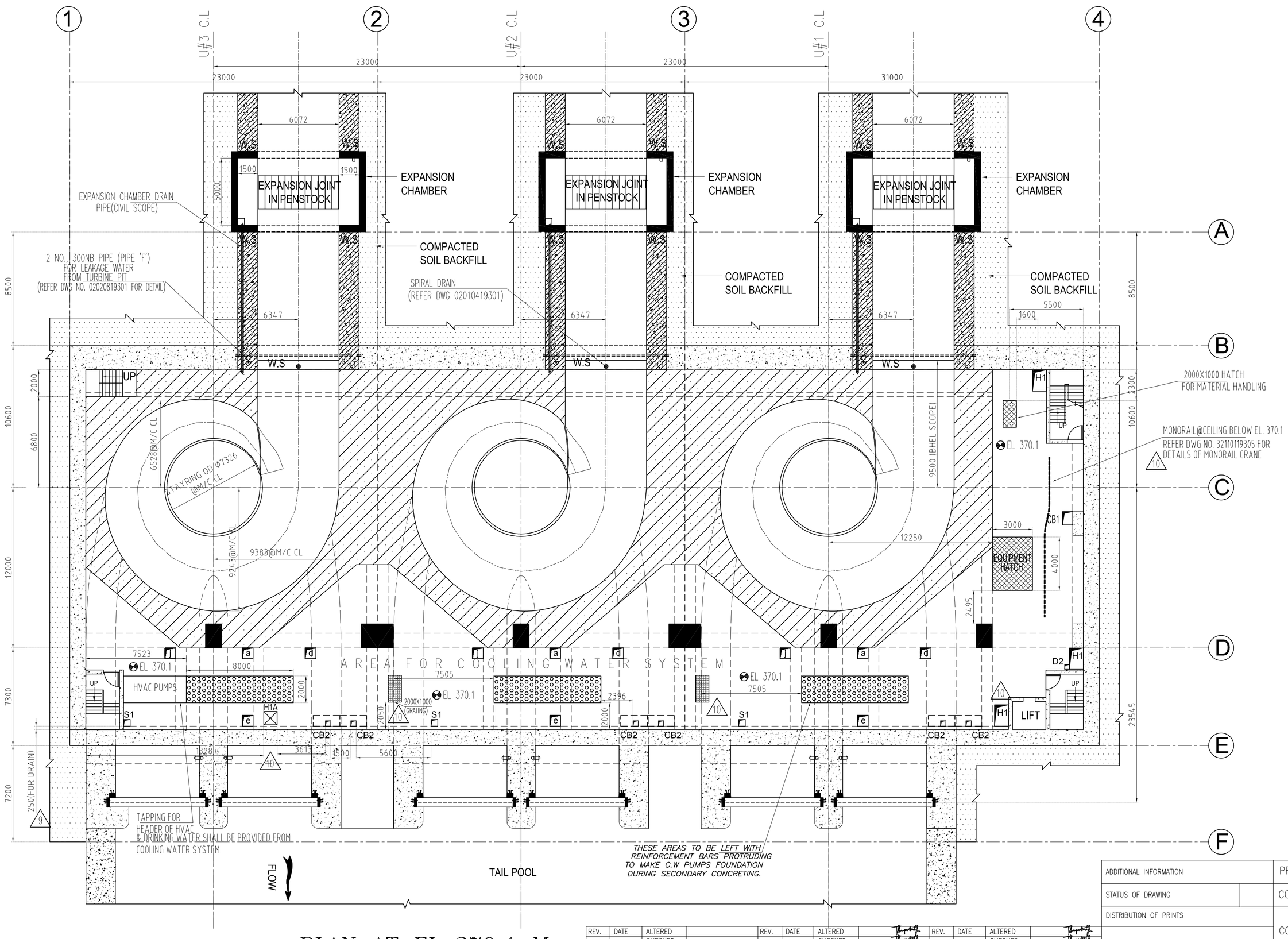
TABLE-A (REFERENCE DRAWINGS)

#	DESCRIPTION	DRAWING NO.
1	PIPES & EMBEDMENT IN FIRST STAGE	02010419301
2	PIPES & EMBEDMENT IN SECOND STAGE	02020819301
3	SIDE CROSS-SECTION VIEW THROUGH POWER HOUSE	12000019351
4	PLAN AT EL 370.1 M	12000019354
5	ARRANGEMENT OF SPIRAL CASING	02020219301

CUTOUT DETAILS

CUT-OUT	SIZE	PURCHASE
H1	1600X1000	FOR DRAINAGE & DEWATERING DISCHARGE PIPE TO TAIL RACE
S1	500X500	SPARE
CB1	1000X750	FOR D&D CABLES/CABLE TRAY
CB2	400X400	FOR CABLES/CABLE TRAY
H1	1600X1000	FOR HVAC/FF/CAS
H1A	1000X1000	FOR HVAC
D2	350X350	FOR AIR VENT PIPE
a	800x800	CW TO TURBINE
d	800x800	CW FROM PENSTOCK TO CW PUMP
e	800x800	FROM CW PUMP TO TAIL RACE
j	800x800	FOR SPARE

10



PLAN AT EL 370.1 M

REV.	DATE	ALTERED / CHECKED / APPROVED	ZONE	DESCRIPTION
10	16.9.23	BSINGH / B.SINGH / R.SINGH		REVISED AS PER GOOGLE MEET DISCUSSION WITH XEN-SKPP, PSPCL DATED 16-19.9.23
09	29.05.23	BSINGH / B.SINGH / R.SINGH		REVISED AS PER GOOGLE MEET DISCUSSION WITH PSPCL DATED 29.05.23
08	13.08.22	BSINGH / B.SINGH / R.SINGH		REVISED AS PER GOOGLE MEET DISCUSSION WITH XEN-SKPP, PSPCL DATED 13.08.22
07	14.06.22	BSINGH / B.SINGH / R.SINGH		REVISED AS PER PSPCL'S REQUIREMENT WRT INPUT DATA OF S/Y PANELS, REVISED HVAC DUCT & REVISED EOT DM. REVISED DURING MEETING DATED 07-06-22 & 08-06-22.
06	26.03.22	BSINGH / B.SINGH / R.SINGH	ZONE	DRAWING REVISED AS PER LATEST CIVIL DRAWINGS AND AS PER MOM DATED 28.01.22
05	24.01.22	BSINGH / B.SINGH / R.SINGH	ZONE	DRAWING REVISED AS PER LATEST CIVIL DRAWINGS
04	12.12.19	BSINGH / B.SINGH / R.SINGH	ZONE	DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 28.11.19 VIDE LETTER 1600/SE/SKPP/HD/128-A & VISIT OF PSPCL'S OFFICIALS AT BHOPAL
03	13.11.19	BSINGH / B.SINGH / R.SINGH	ZONE	DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 21.10.19 VIDE LETTER 1424/27
02	30.08.19	BSINGH / B.SINGH / R.SINGH	ZONE	DRAWING REVISED AS PER PSPCL'S COMMENTS
01	03.09.14	T.KHAN / B.SINGH / R.SINGH	ZONE	

ADDITIONAL INFORMATION	
STATUS OF DRAWING	
DISTRIBUTION OF PRINTS	

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	BSINGH		26.04.14	
CHKD	RSINGH		26.04.14	
APPD	RSINGH		26.04.14	

SUB-SUPPLIER / VENDOR

PROJECT	3X33MW SHAHPURKANDI HEP-I
COTUMER	PSPCL PUNJAB
CONSULTANT	WAPCOS LIMITED
CONTRACTOR	Bharat Heavy Electricals Limited, Bhopal

DEPT / CODE / UNTOL. DIMS. GR. / ANGLE / SCALE 1:183 / WEIGHT(kg) / REF.TO ASSY.DRG. / ITEM NO. / NO.OF ITEMS

TITLE: STATION LAYOUT CUM CIVIL GUIDELINES AT EL 370.1M

DRAWING NO. 12000019354 REV. 10

SHEET NO. / NO. OF SHEETS.

A1 SIZE

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

INVENTORY NO. | SIGN. & DATE | REF. DRG. NO.

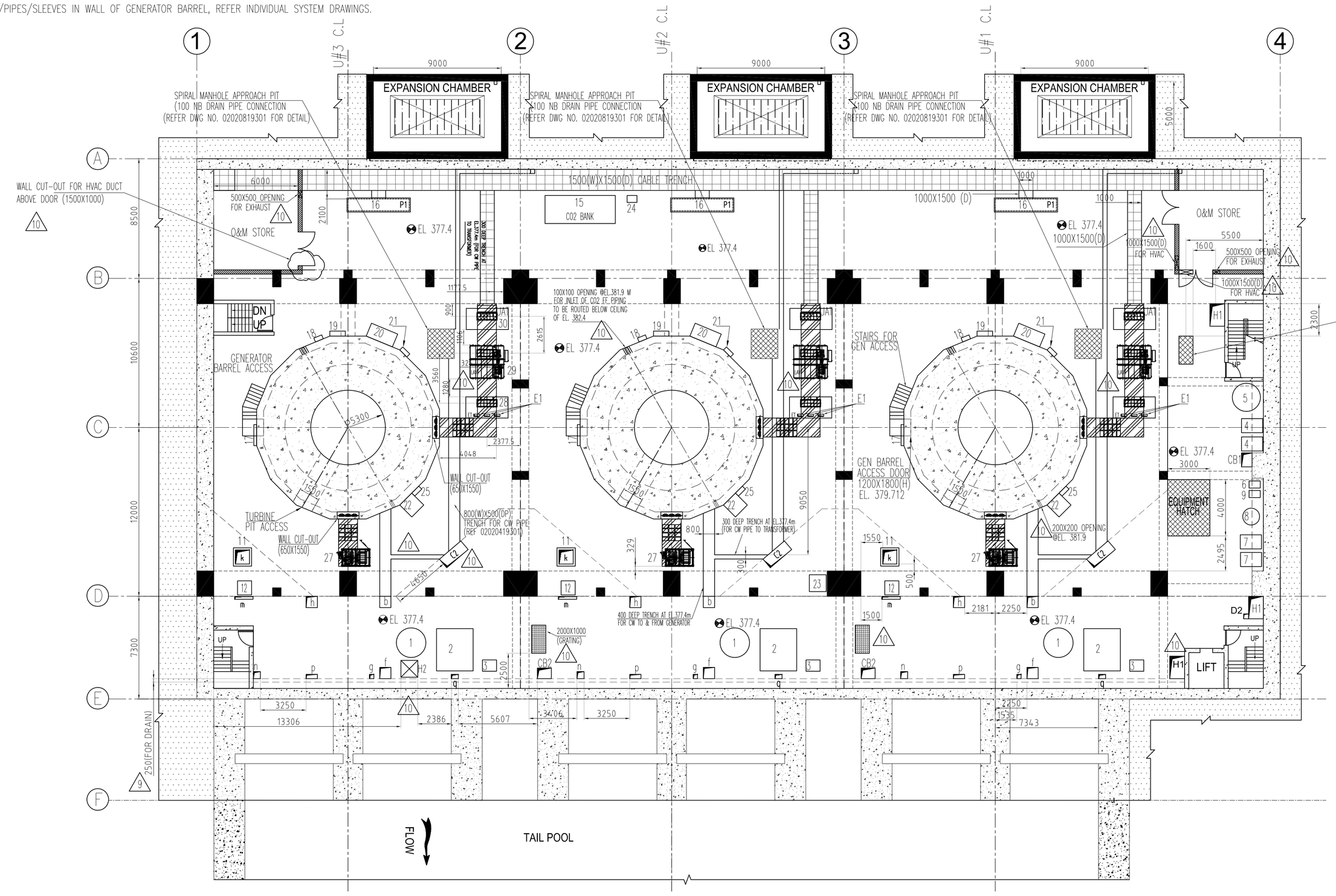
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 12000019355 REV.

NOTES:–

1) LAYOUT SHOWS THE OVERALL DIMENSIONS OF POWER HOUSE
2) ALL CIVIL DESIGN INCLUDING CONCRETE THICKNESS OF FLOORS, SIZE OF COLUMN AND BEAMS ETC. TO BE DECIDED/DEVELOPED BY CIVIL DESIGN/AGENCY.
3) SUPER STRUCTURE, STAIRWAY, RAILINGS ETC TO BE DEVELOPED BY CIVIL DESIGN AGENCY
4) THE LAYOUT OF EACH FLOOR IS TENTATIVE AND SHALL BE FINALIZED DURING DETAIL ENGG.
5) STAGES OF CONCRETE SHOWN IS TENTATIVE .
6) DIMENSIONS/APPROACHES SHOWN FOR EOT CRANE ARE TENTATIVE AND SHALL BE FINALIZED AFTER EOT CRANE DESIGN.
7) ALL THE DIMENSIONS ARE IN MM AND ELEVATIONS IN METER.
8) ANY EQUIPMENT NOT MARKED IN THE LAYOUT DRAWING BUT REQUIRED FOR THE COMPLETENESS OF THE WORK SHALL BE SUPPLIED BY THE BHEL AS PER THE PROVISIONS OF THE CONTRACT
9) ALL THE HATCHES SHALL BE COVERED WITH GRATINGS AND RAILINGS (TO BE PROVIDED BY CIVIL AGENCY).
10) TO REMOVE AMBIGUITY WHICH MAY ARISE DUE TO SEPARATE DRAWINGS, STATION LAYOUT & CIVIL GUIDELINE DRAWINGS HAS BEEN COMBINED.
11) SURFACE DRAIN ARRANGEMENT OF FLOORS SHALL BE IN CIVIL SCOPE.
12) STATION LAYOUT CUM CIVIL GUIDELINES ARE SHOWN TENTATIVELY ON REQUEST OF CIVIL AGENCY, HOWEVER FINAL CUT-OUTS ETC SHOULD BE AS PER INDIVIDUAL SYSTEM/EQUIPMENT DRAWINGS.
13) DETAILS OF COLUMNS/BEAMS/WALL/STAIRS/TOILETS ETC ARE TO BE FINALIZED BY CIVIL AGENCY.
14) CUT-OUTS LESS THAN 500X500 OTHER THAN SHOWN IN THE DRAWING, IF REQUIRED, TO BE MADE AS PER SUIT TO SITE CONDITION.
15) FOR CUT-OUTS/PIPES/SLEEVES IN WALL OF GENERATOR BARREL, REFER INDIVIDUAL SYSTEM DRAWINGS.



PLAN AT EL 377.4M(TURBINE/GENERATOR FLOOR)

TABLE FOR DIMENSION OF EQUIPMENTS FOR (TENTATIVE)

ITEM NO	DESCRIPTION	DIMENSION WIDTH	DEPTH	HEIGHT	QTY/ UNIT	TOTAL QTY	WEIGHT KG.(S)	SUPPLYING UNIT
1	PRESSURE RECEIVER	ø2100	–	3500	1	3	–	HPE GOV
2	PP SET	2300	3000	3200	1	3	–	HPE GOV
3	TURBINE OPU STARTER PANEL	1000	800	3200	1	3	–	HPE ELEC.
4	LP AIR COMPRESSOR	1500	1000	1000	–	2	–	HTE
5	LP AIR RECEIVER	ø2000	–	2500	–	1	–	HTE
6	STARTER PANEL FOR LP AIR COMPRESSORS	500	500	500	–	1	–	HPE ELEC.
7	HP AIR COMPRESSOR	1500	1000	1000	–	2	–	HTE
8	HP AIR RECEIVER	ø1200	–	2500	–	1	–	HTE
9	STARTER PANEL FOR HP AIR COMPRESSORS	500	500	500	–	1	–	HPE ELEC.
SHIFTED TO EL 382.4	~~ELECTRO HYDRAULIC GOVERNOR~~	~~800~~	~~800~~	~~2500~~	~~1~~	~~3~~	~~–~~	~~HPE GOV~~
11	HYDRO MECHANICAL CABINET	1300	1300	2400	1	3	–	HPE GOV
12	RUNNER CONTROL MECHANISM	1000	1000	2200	1	3	–	HPE GOV
SHIFTED TO EL 382.4	~~UNIT CONTROL BOARD(UCB)~~	~~3804~~	~~800~~	~~2465~~	~~1~~	~~3~~	~~–~~	~~EDN~~
SHIFTED TO EL 382.4	~~TEMPERATURE, GAUGE & INSTRUMENT PANEL~~	~~3000~~	~~800~~	~~2465~~	~~1~~	~~3~~	~~–~~	~~EDN~~
10 15	CO2 TYPE FIRE EXTINGUISHING SYSTEM	5000	2000	2300	–	1	1500	HGE
16	UNIT AUXILIARY BOARD(UAB)	3750	1000	2300	1	3	–	HPE ELEC.
17	MARSHALLING BOX(WALL MOUNTED)	1500	200	1200	1	3	100	HGE
18	GENERATOR SPACE HEATER PANEL	600	300	800	1	3	–	HPE ELEC.
19	BRAKE & JACK CONTROL PANEL	1100	350	1200	1	3	350	HGE
20	H.S LUBRICATION UNIT	2000	800	800	1	3	–	HGE
21	H.S LUB. STARTER PANEL	600	300	800	1	3	–	HPE ELEC.
22	BRAKE DUST COLLECTOR	1200	1200	2500	1	3	500	HGE
23	MOTORISED POWER PACK	1200	1200	1800	–	1	300	HGE
24	CONTROL PANEL FOR CO2 TYPE FF SYSTEM	500	700	2300	–	1	200	HGE
25	BRAKE DUST COLLECTOR STARTER PANEL	600	300	800	1	3	–	HPE ELEC.
SHIFTED TO EL 382.4	~~EXCITATION PANELS~~	~~5200~~	~~1250~~	~~2300~~	~~1~~	~~3~~		~~EDN~~
27	NGC	2000	1250	–	1	3	–	JHANSI
28	EXCITATION TRANSFORMER	3000	1500	2400	1	3	–	EDN
29	LAVT	2400	2250	2210	1	3	–	RUDRAPUR
30	UAT	–	–	–	1	3	–	JHANSI

DETAILS OF TENTATIVE CUTOUTS/TRENCH ON THE FLOOR

ITEM	DESCRIPTION	SIZES (LXBXD)
C1	COOLING WATER SYSTEM	300X300
C2	COOLING WATER SYSTEM	800X2000
h,f,b	COOLING WATER SYSTEM	800X800
CB1	CABLE TRAY	1000X750
CB2	CABLE TRAY	1000X750
10 H1	DRAINAGE & DEWATERING SYSTEM	1600X1000
E1	EXCITATION TRANSFORMER	400X150
q	GOVERNING SYSTEM	500X300
m	GOVERNING SYSTEM	1300X200
k	GOVERNING SYSTEM	1000X1000
P	GOVERNING SYSTEM	800X300
H1	FOR HVAC/FF/CAS	1600X1000
H2	FOR HVAC	1200X1200
P1	UNIT AUX BOARD	4350X850X1500 (TRENCH)
n	SPARE OR FF OR HVAC MAKEUP CUTOUT	500X500
D2	FOR AIR VENT PIPE	350X350

REV.	DATE	ALTERED / CHECKED / APPROVED	ZONE	DESCRIPTION
08	13.08.22	BSINGH / B.SINGH / R.SINGH		REVISED AS PER GOOGLE MEET DISCUSSION WITH XEN-SKPP, PSPCL DATED 13.08.22
07	14.06.22	BSINGH / B.SINGH / R.SINGH		REVISED AS PER PSPCL'S REQUIREMENT WRT INPUT DATA OF S/Y PANELS, REVISED HVAC DUCT & REVISED EOT DM. REVISED DURING MEETING DATED 07-06-22 & 08-06-22.
06	26.03.22	BSINGH / B.SINGH / R.SINGH		DRAWING REVISED AS PER LATEST CIVIL DRAWINGS AND AS PER MOM DATED 28.01.22
05	24.01.22	BSINGH / B.SINGH / R.SINGH		DRAWING REVISED AS PER LATEST CIVIL DRAWINGS
04	12.12.19	BSINGH / B.SINGH / R.SINGH		DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 28.11.19 VIDE LETTER 1600/SE/SKPP/HD/128-A & VISIT OF PSPCL'S OFFICIALS AT BHOPAL
03	13.11.19	BSINGH / B.SINGH / R.SINGH		DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 21.10.19 VIDE LETTER 1424/27
02	30.08.19	BSINGH / B.SINGH / R.SINGH		DRAWING REVISED AS PER PSPCL'S COMMENTS
01	03.09.14	T.KHAN / B.SINGH / R.SINGH		
10	16.9.23	BSINGH / B.SINGH / R.SINGH		REVISED AS PER GOOGLE MEET DISCUSSION WITH XEN-SKPP, PSPCL DATED 16-19.9.23
09	29.05.23	BSINGH / B.SINGH / R.SINGH		REVISED AS PER GOOGLE MEET DISCUSSION WITH PSPCL DATED 29.05.23

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	BSINGH		26.04.14	
CHKD	RSINGH		26.04.14	
APPD	RSINGH		26.04.14	

ADDITIONAL INFORMATION | STATUS OF DRAWING | DISTRIBUTION OF PRINTS

SUB-SUPPLIER / VENDOR

PROJECT: 3X33MW SHAHPURKANDI HEP-I
COTUMER: PSPCL PUNJAB
CONSULTANT: WAPCOS LIMITED
CONTRACTOR: Bharat Heavy Electricals Limited, Bhopal

DEPT | CODE | UNTOL. DIMS. GR. | ANGLE | SCALE 1:183 | WEIGHT(kg) | REF.TO ASSY.DRG. | ITEM NO. | NO.OF ITEMS

TITLE: STATION LAYOUT CUM CIVIL GUIDELINES AT 377.4 MTR (TURBINE/GENERATOR FLOOR)

DRAWING NO. 12000019355 REV. 10

SHEET NO. | NO. OF SHEETS.

A1 SIZE

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

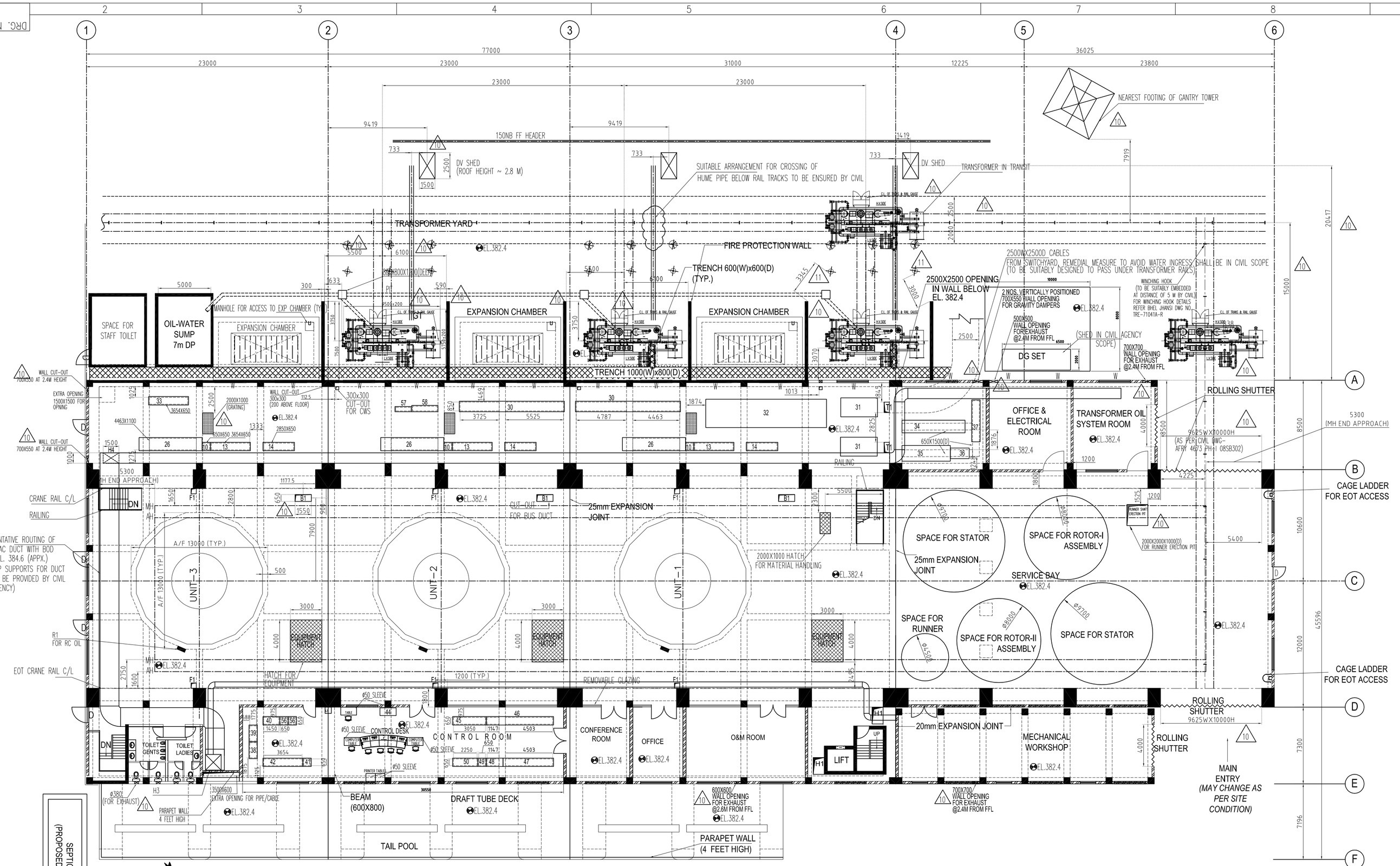
REF. DRG. NO. | SIGN. & DATE | INVENTORY NO.

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 12000019356 REV.

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED.
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.



PLAN AT EL 382.40M(SERVICE BAY/MACHINE HALL FLOOR)

TABLE FOR DIMENSION OF EQUIPMENTS/CUT-OUT (TENTATIVE)

ITEM NO	DESCRIPTION	DIMENSION WIDTH	DEPTH	HEIGHT	QTY/ UNIT	TOTAL QTY	WEIGHT KG.(S)	SUPPLYING UNIT	CUT-OUT SIZE
10	ELECTRO HYDRAULIC GOVERNOR	800	800	2500	1	3	–	HPE GOV	650X650
13	UNIT CONTROL BOARD(UCB)	3804	800	2465	1	3	–	EDN	3654X650
14	TEMPERATURE, GAUGE & INSTRUMENT PANEL	3000	800	2465	1	3	–	EDN	2850X650
30	STATION SERVICE BOARD	10000	1000	2465	–	2		HPE (ELEC)	AS MARKED
31	STATION SERVICE TRANSFORMER	3500	1800	2200	–	2		JHANSI	1000X500
32	11kV SWITCHGEAR PANEL	11000	2400	2465	–	1		BPL SME	AS PER DWG
33	LCB	3804	800	2465	–	1	–	EDN	3654X650
26	EXCITATION PANELS	5200	1250	2300	1	3		EDN	4463X1100
34	LT ACDB (S/Y)	6000	1200	–	–	1		TBG	AS MARKED
35	LT MLDB (S/Y)	4600	1500	–	–	1		TBG	AS MARKED
36	LT ELDB (S/Y)	1800	1000	–	–	1		TBG	AS MARKED
37	220V DCDB (S/Y)	4000	800	–	–	1		TBG	AS MARKED
38	GRP UNIT #1	1600	800	2320	–	1		SWE	1450X650
39	GRP UNIT #2	1600	800	2320	–	1		SWE	1450X650
40	GRP UNIT #3	1600	800	2320	–	1		SWE	1450X650
41	NETWORK PANEL	800	800	2200	–	1		EDN	650X650
42	C&R PANEL SWITCHYARD	3804	800	–	–	1		TBG	3654X650
43	GPS PANEL(WALL MOUNTED)	600	600	–	–	1		EDN	–
44	LARGE VIDEO SCREEN	–	–	–	–	1		EDN	–
45	PLCC & EPBAX	3200	800	–	–	1		TBG	3550X650
46	LRP 1	6400	800	–	–	1		TBG	(1147+4503)X650
47	LRP 2	4800	800	–	–	1		TBG	4503X650
48	BBRP	1600	800	–	–	1		TBG	1147X650
49	BCRP	800	800	–	–	1		TBG	650X650
50	GTRP	2400	800	–	–	1		TBG	2250X650

TABLE FOR DIMENSION OF EQUIPMENTS/CUT-OUT (TENTATIVE)

ITEM NO	DESCRIPTION	DIMENSION WIDTH	DEPTH	HEIGHT	QTY/ UNIT	TOTAL QTY	WEIGHT KG.(S)	SUPPLYING UNIT	CUT-OUT SIZE
56	OPTICAL FIBRE CONNECTION PANEL	800	800	–	–	2		EDN	650X650
57	STARTER PANEL FOR DRAINAGE PUMPS	1600	500	2000	–	1		HPE-ELECT	1450X350
58	STARTER PANEL FOR DEWATERING PUMPS	2500	600	2000	–	1		HPE-ELECT	2350X450

DETAILS OF OTHER TENTATIVE CUTOUTS/TRENCH ON THE FLOOR

ITEM	DESCRIPTION	SIZES (LXBXD)
T1	SST CABLE CUT-OUT	1000X500
B1	GENERATOR BUS DUCT	1550X700
R1	RCM OIL PIPE LINE	800X300
F1	FIRE FIGHTING	500X500
H1	FOR HVAC/FF/CAS	1600X1000
H3	FOR HVAC	1500X1500
H4	FOR HVAC	1500X1000
–	EXTRA OPENING FOR PIPE/ CABLE	3500X600

NOTES:–

1) LAYOUT SHOWS THE OVERALL DIMENSIONS OF POWER HOUSE
2) ALL CIVIL DESIGN INCLUDING CONCRETE THICKNESS OF FLOORS, SIZE OF COLUMN AND BEAMS ETC. TO BE DECIDED/DEVELOPED BY CIVIL DESIGN/AGENCY.
3) SUPER STRUCTURE, STAIRWAY, RAILINGS ETC TO BE DEVELOPED BY CIVIL DESIGN AGENCY
4) THE LAYOUT OF EACH FLOOR IS TENTATIVE AND SHALL BE FINALIZED DURING DETAIL ENGG.
5) STAGES OF CONCRETE SHOWN IS TENTATIVE .
6) DIMENSIONS/APPROACHES SHOWN FOR EOT CRANE ARE TENTATIVE AND SHALL BE FINALIZED AFTER EOT CRANE DESIGN.
7) ALL THE DIMENSIONS ARE IN MM AND ELEVATIONS IN METER.
8) ANY EQUIPMENT NOT MARKED IN THE LAYOUT DRAWING BUT REQUIRED FOR THE COMPLETENESS OF THE WORK SHALL BE SUPPLIED BY THE BHEL AS PER THE PROVISIONS OF THE CONTRACT
9) ALL THE HATCHES SHALL BE COVERED WITH GRATINGS AND RAILINGS (TO BE PROVIDED BY CIVIL AGENCY).
10) TO REMOVE AMBIGUITY WHICH MAY ARISE DUE TO SEPARATE DRAWINGS, STATION LAYOUT & CIVIL GUIDELINE DRAWINGS HAS BEEN COMBINED.
11) SURFACE DRAIN ARRANGEMENT OF FLOORS SHALL BE IN CIVIL SCOPE.
12) STATION LAYOUT CUM CIVIL GUIDELINES ARE SHOWN TENTATIVELY ON REQUEST OF CIVIL AGENCY, HOWEVER FINAL CUT–OUTS ETC SHOULD BE AS PER INDIVIDUAL SYSTEM/EQUIPMENT DRAWINGS.
13) DETAILS OF COLUMNS/BEAMS/WALL/STAIRS/TOILETS ETC ARE TO BE FINALIZED BY CIVIL AGENCY.
14) FIRE PROTECTION WALL TO BE PROVIDED AS PER RELEVANT INDIAN STANDARD CODE
15) CIVIL CUT–OUT LESS THAN 500X500 ARE NOT SHOWN, ANY REQUIREMENT AS SUCH TO BE MADE AS PER SUIT TO SITE CONDITION.

REV.	DATE	ALTERED		CHECKED		APPROVED		ZONE	
11	23.9.23	CHECKED	B.SINGH	APPROVED	R.SINGH				REVISED AS PER PSPCL'S COMMENT
10	19.9.23	CHECKED	B.SINGH	APPROVED	R.SINGH				REVISED AS PER GOOGLE MEET DISCUSSION WITH XEN-SKPP, PSPCL DATED 16-19.9.23
09	13.08.22	CHECKED	B.SINGH	APPROVED	R.SINGH				REVISED AS PER GOOGLE MEET DISCUSSION WITH XEN-SKPP, PSPCL DATED 13.08.22
08	14.06.22	CHECKED	B.SINGH	APPROVED	R.SINGH				REVISED AS PER PSPCL'S REQUIREMENT WRT INPUT DATA OF S/Y PANELS, REVISED HVAC DUCT & REVISED EOT DM. REVISED DURING MEETING DATED 07-06-22 & 08-06-22.
07	26.03.22	CHECKED	B.SINGH	APPROVED	R.SINGH				DRAWING REVISED AS PER LATEST CIVIL DRAWINGS AND AS PER MOM DATED 28.01.22
06	24.01.22	CHECKED	B.SINGH	APPROVED	R.SINGH				DRAWING REVISED AS PER LATEST CIVIL DRAWINGS
05	02.07.20	CHECKED	B.SINGH	APPROVED	R.SINGH				TABLE OF EQUIPMENT ADDED
04	12.12.19	CHECKED	B.SINGH	APPROVED	R.SINGH				DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 28.11.19 VIDE LETTER 1600/SE/SKPP/HD/128-A & VISIT OF PSPCL'S OFFICIALS AT BHOPAL
03	13.11.19	CHECKED	B.SINGH	APPROVED	R.SINGH				DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 21.10.19 VIDE LETTER 1424/27
02	30.08.19	CHECKED	B.SINGH	APPROVED	R.SINGH				DRAWING REVISED AS PER PSPCL'S COMMENTS
01	04.09.14	CHECKED	T.KHAN	APPROVED	R.SINGH				

ADDITIONAL INFORMATION	PROJECT	3X33MW SHAHPURKANDI HEP-I	
STATUS OF DRAWING	COTUMER	PSPCL PUNJAB	
DISTRIBUTION OF PRINTS	CONSULTANT	WAPCOS LIMITED	
	CONTRACTOR	Bharat Heavy Electricals Limited, Bhopal	
SUB-SUPPLIER / VENDOR	DEPT / CODE	UNTOL. DIMS. GR.	ANGLE: 1:183 / SCALE: 1:183 / WEIGHT(kg)
	TITLE	STATION LAYOUT CUM CIVIL GUIDELINE AT 382.4 MTR (SERVICE BAY/MACHINE HALL FLOOR)	REF.TO ASSY.DRG. / ITEM NO. / NO.OF ITEMS
	DRAWING NO.	12000019356	REV. 11
	SHEET NO.	NO. OF SHEETS.	

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	BSINGH		26.04.14	
CHKD	RSINGH		26.04.14	
APPD	RSINGH		26.04.14	

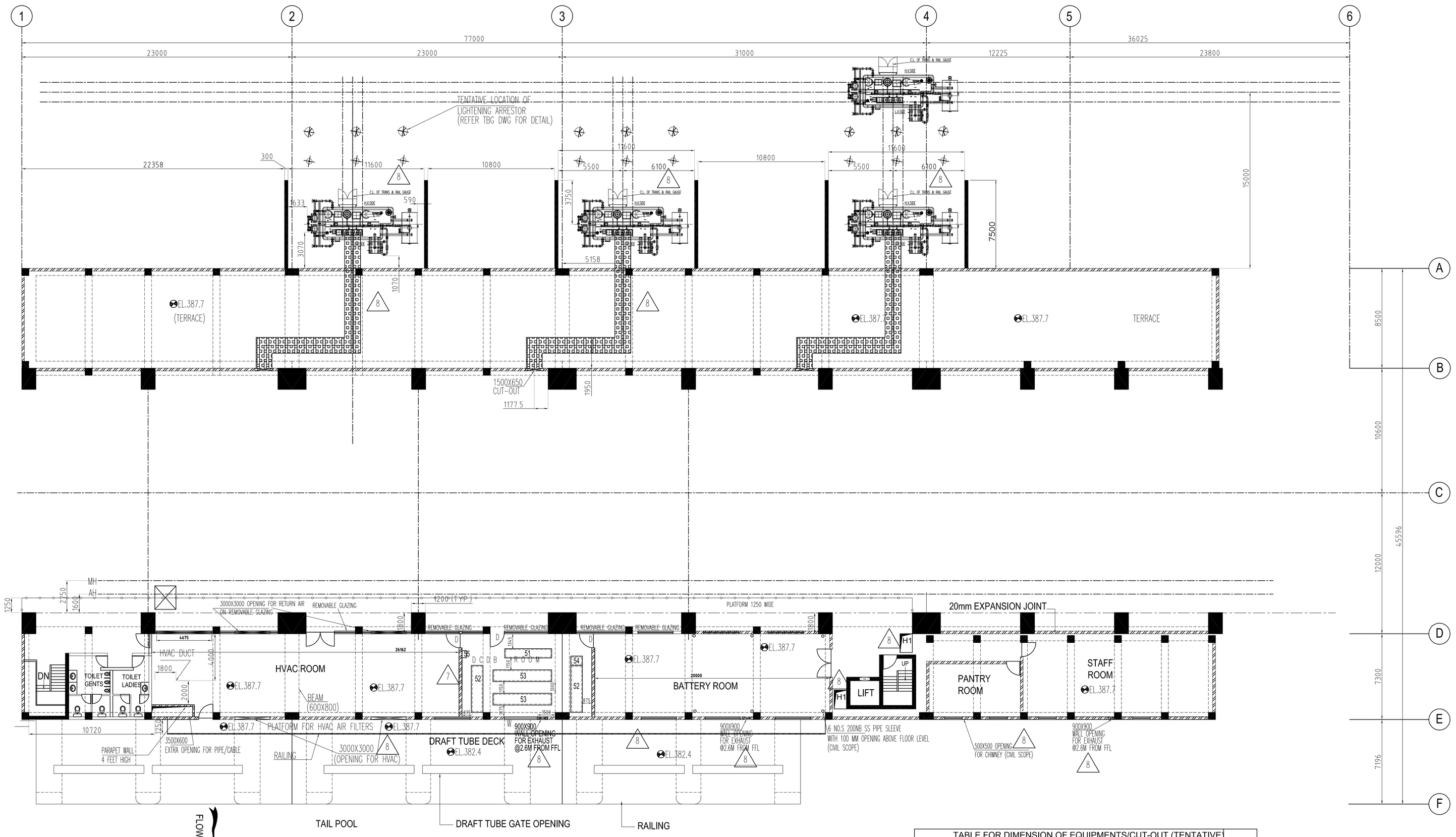
A1 SIZE

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 12000019356 REV.

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED.
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.



NOTES:–

1) LAYOUT SHOWS THE OVERALL DIMENSIONS OF POWER HOUSE
2) ALL CIVIL DESIGN INCLUDING CONCRETE THICKNESS OF FLOORS, SIZE OF COLUMN AND BEAMS ETC. TO BE DECIDED/DEVELOPED BY CIVIL DESIGN/AGENCY.
3) SUPER STRUCTURE, STAIRWAY, RAILINGS ETC TO BE DEVELOPED BY CIVIL DESIGN AGENCY
4) THE LAYOUT OF EACH FLOOR IS TENTATIVE AND SHALL BE FINALIZED DURING DETAIL ENGG.
5) STAGES OF CONCRETE SHOWN IS TENTATIVE .
6) DIMENSIONS/APPROACHES SHOWN FOR EOT CRANE ARE TENTATIVE AND SHALL BE FINALIZED AFTER EOT CRANE DESIGN.
7) ALL THE DIMENSIONS ARE IN MM AND ELEVATIONS IN METER.
8) ANY EQUIPMENT NOT MARKED IN THE LAYOUT DRAWING BUT REQUIRED FOR THE COMPLETENESS OF THE WORK SHALL BE SUPPLIED BY THE BHEL AS PER THE PROVISIONS OF THE CONTRACT
9) ALL THE HATCHES SHALL BE COVERED WITH GRATINGS AND RAILINGS (TO BE PROVIDED BY CIVIL AGENCY).
10) TO REMOVE AMBIGUITY WHICH MAY ARISE DUE TO SEPARATE DRAWINGS, STATION LAYOUT & CIVIL GUIDELINE DRAWINGS HAS BEEN COMBINED.
11) SURFACE DRAIN ARRANGEMENT OF FLOORS SHALL BE IN CIVIL SCOPE.
12) STATION LAYOUT CUM CIVIL GUIDELINES ARE SHOWN TENTATIVELY ON REQUEST OF CIVIL AGENCY, HOWEVER FINAL CUT–OUTS ETC SHOULD BE AS PER INDIVIDUAL SYSTEM/EQUIPMENT DRAWINGS.
13) DETAILS OF COLUMNS/BEAMS/WALL/STAIRS/TOILETS ETC ARE TO BE FINALIZED BY CIVIL AGENCY.

TABLE FOR DIMENSION OF EQUIPMENTS/CUT-OUT (TENTATIVE)

ITEM NO	DESCRIPTION	DIMENSION WIDTH	DEPTH	HEIGHT	QTY/ UNIT	TOTAL QTY	WEIGHT KG.(S)	SUPPLYING UNIT	CUT-OUT SIZE
51	48V DCDB	4000	800	–	–	1	–	TBG	3850X650
52	220V CHARGER	4000	1000	2500	–	2	–	HPE ELEC	3850X850
53	220V DCDB (PH)	5000	1000	2500	–	2	–	HPE ELEC	4594X850
54	INVERTER PANEL (FLOOR MOUNTED)	1000	800	800	–	1		HPE (ELEC)	650X650
55	INVERTER PANEL (WALL MOUNTED)	600	700	600	–	1		HPE ELEC	–
56	OPTICAL FIBRE CONNECTION PANEL	800	800	–	–	2		EDN	650X650

PLAN AT EL 387.70M (BATTERY/HVAC FLOOR)

REV.	DATE	ALTERED / CHECKED / APPROVED	BSINGH	REMARKS
08	19.9.23	CHECKED B.SINGH; APPROVED R.SINGH		REVISED AS PER GOOGLE MEET DISCUSION WITH XEN-SKPP, PSPCL DATED 16-19.9.23
07	13.08.22	CHECKED B.SINGH; APPROVED R.SINGH		REVISED AS PER GOOGLE MEET DISCUSSION WITH XEN-SKPP, PSPCL DATED 13.08.22
06	14.06.22	CHECKED B.SINGH; APPROVED R.SINGH		REVISED AS PER PSPCL'S REQUIREMENT WRT INPUT DATA OF S/Y PANELS, REVISED HVAC DUCT & REVISED EOT DM. REVISED DURING MEETING DATED 07-06-22 & 08-06-22.
05	24.01.22	CHECKED B.SINGH; APPROVED R.SINGH		DRAWING REVISED AS PER LATEST CIVIL DRAWINGS.
04	12.12.19	CHECKED B.SINGH; APPROVED R.SINGH		DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 28.11.19 VIDE LETTER 1600/SE/SKPP/HD/128-A & VISIT OF PSPCL'S OFFICIALS AT BHOPAL
03	13.11.19	CHECKED B.SINGH; APPROVED R.SINGH		DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 21.10.19 VIDE LETTER 1424/27
02	30.08.19	CHECKED B.SINGH; APPROVED R.SINGH		DRAWING REVISED AS PER PSPCL'S COMMENTS
01	04.09.14	CHECKED B.SINGH; APPROVED R.SINGH	T.KHAN	

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	BSINGH		26.04.14	
CHKD	RSINGH		26.04.14	
APPD	RSINGH		26.04.14	

SUB-SUPPLIER / VENDOR

ADDITIONAL INFORMATION	
STATUS OF DRAWING	
DISTRIBUTION OF PRINTS	
PROJECT	3X33MW SHAHPURKANDI HEP-I
COTUMER	PSPCL PUNJAB
CONSULTANT	WAPCOS LIMITED
CONTRACTOR	Bharat Heavy Electricals Limited, Bhopal
DEPT / CODE	UNTOL. DIMS. GR. / ANGLE / SCALE 1:183 / WEIGHT(kg)
TITLE	STATION LAYOUT CUM CIVIL GUIDELINES AT 387.7 MTR (BATTERY/HVAC ROOM)
REF.TO ASSY.DRG.	ITEM NO. / NO.OF ITEMS
DRAWING NO.	12000019357
REV.	08
SHEET NO.	NO. OF SHEETS.

A1 SIZE

REF. DRG. NO. | SIGN. & DATE | INVENTORY NO.

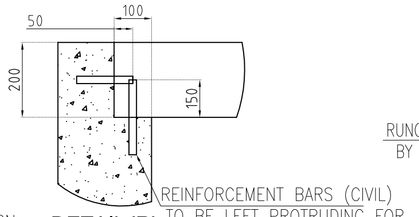
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

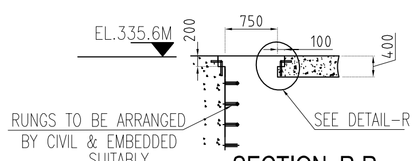
DRG. NO. 12000019453 REV. 14

NOTES:-

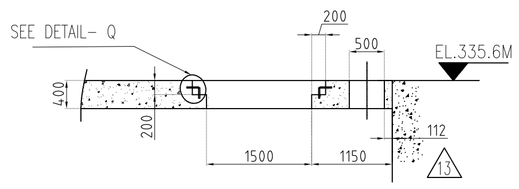
1) LAYOUT SHOWS THE OVERALL DIMENSIONS OF POWER HOUSE
2) ALL CIVIL DESIGN INCLUDING CONCRETE THICKNESS OF FLOORS, SIZE OF COLUMN AND BEAMS ETC. TO BE DECIDED/DEVELOPED BY CIVIL DESIGN/AGENCY.
3) SUPER STRUCTURE, STAIRWAY, RAILINGS ETC TO BE DEVELOPED BY CIVIL DESIGN AGENCY
4) THE LAYOUT OF EACH FLOOR IS TENTATIVE AND SHALL BE FINALIZED DURING DETAIL ENGG.
5) STAGES OF CONCRETE SHOWN IS TENTATIVE.
6) DIMENSIONS/APPROACHES SHOWN FOR EOT CRANE ARE TENTATIVE AND SHALL BE FINALIZED AFTER EOT CRANE DESIGN.
7) ALL THE DIMENSIONS ARE IN MM AND ELEVATIONS IN METER.
8) ANY EQUIPMENT NOT MARKED IN THE LAYOUT DRAWING BUT REQUIRED FOR THE COMPLETENESS OF THE WORK SHALL BE SUPPLIED BY THE BHEL AS PER THE PROVISIONS OF THE CONTRACT
9) ALL THE HATCHES SHALL BE COVERED WITH GRATINGS AND RAILINGS (TO BE PROVIDED BY CIVIL AGENCY).
10) TO REMOVE AMBIGUITY WHICH MAY ARISE DUE TO SEPARATE DRAWINGS, STATION LAYOUT & CIVIL GUIDELINE DRAWINGS HAS BEEN COMBINED.
11) SURFACE DRAIN ARRANGEMENT OF FLOORS SHALL BE IN CIVIL SCOPE.
12) STATION LAYOUT CUM CIVIL GUIDELINES ARE SHOWN TENTATIVELY ON REQUEST OF CIVIL AGENCY, HOWEVER FINAL CUT-OUTS ETC SHOULD BE AS PER INDIVIDUAL SYSTEM/EQUIPMENT DRAWINGS.
13) DETAILS OF COLUMNS/BEAMS/WALL/STAIRS/TOILETS ETC ARE TO BE FINALIZED BY CIVIL AGENCY.
14) REFERENCE DRAWINGS/INDIVIDUAL SYSTEM DRAWINGS MUST BE REFERRED FOR CUT-OUTS/SLEEVES/PIPES & OTHER DETAILS.



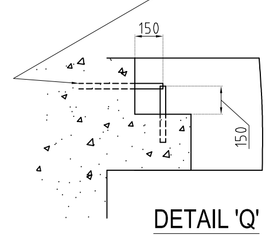
DETAIL 'R'
NTS



SECTION R-R
NTS

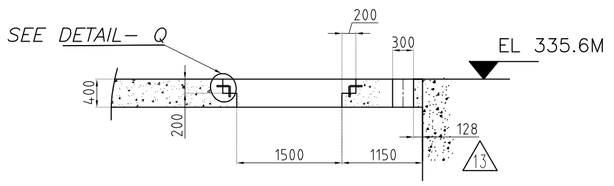


SECTION P-P
NTS

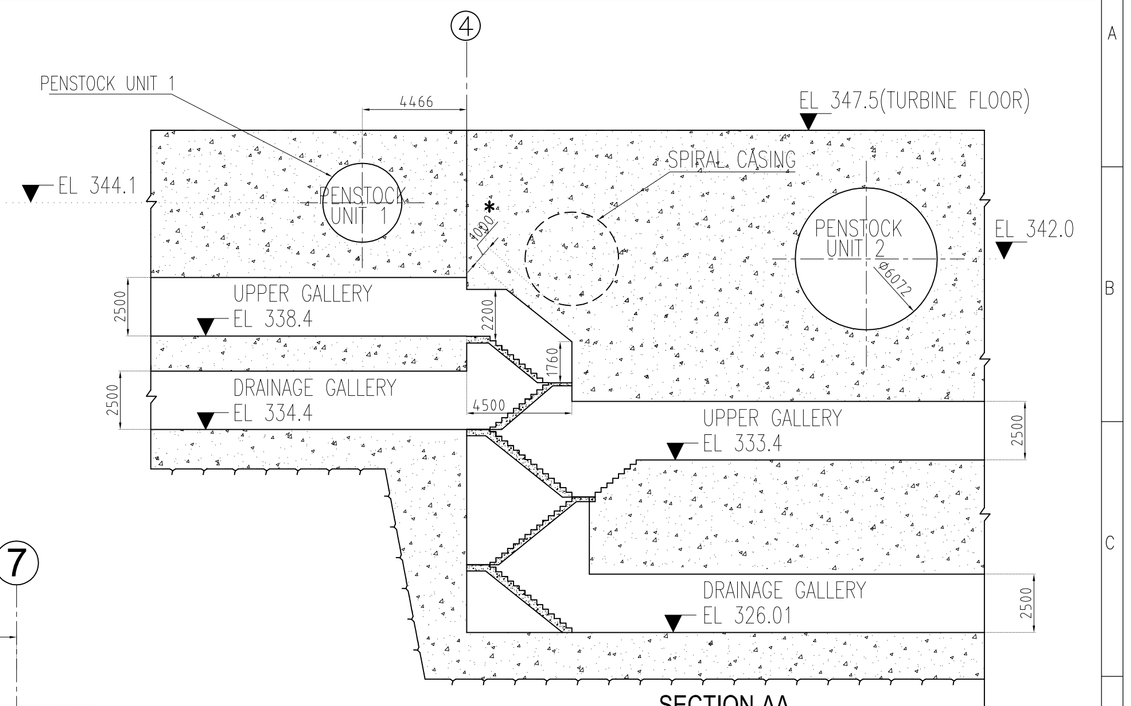


DETAIL 'P'
NTS

DETAIL 'Q'
NTS

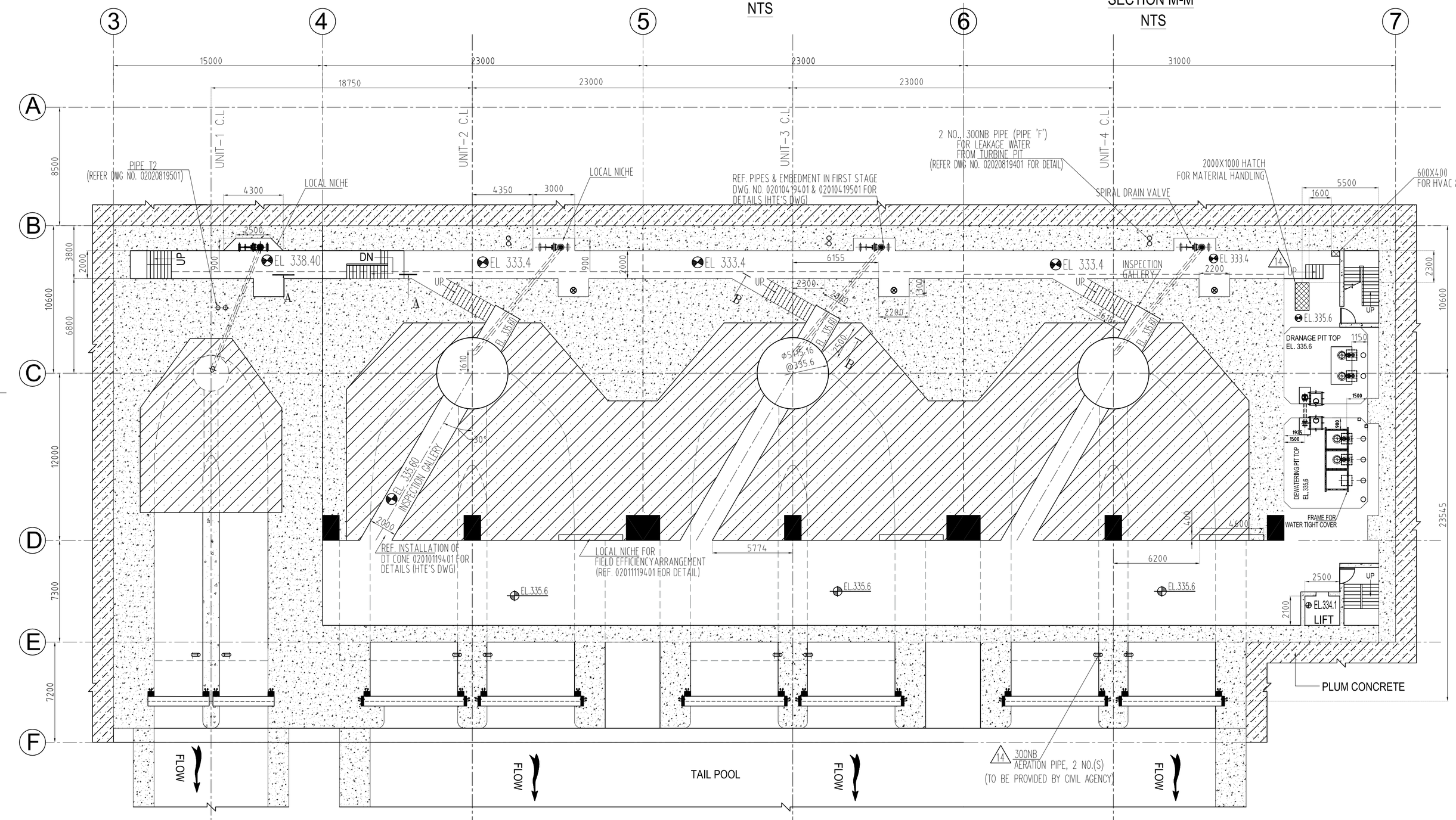


SECTION M-M
NTS

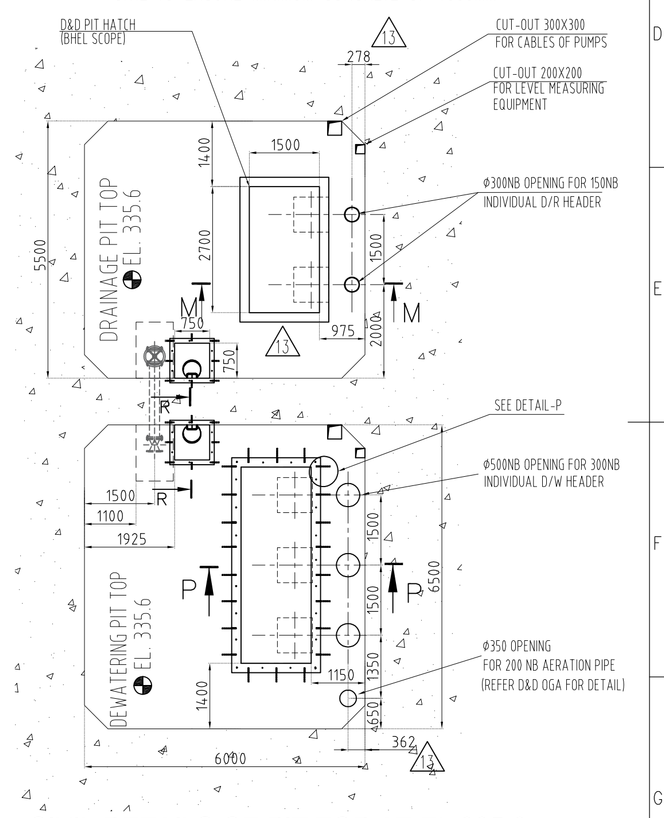


SECTION-AA

ARRANGEMENT OF STAIRS SHOWN IS TENTATIVE AND TO BE FINALIZED BY PSPCL/IRRIGATION
*-CIVIL TO ENSURE MINIMUM CONCRETE OF 1000MM

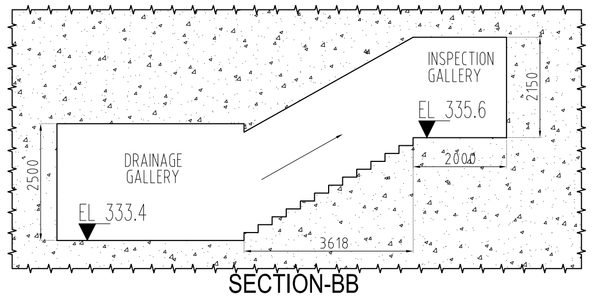


PLAN AT EL 333.4M /EL 335.60M /338.4M (UPPER GALLERY & INSPECTION GALLERY FLOORS)



CIVIL DETAILS OF PIT TOP AT EL.335.6

VIEW-A (SCALE 1:50)



SECTION-BB

(NOTE: PSPCL TO CHECK WRT TO CIVIL DESIGN ASPECTS)

TABLE-A (REFERENCE DRAWINGS)

#	DESCRIPTION	DRAWING NO.
1	PIPES & EMBEDMENT IN FIRST STAGE	02010419401
2	PIPES & EMBEDMENT IN SECOND STAGE	02020819401
3	SIDE CROSS-SECTION VIEW THROUGH POWER HOUSE	12000019451
4	PLAN AT EL 355.9 (DRAINAGE GALLERY FLOOR)	12000019452
5	PLAN AT EL 333.4 M/EL 335.60 M	12000019453
6	EMBEDDED TUBES FOR FIELD EFFICIENCY TESTING	02011119401
7	INSTALLATION OF DT CONE	02010119401

REV.	DATE	ALTERED		
		CHECKED		
		APPROVED		

REVISED AS PER GOOGLE MEET DISCUSSION WITH , PSPCL DATED 29.05.23

REV.	DATE	ALTERED		
14	31.05.23	CHECKED	B.SINGH	
		APPROVED	R.SINGH	

REVISED AS PER GOOGLE MEET DISCUSSION WITH XEN-SKPP , PSPCL DATED 13.08.22

REV.	DATE	ALTERED		
13	13.08.22	CHECKED	B.SINGH	
		APPROVED	R.SINGH	

ZONE: REVISED AS PER PSPCL'S REQUIREMENT WRT INPUT DATA OF S/Y PANELS, REVISED HVAC DUCT & REVISED EOT CRN. REVISED DURING MEETING DATED 07-06-22 & 08-06-22.

REV.	DATE	ALTERED		
12	18.06.22	CHECKED	B.SINGH	
		APPROVED	R.SINGH	

ZONE: REVISED AS PER THE WAPCOS COMMENTS

REV.	DATE	ALTERED		
11	01.03.22	CHECKED	B.SINGH	
		APPROVED	R.SINGH	

ZONE: REVISED AS PER THE LATEST CIVIL DRAWINGS

REV.	DATE	ALTERED		
10	08.01.21	CHECKED	B.SINGH	
		APPROVED	R.SINGH	

ZONE: DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 19.06.20 VIDE LETTER 567/71 SE/SKPP/HD/107-VOL-6

REV.	DATE	ALTERED		
09	02.07.20	CHECKED	B.SINGH	
		APPROVED	R.SINGH	

ZONE: DRAWING REVISED IN LINE WITH MOM DATED 28/5/14

REV.	DATE	ALTERED		
08	17.01.20	CHECKED	B.SINGH	
		APPROVED	R.SINGH	

ZONE: ADDITIONAL INSPECTION GALLERY SHOWN AS PER THE CUSTOMER'S COMMENT

REV.	DATE	ALTERED		
07	12.12.19	CHECKED	B.SINGH	
		APPROVED	R.SINGH	

ZONE: DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 27.11.19 VIDE LETTER 1595/98/SE/SKPP/HD/128-A & VISIT OF PSPCL'S OFFICIALS AT BHOPAL

REV.	DATE	ALTERED		
06	06.11.19	CHECKED	B.SINGH	
		APPROVED	R.SINGH	

ZONE: DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 21.10.19 VIDE LETTER 1424/27

REV.	DATE	ALTERED		
05	30.08.19	CHECKED	B.SINGH	
		APPROVED	R.SINGH	

ZONE: DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 28.08.19 VIDE LETTER NO 1154/59

REV.	DATE	ALTERED		
04	06.09.14	CHECKED	B.SINGH	
		APPROVED	R.SINGH	

ZONE: DRAWING REVISED AS PER PSPCL COMMENTS DATED 20/08/14

REV.	DATE	ALTERED		
03	12.08.14	CHECKED	B.SINGH	
		APPROVED	R.SINGH	

ZONE: DRAWING REVISED AS PER PSPCL COMMENTS DATED 07/08/14

REV.	DATE	ALTERED		
02	22.07.14	CHECKED	B.SINGH	
		APPROVED	R.SINGH	

ZONE: DRAWING REVISED AS PER PSPCL COMMENTS

REV.	DATE	ALTERED		
01	10.06.14	CHECKED	T.KHAN	
		APPROVED	R.SINGH	

ZONE: DRAWING REVISED IN LINE WITH MOM DATED 28/5/14

ADDITIONAL INFORMATION

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	BSINGH		26.04.14	
CHKD	RSINGH		26.04.14	
APPD	RSINGH		26.04.14	

SUB-SUPPLIER / VENDOR

PROJECT: 3X33MW+1X8MW SHAHPURKANDI HEP-II

COTUMER: PSPCL PUNJAB

CONSULTANT: WAPCOS LIMITED

CONTRACTOR: Bharat Heavy Electricals Limited, Bhopal

DEPT CODE	UNTOL. DIMS. GR.	ANGLE	SCALE	WEIGHT(kg)	REF.TO ASSY.DRG.	ITEM NO.	NO.OF ITEMS
			1:100				

TITLE: STATION LAYOUT CUM CIVIL GUIDELINES AT EL 333.4M /EL 335.60M /338.4M (UPPER GALLERY & INSPECTION GALLERY FLOOR)

DRAWING NO. 12000019453 REV. 14

SHEET NO. NO. OF SHEETS.

A1 SIZE

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

REF. DRG. NO.

SIGN. & DATE

INVENTORY NO.

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 12000019454 | REV. 15

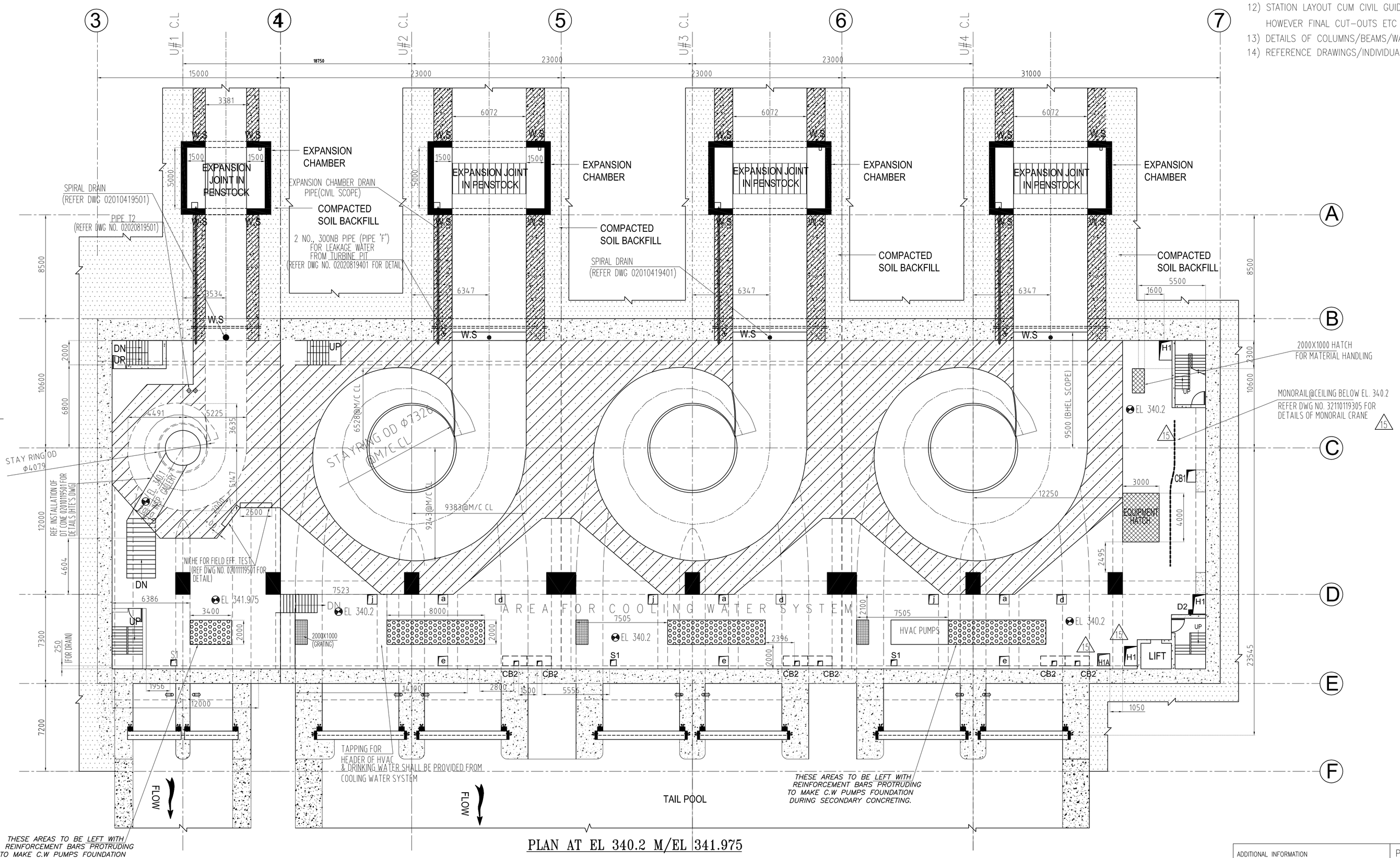
THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED.
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

TABLE-A (REFERENCE DRAWINGS)

#	DESCRIPTION	DRAWING NO.
1	PIPES & EMBEDMENT IN FIRST STAGE	02010419401, 02010419501
2	PIPES & EMBEDMENT IN SECOND STAGE	02020819401, 02020819501
3	SIDE CROSS-SECTION VIEW THROUGH POWER HOUSE	12000019451
4	PLAN AT EL 340.2 M	12000019454
5	ARRANGEMENT OF SPIRAL CASING	02020219401, 02020219501
6	EMBEDDED TUBES FOR FIELD EFFICIENCY TESTING	02011119501

NOTES:–

1) LAYOUT SHOWS THE OVERALL DIMENSIONS OF POWER HOUSE
2) ALL CIVIL DESIGN INCLUDING CONCRETE THICKNESS OF FLOORS, SIZE OF COLUMN AND BEAMS ETC. TO BE DECIDED/DEVELOPED BY CIVIL DESIGN/AGENCY.
3) SUPER STRUCTURE, STAIRWAY, RAILINGS ETC TO BE DEVELOPED BY CIVIL DESIGN AGENCY
4) THE LAYOUT OF EACH FLOOR IS TENTATIVE AND SHALL BE FINALIZED DURING DETAIL ENGG.
5) STAGES OF CONCRETE SHOWN IS TENTATIVE.
6) DIMENSIONS/APPROACHES SHOWN FOR EOT CRANE ARE TENTATIVE AND SHALL BE FINALIZED AFTER EOT CRANE DESIGN.
7) ALL THE DIMENSIONS ARE IN MM AND ELEVATIONS IN METER.
8) ANY EQUIPMENT NOT MARKED IN THE LAYOUT DRAWING BUT REQUIRED FOR THE COMPLETENESS OF THE WORK SHALL BE SUPPLIED BY THE BHEL AS PER THE PROVISIONS OF THE CONTRACT
9) ALL THE HATCHES SHALL BE COVERED WITH GRATINGS AND RAILINGS (TO BE PROVIDED BY CIVIL AGENCY).
10) TO REMOVE AMBIGUITY WHICH MAY ARISE DUE TO SEPARATE DRAWINGS, STATION LAYOUT & CIVIL GUIDELINE DRAWINGS HAS BEEN COMBINED.
11) SURFACE DRAIN ARRANGEMENT OF FLOORS SHALL BE IN CIVIL SCOPE.
12) STATION LAYOUT CUM CIVIL GUIDELINES ARE SHOWN TENTATIVELY ON REQUEST OF CIVIL AGENCY, HOWEVER FINAL CUT-OUTS ETC SHOULD BE AS PER INDIVIDUAL SYSTEM/EQUIPMENT DRAWINGS.
13) DETAILS OF COLUMNS/BEAMS/WALL/STAIRS/TOILETS ETC ARE TO BE FINALIZED BY CIVIL AGENCY.
14) REFERENCE DRAWINGS/INDIVIDUAL SYSTEM DRAWINGS MUST BE REFERRED FOR CUT-OUTS/SLEEVES/PIPES & OTHER DETAILS.



PLAN AT EL 340.2 M/EL 341.975

CUTOUT DETAILS

CUT-OUT	SIZE	PURCHASE
~~D1~~	~~1200X1000~~	~~FOR DRAINAGE & DEWATERING DISCHARGE PIPE TO TAIL RACE~~
S1	500X500	SPARE
CB1	1000X750	FOR D&D CABLES/CABLE TRAY
CB2	400X400	FOR CABLES/CABLE TRAY
H1	1600X1000	FOR HVAC/FF/CAS/DDS
H1A	1000X1000	FOR HVAC
D2	350X350	FOR AIR VENT PIPE
a	800x800	CW TO TURBINE
d	800x800	CW FROM PENSTOCK TO CW PUMP
e	800x800	FROM CW PUMP TO TAIL RACE
j	800x800	FOR SPARE

REV.	DATE	ALTERED		ZONE	REVISED AS PER
15	22.09.23	CHECKED	B.SINGH		
		APPROVED	R.SINGH		DATED 15-20TH SEP 2023
14	31.05.23	CHECKED	B.SINGH		
		APPROVED	R.SINGH		REVISED AS PER GMEET DISCUSSION WITH PSPCL DATED 29.05.23.
13	22.08.22	CHECKED	B.SINGH		
		APPROVED	R.SINGH		AREA FOR CW PUMP'S FOUNDATION OF 8 MW SHOWN
12	13.08.22	CHECKED	B.SINGH		
		APPROVED	R.SINGH		REVISED AS PER GOOGLE MEET DISCUSSION WITH XEN-SKPP , PSPCL DATED 13.08.22
11	18.06.22	CHECKED	B.SINGH		
		APPROVED	R.SINGH		REVISED AS PER PSPCL'S REQUIREMENT WRT INPUT DATA OF S/Y PANELS, REVISED HVAC DUCT & REVISED EOT CRN. REVISED DURING MEETING DATED 07-06-22 & 08-06-22.
10	01.03.22	CHECKED	B.SINGH		
		APPROVED	R.SINGH		REVISED AS PER THE WAPCOS COMMENTS
09	08.01.21	CHECKED	B.SINGH		
		APPROVED	R.SINGH		REVISED AS PER THE LATEST CIVIL DRAWINGS
08	02.07.20	CHECKED	B.SINGH		
		APPROVED	R.SINGH		DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 19.06.20 VIDE LETTER 567/71 SE/SKPP/HD/107-VOL-6
07	12.12.19	CHECKED	B.SINGH		
		APPROVED	R.SINGH		DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 27.11.19 VIDE LETTER 1595/98/SE/SKPP/HD/128-A & VISIT OF PSPCL'S OFFICIALS AT BHOPAL
06	06.11.19	CHECKED	B.SINGH		
		APPROVED	R.SINGH		DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 21.10.19 VIDE LETTER 1424/27
05	30.08.19	CHECKED	B.SINGH		
		APPROVED	R.SINGH		DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 28.08.19 VIDE LETTER NO 1154/59
04	06.09.14	CHECKED	B.SINGH		
		APPROVED	R.SINGH		DRAWING REVISED AS PER PSPCL COMMENTS DATED 20/08/14
03	12.08.14	CHECKED	B.SINGH		
		APPROVED	R.SINGH		DRAWING REVISED AS PER PSPCL COMMENTS DATED 07/08/14
02	22.07.14	CHECKED	B.SINGH		
		APPROVED	R.SINGH		DRAWING REVISED AS PER PSPCL COMMENTS
01	10.06.14	CHECKED	B.SINGH		
		APPROVED	R.SINGH		DRAWING REVISED IN LINE WITH MOM DATED 28/5/14

ADDITIONAL INFORMATION		PROJECT	3X33MW+1X8MW SHAHPURKANDI HEP-II
STATUS OF DRAWING		COTUMER	PSPCL PUNJAB
DISTRIBUTION OF PRINTS		CONSULTANT	WAPCOS LIMITED
	NAME / SIGN / DATE / NO. OF VAR.		
	DRWN BSINGH 26.04.14	CONTRACTOR	Bharat Heavy Electricals Limited, Bhopal
	CHKD RSINGH 26.04.14		
	APPD RSINGH 26.04.14		
SUB-SUPPLIER / VENDOR		DEPT / CODE	UNTOL. DIMS. GR. / ANGLE / SCALE 1:183 / WEIGHT(kg) / REF.TO ASSY.DRG. / ITEM NO. / NO.OF ITEMS
		TITLE	STATION LAYOUT CUM CIVIL GUIDELINES AT EL 340.2M /EL 341.975M
		DRAWING NO.	12000019454 REV. 15
		SHEET NO. / NO. OF SHEETS.	

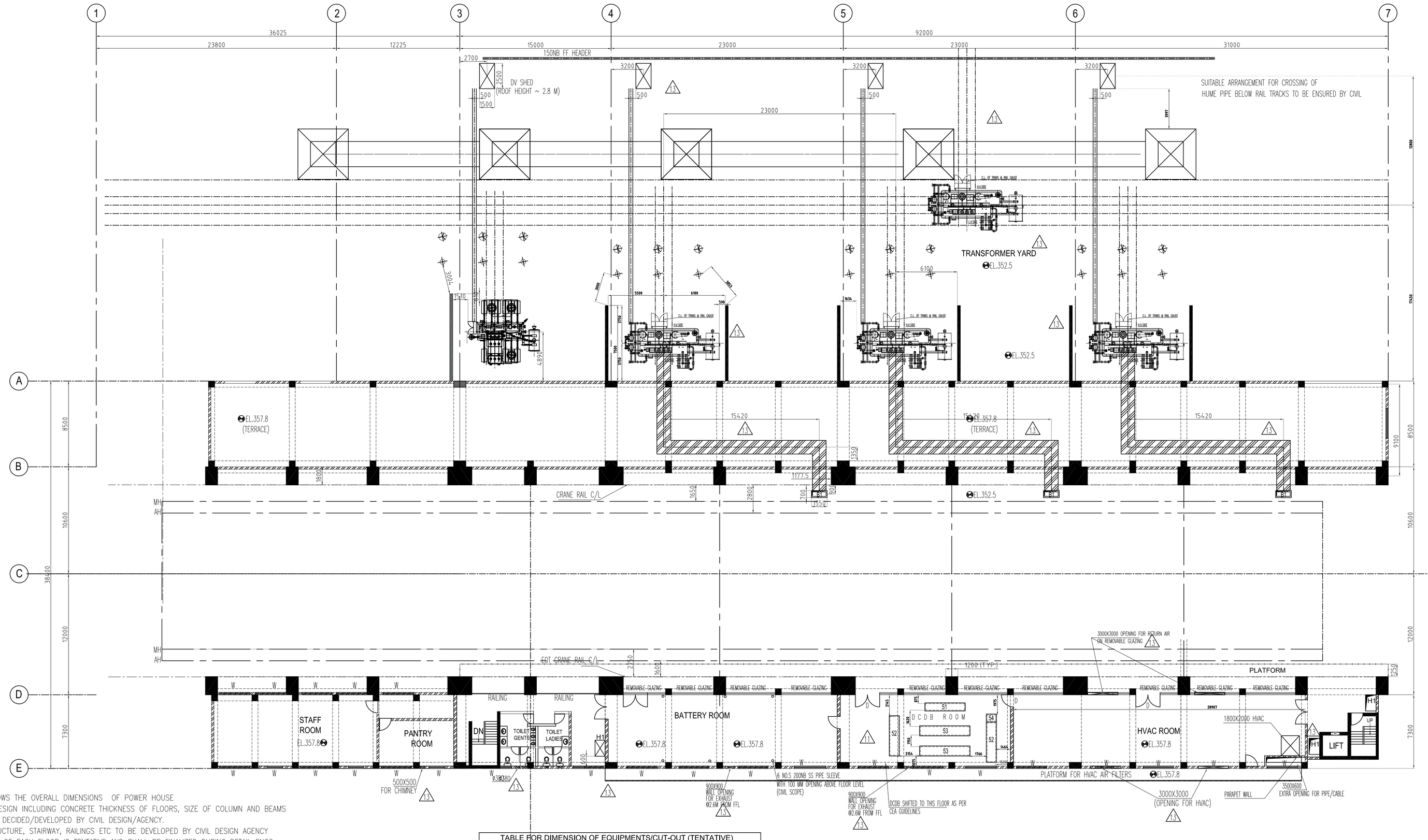
A1 SIZE

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 12000019457 REV. 13

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED.
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.



NOTES:–

1) LAYOUT SHOWS THE OVERALL DIMENSIONS OF POWER HOUSE
2) ALL CIVIL DESIGN INCLUDING CONCRETE THICKNESS OF FLOORS, SIZE OF COLUMN AND BEAMS ETC. TO BE DECIDED/DEVELOPED BY CIVIL DESIGN/AGENCY.
3) SUPER STRUCTURE, STAIRWAY, RAILINGS ETC TO BE DEVELOPED BY CIVIL DESIGN AGENCY
4) THE LAYOUT OF EACH FLOOR IS TENTATIVE AND SHALL BE FINALIZED DURING DETAIL ENGG.
5) STAGES OF CONCRETE SHOWN IS TENTATIVE .
6) DIMENSIONS/APPROACHES SHOWN FOR EOT CRANE ARE TENTATIVE AND SHALL BE FINALIZED AFTER EOT CRANE DESIGN.
7) ALL THE DIMENSIONS ARE IN MM AND ELEVATIONS IN METER.
8) ANY EQUIPMENT NOT MARKED IN THE LAYOUT DRAWING BUT REQUIRED FOR THE COMPLETENESS OF THE WORK SHALL BE SUPPLIED BY THE BHEL AS PER THE PROVISIONS OF THE CONTRACT
9) ALL THE HATCHES SHALL BE COVERED WITH GRATINGS AND RAILINGS (TO BE PROVIDED BY CIVIL AGENCY).
10) TO REMOVE AMBIGUITY WHICH MAY ARISE DUE TO SEPARATE DRAWINGS, STATION LAYOUT & CIVIL GUIDELINE DRAWINGS HAS BEEN COMBINED.
11) SURFACE DRAIN ARRANGEMENT OF FLOORS SHALL BE IN CIVIL SCOPE.
12) STATION LAYOUT CUM CIVIL GUIDELINES ARE SHOWN TENTATIVELY ON REQUEST OF CIVIL AGENCY, HOWEVER FINAL CUT–OUTS ETC SHOULD BE AS PER INDIVIDUAL SYSTEM/EQUIPMENT DRAWINGS.
13) DETAILS OF COLUMNS/BEAMS/WALL/STAIRS/TOILETS ETC ARE TO BE FINALIZED BY CIVIL AGENCY.
14) REFERENCE DRAWINGS/INDIVIDUAL SYSTEM DRAWINGS MUST BE REFERRED FOR CUT–OUTS/SLEEVES/PIPES & OTHER DETAILS.

TABLE FOR DIMENSION OF EQUIPMENTS/CUT-OUT (TENTATIVE)

ITEM NO	DESCRIPTION	DIMENSION WIDTH	DEPTH	HEIGHT	QTY/ UNIT	TOTAL QTY	WEIGHT KG.(S)	SUPPLYING UNIT	CUT-OUT SIZE
51	48V DCDB	4000	800	–	–	1	–	TBG	3850X650
52	220V CHARGER	4000	1000	2500	–	2	–	HPE ELEC	3850X850
53	220V DCDB (PH)	5000	1000	2500	–	2	–	HPE ELEC	4594X850
54	INVERTER PANEL (FLOOR MOUNTED)	1000	800	800	–	1	–	HPE (ELEC)	1500X650
55	INVERTER PANEL (WALL MOUNTED)	600	700	600	–	1	–	HPE ELEC	–

PLAN AT EL 357.80M((BATTERY/HVAC ROOM))

REV.	DATE	ALTERED		DESCRIPTION
13	22.09.23	CHECKED	B.SINGH	REVISED AS PER QMEET DISCUSSION WITH PSPCL DATED 15-20TH SEP 2023
		APPROVED	R.SINGH	
12	31.05.23	CHECKED	B.SINGH	REVISED AS PER QMEET DISCUSSION WITH PSPCL DATED 29.05.23.
		APPROVED	R.SINGH	
11	13.08.22	CHECKED	B.SINGH	REVISED AS PER QQOGLE MEET DISCUSSION WITH XEN-SKPP , PSPCL DATED 13.08.22
		APPROVED	R.SINGH	
10	18.06.22	CHECKED	B.SINGH	REVISED AS PER PSPCL'S REQUIREMENT WRT INPUT DATA OF S/Y PANELS, REVISED HVAC DUCT & REVISED EOT DM. REVISED DURING MEETING DATED 07-06-22 & 08-06-22.
		APPROVED	R.SINGH	
09	01.03.22	CHECKED	B.SINGH	REVISED AS PER THE WAPCOS COMMENTS
		APPROVED	R.SINGH	
08	08.01.21	CHECKED	B.SINGH	REVISED AS PER THE LATEST CIVIL DRAWINGS
		APPROVED	R.SINGH	
07	12.12.19	CHECKED	B.SINGH	DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 27.11.19 VIDE LETTER 1595/98/SE/SKPP/HD/128-A & VISIT OF PSPCL'S OFFICIALS AT BHOPAL
		APPROVED	R.SINGH	
06	06.11.19	CHECKED	B.SINGH	DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 21.10.19 VIDE LETTER 1424/27
		APPROVED	R.SINGH	
05	30.08.19	CHECKED	B.SINGH	DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 28.08.19 VIDE LETTER NO 1154/59
		APPROVED	R.SINGH	
04	06.09.14	CHECKED	B.SINGH	DRAWING REVISED AS PER PSPCL COMMENTS DATED 20/08/14
		APPROVED	R.SINGH	
03	12.08.14	CHECKED	B.SINGH	DRAWING REVISED AS PER PSPCL COMMENTS DATED 07/08/14
		APPROVED	R.SINGH	
02	22.07.14	CHECKED	B.SINGH	DRAWING REVISED AS PER PSPCL COMMENTS
		APPROVED	R.SINGH	
01	10.06.14	CHECKED	B.SINGH	DRAWING REVISED IN LINE WITH MOM DATED 28/5/14
		APPROVED	R.SINGH	
00	28.05.14	CHECKED	T.KHAN	
		APPROVED	R.SINGH	

ADDITIONAL INFORMATION	
STATUS OF DRAWING	
DISTRIBUTION OF PRINTS	
PROJECT	3X33MW+1X8MW SHAHPURKANDI HEP–II
COTUMER	PSPCL PUNJAB
CONSULTANT	WAPCOS LIMITED
CONTRACTOR	Bharat Heavy Electricals Limited, Bhopal
SUB–SUPPLIER / VENDOR	

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	BSINGH		26.04.14	
CHKD	RSINGH		26.04.14	
APPD	RSINGH		26.04.14	

DEPT	UNTOL. DIMS. GR.	ANGLE	SCALE	WEIGHT(kg)	REF.TO ASSY.DRG.	ITEM NO.	NO.OF ITEMS
CODE			1:183				

TITLE: STATION LAYOUT CUM CIVIL GUIDELINE AT EL. 357.8 M (BATTERY/HVAC ROOM)

DRAWING NO. 12000019457 REV. 13

SHEET NO. | NO. OF SHEETS.

A1 SIZE

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

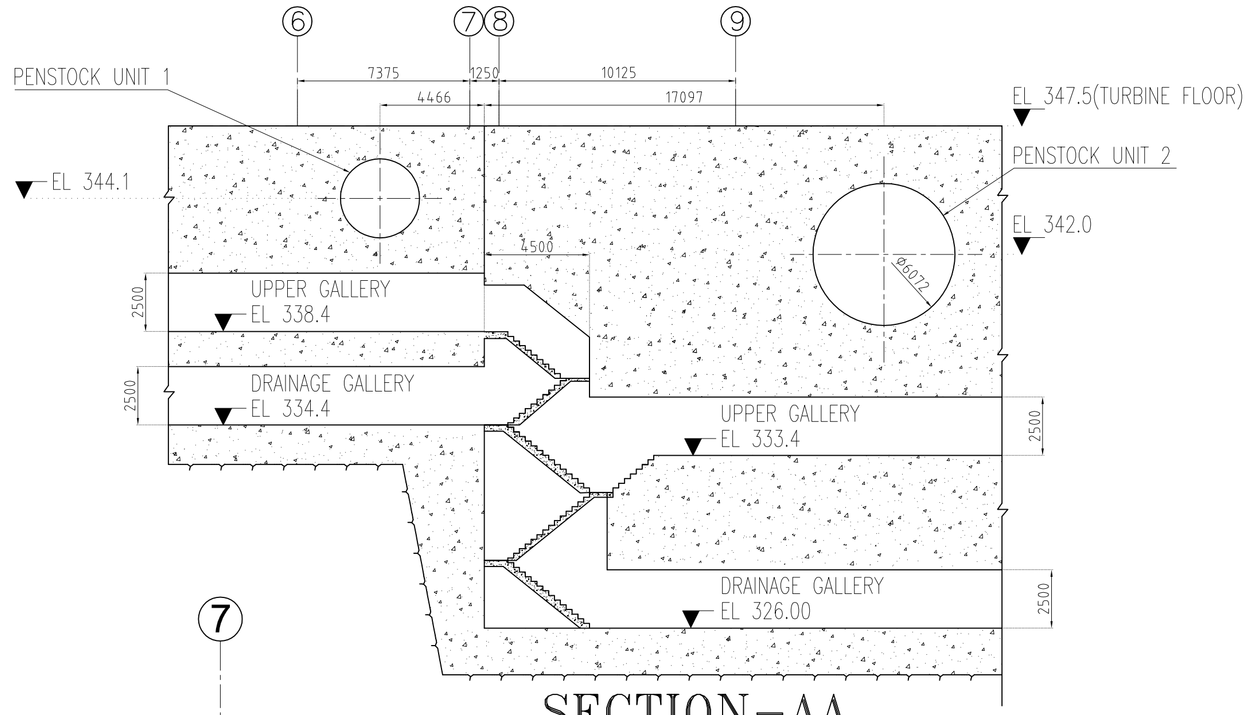
DRG. NO. 12000019452 REV. 10

NOTES:-

1) LAYOUT SHOWS THE OVERALL DIMENSIONS OF POWER HOUSE
2) ALL CIVIL DESIGN INCLUDING CONCRETE THICKNESS OF FLOORS, SIZE OF COLUMN AND BEAMS ETC. TO BE DECIDED/DEVELOPED BY CIVIL DESIGN/AGENCY.
3) SUPER STRUCTURE, STAIRWAY, RAILINGS ETC TO BE DEVELOPED BY CIVIL DESIGN AGENCY
4) THE LAYOUT OF EACH FLOOR IS TENTATIVE AND SHALL BE FINALIZED DURING DETAIL ENGG.
5) STAGES OF CONCRETE SHOWN IS TENTATIVE.
6) DIMENSIONS/APPROACHES SHOWN FOR EOT CRANE ARE TENTATIVE AND SHALL BE FINALIZED AFTER EOT CRANE DESIGN.
7) ALL THE DIMENSIONS ARE IN MM AND ELEVATIONS IN METER.
8) ANY EQUIPMENT NOT MARKED IN THE LAYOUT DRAWING BUT REQUIRED FOR THE COMPLETENESS OF THE WORK SHALL BE SUPPLIED BY THE BHEL AS PER THE PROVISIONS OF THE CONTRACT
9) ALL THE HATCHES SHALL BE COVERED WITH GRATINGS AND RAILINGS (TO BE PROVIDED BY CIVIL AGENCY).
10) TO REMOVE AMBIGUITY WHICH MAY ARISE DUE TO SEPARATE DRAWINGS, STATION LAYOUT & CIVIL GUIDELINE DRAWINGS HAS BEEN COMBINED.
11) SURFACE DRAIN ARRANGEMENT OF FLOORS SHALL BE IN CIVIL SCOPE.
12) STATION LAYOUT CUM CIVIL GUIDELINES ARE SHOWN TENTATIVELY ON REQUEST OF CIVIL AGENCY, HOWEVER FINAL CUT-OUTS ETC SHOULD BE AS PER INDIVIDUAL SYSTEM/EQUIPMENT DRAWINGS.
13) DETAILS OF COLUMNS/BEAMS/WALL/STAIRS/TOILETS ETC ARE TO BE FINALIZED BY CIVIL AGENCY.
14) REFERENCE DRAWINGS/INDIVIDUAL SYSTEM DRAWINGS MUST BE REFERRED FOR CUT-OUTS/SLEEVES/PIPES & OTHER DETAILS.

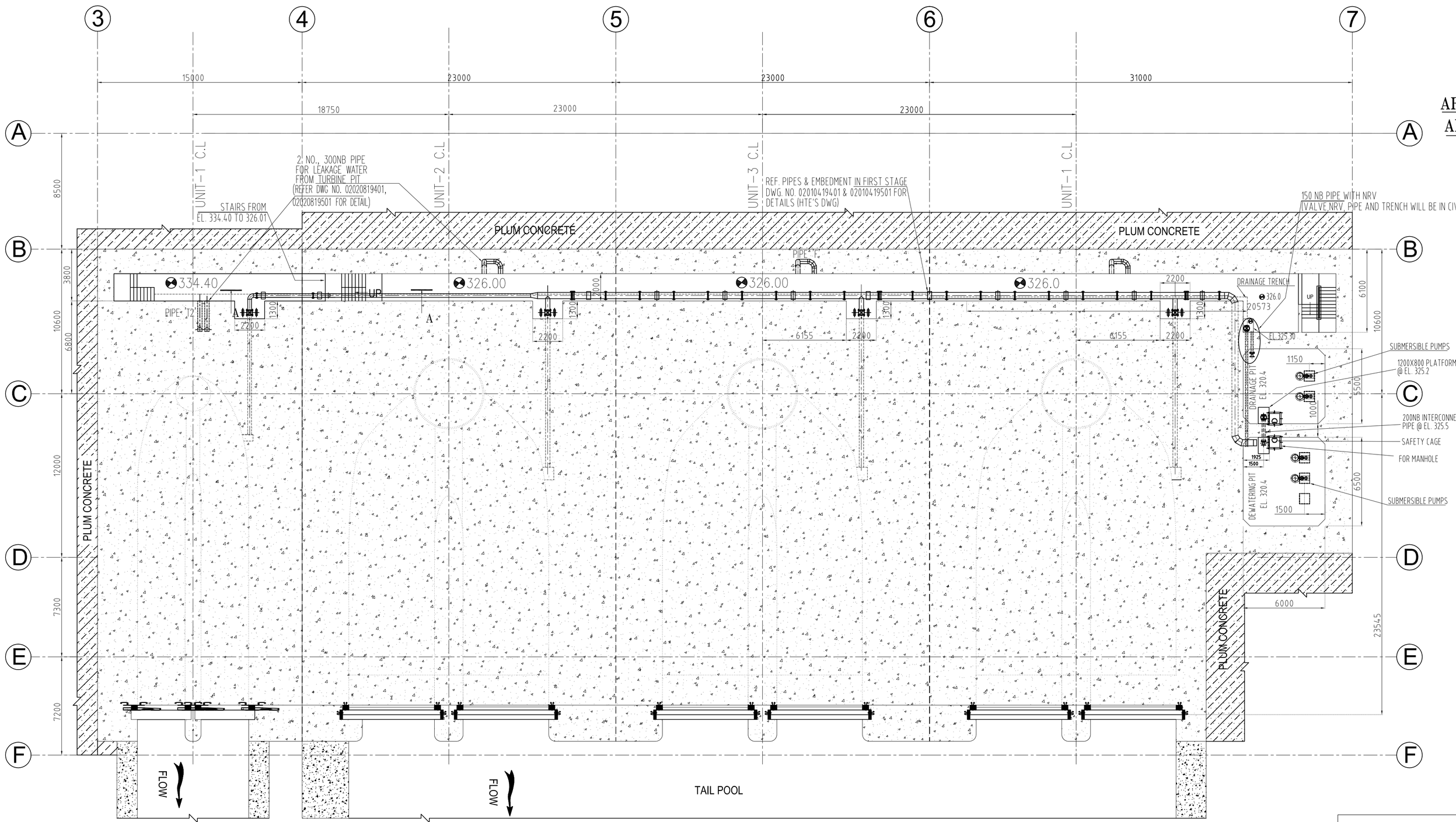
TABLE-A (REFERENCE DRAWINGS)

#	DESCRIPTION	DRAWING NO.
1	PIPES & EMBEDMENT IN FIRST STAGE	02010419401, 02010419501
2	PIPES & EMBEDMENT IN SECOND STAGE	02020819401, 02020819501
3	SIDE CROSS-SECTION VIEW THROUGH POWER HOUSE	12000019451
4	INSTALLATION OF PIER NOSE LINER	02010319401, 02010319501
5	CAVITY FOR DT ELBOW LINER AND PIER NOSE LINER	02010019401, 02010019501
6	INSTALLATION OF DT ELBOW LINER	02010219401, 02010219501

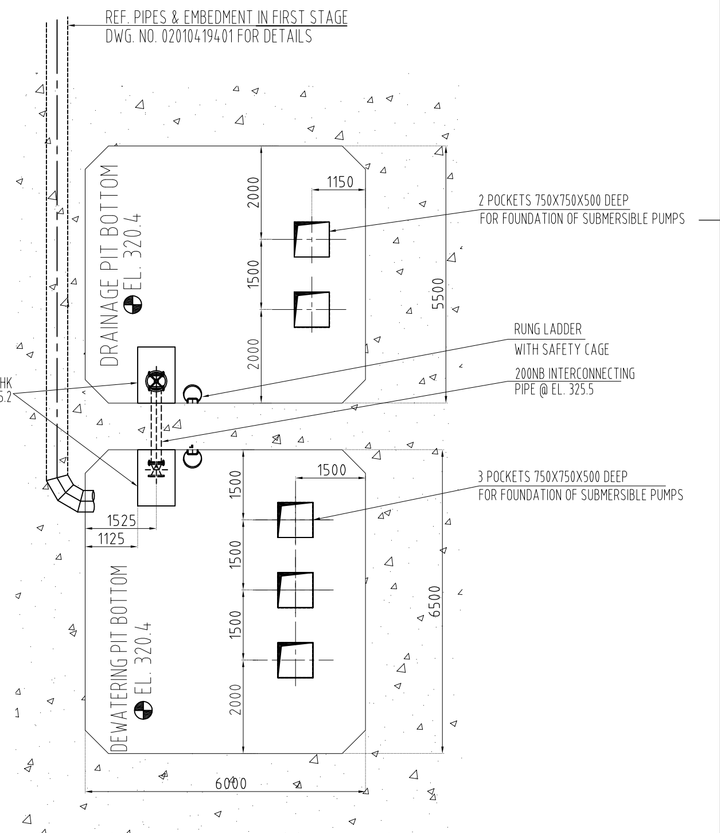


SECTION-AA

ARRANGEMENT OF STAIRS SHOWN IS TENTATIVE AND TO BE FINALIZED BY PSPCL/IRRIGATION



PLAN AT EL 326.00M & EL 334.4M (DRAINAGE GALLERY FLOOR)



CIVIL DETAILS OF PITS AT EL.320.4

VIEW-A (SCALE 1:50)

REV.	DATE	ALTERED / CHECKED / APPROVED	ZONE	DESCRIPTION
08	08.01.21	B.SINGH / R.SINGH	ZONE	REVISED AS PER THE LATEST CIVIL DRAWINGS
07	12.12.19	B.SINGH / R.SINGH	ZONE	DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 27.11.19 VIDE LETTER 1595/98/SE/SKPP/HD/128-A & VISIT OF PSPCL'S OFFICIALS AT BHOPAL
06	06.11.19	B.SINGH / R.SINGH	ZONE	DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 21.10.19 VIDE LETTER 1424/27
05	30.08.19	B.SINGH / R.SINGH	ZONE	DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 28.08.19 VIDE LETTER NO 1154/59
04	06.09.14	B.SINGH / R.SINGH	ZONE	DRAWING REVISED AS PER PSPCL COMMENTS DATED 20/08/14
03	12.08.14	B.SINGH / R.SINGH	ZONE	DRAWING REVISED AS PER PSPCL COMMENTS DATED 07/08/14
02	22.07.14	B.SINGH / R.SINGH	ZONE	DRAWING REVISED AS PER PSPCL COMMENTS
01	10.06.14	T.KHAN / B.SINGH	ZONE	DRAWING REVISED IN LINE WITH MOM DATED 28/5/14
10	18.06.22	B.SINGH / R.SINGH	ZONE	REVISED AS PER PSPCL'S REQUIREMENT WRT INPUT DATA OF S/Y PANELS, REVISED HVAC DUCT & REVISED EOT CM. REVISED DURING MEETING DATED 07-06-22 & 08-06-22.
09	01.03.22	B.SINGH / R.SINGH	ZONE	REVISED AS PER THE WAPCOS COMMENTS

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	BSINGH		26.04.14	
CHKD	RSINGH		26.04.14	
APPD	RSINGH		26.04.14	

ADDITIONAL INFORMATION

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

SUB-SUPPLIER / VENDOR

PROJECT: 3X33MW+1X8MW SHAHPURKANDI HEP-II

COTUMER: PSPCL PUNJAB

CONSULTANT: WAPCOS LIMITED

CONTRACTOR: Bharat Heavy Electricals Limited, Bhopal

DEPT | CODE | UNTOL. DIMS. GR. | ANGLE | SCALE 1:100 | WEIGHT(kg) | REF.TO ASSY.DRG. | ITEM NO. | NO.OF ITEMS

TITLE: STATION LAYOUT CUM CIVIL GUIDELINES AT 326.00/334.4 MTR (DRAINAGE GALLERY FLOOR)

DRAWING NO. 12000019452 REV. 10

SHEET NO. | NO. OF SHEETS.

A1 SIZE

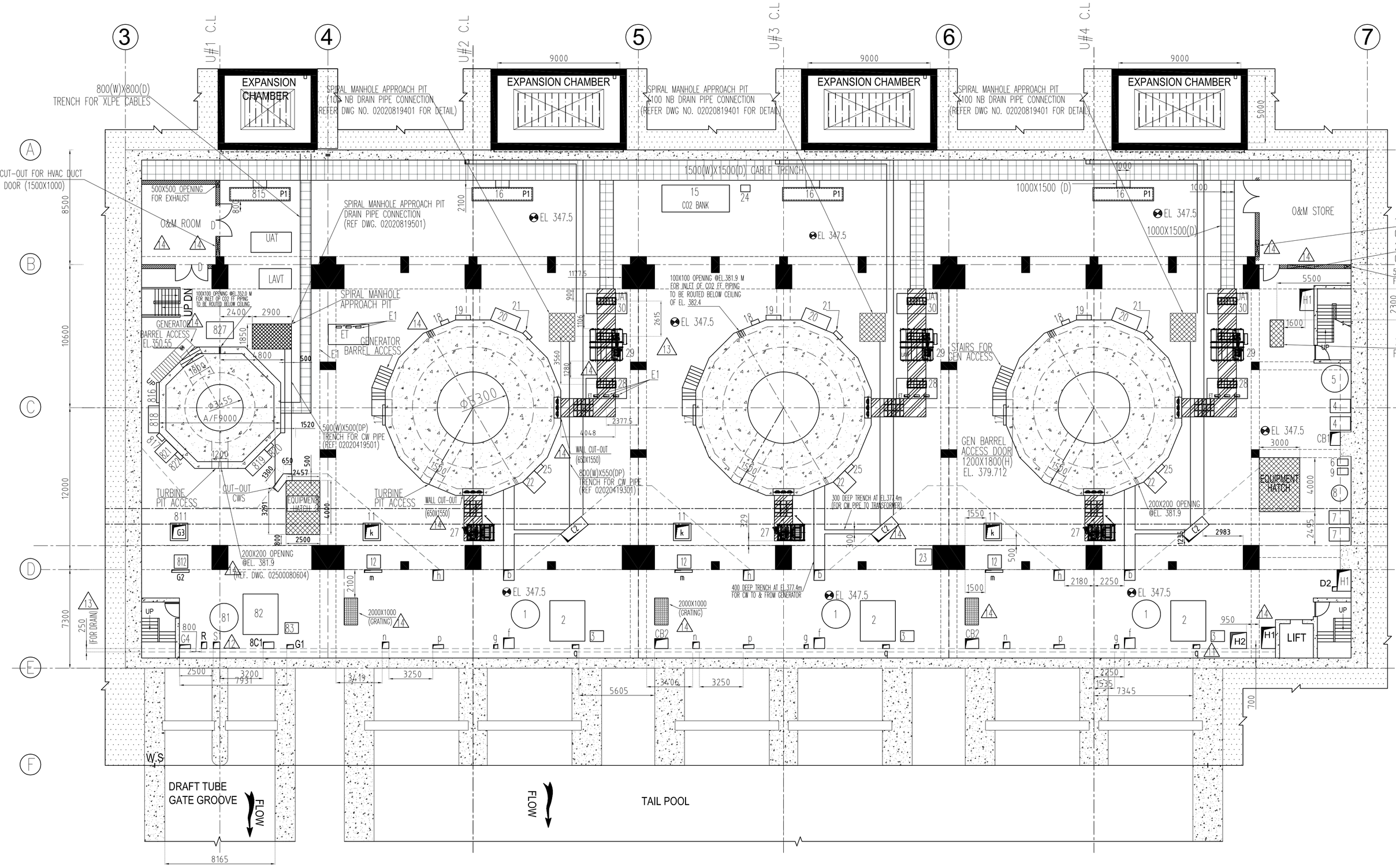
THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

INVENTORY NO. | SIGN. & DATE | REF. DRG. NO.

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN "mm")

DRG. NO. 12000019455 | REV. 14



PLAN AT EL 347.5M(TURBINE/GENERATOR FLOOR)

NOTES:-

1) LAYOUT SHOWS THE OVERALL DIMENSIONS OF POWER HOUSE
2) ALL CIVIL DESIGN INCLUDING CONCRETE THICKNESS OF FLOORS, SIZE OF COLUMN AND BEAMS ETC. TO BE DECIDED/DEVELOPED BY CIVIL DESIGN/AGENCY.
3) SUPER STRUCTURE, STAIRWAY, RAILINGS ETC TO BE DEVELOPED BY CIVIL DESIGN AGENCY
4) THE LAYOUT OF EACH FLOOR IS TENTATIVE AND SHALL BE FINALIZED DURING DETAIL ENGG.
5) STAGES OF CONCRETE SHOWN IS TENTATIVE .
6) DIMENSIONS/APPROACHES SHOWN FOR EOT CRANE ARE TENTATIVE AND SHALL BE FINALIZED AFTER EOT CRANE DESIGN.
7) ALL THE DIMENSIONS ARE IN MM AND ELEVATIONS IN METER.
8) ANY EQUIPMENT NOT MARKED IN THE LAYOUT DRAWING BUT REQUIRED FOR THE COMPLETENESS OF THE WORK SHALL BE SUPPLIED BY THE BHEL AS PER THE PROVISIONS OF THE CONTRACT
9) ALL THE HATCHES SHALL BE COVERED WITH GRATINGS AND RAILINGS (TO BE PROVIDED BY CIVIL AGENCY).
10) TO REMOVE AMBIGUITY WHICH MAY ARISE DUE TO SEPARATE DRAWINGS, STATION LAYOUT & CIVIL GUIDELINE DRAWINGS HAS BEEN COMBINED.
11) SURFACE DRAIN ARRANGEMENT OF FLOORS SHALL BE IN CIVIL SCOPE.
12) STATION LAYOUT CUM CIVIL GUIDELINES ARE SHOWN TENTATIVELY ON REQUEST OF CIVIL AGENCY, HOWEVER FINAL CUT-OUTS ETC SHOULD BE AS PER INDIVIDUAL SYSTEM/EQUIPMENT DRAWINGS.
13) DETAILS OF COLUMNS/BEAMS/WALL/STAIRS/TOILETS ETC ARE TO BE FINALIZED BY CIVIL AGENCY.
14) REFERENCE DRAWINGS/INDIVIDUAL SYSTEM DRAWINGS MUST BE REFERRED FOR CUT-OUTS/SLEEVES/PIPES & OTHER DETAILS.
15) CUT-OUTS LESS THAN 500X500 OTHER THAN SHOWN IN THE DRAWING, IF REQUIRED, TO BE MADE AS PER SUIT TO SITE CONDITION.
16) FOR CUT-OUTS/PIPES/SLEEVES IN WALL OF GENERATOR BARREL, REFER INDIVIDUAL SYSTEM DRAWINGS.

TABLE FOR DIMENSION OF EQUIPMENTS FOR (TENTATIVE)

ITEM NO	DESCRIPTION	DIMENSION WIDTH	DEPTH	HEIGHT	QTY/ UNIT	TOTAL QTY	WEIGHT KG.(S)	SUPPLYING UNIT
1	PRESSURE RECEIVER	ø2100	–	3500	1	3	–	HPE GOV
2	PP SET	2300	3000	3200	1	3	–	HPE GOV
3	TURBINE OPU STARTER PANEL	1000	800	3200	1	3	–	HPE ELEC.
4	LP AIR COMPRESSOR	1500	1000	1000	–	2	–	HTE
5	LP AIR RECEIVER	ø2000	–	2500	–	1	–	HTE
6	STARTER PANEL FOR LP AIR COMPRESSORS	500	500	500	–	1	–	HPE ELEC.
7	HP AIR COMPRESSOR	1500	1000	1000	–	2	–	HTE
8	HP AIR RECEIVER	ø1200	–	2500	–	1	–	HTE
9	STARTER PANEL FOR HP AIR COMPRESSORS	500	500	500	–	1	–	HPE ELEC.
~~10~~	~~ELECTRO HYDRAULIC GOVERNOR~~	~~800~~	~~800~~	~~2500~~	~~1~~	~~3~~	~~–~~	~~HPE GOV~~
11	HYDRO MECHANICAL CABINET	1300	1300	2400	1	3	–	HPE GOV
12	RUNNER CONTROL MECHANISM	1000	1000	2200	1	3	–	HPE GOV
~~13~~	~~UNIT CONTROL BOARD(UCB)~~	~~3804~~	~~800~~	~~2465~~	~~1~~	~~3~~	~~–~~	~~EDN~~
~~14~~	~~TEMPERATURE, GAUGE & INSTRUMENT PANEL~~	~~3000~~	~~800~~	~~2465~~	~~1~~	~~3~~	~~–~~	~~EDN~~
15	CO2 TYPE FIRE EXTINGUISHING SYSTEM	8000	2000	2500	–	1	1500	HGE
16	UNIT AUXILIARY BOARD(UAB)	3750	1000	2300	1	3	–	HPE ELEC
17	MARSHALLING BOX(WALL MOUNTED)	1500	200	1200	1	3	100	HGE
18	GENERATOR SPACE HEATER PANEL	600	300	800	1	3	–	HPE ELEC.
19	BRAKE & JACK CONTROL PANEL	1100	350	1200	1	3	350	HGE
20	H.S LUBRICATION UNIT	2000	800	800	1	3	–	HGE
21	H.S LUB. STARTER PANEL	600	300	800	1	3	–	HPE ELEC
22	BRAKE DUST COLLECTOR	1200	1200	2500	1	3	500	HGE
23	MOTORISED POWER PACK	1200	1200	1800	–	1	300	HGE
24	CONTROL PANEL FOR CO2 TYPE FF SYSTEM	500	700	2300	–	1	200	HGE
25	BRAKE DUST COLLECTOR STARTER PANEL	600	300	800	1	3	–	HPE ELEC
~~26~~	~~EXCITATION PANELS~~	~~5200~~	~~1250~~	~~2300~~	~~1~~	~~3~~	~~–~~	~~EDN~~
27	NCC	2000	1250	–	1	3	–	JHANSI
28	EXCITATION TRANSFORMER	3000	1500	2400	1	3	–	EDN
29	LAVT	2400	2250	2210	1	3	–	RUDRAPUR
30	UAT	–	–	–	1	3	–	JHANSI

TABLE FOR DIMENSION OF EQUIPMENTS FOR 8MW UNIT (TENTATIVE)

~~810~~	~~ELECTRO HYDRAULIC GOVERNOR~~	~~800~~	~~800~~	~~2500~~	~~1~~	~~3~~	~~–~~	~~HPE GOV~~
811	HYDRO MECHANICAL CABINET	1300	1300	2400	1	3	–	HPE GOV
812	RUNNER CONTROL MECHANISM	1000	1000	2200	1	3	–	HPE GOV
~~813~~	~~UNIT CONTROL BOARD(UCB)~~	~~3804~~	~~800~~	~~2465~~	~~1~~	~~3~~	~~–~~	~~EDN~~
~~814~~	~~TEMPERATURE, GAUGE & INSTRUMENT PANEL~~	~~3000~~	~~800~~	~~2465~~	~~1~~	~~3~~	~~–~~	~~EDN~~
815	UNIT AUXILIARY BOARD(UAB)	3750	1000	2300	1	3	–	HPE ELEC
816	MARSHALLING BOX(WALL MOUNTED)	1500	200	1200	1	3	100	HGE
817	GENERATOR SPACE HEATER PANEL	600	300	800	1	3	–	HPE ELEC.
818	BRAKE & JACK CONTROL PANEL	1100	350	1200	1	3	350	HGE
819	H.S LUBRICATION UNIT	2000	800	800	1	3	–	HGE
820	H.S LUB. STARTER PANEL	600	300	800	1	3	–	HPE ELEC
821	BRAKE DUST COLLECTOR	1200	1200	2500	1	3	500	HGE
822	BRAKE DUST COLLECTOR STARTER PANEL	600	300	800	1	3	–	HPE ELEC
~~823~~	~~EXCITATION PANELS~~	~~5200~~	~~1250~~	~~2300~~	~~1~~	~~3~~	~~–~~	~~EDN~~
827	NCC	2000	1250	–	1	3	–	JHANSI
81	PRESSURE RECEIVER	ø2100	–	3500	–	1	–	HPE GOV
82	PP SET	2300	3000	3200	–	1	–	HPE GOV
83	TURBINE OPU STARTER PANEL	1000	800	3200	–	1	–	HPE ELEC.

TABLE-A (REFERENCE DRAWINGS)

#	DESCRIPTION	DRAWING NO.
1	PIPES & EMBEDMENT IN FIRST STAGE	02010419401,02010419501
2	PIPES & EMBEDMENT IN SECOND STAGE	02020819401,02020819501
3	SIDE CROSS-SECTION VIEW THROUGH POWER HOUSE	12000019451

DETAILS OF TENTATIVE CUTOUTS/TRENCH ON THE FLOOR

ITEM	DESCRIPTION	SIZES (LXBXD)
1	q COOLING WATER SYSTEM	300X300
1	C2 COOLING WATER SYSTEM	2000X800
	R RUNNER AERATION PIPE (8MW)	400X500
	8C1 COOLING WATER SYSTEM (8MW)	800X500
	CB1 CABLE TRAY	1000X750
	CB2 CABLE TRAY	1000X750
	H1 DRAINAGE & DEWATERING SYSTEM	1600X1000
	E1 EXCITATION TRANSFORMER	500X500
1	q GOVERNING SYSTEM	500X300
1	m GOVERNING SYSTEM	1300X200
1	k GOVERNING SYSTEM	1000X1000
1	p GOVERNING SYSTEM	1300X200
	H1 FOR HVAC/FF/CAS	1600X1000
	H2 FOR HVAC	1200X1200
	P1 UNIT AUX BOARD	4350X850X1500 (TRENCH)
1	n SPARE OR FF OR HVAC MAKEUP CUTOUT	500X500
	CWS COOLING WATER SYSTEM FOR 8 MW	AS MARKED
	D2 FOR AIR VENT PIPE	350X350
1	h,b,f COOLING WATER SYSTEM	800X800

REV.	DATE	ALTERED / CHECKED / APPROVED		ZONE	DESCRIPTION
14	22.09.23	B.SINGH / B.SINGH / R.SINGH			REVISED AS PER GMEET DISCUSSION WITH PSPCL DATED 15-20TH SEP 2023
13	31.05.23	B.SINGH / B.SINGH / R.SINGH			REVISED AS PER GMEET DISCUSSION WITH PSPCL DATED 29.05.23.
12	22.08.22	B.SINGH / B.SINGH / R.SINGH			REVISED AS PER THE LATEST 2ND STAGE EMBEDMENT DRAWING DWG NO. 0-202-08-19501, REV 05, DATED 19.08.22.
11	13.08.22	B.SINGH / B.SINGH / R.SINGH			REVISED AS PER GOOGLE MEET DISCUSSION WITH XEN-SKPP , PSPCL DATED 13.08.22
10	18.06.22	B.SINGH / B.SINGH / R.SINGH			REVISED AS PER PSPCL'S REQUIREMENT WRT INPUT DATA OF S/Y PANELS, REVISED HVAC DUCT & REVISED EOT CM. REVISED DURING MEETING DATED 07-06-22 & 08-06-22.
09	08.01.22	B.SINGH / B.SINGH / R.SINGH			REVISED AS PER THE LATEST CIVIL DRAWINGS
08	02.07.20	B.SINGH / B.SINGH / R.SINGH			DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 19.06.20 VIDE LETTER 567/71 SE/SKPP/HD/107-VOL-6
07	12.12.19	B.SINGH / B.SINGH / R.SINGH			DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 27.11.19 VIDE LETTER 1595/98/SE/SKPP/HD/128-A & VISIT OF PSPCL'S OFFICIALS AT BHOPAL
06	06.11.19	B.SINGH / B.SINGH / R.SINGH			DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 21.10.19 VIDE LETTER 1424/27
05	30.08.19	B.SINGH / B.SINGH / R.SINGH			DRAWING REVISED AS PER PSPCL'S COMMENTS DATED 28.08.19 VIDE LETTER NO 1154/59
04	06.09.14	B.SINGH / B.SINGH / R.SINGH			DRAWING REVISED AS PER PSPCL COMMENTS DATED 20/08/14
03	12.08.14	B.SINGH / B.SINGH / R.SINGH			DRAWING REVISED AS PER PSPCL COMMENTS DATED 07/08/14
02	22.07.14	B.SINGH / B.SINGH / R.SINGH			DRAWING REVISED AS PER PSPCL COMMENTS
01	10.06.14	T.KHAN / B.SINGH / R.SINGH			DRAWING REVISED IN LINE WITH MOM DATED 28/5/14

ADDITIONAL INFORMATION		PROJECT	3X33MW+1X8MW SHAHPURKANDI HEP-II
STATUS OF DRAWING		COTUMER	PSPCL PUNJAB
DISTRIBUTION OF PRINTS		CONSULTANT	WAPCOS LIMITED
		CONTRACTOR	Bharat Heavy Electricals Limited, Bhopal
SUB-SUPPLIER / VENDOR			

	NAME	SIGN	DATE	NO. OF VAR.
DRWN	BSINGH		26.04.14	
CHKD	RSINGH		26.04.14	
APPD	RSINGH		26.04.14	

DEPT / CODE	UNTOL. DIMS. GR.	ANGLE	SCALE	WEIGHT(kg)	REF.TO ASSY.DRG.	ITEM NO.	NO.OF ITEMS
			1:183				

TITLE: STATION LAYOUT CUM CIVIL GUIDELINES AT 347.5 MTR

DRAWING NO. 12000019455 | REV. 14 | SHEET NO. | NO. OF SHEETS.

A1 SIZE

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

REF. DRG. NO. | SIGN. & DATE | INVENTORY NO.