KERALA STATE ELECTRICITY BOARD LTD.
(KSEBL)

3X27.5 MW KSEBL KUTTIYADI
HYDRO ELECTRIC PROJECT (HEP)
RENOVATION, MODERNIZATION AND UPRATING (RMU)

TECHNICAL SPECIFICATION

FOR

HVAC SYSTEM

SPECIFICATION NO.: - PE-TS-471-571-11000-A001 (REV0)
(DEC-2021)

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

	TITLE: 3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT TECHNICAL SPECIFICATIONS FOR HVAC SYSTEM	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION	
		REV. 00	DATE: DEC 2021
		SHEET: 1 OF 2	

CONTENTS

This Technical specification consists of two sections:

SECTION - I

SUB- SECTIONS	TITLE			Page No
Sub-Section-A	INTENT OF SPECIFICATION			5-7
Sub-Section-B	PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA			8-11
Sub-Section-C	TECHNICAL SPECIFICATIONS			12
	Sub Section-C1	SPECIFIC TECHNICAL REQUIREMENT		13-26
	Sub Section-C2	CUSTOMER SPECIFICATION		
		C2 - A	TECHNICAL REQUIREMENT	27-38
		C2 - B	PROJECT SPECIFIC GENERAL REQUIREMENTS INCLUDING:	39-152
			GENERAL TECHNICAL REQUIREMENT	
			QUALITY ASSURANCE	
	Sub Section-C3	TECHNICAL SPECIFICATION (ELECTRICAL PORTION)		153-400
	Sub Section-C4	TECHNICAL SPECIFICATION (C&I PORTION)		401-434
Sub Section-D	STANDARD TECHNICAL SPECIFICATIONS			435-465
Sub Section-E	ANNEXURE-I	LIST OF MAKES OF SUB-VENDOR ITEMS		466-474
	ANNEXURE-II	MANDATORY SPARE LIST		475-476
	ANNEXURE-III	LIST OF TOOLS & TACKLES AND LIST OF COMMISSIONING SPARES.		477-478
	ANNEXURE-IV	DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE		479
	ANNEXURE-V	MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION		480-482
	ANNEXURE-VI	FORMAT FOR OPERATION AND MAINTENANCE MANUAL		483-486
	ANNEXURE-VII	SITE STORAGE AND PRESERVATION		487-502
	ANNEXURE-VIII	PAINTING SPECIFICATION & COLOUR SCHEME		503
	ANNEXURE-IX	PACKING PROCEDURE		504

	TITLE: 3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT TECHNICAL SPECIFICATIONS FOR HVAC SYSTEM	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION	
		REV. 00	DATE: DEC 2021
		SHEET: 2 OF 2	

SECTION – II

SUB SECTIONS		TITLE	Page No
Sub Section-1		INSPECTION AND TESTING WITH STANDARD QUALITY PLAN	506-509
Sub Section-2		LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	510-511
Sub Section-3		COMPLIANCE CUM CONFIRMATION CERTIFICATE	512-514
Sub Section-4		PRE BID CLARIFICATION SCHEDULE	515-516
Sub Section-5		NO DEVIATION CERTIFICATE	517-519
Sub Section-6		**TENDER DRAWINGS**	520
		DRG TITLE	
	a	SCHEME OF VENTILATION SYSTEM FOR POWER HOUSE	521
	b	POWER HOUSE GENERAL ARRANGEMENT PLAN OF CROSS SECTION	522
	c	GENERAL ARRANGEMENT PLAN OF MACHINE HALL, GENERATOR FLOOR & SWITCH GEAR ROOM AT EL.96.01M	523
	d	GENERAL ARRANGEMENT PLAN OF TURBINE FLOOR AT EL.93.36M	524
	e	GENERAL ARRANGEMENT PLAN OF MIV FLOOR AT EL.90.00M	525
	f	GENERAL ARRANGEMENT PLAN OF CABLE FLOOR AT EL.99.06M	526
	g	GENERAL ARRANGEMENT PLAN OF CONTROL ROOM.	527

SECTION - I

SECTION-I

SUB-SECTION-A

INTENT OF SPECIFICATION

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM INTENT OF SPECIFICATION	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION : I	
		Sub Section: A	
		REV. 00	DATE: DEC 2021
		SHEET 3 OF 3	

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, supply / procurement, inspection and testing at vendor's / sub vendor's / manufacturer's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables till handing over, mandatory spares along with spares for erection, start-up and commissioning as required, proper packing, forwarding and shipment till storage area and delivery from storage area to site, unloading, handling & on-site transportation, storage, preservation , security / safety at site , Erection & Commissioning, 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 **3x27.5 MW KSEBL KUTTIYADI 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 items required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.

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

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM INTENT OF SPECIFICATION	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION : I	
		Sub Section: A	
		REV. 00	DATE: DEC 2021
		SHEET 3 OF 3	

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.

1.12 Bidders, in their own interest, are suggested to visit the site, before quoting for this tender, to know about actual conditions prevailing at site and take cognizance of the same in their offer.

SECTION: I

SUB-SECTION: B

PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA

PART 2 INFORMATION TO BIDDERS

2.1 General Information

2.1.1 Description of State

Kerala is one of the States located in the southern part of the Republic of India. It occupies a narrow strip of land between the Arabian Sea in the West and the Western Ghats in the east. The States of Karnataka and Tamil Nadu lie in the North - East and South - East respectively.

2.1.2 Description of KSEBL

Kerala State Electricity Board Limited (Erstwhile KSEB) is a fully Government owned company incorporated under the Indian Companies Act 1956 to develop infrastructure relating to the State's growing needs for electrical energy.

2.2 Project Information

2.2.1 Name of Work

Execution of Hydro-Mechanical & Electro-Mechanical works (Planning, Engineering, Design, Manufacture, Supply, Erection, Testing and Commissioning of Main Inlet Valve, complete Turbine excluding embedded turbine header / manifold / distributor piping, Generator and accessories complete) for the Renovation, Modernization & Uprating works of the existing Kuttiyadi Hydro Electric Project (3x25 MW) to (3x27.5 MW).

2.2.5 Location

State	-	Kerala
District	-	Kozhikode
Taluk	-	Koyilandi
Panchayath	-	Koorachund
River	-	Kuttiyadi
Latitude (North)	-	11^0 33' 00" N

Longitude (East) - 75^0 54' E

2.2.7 Climatic Condition

The climate in the project site is generally cold with monsoon season from June to November. The S-W Monsoon is from June to September and N-E Monsoon, in October and November, besides the isolated and intermittent rain fall during non-monsoon seasons from cyclonic storms.

SECTION: I

SUB SECTION: C1

TECHNICAL SPECIFICATION

SECTION: I

SUB-SECTION: C 1

SPECIFIC TECHNICAL REQUIREMENT

1.0 FUNCTION

The purpose of the system is to provide HVAC (Air conditioning and ventilation) for different areas of 3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT under the scope of this tender. To achieve proper working conditions inside the power house complex, HVAC system is provided to serve the following purpose:

a. To prevent temperature stratification
b. To remove contaminated air and smoke (during fire)
c. To remove waste heat from equipment
d. To provide outside fresh air necessary for human comfort

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

2.1 AC SYSTEM ZONE CONSIST OF THE FOLLOWING AREAS.

2.1.1 Air-cooled Split AC/Cassette AC system shall be provided to cater to the air conditioning requirements of New control room of power house.

2.1.2 Split AC system for conference room/meeting room.
2.1.3 Split AC system for communication room.
2.1.4 Split AC system for office area.
2.1.5 Split AC system for C&I store area.
2.1.6 Split AC system for excitation panel room in Machine hall floor.

2.2 VENTILATION SYSTEM ZONE CONSIST OF THE FOLLOWING AREAS

2.2.1. FORCED VENTILATION SYSTEM THROUGH CENTRIFUGAL FAN WITH FILTER ARRANGEMENT

Supply air from Double skin, package cabinet type fan filter unit (FFU) shall be fed to various areas of power house as detailed below through duct

2.2.1.1 Machine floor/ Generator Floor including Service bay area at EL 96.01M.

2.2.1.2 Turbine floor and pump room at EL 93.36M.

2.2.1.3 MIV Floor at EL 90.00M.

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 normal exhaust fans, smoke exhaust fans equivalent to 50% of the capacity of normal exhaust shall be provided.

2.2.2 FORCED VENTILATION SYSTEM THROUGH AXIAL FANS

Supply/Exhaust Axial fans shall be provided for following areas:

2.2.2.1 Switch gear room for power house

2.2.2.2 Cable vaults of power house

2.2.2.3 Toilets, pantry, store and Battery Room for power house.

2.3 REFERENCE DOCUMENT / DRAWINGS

The following drawings have been referred while designing the HVAC System:

2.3.1 12000020651: Power house general arrangement plan of cross section

2.3.2 12000020654: General arrangement plan of machine hall, generator floor & switch gear room at EL.96.01M

2.3.3 12000020653: General arrangement plan of turbine floor at EL.93.36M

2.3.4 12000020652: General arrangement plan of MIV floor at EL.90.00M

2.3.5 12000020655: General arrangement plan of cable floor at EL.99.06M

2.3.6 12000020656: General arrangement plan of Control room.

2.4 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.

1) Duct support structure outside and inside power house for routing supply / exhaust duct / cable trays etc. from FFU 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.

2) Fixing frame works for diffusers and grilles in the scope of Vendor.

3) Anchor fastener / HILTI fasteners shall be used by vendor for fixing duct/ pipes etc. wherever applicable.

4) 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

3.1.1 The outside design conditions considered shall be under: -

	Summer	Monsoon	Winter
DBT (°C)	**35.6**	29.4	**22.2**
WBT (°C)	27.8	27.8	18.3

3.1.2 Maximum ambient temperature of air in summer: 45°C
3.1.3 Minimum ambient temperature of air in winter: 10°C
3.1.4 Maximum Relative humidity: 100%

3.2 SYSTEM DESIGN CRITERIA - AIR CONDITIONING SYSTEM

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

24°C ± 1^{0}C DBT

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

3.3 SYSTEM DESIGN CRITERIA - VENTILATION SYSTEM

3.3.1 Inside design temperature shall be maximum 3 deg. C above the ambient air temperature.

3.3.2 Ventilation provision for various location through FFU is envisaged as follows

S.No.	Name of premises	Type of Ventilation
1.	Power House (machine/generator/turbine/MIV floor/service bay etc.)	Filtered supply air ventilation system from FFU through duct having 15 ACPH. Exhaust by means of Axial flow Exhaust fans.

3.3.3 Ventilation provision for various location through Wall mounted Axial Fans is envisaged as follows

S.No.	Name of premises	Type of Ventilation	ACPH
1.	Switchgear/MCC room in power house	Fresh air supply through axial supply fan with pre and fine filters. Exhaust by means of gravity damper.	20
2.	Cable vault in power house	Fresh air supply through axial supply fan with pre filters. Exhaust by means of gravity damper/grating.	20
3.	Battery room	Wall mounted exhaust fans (spark proof with flame proof motor) with ducting (if required) Fresh air supply through air intake Louvers	30
5.	Toilets & pantries	Exhaust by means of propeller type exhaust fan. Supply through door undercuts / door louvers	20

3.3.4 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.

3.3.5 The maximum air velocity through ventilation duct shall be 12 m/sec.

3.4 CODES AND STANDARDS

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

3.4.1 ASHRAE/ ISHRAE Guide and data book, American Society of Heating, Refrigerating and Air Conditioning Engineers.

3.4.2 IS: 655/ IS 277 for Sheet Metal Air ducts.

3.4.3 IS: 4720, Indian Standard Code of Practice for Ventilation of Surface Hydel Power Stations.

3.4.4 IS: 3103- Code of practice for industrial ventilation

3.4.5 ANSI/ Standard 62- Ventilation for acceptable indoor air quality

3.4.6 IS 659- Safety code for Air-conditioning.

3.5 GENERAL PRINCIPLES

3.5.1 Cooled air shall be supplied generally at low points of the powerhouse and exhaust air shall be at high points.

3.5.2 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.

3.5.3 Lighting load considered shall be 2 Watts/sq. feet.

3.5.4 The Occupancy considered shall be 1 person in 25SQM or (actual).

3.5.5 All the equipment for HVAC system shall be designed for continuous duty.

3.5.6 For winter Load calculations, the lighting load and 50% equipment load shall be taken into account.

3.5.7 The heat dissipation values from various equipment / Occupants shall be taken into consideration while designing the HVAC system.

3.5.8 For switchgear room, the supply air flow rate shall be maintained higher than that of exhaust air flow rate to prevent the ingress of dust into the room from outside.

3.5.9 Exhaust air quantity from Power House shall be estimated as 60% of supply air quantity.

4. GENERAL DESCRIPTION OF VENTILATION AND AIR CONDITIONING SCHEME

4.1 VENTILATION SYSTEM

4.1.1 POWER HOUSE AREA

4.1.1.1 To meet the ventilation requirement of various areas (machine/generator/turbine/MIV floor/service bay etc.) of power house building, total 2X50% fan Filter units each having capacity of 50,000 CMH shall be provided. Coursing of air in desired direction / areas shall be made by using Exhaust fans.

4.1.1.2 Air from Fan filtration unit shall be distributed to the respective areas through galvanized sheet steel ducting and diffusers / grilles.

4.1.1.3 60% of fresh air supplied to Power House area, shall be exhausted with the help of exhaust fans. These fans shall be mounted at a higher level in Machine hall. These fans shall be complete with air inlet bird mesh, exhaust air cowl with gravity louver and bird mesh and supporting/ fixing frame.

4.1.1.4 Automatic motorized dampers shall be provided at the common discharge duct of FFU for power house. Fire rating of dampers shall be 90 minutes.
In order to avoid spreading of fire, the motorized damper with programmable logic controller having a provision of interfacing with the control panel of fire-fighting equipment of power house shall be considered.

4.1.1.5 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 normal exhaust fans, smoke exhaust fans equivalent to 50% of the capacity of normal exhaust shall be provided. 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 FFU 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 fans. 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 Control room as per details given below.

Sr. No.	Area to be Air-Conditioned	No. of Split AC/Cassette AC
1.	Control Room /Conference/Communication room/Office/C&I store	3 x 50%
2.	Excitation panel room in Machine hall floor	2X100%

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.

5. LAYOUT CONSIDERATIONS:

5.1 VENTILATION SYSTEM

5.1.1 Double Skin Package Cabinet Type Centrifugal Fan filter units (suitable to open conditions) shall be placed in open space outside the power house building.

6. EQUIPMENTS TO BE PROVIDED

6.1 2x50% Fan filter Units (FFU) of suitable capacity for Ventilation system.

6.2 The supply air duct shall be provided with motor operated fire damper at locations where duct pass through walls & floors for ease of isolation, maintenance and as well as for

emergency operation. The operation of these automatic dampers shall be interlocked with the fire alarm system. Fire dampers shall be of rating 90 minutes.

6.3 Lot – GSS Ducting (as per IS-277) with 275 g/sq.m. of zinc coating sheet metal work, complete with volume control dampers, extruded aluminium supply air (with VCD) and return air grills, hangers, supports, flexible connections, including thermal insulation on Ventilation duct, wherever they are exposed to outside the building.

7. AC EQUIPMENT

7.1 SPLIT AIR CONDITIONER/CASSETTE AC

Hi-wall Split/cassette air conditioners shall in general consist of the following:

i) Casing

ii) Hermetically sealed rotary/scroll Compressor

iii) 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, etc as required.

x) Refrigerant as per manufacturer practice.

Split type air conditioners/cassette AC shall be provided to cater to the air conditioning requirements for control room and other areas as specified above. 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 shall be provided. Local Distribution Boards containing Switch / MCB shall be provided for Split Air Conditioners/cassette AC. Each split unit/cassette AC shall also be provided with suitable rating stabilizer. 100 % stand by or 3X50% stand by split AC/Cassette AC units shall be provided.

Split AC shall conform to latest available highest BEE rating.

Indoor unit of Ceiling Mounted Cassette Type Unit (Multi Flow Type):

The housing of the unit shall be powder coated galvanized steel. All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view.

Unit shall have four-way supply air grills on sides and return air grill in center.

Each unit shall have high lift drain pump and very low operating sound.

8.0 VENTILATION EQUIPMENT:

8.1 FAN FILTER UNIT (DOUBLE SKIN PACKAGE CABINET TYPE)

Each Double Skin package cabinet type fan filter unit shall comprise of the following: -

a. Fan section complete with forward / backward curved multi-bladed centrifugal fan with casing and supports.
b. Electric drive motor.
c. Drive pulleys, V-belt and belt guard, slide rails etc.
d. Flat filter sections with filters
e. Vibration isolation (Spring type/Neoprene rubber cushy foot / neoprene serrated rubber pad type with isolation efficiency not less than 85 %.) with foundation bolts and nuts.
f. Removable drain plug with fan casing.

8.2 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.

1	Axial flow supply fans with 30 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
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.		
	Capacity	Motor rating	Wall opening
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.	Capacity	Motor rating	Wall opening
b.	15,000 CMH	2.2 KW	900mmx900mm
c.	10,000 CMH	1.5 KW	800mmx800mm
d.	7,500 CMH	1.1 KW	700mmx700mm
e.	4,000 CMH	0.75 KW	600mmx600mm
f.	2,000 CMH	0.55 KW	500mmx500mm
4	Axial flow exhaust fans with 25 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	15,000 CMH	2.2 KW	900mmx900mm
	Axial flow exhaust fans with 10 mmwc static pressure.		
5	Capacity	Motor rating	Wall opening
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
6	Exhaust fan (propeller type) with 5 mmwc static pressure.		
	Capacity	Motor rating	Wall opening
a.	1000 CMH	100 W	300 mm circular

8.3 SHEET METAL WORK

a) Lot – GSS (Galvanised Steel Sheet) supply and return air Ducting (as per IS-277) with 275 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 aluminium 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 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 1.3.13.7.7 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)	Ventilation duct (running outside the building)	resin bonded fiber glass, (25 Kg/m3 density)/ Resin Bonded Mineral Wool density (24 kg/cub.m)	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.
ii)	Refrigerant Piping	Al foil faced Nitrile rubber / Eqvt	Roll / Slab	39	Al cladding

10. CONTROL PHILOSPHY

Control system for Ventilation system shall be controlled through main **"Power House SCADA"** and following equipment shall be controlled through SCADA.

- Fan filter Units
- Smoke Exhaust fans
- Motorized Fire Damper
- 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 FFU motor etc. shall stop on closure of fire damper.

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

Supply and Exhaust Fans shall be provided with local starter panel.

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

11. 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. Room condition test shall be done after stabilization of the system. The dry and wet bulb temp shall be measured by sling psychrometer which will have accuracy of +/-0.5% with aleast count of 0.5 degC. This will be carried out for 24 hrs continuously and readings will be taken every two hours. Standby equipment should be changed over during these 24 hours. This test shall be carried out during summer during month April to June when the dry bulb temp is generally high. 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 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. 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 Control Room.

e. The Noise level of the rotating drive shall not be exceeding 85dB (A) at 1.5m from source.

Acceptance Test to be covered separately 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 at various location of different floors
10. All equipment (fans, blowers, motors etc.) checking.

12. 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 equipments/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.
    - Design dry bulb temperature of conditioned air, Vibration and noise level etc.
    - All calibrated instruments to be used for the tests at manufacturer's works/site shall be arranged by the bidder.

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) Flat, platform type RCC / PCC foundation shall be provided for installing FAN etc. Vendor shall fix the equipment using anchor fasteners to secure the equipment obtain parameters related to vibration and noise.

24) 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.

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

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

27) The bidder's proposal shall be for equipment in accordance with the tech. Specification.

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

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

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

31) Construction of openings in brick-walls, as required, for routing the ventilation duct and installation of axial fans, shall be provided by BHEL. Floor openings, as available

at site, for duct routing can be used by bidder during erection of duct. However, minor modification/ shifting of these opening at site, if required, shall be carried out by bidder.

32) 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.

33) Necessary duct mounted Booster fan (if required) to maintain the static pressure for Ventilation duct shall be provided without any implication.

13. EXCLUSIONS

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

a) Foundations for HVAC equipments.

b) False ceiling, drop ceiling.

c) Provision of drain traps / points,

14. 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.

Indian standard equivalent to International standards organization (ISO) standard is acceptable.

For other details please refer to clauses no 1.1.9.1, 1.3.13.2 and other relevant clauses of Customer technical specification section C2-A.

SECTION: I

SUB-SECTION: C2-A

CUSTOMER SPECIFICATION

(TECHNICAL REQUIREMENT)

1.3.13.7.7 Air Conditioning and Ventilation System

A ventilation and air-conditioning system shall be provided as per the requirements specified in Part-2, to achieve proper working conditions inside the power house complex, to serve the purposes such as prevention of temperature stratification, removal of contaminated air, removal of waste heat from equipment as well as provide fresh air necessary for human comfort with regard to temperature, humidity, and oxygen content, and to extract / force out smoke and other toxic gases during fire.

Suitable system for circulation of natural air and exhaust shall be provided as a minimum requirement. Cooling of air, wherever required, may be provided by evaporating, water cooled cooling tubes or chiller units.

A choice of installation out of 3 different types of installations i.e. split type, package type or centralized air conditioning plants shall be made on the basis of the required tonnage and suitability of the installation at that particular location.

The air conditioning system shall provide conditioned air in powerhouse control room, communication room, conference hall etc... The system shall be designed to maintain a temperature of 24ºC at suitable humidity of 50 ±5% in all air-conditioned areas.

Each split air conditioners shall be complete with compressor, condenser, air handling unit, cooling coil, humidification package, filters and vibration isolation pads, control and instruments etc... The evaporator unit shall be horizontally / vertically / floor mounted type as required and constructed of galvanized steel sheet of thickness not less than 18 gauge. It shall be suitable for indoor installation and shall have provision for draining out condensate water. The fan shall be of centrifugal type made of heavy gauge aluminium designed for low noise operation. The cooling coil section shall consist of copper tubes with aluminium fins to provide efficient heat transfer between tubes and fins. Air filters for the

blower suction shall be of synthetic washable type provided. Coil filters shall not be acceptable.

The condensing unit shall be supplied in weatherproof heavy gauge enclosure suitable for outdoor installation. Each unit shall comprise of 2 or 3 independent hermetically / semi-hermetically sealed compressor units together with associated air cooled condensers, refrigerant tubing and electrical system so that if one compressor unit is down, the other compressors can remain in service. The condenser tubes shall be of copper having extended aluminium fins. The compressor shall be easily accessible during running of the unit.

Redundancy of the Air conditioners shall be 2x100% or 3x50%. All the equipment of air conditioning system shall be designed for continuous duty. For fans, compressors and blowers continuous Motor rating (at 50^0C ambient) shall be at least ten percent (10%) above the maximum load demand of the fan, compressors, blower at the design duty point.

All GI sheets under air conditioning system shall be hot dip galvanized or spray galvanized unless otherwise specified and minimum zinc deposition shall conform to class 275 of IS: 277.

In the Control room, false ceiling shall be provided 3m above the finished floor level and shall be of non luminous (opaque) type fire resistant material. Glass areas exposed to sun shall be provided with Venetian blinds of light colour.

Sufficient numbers of ventilating fans shall be provided in all other areas for proper ventilation.

There shall be forced air ventilation to generator floor, turbine floor, spherical valve area, service bay, Cable vault, switchgear room etc... Mechanical type ventilation system using supply air fans, exhaust air fans or roof exhausters as applicable shall be provided for the above purpose. Ventilation of the turbine pit with suitable exhaust system for removing welding fumes during maintenance shall be provided.

Sufficient number of exhaust fans of suitable capacity shall be provided in the battery room, toilets etc... for their ventilation. Gravity louver dampers shall be provided for all exhaust air fans.

The number of air changes per hour in evaporative/ mechanically ventilated areas shall be as follows:

Sl. No.	Area	Air changes
1.	General areas except toilets and pantries	15
2.	Various switch-gear / MCC rooms, pump rooms, toilets, pantries etc...	20
3.	Battery rooms etc... where gaseous fumes are generated	30

In the areas producing lot of heat, the temperature limitation shall be the criteria for ventilation system design. In this case the inside dry bulb temperature shall be maximum 3^0C above the summer design ambient dry bulb temperature during summer.

The criterion, which gives higher number of air changes / higher quantity of air in either of the conditions as mentioned above, shall be the basis for selecting the required airflow for that area.

All ventilation systems shall be designed for continuous duty and shall operate on 100% fresh air basis. For fans and blowers continuous motor rating (at 50^0C ambient) shall be at least ten percent (10%) above the maximum load demand of the Fan / blower at the design duty point.

All mechanically ventilated areas shall be positively ventilated by means of supply air fans, generally in combination with exhaust fan / roof extractors. Wherever exhaust fan / roof extractors are not provided, such as MCC / switchgear rooms, the pressurized condition shall be maintained with gravity operated back draft dampers. However, as exception, hazardous areas and fumes / odor generating areas such as toilets shall be negatively ventilated by means of exhaust air fans / roof exhausters and inlet louvers.

Supply air fan catering for electrical switchgear / MCC rooms shall be provided with pre-filters and fine filters, while supply air fans for other areas shall be provided with pre-filter only.

Supply air fans, exhaust air fans and roof ventilators / extractors of each area shall be provided with their local starter panel.

All accessories such as rain protection exhaust hood, transformation piece, vibration isolators, Galvanized bird screen etc... as required shall be provided for the ventilators / extractors.

The operations of the air-conditioning and ventilation systems shall be interlocked with the fire alarm system.

The sizing calculations for all the equipment shall be furnished by the bidder and shall be subject to approval of the KSEBL.

Following shall also form part of the scope of supply as a minimum:

One (1) set of spares for all the above requirements for normal operation of 5 years.

One (1) set of special tools, devices, test devices, etc... for assembly, installation, testing commissioning and dismantling etc...

Any item of work not specifically mentioned in the specifications but which are usual and / or necessary for the satisfactory operation of the equipment / system shall be deemed to be provided by the Contractor and included in the quoted Price. All work shall be complete in all details whether such details are mentioned in the specifications or not.

Any ratings, if mentioned, are indicative only and are a minimum for giving a base line. The Bidder should ensure that the ratings of the various equipment are sufficient to take care of the design requirements of the equipment offered for the concerned project. Any increase in rating during detailed engineering stage will not entitle the Successful Bidder / Contractor for any extra charges. The Contractor should submit for approval the calculations for arriving at the ratings of the various equipment.

1.3.13.7.7.1 Tests

The Contractor shall conduct shop tests on dates agreed with the KSEBL and make arrangements for the KSEBL's representative to witness the tests.

All testing envisaged in IS / IEC shall be carried out. The Contractor shall make all arrangements, equipment, material and consumables to the tests and prove compliance of the equipment with the standards at shop and at site.

The test reports shall be got approved by the KSEBL before despatch of any item.

2.2.5.9 Ventilation & Air-conditioning System

Suitably rated Split type air condition system shall be provided in the Control room along with sufficient number of exhaust fans in the Power House.

1.3.4.6.7 Cooling

The equipment shall be cooled by forced air under positive pressure or by natural convection. In the case of forced air-cooling, dual redundant air blowers shall be provided to increase cooling system reliability. It is desirable that the hot air be thrown out of the powerhouse via ducting. The control system shall permit manual selection of either blower unit for standby operation.

All excitation panels shall be enclosed in dust proof air-conditioned cabinet.

1.3.13 Auxiliary Mechanical Equipment

1.3.13.1 Introduction

The scope of these specifications is to stipulate the basic general guidelines to the Bidder / Contractor for the design, manufacture, testing at manufacturer works, standard and quality of workmanship, general finish of plant, compliance to the latest published edition (prior to the date of closing of tender) of the international standards and recommendations specified throughout the specifications, supply, insurance, delivery and storing at site, erection, site testing, commissioning, performance and reliability confirmation, warranty confirmation of the complete equipment and other general requirements as per **Section 1.1,** which are required for the plant / equipment being provided under the scope of this tender / contract.

Any item of work not specifically mentioned in the specifications but which are usual and / or necessary for the satisfactory operation of the equipment / system shall be deemed to be provided by the Contractor and included in the quoted Price. All work shall be complete in all details whether such details are mentioned in the specifications or not.

This section covers the KSEBL's requirements for the auxiliary mechanical equipment in the powerhouse.

1.3.13.2 Reference Standards and Codes

The Equipment shall be designed, manufactured, tested, installed and commissioned in accordance with the latest revision of applicable IS / IEC or equivalent standards.

The Contractor shall adhere to sound design and construction practices with regard to codes and material specifications in order to warrant operational safety and ease of maintenance of plants as well as simplicity of control and stability in plant operation.

- I S 325 - Three phase induction motors
- I S 9046 - AC Contactors
- I S 13947 - Low voltage switchgear and control gear
- I S 4503 - Heat exchangers
- IS 11465 - Reciprocating air compressors up to 25 kW
- IS 10962 - Reciprocating air compressors above 60 kW
- IS 5456 - Testing of air compressors
- I S 13118 - Circuit breakers

- IS 7613 - Air filters
- IS 8148 - Packaged air conditioners
- IS 1391 - Room air conditioners
- IS 3103 - Code of Practice for Industrial Ventilation
- IS 4720-82 - Practice for Ventilation of Surface Hydel Power Stations
- IS 2825 - Code for unfired pressure vessels
- IS 1646 - Code of practice for fire safety of buildings (general): Electrical installations
- IS 3034 - Fire safety of Industrial buildings: Electrical Generating and Distributing Stations – Code of Practice
- IS 1948 - Specification for Aluminium doors, windows and Ventilators
- IS 4721–2000 - Code of Practice for Drainage and Dewatering of Surface / Underground hydro Electric Power Stations.
- IS 6595-2 - Horizontal centrifugal pump.

1.3.13.3 Reference Sections

Section 1.1	-	General Technical Requirements
Section 1.3.1	-	Turbines
Section 1.3.3	-	Generators
Part - 2	-	Specific Requirements for the Project

1.3.13.4 Submittals and Approvals

The Contractor shall seek the prior approval of the KSEBL for the following through timely submittals.

- The design and drawings of the Auxiliary system and Equipment as detailed below in Cause 1.3.13.5.
- Calculations for HVAC, Cooling Water systems, Dewatering & Drainage systems, Compressed Air Pressure systems, Fire fighting systems etc...
- **Vendor List - The Contractor shall purchase equipment from reputed vendors approved by the KSEBL only and the name of vendors shall be submitted for KSEBL's approval prior to sourcing the equipment.**

1.1.32 Spare Parts, Special Tools and Site Consumables

A) Spare Parts

The Contractor shall provide a list of recommended spare parts and special tools with the respective unit prices to KSEBL's approval and supply sufficient parts, as per approved list, to assure satisfactory operation for at least five years. All spare parts and accessories shall be electrically and mechanically identical to corresponding parts in the equipment supplied and shall be suitably packed and clearly marked, ready for long term indoor storage.

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 KSEBL’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 recommend by them in addition to the list given in particular specifications and offer the price of the same separately in schedule of prices for spares. Wherever the quantity of spares is given as set / sets, it will be taken as quantity for all the generating units. Sufficient quantity of spares will be included for parts which are more prone to frequent wear and tear and can be replaced easily without involving long shutdown.

The Contractor shall provide 5%, but at least two pieces of all types of bolts, screws, nuts, washers, spanner rings and cotters. The quantity may be taken from the surplus handed over to the Purchaser after completion of the installation as described under the chapter "Fasteners." of this Section.

Mandatory Spares: All spares required during the Defects liability period, needs to be compulsorily provided by the Contractor and a list is also to be provided by the Contractor. It is also specified that any spare other than that specified in the list is necessitated during the defects liability period, the same will be deemed to have been included in the mandatory list and will have to be provided free of cost by the Contractor.

Recommended Spares: The Contractor shall provide a list of spares with unit rates that may be required for a two year period after the defects liability period. Based on the list, KSEBL may issue separate order for the needed spares, based on the rates quoted by the Contractor.

B) Tools

The scope of work shall include all customary and special tools, as well as auxiliary devices including lifting devices, ropes, etc... necessary for total assembly and disassembly of all parts of the supplied Works. Furthermore, all accessories for maintenance shall be supplied and included in the Tender. The total price for tools and devices as required by this article shall be included in the Total Tender Price. The special lifting devices and tools designed and supplied for the project, can be

used by the Contractor during erection and will be handed over to Purchaser in good working condition without any wear and tear. However, normal tools and appliances supplied shall not be used for erection purposes by the contractor and shall be handed over in new condition. All ropes, slings, small hoists and winches etc... shall be handed over in new condition.

All lifting devices and wire ropes slings to be used at site shall be tested at works and test certificate shall be supplied to the Engineer-in-Charge.

Suitable toolboxes shall also be included in the delivery. An itemized list and description of all provided tools, auxiliary devices, etc... shall be included in the Tender. The KSEBL shall be entitled to take over from the Contractor the entire erection tools, appliances, instruments at mutually agreed conditions.

Each set of tools and appliances to be supplied under the contract shall be arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the quantity and type of tools and appliance. If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be split into multiple boxes.

All tools and appliances shall be clearly marked outside its packing with its description, identification number and reference manual number. Each toolbox shall be painted black, fitted with a pad lock and clearly marked in white letters with the name of the item of equipment for which the tools or appliances are intended.

The Contractor shall open all the toolboxes at the Site stores for inspection by the KSEBL's representative. The Contractor shall be responsible for all such unpacking and subsequent re-labelling and re-packing.

C) Consumables

Scope of work shall include all site consumables like welding electrodes, brazing materials, insulating materials, sealants, cleaning agents, paints and varnishes, grinding wheels/discs, fasteners and raw materials etc... in fairly sufficient quantity so that erection and commissioning activity is not held up for want of these items.

For all items under this Contract, the Contractor shall deliver 5 % of the quantity of painting material, but at least one litre, in new sealed containers, for later repair works other than the Contractor's.

Lubricating oils, insulating oils and greases etc... required for first filling in the plant and equipment supplied by the Contractor under this Contract shall be supplied in quantity 10 % (ten percent) higher than the actual capacity for first filling. These items shall be supplied as per site requirement and shall not be stocked with main

SECTION: I

SUB-SECTION: C2-B

CUSTOMER SPECIFICATION

(PROJECT SPECIFIC GENERAL REQUIREMENTS)

1 PART-1 TECHNICAL REQUIREMENTS

1.1 General Requirements

1.1.1 Introduction

This section covers technical requirements supplement to all the technical specifications and requirements brought out in the accompanying sections on technical specification. The scope of this specification includes the Mechanical, Electrical, Control, Protection, Instrumentation and Automation system etc... for the plants supplied to complete in all respect for the safe and reliable operation of the units including the auxiliary system. The specification also covers complete planning, design, detailed engineering, fabrication and inspection of equipment and components at manufacturer's works, supply, installation of supplied equipment / items at site, after dismantling the existing equipment / systems completely except those specified for retaining, all works needed to install the equipment / components supplied, site testing, providing necessary assistance for site testing, commissioning of equipment / components supplied, confirmation of reliability and warranty of the complete plants supplied for the tendered project.

It is not intended here to describe the design, arrangement or installation, or to specify each and every component required for the completeness of the plants or to select each material for safe and reliable operation of the proposed plants / equipment. In general the plant shall be complete in all respect with its equipment and accessories, in conformity with the existing civil works and the retained embedded parts of turbine header / spiral casing, as required to make a complete, highly reliable and maintainable installation, conforming to highest standards of engineering design, safety and workmanship.

Every component required for the completeness of the plants / equipment and suitable material required for safe and reliable operation of the proposed plants / equipment is deemed to be included.

The station layout is furnished in Volume-5. The final equipment arrangement shall be that proposed by the Contractor and approved by the KSEBL.

The Contractor shall strictly observe these General Technical Requirements in conjunction with the project related specification **2 "Specific Requirements for the Project"**. The contractor shall strictly observe those specifications / details specified in the above Specification for detailed engineering / design. If the Project Specific Specification has any contradiction with this Specification, the former shall prevail. If the contractor is having any

doubts, he shall contact the KSEBL before quoting for the same.

1.1.2 General

This section of the specifications covers the **general specifications** for planning, design, manufacture, testing at works, supply, erection and commissioning of the mechanical systems, instrumentation and control systems, electrical systems, civil engineering works related to the equipment / plant supplied and other general requirements. These specifications stipulates the basic general guidelines to the Tenderer / Contractor for the design, manufacture, supply, standard and quality of workmanship, general finish of plant, compliance to the latest published edition (prior to the date of closing of tender) of the international standards and recommendations specified throughout the specifications.

The provisions of specific and detailed technical requirements given in other parts of these specifications shall take precedence over these general specifications in case of contradiction between these general specifications and other parts of these specifications. In case of any specific doubts or issues, clarifications shall be obtained from the KSEBL before proceeding.

The intent of specification is to provide services according to the most modern and proven techniques and codes. The omission of specific reference to any method, equipment or material necessary for proper and efficient execution of this work shall not relieve the contractor of the responsibility of providing such facilities to complete the work without any extra compensation.

1.1.3 Scope of Work

1.1.3.1

The work under these specifications broadly covers the complete design, detailed engineering, equipment and components fabrication and testing at manufacturer's works, supply, transportation, storage, complete work of handling at storage yard / stores, transportation to work site, calibration, pre-assembly, erection of supplied equipment / items at site, assistance for all civil works to install the equipment / components supplied, site testing, pre-commissioning, commissioning, provision of necessary assistance for erection, operational testing, trial operation of equipment / components supplied as required, reliability and warranty confirmation of complete supplied plants for the tendered project and handing over of various systems as listed under:

- Air-Conditioning and Ventilation systems

The bidder should ensure supply of machines to suit the existing layout of Powerhouse building. Being a renovation project, the bidders are advised to carry-out a site inspection to ascertain the suitability of their proposed equipment with the pre-existing / retained systems in place.

1.1.3.2

All the E & M components shall be procured only from reputed manufacturers / company approved by the KSEBL. For this the equipment shall be sourced only from a Vendor / Manufacturers list submitted by the Contractor and approved by the Engineer-in-Charge or his representative prior to the start of procurement actions. The Vendor list should clearly mention the equipment details and complete address of the Vendor / manufacturer etc... Complete credentials including brochures / catalogue etc... of the Vendor / Manufacturer and details of performance of their product / equipment etc... shall be also submitted for the approval process.

1.1.3.3

The work to be carried out at site under the scope of this specification covers the complete work of loading, handling, transporting, unloading, pre-assembly, erection, calibration, testing, air flushing, pre-commissioning / commissioning / Acceptance tests, commissioning of systems, trial run of various auxiliaries and equipment as per the approved schedule, achieving various milestones till handing over of the unit to the KSEBL. The work shall conform to the various drawings submitted by the Contractor and approved and issued for construction by the KSEBL. If any portion of the work is found to be defective in workmanship or not conforming to drawings or other specifications, the contractor shall dismantle and redo the work duly replacing the defective materials at his cost, failing which the work will be got done by engaging other agencies or departmentally and recoveries will be effected from contractor's bills towards expenditure incurred including departmental charges.

1.1.3.4

The work shall be executed under the usual conditions without affecting power plant operation and in conjunction with numerous other operations at site. The contractor and his personnel shall cooperate with personnel of the KSEBL and other contractors including civil, coordinating his work with others and proceed in a manner that shall not delay or hinder the progress of work of the project as a whole.

1.1.3.5

The work covered under this specification is of highly sophisticated nature, requiring the best quality workmanship, supervision, engineering and construction management. The contractor should ensure proper planning and successful & timely completion of the work to meet the overall project schedule. The Successful bidder shall submit a Work schedule with

micro level details for approval prior to start of the work as specified in Clause 5.3.5 of Vol. 2 - Conditions of Bid and Contract. The contractor must deploy adequate quantity of tools & plants, modern / latest construction and project management aids, testing and commissioning equipment etc... He must also deploy and make available adequate trained, qualified, competent and experienced supervisory staff and skilled personnel during the period of the Contract and for the training of the operating staff during commissioning and providing assistance and required guidance during trial operations of the Plant.

1.1.3.6

All transport equipment, handling equipment, tools, tackles, fixtures, equipment, materials, manpower, supervisors / engineers, testing equipment, consumables for erection testing and commissioning etc..., except otherwise specified as KSEBL's scope of free issue, required for this scope of work shall be provided by the contractor. All expenditure including taxes and incidentals in this connection will have to be borne by him unless otherwise specified in the relevant clauses. The contractor's quoted rates should be inclusive of all such contingencies.

1.1.3.7

All works such as cleaning, levelling, aligning, trial assembly, dismantling of certain equipment / components for checking and cleaning, surface preparation, fabrication of sheets, tubes and pipes as per general engineering practice and as per KSEBL representative's instructions at site, cutting, gouging, weld depositing, grinding, straightening, chamfering, filing, chipping, drilling, reaming, scrapping, lapping, fitting up etc..., as may be applicable in such erection works and which are treated incidental to the erection works and necessary to complete the work satisfactorily, shall be carried out by the contractor as part of the work within the quoted rates.

1.1.3.8

The contractor shall plan and transport equipment, components from storage to erection site and erect them in such a manner and sequence that material accumulation at site does not lead to congestion at site of work. Materials shall be stacked neatly, preserved and stored in the contractor's shed and at work areas in an orderly manner. In case it is necessary to shift and re-stack the materials kept at work areas / site to enable other agencies to carry out their work or for any other reason, contractor shall do it most expeditiously. No claim for extra payment for such work will be entertained.

1.1.3.9

The Scope of work & description of system / equipment, testing requirements, spares etc... as given in the various clauses of this tender specification and schedules are only for understanding the system requirement, contractor shall note this point and assess the volume of work and the sizing of various equipment along with the required ratings for generating and transmitting the specified power at specified voltage level from the generator terminals, prior to submitting the offer. No compensation shall be considered later on for any omissions in this regard while quoting.

1.1.3.10

Any ratings, if mentioned, are indicative only and are a minimum for giving a base line. The Bidder should ensure that the ratings of the various equipment are sufficient to take care of the design requirements of the equipment offered for the concerned project. Any increase in rating during detailed engineering stage will not entitle the Successful Bidder / Contractor for any extra charges. The Contractor should submit for approval the calculations for arriving at the ratings of the various equipment.

1.1.3.11

The contractor shall have total responsibility for all equipment and materials in his custody at contractor’s stores, loose, semi-assembled, assembled or erected by him at site. He shall effectively protect the finished works from action of weather and from damages or defacement and shall also cover the finished parts immediately on completion of work as per KSEBL’s representative’s instructions. The machine surfaces / finished surfaces should be greased and covered.

1.1.3.12

The contractor shall make suitable security arrangements and ensure protection of all materials / equipment in their custody and installed equipment from theft / fire / pilferage and any other damages and losses.

1.1.3.13

The contractor shall ensure that all the packing materials and protection devices used for the various equipment during transit and storage are removed before these equipment are erected in position.

1.1.3.14

The Control and Relay / Automation panels, Starter panels, Switchgear panels etc... shall

be transported from stores to the place of installation in vertical position. Care shall be taken such that the switches, lamps, instruments etc... mounted on the panel do not get damaged during transit. Panel and instruments once erected in position should be properly protected using necessary care to prevent ingress of dust / moisture. This will have to be periodically cleaned and surroundings have to be kept tidy. All unused openings / cable entry etc... shall be sealed properly to avoid entry of vermin etc...

1.1.3.15

Contractor shall prepare Marked-Up drawings incorporating modifications and deviations from original drawings or prepare fresh sketch for actual installation / connection details if needed, which can be converted to "As-Built" drawings for submitting after commissioning of the Work.

1.1.3.16

The contractor shall perform any services, tests etc... which may not be specified herein but are essential for the completion of work within quoted rates as per the direction of Engineer-in-Charge.

1.1.4 Specifications and Drawings

1.1.4.1

The Work shall be carried out in accordance with the latest Standards and codes, with the Technical Specifications and with the Drawings and Schedules appended hereto (Volume - 5 of the document) and additional Specifications and Drawings issued from time to time by the KSEBL.

1.1.4.2

In case of conflict between a general and more detailed requirement of the Specifications, the most stringent of these shall govern.

1.1.4.3

The drawings supplied by the KSEBL shall not be considered as defining the design of the Work but only as a simple indication of its general layout. All information provided in the drawings shall be checked at Site by the Contractor. **The bidders are advised to acquaint themselves with the site conditions, before bidding. No compensation whatsoever, on account of lack of familiarization with these, subsequent to bidding, will be**

entertained. The bidders have to design the equipment so that it can be accommodated in the space defined by the existing structure of the Powerhouse and on the foundation for the renovated unit. The size and weight of each component should be designed such that these are manoeuvrable by the existing crane through the space available.

1.1.5 Climatic Conditions

All equipment shall be suitable for indoor / outdoor installation under the following climatic conditions:

- Maximum ambient temperature :: 45ºC
- Minimum ambient temperature :: 10ºC
- Maximum relative humidity :: 100%
- Altitude :: < 1000 m
- Wind Speed :: 39 m/s (Zone 2)

The minimum ambient temperature may occasionally go below 10ºC during the winter season.

1.1.6 Available Power Supply During Erection

Available electrical supply will be 3-phase, 4-wire, 50 Hz, 415V (Ph-Ph) and 240V (Ph-N). The KSEBL will not be responsible for interruption of power during execution of the Work. If necessary the Contractor has to arrange his own diesel generator set for availing power supply during interruption.

1.1.7 Civil Works

1.1.7.1

All civil works, required for this Contract shall be carried out by the Contractor.

1.1.7.2

The contractor shall verify the suitability of the foundation for the equipment to be erected and necessary tests may be done for the same.

1.1.7.3

Detailed schedules for Drawing submission, Supply and Construction shall be submitted for approval immediately on receiving the Letter of Acceptance. A Project schedule indicating

micro-level details and milestones shall be submitted prior to start of work as specified in Clause 5.3.5 of Vol.2 - Conditions of Bid and Contract.

1.1.7.4

For Work / equipment / items supplied under this Contract, all necessary embedded parts, steel structures, support / base frames, fasteners and anchor bolts etc... shall be supplied by the Contractor.

1.1.8 Temporary Provisions

Prior to the commencement of the works, it may be necessary to make provisions for the safety and storage of materials and works, for access control of the work site, etc... and to prevent dust spread, to the extent possible, to the existing plants at site. The Contractor shall install such temporary provisions after prior written approvals.

It is the responsibility of the Contractor to provide, erect, put into service and subsequently remove from site, such equipment as is deemed necessary, to facilitate these requirements. Contractor shall provide all material required for the temporary facilities.

All interfacing and integrating activities with existing systems, if required, shall be carried out only after obtaining the "Permit to Work" from the concerned authorities.

1.1.9 Units, Standards and Codes

1.1.9.1

Metric units according to the latest edition of the relevant International Standards Organization (ISO) publications shall be used for this Contract.

1.1.9.2

Unless another standard is specifically mentioned in these Specifications, all materials and Work used and provided under the Contract shall be designed, manufactured, constructed, installed and tested and all design calculations and tests shall be done in accordance with the latest edition, prior to the date of closing tenders, of the appropriate standards and codes published by the following issuing authorities wherever applicable as listed alphabetically:

Abbreviation	Designation
ACI	American Concrete Institute
AGMA	American Gear Manufacturer's Association

AISC	American Institute of Steel Construction
AISE	Association of Iron and Steel Engineers
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
AWWA	American Water Works Association
BSI	British Standards Institute
CSA	Canadian Standards Association
IEC	International Electro-technical Commission
IEEE	Institute of Electrical and Electronics Engineers
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISI	Indian Standards Institute
NEC	National Electrical Code of USA
NEMA	National Electrical Manufacturers Association (USA)
NESC	National Electrical Safety Code of USA
NFPA	National Fire Protection Association
SAE	Society of Automotive Engineers
SSPC	Steel Structure Painting Council
TEMA	Tubular Exchangers Manufacturers Association
UL	Underwriters Laboratories Inc. (USA)

1.1.9.3

The codes and / or standards referred to in these specifications shall govern in all the cases wherever such references are made. In case of conflict between such codes / standards and the specifications, the latter shall govern. Such codes / standards referred to shall mean the latest revisions / versions, amendments / changes adopted and published by the relevant agencies. In case of any further conflict in this matter, the same shall be referred to the KSEBL, whose decision, given in writing, shall be binding.

1.1.9.4

Other internationally acceptable standards, which ensure equal or higher performance than those specified, shall also be accepted subject to the prior approval of the KSEBL. Where required for purposes of approval, the Contractor shall supply necessary information to the KSEBL, in support of his claim that the Standard to which he proposes to work will ensure an acceptable quality in all respects in comparison with the specified Standards. The supply of such information shall include the free issue to the KSEBL, authenticated copies of the proposed Standards other than the international Standard, with English translation

for the purpose of this clause.

1.1.10 Compliance with Specification

1.1.10.1

Notwithstanding any description, drawings or illustrations which may have been submitted with the Tender, all details other than those shown on the Schedule of Deviations shall be deemed to be in accordance with the specification and the standard specifications and codes referred to therein.

1.1.10.2

No departures from the specification shall be made, whether minor or major, except those listed and shown in the Schedule of Deviations and approved by the KSEBL.

1.1.10.3

While complying with specification requirements, the Contractor shall endeavour to obtain with his supervisors / sub-Contractors a uniformity of supply for items such as electrical equipment, motors, relays, pumps, valves, instrumentation and control equipment.

1.1.10.4

A reduction in the number of makes / manufacturers for such equipment will be preferred that will facilitate the training of the maintenance staff of the KSEBL and reduce the number of spare parts. Contractor should make an earnest effort in this direction while executing the Work.

1.1.11 Quality Assurance

1.1.11.1

To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor’s works or at his sub-contractor’s premises or at the KSEBL’s site or at any other place of work, are in accordance with the specifications, the Contractor shall adopt suitable quality assurance program to control such activities at all points necessary. Such a program shall be outlined by the Contractor and shall be got accepted by the KSEBL.

1.1.11.2

The quality assurance program of the Contractor shall generally cover the following:

- His organisation structure for the management and implementation of the proposed quality assurance program,
- Documentation control system,
- The procedure of purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection / verification of materials purchased, etc...,
- System for shop manufacturing and site erection controls including process controls and fabrication and assembly controls,
- Control of non-conforming items and system for objective actions,
- Inspection and test procedure both for manufacture and field activities,
- Control of calibration and testing of measuring and testing equipment,
- System for indication and appraisal of inspection status,
- System for quality audits,
- System for handling storage and delivery,
- System for maintenance of records.

1.1.11.3

For the components / equipment produced by the Contractor for the purpose of this contract, his purchase specifications and enquiry shall call for such quality plans along with their proposals. The KSEBL also reserves its right to carry-out quality audit and quality surveillance of the system and procedures of Contractor's / his vendor's quality management and control activities.

1.1.11.4

The Contractor shall furnish the field quality manuals for the various field activities detailing the procedures and inspection check-lists for transportation, storage / preservation,

erection, pre-commissioning and commissioning activities. The field quality manuals shall indicate the various assembly / erection / operation tolerances and the limits of deviations for each individual equipment and system.

1.1.12 Design & Construction Standardization

1.1.12.1

In complying with the requirements of the specifications, both with respect to arrangement and detail, the design shall conform to the best of the current engineering practice. Each of the several parts of the plant shall be of the manufacturers' standard design, provided that this design is in general accordance with the specification and proven to be satisfactory in its past operational experience.

1.1.12.2

All equipment coming under the scope of work shall be sourced only from reputed and qualified national / inter-national manufactures for which a Vendor approval procedure shall be followed as specified in Clause 1.1.3.2 above.

1.1.12.3

The essence of design shall be operational simplicity, safety and reliability in order to give long continuous service with acceptable economy and low maintenance costs. Particular attention shall be given to internal and external access, in order to facilitate inspection, cleaning and maintenance.

1.1.12.4

The design, dimensions and materials of all parts shall be such that they will not suffer damage as a result of stresses under the most severe service conditions. Fully detailed specifications of the several parts of the plant shall be submitted describing particularly the materials being used. The materials used in the construction of the plant are to be of the highest quality and selected particularly to meet the duties required of them. The design and construction shall ensure adequate drainage to prevent accumulation of water on equipment or on its enclosures. Where unavoidable, means shall be provided to minimize rust or corrosion.

1.1.12.5

Workmanship and general finish shall be of the highest quality and standard throughout its

engineering. All similar components or parts of similar standards of the Plant shall be inter-changeable as far as possible. Parts of Plant including spare parts, which are intended to be inter-changeable, shall be manufactured to ensure that replacements will fit accurately in place without additional machining. Any item of a Plant, which may have to be replaced, shall be interchangeable with any item of the same type. The plants shall be constructed to allow complete inter-changeability of a maximum of parts with similarly placed parts of the other plants.

1.1.12.6

All equipment shall operate without undue vibration and with the least possible amount of noise and is not to cause an irritation. The noise level shall confirm to the requirement specified in the relevant Standards. Special attention has to be paid to environmental impacts, mainly regarding visual aspect, noise level and water and air pollution.

1.1.12.7

Risk of accident shall be kept to the minimum, by adequate design. Risk of fire shall be reduced to the minimum by a relevant choice of materials and general arrangements. All materials and compounds used in the plant design and construction shall be free from health hazards.

1.1.12.8

The equipment shall also be designed to prevent ingress of all vermin, accidental contact with live parts and to minimize the ingress of dust and dirt. The use of materials, which may be liable to attack by termites or other insect, shall be avoided.

1.1.12.9

All materials used shall be of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions arising under working conditions without undue distortion or deterioration or the setting up of undue stress in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform.

1.1.12.10

Cast iron shall not be used for chambers of oil filled apparatus or for any part of the equipment, which is in tension or subject to impact stresses. This clause is not intended to prohibit the use of suitable grades of cast iron for parts where service experience has shown it to be satisfactory.

1.1.12.11

All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid pockets in which water can collect.

1.1.12.12

Means shall be provided for the easy lubrication of all bearings and, where necessary, of any mechanism of moving parts, which are not oil immersed. All mechanism shall, where necessary, be constructed of stainless steel, brass or gunmetal to prevent sticking due to rust or corrosion.

1.1.13 Drawings and Design Data

Preparation of all designs, finalisation of ratings and drawings in respect of the scope of work shall be the entire responsibility of the contractor.

1.1.13.1 Information to be Submitted on Receipt of Order

1.1.13.1.1

Immediately on receipt of Work order the Successful Bidder / Contractor shall submit detailed schedules for Drawing submission, Supply and Erection, Testing and Commissioning etc... for approval. A Project schedule indicating micro-level details and milestones shall be submitted prior to start of work as detailed in Clause 5.3.5 of Vol.2-Conditions of Bid and Contract.

The Contractor shall prepare all necessary detailed drawings, designs, logic diagrams, write-ups etc... giving full and complete information to enable the KSEBL to properly consider the design of the works. The design of the equipment should be in such a way that they should be accommodated in the existing space.

Drawings and design data shall be submitted without delay in the order in which they are required for finalization of Civil Design, ordering of material and / or installation at site.

All drawings and documentation shall be submitted to the KSEBL as outlined in the various sections contained in the Technical Specification.

The Contractor shall submit for approval the list of drawings and drawing schedule, indicating:

- **Each kind of drawing per job site, and the estimated first submission date**
- **Enough number of columns indicating approval stages and dates.**

The list of drawing shall be updated whenever necessary until completion of the works.

Where required, the Contractor shall submit copies of his drawing lists, having incorporated the updated drawing schedule as mentioned above. These lists shall clearly indicate the actual status of every drawing, i.e. "**For Information only", "For Approval", "Resubmitted for Approval", "Approved or As-Built".**

1.1.13.1.2

All drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement, weight of each component, breakdown for packing and shipment, external connections, fixing arrangements required, dimensions required for installation and interconnections with other equipment, clearances and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

1.1.13.1.3

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor's risk. The Contractor may make any changes in the design, which are necessary to make the equipment conform to the provisions and intent of the contract and such changes will again be subject to approval by the KSEBL. **Approval of the Contractor's drawings or work by the KSEBL shall not relieve the Contractor of any of his responsibilities and liabilities under the Contract**.

1.1.13.1.4

The Contractor shall design the various components of the Plant and submit to the KSEBL for approval, drawings and other technical data and instructions required for manufacturing, shop assembly and testing, site erection and testing, operation and maintenance of the Work.

1.1.13.2 Drawings & Design data during Engineering

1.1.13.2.1

The Contractor shall submit drawings and documentation to the KSEBL as outlined in the Vendor Data Requirements Form contained in the Technical Specification. The drawings and data to be provided by the Contractor shall be in English with the units used in Metric /

SI system in ISO standard sheet sizes shall include but shall not be limited to:

1. Quality Assurance Plan — Full details of the quality assurance plan and outline of quality assurance procedures to be employed. Proof of certification with an approved national or international quality assurance standards organization.

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3. Detailed Inspection and Test Plan — A comprehensive schedule of inspection and testing (factory and site) for all major parts of the Work. This should include inspection and survey of the portions of the generating station pertaining to Work at the earliest practicable stage.
4. Schedule of Drawings — Indicating the proposed submission dates for KSEBL's approval. The schedules shall be revised and re-issued every month until completion of all drawings.
5. Design Documents — Calculations required by the KSEBL to substantiate the Contractor's design:
   - Cable sizing (HV & LV)
   - CT & PT sizing
   - Unit Auxiliary Transformer & Station Service Transformer sizing
   - Busbar Sizing, NGT sizing, NGR sizing
   - HVAC design, Ventilation system design
   - Battery and Charger sizing, UPS sizing etc...
   - Fire fighting and emergency water tank sizing etc...
   - Sag-Tension calculations, Clearance drawings
   - 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...
6. Single Line Diagrams
   - Each electrical works and their circuits shall be represented by a single line diagram. It shall contain all required technical information of the Works

represented, e.g. voltage, current, capacity, short-circuit level, ratios, voltage variations, measuring transformer and protection relay indices, interlocking, kind of switch drive, code designation, etc... as applicable.

- Single-line diagrams of individual main components and switchboards shall additionally show the control, indicating, measuring, metering, protection, automatic, and other auxiliary electric devices separated for each individual installations item and location as applicable.
- Furthermore, the applied recommended setting of adjustable devices (protection and control elements, time relays, etc.) shall be indicated.

7. General Arrangement Drawings

Outline drawings to scale showing relation of major equipment components and accessories, principal dimensions, levels and weights sufficient for planning and coordination of the overall project. The General Arrangement Drawings shall show the physical arrangement of Works embedded and equipment and their layout in the Power House, switch-yard and appurtenances:

- General assembly drawings of the mechanical plants / equipment to be supplied together with sufficient sub-assembly drawings including piping layouts / isometrics, valve arrangements, etc...
- General assembly drawings of the electrical plants/equipment to be supplied together with sufficient sub-assembly drawings.
- General arrangement drawings, showing cable and grounding conductor routes with location of earth rods, test links and bonding connections to steelwork.
- General arrangement drawings of the emergency services such as location of fire extinguishers, emergency lighting, fire alarm panels, location of

	detectors, fittings, etc...
8. Detailed Drawings	All details of equipment and materials required for fabrication and assembly. These drawings are to be cross-referenced to all other drawings. They shall include material of construction, coating / painting specifications for all equipment and materials etc...
10. Electrical Drawings and Diagrams, Wiring Diagrams and Wiring Lists	All data pertaining to electrical equipment including rating & name plate details, Bill of materials (indicating make, type, rating etc... of electrical equipment), single line, schematic diagrams, logic diagrams, wiring connection and outline drawings and a description of operation: • Plant instrumentation and control layout and logic diagrams confirming to the requirements specified. • Electrical control, protection and instrumentation diagrams and logic schematic diagrams of the systems including panel layouts drawings, indication and alarm circuits and logic diagrams (including plant control and synchronising logic) and interlock circuits bearing nomenclature as specified. • Interlocking and control logics, Trip Matrix and trip logic etc... • General arrangement drawings showing the location of control gear, transformers and fuse boards, socket outlets, lighting points, controls and switches of indoor and outdoor lighting.

- Building services layout and detailed drawings, such as electrical lighting and power services layouts, AC and ventilation layouts, communication system layouts, computer local area network layouts (LAN), if any, other services layouts, etc...
- Detailed interface drawings like inter-panel and inter equipment wiring / connection diagrams, cable schedules etc...
- Block Diagrams

11. Erection Drawings — All details and data in sequence as required for installation or erection of the work.
12. Foundation Drawings — The contractor shall verify the suitability of the existing foundation and if found not satisfactory, all the required drawing for the modifications to be made in the existing foundation shall be provided.
13. Load Diagrams and Calculations — Total static and dynamic loads, including short circuit forces, impact forces etc..., load centres and design calculations of major components.
14. Bill of Materials / Schedules — A complete separate list giving details of make, type and rating of all materials, which the Contractor expects to provide:
    - Cable Schedule and Inter-connection lists
    - Schedules for piping, valves, instruments, cables, alarms, controls etc...,in form as required by KSEBL.
        - The Alarm lists shall indicate all alarms and shall contain at least:
            - ✔ Description and priority level of alarm
            - ✔ Data of alarm detector (contact) referring to applicable circuit diagram.
            - ✔ Data of alarm annunciator (location and clear text labelling)
        - The piping and valve control 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

15. Performance Data	To include graphs and all other pertinent information viz; Catalogues, performance curves, test certificates, data sheets of equipment etc...
16. Wearing Parts Drawings	Drawings of all component parts, which require replacement due to wear in normal operation. Drawings shall include notations as to Specification of materials for fabrication of replacement parts.
17. Motor List	A complete list of all electric motors supplied including all normal nameplate data.
18. Operation and Maintenance Manuals	Complete detailed instructions for operation, maintenance, future removal and replacement of equipment, including all components and accessories.
19. List of Spare Parts and Special Tools	Complete listing of special tools and replaceable spare parts with descriptions, catalogue numbers and illustrations.
20. Erection Procedures	Complete erection procedure / Method statement.
21. Inspection, Testing & Commissioning Procedures	Method Statement for Inspection, Testing and Commissioning complete with list of commissioning instrumentation and testing equipment.
22. As Built Drawings	All revisions, corrections and approvals, and any physical changes made during construction, assembly or erection, so that the drawing accurately represents that part or portion of the Work as it was actually completed and accepted by the KSEBL.
23. General	Any other Drawings / Documents as listed in the specification for each equipment.

1.1.13.2.2 Schematic Diagrams

Schematic diagrams of turbine control and auxiliary systems like oil pressure unit, compressed air system, drainage / dewatering system, cooling water system, inlet valve etc... shall be supplied. These drawings shall show all instruments and control devices. Standard abbreviations and component numbers shall be used as per relevant standards.

1.1.13.2.3 Single Line Diagrams

Each electrical Plant and their circuits shall be represented by a Single line diagram. It shall

contain all required technical information of the Plant represented, e.g. voltage, current, capacity, short-circuit level, ratios, voltage variations, measuring transformer and protection relay indices, interlocking, kind of switch drive, code designation, etc... as applicable. Single-line diagrams of individual main components and switchboards shall additionally show the control, indicating, measuring, metering, protection, automatic, and other auxiliary electric devices separated for each individual installations item and location as applicable: Furthermore, the applied recommended setting of adjustable devices (protection and control elements, time relays, etc...) shall be indicated.

1.1.13.2.4 Circuit Diagrams

The Circuit Diagrams shall show the power circuits in all phases with the main apparatus as well as the pilot circuits (measuring and control circuits). It shall show in full the functioning of part or all installations, Plant or circuits with all required technical information. A detailed Bill of Materials indicating the make, type no. and ratings of the devices / equipment used shall also be provided along with the schematic / circuit drawings.

Contact developments of the installed switches, contactors, relays and other apparatus which appear in the diagram shall be shown below the respective contactor coil, indicating by means of numbers and, if not on the same, also the page No., the circuit path (grid reference) in which the corresponding contact has been used.

Circuit diagrams shall also contain all terminals and their correct designations. Terminals shall be grouped together to terminal blocks of switchboards, distributors, etc...

The representation of electrical works and control circuits shall not be terminated at the limits of the scope of supply, but has to be extended beyond this limit by all switchgear, protective, measuring and monitoring equipment required for full comprehension of the whole circuit. All terminals and functions of Plant or Works to be supplied by others shall be taken over as well through proper cross-references.

1.1.13.2.5 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.

1.1.13.2.6 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.

1.1.13.2.7 Lists and Schedules

Following lists and schedules shall be supplied:

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 material 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.

1.1.13.3 Final Drawing and Documentation

The Contractor shall submit final updated copies of above drawings and documentation to the KSEBL as outlined in the various sections contained in the Technical Specification. Drawings and documentation submitted to the KSEBL shall comprise one good quality sepia or polyester reproducible printed on the face side and clear prints with black lines on a white background. As-Built drawings and documents shall be provided in quintuplicate (five copies) for the use of KSEBL. Hard copy of the Drawings / documents shall be submitted **in an appropriate form, and in Hardbound volumes and/or with heavy-duty**

spiral binding, giving due importance to the document. Soft-copies of the Manuals / Documents submitted shall also be provided in a good quality CD / DVD.

Any software required for the configuration of various devices / equipment, supplied under the scope of work, shall also be provided in sufficient number of copies, free of cost, along with the required communication interfaces, connecting cables, converters and manuals, if any.

The Contractor shall also provide electronic files of drawings formatted in the latest version of AUTOCAD.

1.1.13.4 Drawing and Document Submittal Procedure

A Document Transmittal Letter (DTL) giving the titles and number thereof, status of the document and the action required by the receiver, shall accompany each submittal of drawings and design data.

In order to scrutinize drawings and documents in a reasonable period with priority, the Contractor shall submit the drawings/documents as detailed below:

i. The drawings / documents are submitted as per the drawing / document schedule sequentially and in batches and not in bulk at a time.
ii. All the required technical particulars, calculations, technical catalogues, relevant details plant/equipment are submitted.
iii. All protection and control schemes are submitted with a detailed explanatory notes and logic and / or block diagrams for quick understanding.
iv. Deviations, if any, from the specifications or the contract documents shall be listed and submitted with an explanation or justification.
v. All the comments given by the KSEBL in the previous submissions are duly incorporated while resubmitting the drawings / documents for approval.
vi. All the drawings and documents of the sub-contractor are checked and certified by the Contractor after affixing his signature that he has fully examined them for compliance with the contractual requirements.
vii. For each drawings / documents, the Contractor shall indicate clearly the deviations, if any, from the contract documents, explaining the reason for the deviation and request the KSEBL explicitly for approval. Failure to do so shall not release the Contractor from his obligation to supply and execute the works in strict conformity with the contract documents, even if the deviated documents / drawings submitted by the Contractor were approved by the KSEBL.
viii. The Drawings / documents shall be submitted in soft copy also in PDF format (by email) in addition to the hard copy as required above for facilitating faster

processing by various concerned sections during approval stage.

1.1.13.5 Manuals and other Documents

This shall generally include the following but not limited to these:

- Design Manuals
- Schedules
- Erection and Start-up Manuals
- Quality Assurance and Control Manuals
- Operation and Maintenance Manuals

All manuals and other documents shall be printed on A4 size paper unless other wise approved by the KSEBL.

A) Design Manuals

These generally include the design calculation sheets, design data sheets, stress analysis, computer outputs, manufacturer catalogues, etc..., which shall be provided by the Contractor during engineering stage of the contract to the KSEBL for approval or information.

B) Schedules

Various time schedules including site activity plans and drawing/document submittal schedule, Equipment Delivery Schedule etc...

C) Erection and Start-up Manuals

The Contractor shall provide detailed erection and start-up manuals covering the step-by-step erection, testing, start-up commissioning procedure of all the plants and equipment provided by him under the contract. These documents shall be provided at least 1 month prior to the erection or start-up works at site. Test procedure and protocols shall be provided at least one week prior to the test witness request.

D) Quality Assurance and Control Manuals

The QA/QC manuals shall generally include the following but not limited to these:

- Field test record manual
- Quality Assurance at manufacturer works, if possible
- Quality control at site for civil engineering works of electrical/mechanical equipment
- Quality control at site for erection / installation
- Safety plans at site
- Environmental plan at site

The Contractor shall submit entire field test record manual before the provisional taking over of the works.

Where applicable and requested by the KSEBL, the Contractor shall provide manufacturer / sub-vendor / QA / QC procedure manuals, along with the factory type / routine test certificates of the plants / equipment being supplied under the contract. Such documents shall be provided prior to the shipment of plant / equipment and got approved. It will not be sufficient to provide manufacturers standard brochures or copy of certificate issued by ISO or similar authorities.

E) Operation and Maintenance Manuals

The Contractor shall submit to the KSEBL 10 copies of the Operation and Maintenance Manuals.

The O & M manuals shall generally include the following but not limited to these:

- Operation manual
- Maintenance manual
- Detailed components manual
- Spare parts manual
- Consumables manual
- Operator trouble shooting manual

The Contractor shall provide detailed instruction manuals covering the operation and maintenance aspects of all the plants and equipment provided by him under the contract. It will not be sufficient to incorporate manufacturer's standard brochures as part of the text unless they refer particularly to the equipment supplied and are free of extraneous matter. The O & M manuals shall contain information in sufficient detail to enable the Purchaser to maintain, dismantle, reassemble, adjust and operate the Works with all its items of Works and installations. Details 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 also included.

Required copies of the draft O&M manuals shall be submitted to the KSEBL for approval as per required schedule. In the event of any change to the plant or any variation of the instructions occurring after the approval of the manuals and before the end of the guarantee period, the Contractor shall submit the proposed amendments for approval and subsequently provide required copies for each of the manuals already supplied. The approved schematic diagrams, wiring drawings, logic diagrams, etc...,shall be mounted in hard cover folder with cover page embossed

with the document title.

All copies of operation and maintenance manual shall be original and shall be provided in hardbound volumes. The front side and spine (hard end) side of the bound cover shall be embossed with document title. All volumes of the operation and maintenance manuals shall be of same size and of thickness, which could be easily manageable and marked with volume numbers.

a) Operation Manual

This manual shall include basic step-by-step instructions on how to operate the plant/ equipment both with regard to individual items and to systems under all patterns of normal and abnormal conditions. The instructions shall include reference to the applicable operation limits. Precautions and warnings in relation to the safety of operator's life and equipment shall be included wherever relevant. The entire testing and adjustment procedure required for the Works after overhauls and during operation shall be described.

b) Maintenance Manual

The maintenance manual shall include the following but not limited to these:

- Preventive maintenance schedules
- Maintenance schedules
- Maintenance procedures and troubleshooting charts

The schedules and procedures shall be for all the items of the plant / equipment and shall include the following but not limited to these:

- A table 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.
- The step-by-step procedures for maintenance

- The checks to be made, including the limits of fits and other tolerances
- A fault diagnosis guide (where appropriate) giving Repair and adjustment procedures including fault tracing etc...
- The spares required
- The special tools required
- Drawings sufficient to illustrate the maintenance procedures, retrofitting of spares and fixing of special tools etc... shall be included
- Frequency of routine and overhaul maintenance

c) Spare Parts Manuals

The Contractor should provide a consolidated list of spare parts along with the blown up views for all the systems/plants/equipment provided by him, which normally require replacement. The manuals shall be organized such that it facilitate the procurement planning and optimum stocking of spare parts ease in identification and preparation of specification of spare parts for procurement and to reduce the duplicate stocking of similar spares and sub-assemblies, all placed together system wise, subject wise, and discipline wise.

The following details shall be incorporated in the spare parts list:

- Manufacturers part No. / Catalogue No.
- Name plate details and specification of standard spares so that these items can be purchased from alternative sources.
- Detailed drawing for each item of spare parts shall be supplied
- Indicate optimum stocking level of each item so that equipment availability and reliability is ensured without excessive stocks. The information should include minimum and maximum quantities of spares to be maintained by the project for a period of 5 years.
- Inter-changeability of spare parts between the similar equipment.
- The list further divided the spare parts into:
    - Operation consumables.
    - Operations back up.
    - Consumable for each type of scheduled works.
    - Back up for each type of scheduled works.

- Emergency or insurance spares.

d) Consumable Manual

This manual shall include a list of all consumables with the frequency of their replacement and consumption, manufacturer name and product name/type, identification code, if any, etc... The manual shall also include a schedule of lubricants. The schedule shall include all lubricants, greases and other consumables used in the plant / equipment

e) Operator Trouble Shooting Manual

This manual shall include a list of actions the operator has to take during the various process alarm conditions and during the emergency conditions. The manual shall describe each and every alarm that will be appear, immediate action and troubleshooting plans.

1.1.13.6 Erection, Pre-Commissioning and Commissioning Procedures

The Contractor shall submit to the KSEBL for approval erection, pre-commissioning and commissioning procedures for the Work as outlined in the various sections contained in the Technical Specification.

The **Erection / Installation 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 / Purchaser 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 shall be described in sequential steps for the pre-commissioning of all electrical and mechanical equipment and shall also contain sufficient details viz. checking of installations, ratings, cable terminal checking and operation test of all auxiliary equipment etc... necessary Log Sheets shall be annexed to facilitate proper recording of test results.

The **Commissioning procedures** shall sequentially and in sufficient detail describe activities and tests for all systems covered by the Contract Document.

1.1.13.7 Quality Assurance Plan and Test Reports

The Contractor shall submit to the KSEBL copies of all tests required under the Contract as

outlined in the various sections contained in the Technical Specification along with the procedure for inspection and quality assurance.

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 finalised 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-in-Charge 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.

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 judgement.

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-in-Charge 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.

1.1.13.8 Drawing and Document Approval Procedure

1.1.13.8.1

All specifications, drawings, reports, design calculation, data etc... shall be submitted for

KSEBL's approval. The KSEBL shall give comments or approval within specified period from the date of receipt of such documents. Any manufacturing work carried out prior to such approval will be at the Contractor's own risk and expense.

If the KSEBL fails to approve or comment on the documents submitted by the Contractor within the agreed period, the Contractor may request for a meeting with the Engineer in Charge or his representative, for sorting out any issues and getting approval without any inordinate delay.

1.1.13.8.2

Each document for which no approval is required shall be clearly marked "**FOR INFORMATION ONLY**" in a visible place. The KSEBL may, however, decide to treat such document as sent for approval, if deemed necessary.

Each document sent for approval shall be clearly marked "**FOR APPROVAL**" in a visible place. The KSEBL may, however, decide to mark such document "**Not subject to Approval**", if deemed necessary.

The Contractor must in no case distribute any document without either one of the above-mentioned marks or his approval of a sub-contractor's drawing without the mark "Approved, Date, Signature". Documents distributed otherwise may be regarded as non-existent.

1.1.13.8.3

As far as documents submitted for approval are concerned, the KSEBL will notify the Contractor, within 30 days after receipt, by returning one copy marked with one of the following categories, as applicable:

Cat. No. A: "For Information Only. Not Subject to Approval"

Cat. No. B: "NOT APPROVED"

Cat. No. C: "APPROVED EXCEPT AS NOTED. RESUBMIT"

Cat. No. D: "APPROVED – SUBMIT CERTIFIED COPIES (8Sets)"

Cat. No. E: "FINAL – ISSUED FOR CONSTRUCTION"

i. The notification "**APPROVED**" authorizes the Contractor to commence the procurement or to proceed with the construction / fabrication of equipment covered by such drawings in compliance with his contractual obligations. On receiving this notification, the Contractor shall submit sufficient copies (8 copies for the Engineer-in-Charge's use) of the Drawings / documents after affixing his seal and signature for stamping under Cat E: "FINAL – ISSUED FOR CONSTRUCTION". **Only drawings stamped under CAT. No. E: "FINAL – ISSUED FOR CONSTRUCTION" shall be issued to site for Erection / Installation.**

ii. The notification "**APPROVED EXCEPT AS NOTED**" authorizes the Contractor to commence the procurement at his risk or to proceed with the fabrication in compliance with his contractual obligations, subject to all corrections noted on the document or submitted on a comments list are acceptable to the Contractor and the Contractor ensures that the work at this stage is in full compliance with the KSEBL's requirements.

After incorporating the remarks fully, the document shall be resubmitted for approval at the earliest but within the specified period indicating clearly the details of the revision. **Every revision shall be clearly identified on the drawing with bubble mark indicating the revision number inside the bubble and described by number, date and subject in a revision block on all drawings**.

iii. The notification "**NOT APPROVED**" indicates that the document must be revised and resubmitted for approval before proceeding further.

iv. The information documents shall be notified as "**FOR INFORMATION ONLY**".

v. If any specific approval is required or requires specific attention for a design/construction feature the Contractor shall notify accordingly.

1.1.13.8.4

During the preliminary stage of the design work, the Contractor may submit to the KSEBL drawings and documents for information and general review along with lists of deviations (if any), being basis for eventual design meetings. At the latest when quality, completeness and conformity with the contractual documents have reached satisfactory level, the Contractor shall submit these documents for approval. ***The Contractor should certify all the drawings / documents received from sub-vendors for equipment procured through out-sourcing and submit the same with a Cover sheet having Title Block and format as indicated in Clause 1.1.13.9 along with Contractor's drawing / document number***.

Each of the drawings / documents for a subject submitted as above shall be reviewed and checked by the KSEBL to reach the status "APPROVED".

1.1.13.8.5

At least 48 hours prior to starting any work, the Contractor shall have obtained the "APPROVED" or "RELEASED FOR CONSTRUCTION" status for the documents pertaining

to work and shall have supplied the required number of copies to the KSEBL's representative at site.

1.1.13.8.6

The KSEBL / KSEBL's representative may order the interruption of the execution of any work for which the Contractor cannot present approved drawings. Such an interruption shall not relieve the Contractor from executing his work as stipulated in the contract and shall be no reason whatsoever for claiming a delay or additional costs / escalation.

1.1.13.8.7

The approval of drawings by the KSEBL shall not exonerate the Contractor from any of his responsibilities under the Contract.

1.1.13.8.8

Should an error be found in a Contractor's drawing during the erection of structures or the installation of equipment, the Contractor shall correct the drawing thereon by including the delineations of any changes found necessary at Site and shall resubmit the drawing for approval as specified.

1.1.13.8.9

Both the KSEBL and the Contractor shall sign approved drawings and no departure from these drawings shall be allowed without the approval of the KSEBL.

1.1.13.8.10

After a drawing is finally approved by the KSEBL and signed by both the parties, sufficient number of copies of the approved drawings (8 copies) may be issued to the KSEBL.

1.1.13.9 Format of Drawings

1.1.13.9.1

The drawings of the Work shall be ISO standard sheet sizes as indicated in Clause 1.1.13.9.5, with a left-hand border of 30 mm and all other borders 20 mm.

1.1.13.9.2

Drawings shall have the title block placed in the bottom right corner with a space of approximately 75 mm x 150 mm immediately above it for use by the KSEBL to indicate approval or otherwise.

1.1.13.9.3

The “Project Name” field of the title block shall prominently display the information given in Clause 2.1.4.1.3 of Specific Requirement of the Project, in the upper part of the block.

1.1.13.9.4

The title block shall also contain the drawing number and its title, the date, scale, serial number, revision no, date of issue and date of revision. The names of Contractor and KSEBL (“KERALA STATE ELECTRICITY BOARD LIMITED” with Logo / Emblem on the Left Hand side) shall be prominently displayed and these shall be subject to approval of the KSEBL.

1.1.13.9.5

All drawings shall show the scales of the metric system, and all descriptive wording shall be in the English language.

The drawings shall have a size according to 'A' series of DIN 476 or equivalent international standards.

The drawing size shall conform to the following :

Site layout drawing General arrangement drawing Civil construction drawing	A0 Size
Equipment assembly drawing Electrical single line diagram Electrical route layout drawing Piping layouts (Isometrics) Flow diagrams and schematics	A1 Size
Electrical schematics Control schematics Instrument hook-up drawings Interlock and logic diagrams	A3 Size

The scales shall be according DIN 476 or equivalent international standard

- for reduction M 1:2.5, 1:5, 1:10, 1:50, 1:100, 1:200, 1:500, 1:1000, 1:5000
- for enlargement M 2:1, 5:1, 10:1

Drawings shall be folded according to DIN 824 (A4) being 297 mm in height.

1.1.13.9.6

Modified drawings shall bear a revision letter and revision date, and the nature of the modification shall be clearly stated and the modifications undertaken highlighted / marked in the corresponding areas, no matter if the drawing was already approved, approved with comments or not approved.

1.1.13.9.7

The erection works shall be carried out only as per approved drawings with all KSEBL's comments incorporated. These drawings shall be clearly and tidily updated with red ink incorporating all changes carried out at site during the erection and testing works. The changed or cancelled items shall not be deleted by eraser or liquid corrector, but crossed only, in order to keep visible the cancelled part. Two sets of these "marked up" drawings shall be handed over before the energizing of any section of works.

1.1.13.10 As-Built Drawings

As built drawings, technical documents and data sheets of the work as completed shall be prepared by the Contractor based on the "Marked Up" drawings approved by the KSEBL. These documents shall be sufficient in detail to enable the KSEBL to maintain, dismantle, reassemble and adjust all parts of the work. The "As-Built" documentation and file arrangement shall be subject to approval by the KSEBL. The documents shall be submitted in an appropriate form, and in Hardbound volumes and/or with heavy-duty spiral binding, giving due importance to the documents. Soft-copies of the Manuals / Documents submitted shall also be provided in a good quality CD / DVD.

It is understood that as a result of experience gained during commissioning of plant / equipment certain logic, schematic and wiring diagrams require revisions. The Contractor shall provide 2 draft copies of such revision mark-up drawings to the KSEBL's representative for their use until the final "As-Built" drawings are provided.

The Contractor shall obtain Authority's approval on each of the "As-Built" reproducible prior to making required copies. The Contractor shall provide required prints of as-built drawings mounted in suitable box file(s) with attached list showing contents in each file with

separation between the engineering disciplines i.e. civil, mechanical, electrical, control system, etc... The edges of as built drawing reproducible shall be suitably protected from wear and damage due to handling. The Contractor shall also provide electronic files of drawings formatted in the latest version of AUTOCAD.

1.1.14 Progress Reports

During each stage of Design, Manufacturing, installation etc... detailed progress reports shall be submitted by the Contractor as specified in C**lause 5.3.6 of Vol. 2 - Conditions of Bid and Contract** and as detailed below:

1.1.14.1 During Design and Manufacturing

During design and manufacturing the Contractor shall monthly submit four (4) copies of the progress reports in a format approved by 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 includes any notable problems, which were encountered.
- The total overall percentages of design and manufacturing works completed, with reference to the CPM / PERT schedule. 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 / PERT schedule, an explanation shall be given.

1.1.14.2 During Installation at Site

During erection the Contractor shall, submit four (4) copies of the fortnightly progress reports in a format approved by 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 includes any notable problems, which were encountered.
- The total overall percentages of erection works completed, with reference to the

CPM / PERT schedule. Appropriate comments shall explain any differences.

- The percentages of each main work activity completed during the reported fortnight 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 / PERT Schedule, an explanation shall be given.
- A list of local manpower (by trade classification) employed during the reporting period.
- A list of foreign 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.

1.1.15 Materials

1.1.15.1 General Specifications

1.1.15.1.1

The materials used in the construction of the Work shall be new, of high quality and selected particularly to meet the duties required of them. The material specification shall be indicated in the Contractor's detailed drawings. The use of materials liable to be attacked by termites or other insects will not be allowed. All workmanship is to be of the highest quality throughout to ensure smooth and vibration free operation under all possible operating conditions, and the design, dimensions and materials of all parts are to be such that the stresses to which they may be subjected shall not render them liable to distortion or damage under the most severe conditions encountered in service.

1.1.15.1.2

Materials shall meet the latest issue of the following ASTM Standard Specifications:

a)	Steel Piping, Tubing and Fittings	ASTM A53	Pipe, steel, black and hot-dipped, Zinc-coated, welded and seamless
		ASTM A181	Forgings, Carbon steel for general purpose piping
		ASTM A789	Seamless and welded ferritic / austenitic stainless steel pipe for general service
b)	Ferrous Castings, Ferro alloys	ASTM A743	Corrosion-resistant Iron-Chromium, Iron-Chromium-Nickel and Nickel base alloy castings for general application Grade CA-15, Grade CF-8M and Grade CA-6M
		ASTM A27	Mild to medium strength Carbon steel castings for general application grade 65-35, or 70-40
		ASTM A487	Steel castings for pressure service
c)	Steel Plates, Sheets, Strips	ASTM A176	Stainless and heat-resisting Chromium steel plate, sheet and strip
		ASTM A240	Heat resisting Chromium and Chromium-Nickel stainless steel plate, sheet and strip
		ASTM A345	Flat rolled electrical steels for magnetic applications
d)	Structural Steel, Pressure Vessel Plate and Forgings	ASTM A36	Structural steel
		ASTM A515	Pressure vessel plates, Carbon steel for intermediate and higher temperature service
		ASTM A516	Pressure vessel plates, Carbon steel for moderate and lower temperature service
e)	Steel Bars, Steel Forgings	AST A276	Stainless and heat resisting steel bars and shapes types 316 and 302
		ASTM A668	Steel forgings, Carbon and alloy for general industrial use Class D
f)	Copper and Copper	ASTM B23	White metal bearing alloys (known

Alloys		commercially as Babbit metal)
	ASTM B43	Seamless red brass pipe, standard sizes
	ASTM B66	Bronze castings in the rough for locomotive wearing parts
	ASTM B88	Seamless Copper water tube
	ASTM B466	Seamless Copper Nickel pipe and tube
	ASTM B584	Copper alloy sand castings for general application

1.1.15.1.3

Materials shall meet the latest issue of the following ANSI standard specifications:

ANSI B15-5	Flanges and fittings for steel pipes and valves.
ANSI C80.1	Rigid steel conduits, Zinc coated.

1.1.15.2 Trade Names

When, as described in these Specifications, certain work, articles, materials and/or manufacturing processes have been named by their trade names or by their catalogue name or number, these designations are meant to be followed by the words "or approved equal" even if they are not included in the text. The Contractor may substitute other work, articles, materials and/or fabrication processes subject to the approval of the KSEBL, provided these are equivalent in quality and type to those indicated and / or specified. It will be the Contractor's responsibility to demonstrate and prove to the KSEBL the quality and suitability of the alternatives proposed.

1.1.15.3 Fasteners

1.1.15.3.1

Nuts, bolts, studs and washers for incorporation in the Work shall conform to the requirements of the appropriate Standard. Where non-standard fasteners are used in the Work, appropriate tools, including wrenches, taps and dies, shall be provided. Nuts and bolts for pressure parts shall be of the best quality bright steel, machined on the shank and under the head and nut.

1.1.15.3.2

All washers shall be included under the Contract, including locking devices and anti-vibration arrangements, which shall be subject to the approval of the KSEBL. Taper washers shall be fitted where necessary. Where there is a risk of corrosion, bolts and studs shall be finished flush with the surface of the nuts.

1.1.15.3.3

Bolts, except for high strength friction grip bolts, shall be designed so that, with the nuts fully tightened, the stress intensity at the bottom of the thread shall not exceed one half of the yield point of the material under all conditions. Connections employing high strength friction grip bolts as per ASTM A325 or A490 shall follow the requirements of "Specification for Structural Joints Using ASTM A325 or A490 Bolts" as given in the AISC Manual of Steel Construction. Bolts, nuts and screws, which are subject to frequent adjustment, frequent removal or immersion in the course of operation, shall be made of corrosion-resistant steel or bronze. The material of stainless steel bolts and nuts shall be selected to prevent galling. Spring type washers will not be permitted where they may damage any protective coatings.

1.1.15.3.4

Steel bolts and nuts exposed to atmosphere shall have suitable finish like cadmium plating or zinc plating for diameters above 6 mm. All bolts, nuts and pins used inside the equipment shall be locked in position.

1.1.15.3.5

On outdoor equipment, all bolts, nuts and washers in contact with non-ferrous parts, which carry current, shall be of phosphor bronze, where the transfer of current is through the bolts.

1.1.15.3.6

If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, suitable special spanners shall be provided by the Contractor.

1.1.15.4 Forgings

Forgings in excess of 150 mm in diameter shall be subjected to examination internally for the detection of flaws and to heat treatment for the relief of residual stresses. Particulars of

the heat treatment proposed for all forgings, and in each case the name of the proposed maker, shall be submitted to the KSEBL for approval. Each forging incorporated into the Work shall be clearly stamped with the heat number readily visible. All such forgings shall be jointly examined at the place of manufacture by the KSEBL and by a representative of the Contractor during the heat treatment and shall be examined by the latest non-destructive methods for the detection of defects.

1.1.15.5 Castings

1.1.15.5.1

Castings shall not contain damaging defects and they shall be satisfactorily cleaned before use. Surfaces that are not machine finished and which will be exposed after their final installation shall be such that grinding at site will not be required before painting. The presence of defective material shall be determined and it shall be removed down to sound metal. Castings shall be homogeneous and free from excessive non-metallic inclusions. An excessive concentration of impurities or a separation of the alloy elements in the critical points of a cast part shall be sufficient reason for its rejection.

1.1.15.5.2

Castings of main parts, including all those subject to hydraulic pressure and all castings, which underwent major repair, shall be radio-graphically examined as specified. Other castings shall be tested using radiographic, ultrasonic, dye penetration, magnetic particle or any other standard non-destructive test method approved by the KSEBL. The KSEBL has the right to ask the Contractor to carry out non-destructive tests to determine:

- the presence of defects;
- the maximum extent of defects;
- that the area to be welded is satisfactorily prepared;
- that the repairs are satisfactory.

The costs incurred by such tests shall be at the Contractor's expense.

1.1.15.5.3

Minor defects or imperfections which definitely do not affect the strength or utilization of the cast parts may be repaired by welding, according to the accepted practice for the repair of such parts, without requiring the KSEBL's approval. Minor defects shall be considered as such when the depth of the prepared cavity to be welded is not greater than 25% of the

effective wall thickness but in no case may it exceed 25 mm when the area to be welded is greater than 16,000 sq. mm. However, a cluster of minor defects shall be considered an important fault when judged by the KSEBL to cast serious doubts on the general quality of the casting and shall constitute cause for rejection at the KSEBL's discretion.

1.1.15.5.4

Before proceeding to repair any major defect, a written report shall be submitted to the KSEBL in which the fault is fully described, together with diagrams, photographs and reports of metallurgical tests, when applicable, as well as with the description of the proposed repair method. If the removal of metal required to correct any fault reduces the cross-section of the casting by more than 50% or such that the stress calculated in the remaining metal exceeds the permissible stresses by more than 50%, the cast part may be rejected by the KSEBL. Castings, which after the first heat treatment, have been repaired by welding of major defects, which has affected the dimensional stability of the repaired parts, shall be subject to a second heat treatment.

1.1.15.5.5

The thickness and other dimensions of castings shall agree substantially with the dimensions shown on the drawings and shall not be reduced by shop or casting practices to such an extent that the effective strength of the cast parts is diminished by more than 10% when calculated using the actual dimensions, or that the stresses allowed by these specifications are exceeded. Castings, which are warped or have any other type of deformation, shall not be used without submitting a complete report for the KSEBL's study, review and approval nor shall their dimensions be increased such that interference is caused in manufacturing operations or with the appropriate assembly with other parts.

1.1.15.6 Steel Plates

Rolled steel plates which are to be used in the fabrication of pressure vessels or parts that are subject to internal pressure and are encased in concrete, and rolled steel plates forming large highly stressed weldments shall be tested for laminations at the place of manufacture in accordance with ASTM A435. Mill sheets for all plates shall be supplied.

1.1.15.7 Lubrication

Unless otherwise specified the Contractor shall supply within the scope of contract, the initial fill of lubricants and up to the Provisional Take Over, all necessary lubricants such as

oil for system cleaning lubrication, control and cooling as well as all greases. In the case of grease lubricated roller type bearings for electric motors, lithium grease is preferred. The lubricants must preferably be non-inflammable and suitable for use in the specified equipment under the climatic conditions prevailing at site. However, self-lubricating system shall be preferred, wherever feasible.

A schedule of the oils and other lubricants recommended for all components of the plant shall be submitted to the KSEBL before commissioning. The type of lubricants shall be such that these are locally available.

The list shall mention (for lube oil and greases):

- The name of the equipment, the frequency of lubricant refills, the quantity required, the type of lubricant.
- The list shall terminate by following summary of all types of lubricants to be stored and given for each: -
    - Exact specification
    - Quantities to be stored up to provisional take over.
    - Brand names

The number of different types of lubricants is to be kept to a minimum. The lubricants shall be supplied in such a way as to ensure proper transportation as well as storage and handling at site. Copies of this schedule shall be included in both the draft and final copies of the operating and maintenance instructions required by this specification.

For any equipment for which oil flushing should be required, the Contractor shall provide the flushing oil when these items are fitted and started up and shall replace it after the specified period, by a fresh refill. The flushing oil should be same as the final lubricant.

The lubrication specified should be efficient in any service conditions, including transient temperature conditions that may be due to the absence of cooling.

For grease lubricated equipment, the contractor shall provide individual lubricating connections with grease nipples of uniform type and shall provide the necessary tubing to make the connections readily accessible to the operating personnel.

The contractor shall provide two grease guns for each type of lubrication connection nipple, which he supplies. **Where automatic lubricators are fitted, provision for manual lubrication shall also be provided.**

1.1.15.7.1 General Specifications

All the Bearings, Journals and locations where sliding among parts takes place, shall be provided with an adequate means of lubrication.

Adequate seals shall be provided where necessary to prevent the escape of lubricants during normal operation and the entry of foreign matter.

The Work shall be handed over to the KSEBL in acceptable running order with all moving parts properly lubricated and fully charged with the recommended lubricant.

1.1.15.7.2 Oil Lubrication

It is preferred that only one type of oil shall be used that is suitable for both the lubrication of bearings and gears, and high pressure oil actuated applications.

The oil shall be of a type that is readily available in India. The KSEBL will provide details of the preferred type of oil to be provided.

1.1.15.7.3 Self Lubricated Bushings

Unless otherwise specified all bushings shall be of the self-lubricated type. Grease lubrication will not be permitted except in special cases after approval by the KSEBL.

Unless otherwise specified, the self-lubricated material shall be selected from the following:

- Acetal resin thermoplastic reinforced with fluorocarbon, e.g., Delrin AF;
- Woven fluorocarbon with fibre reinforcing, e.g., Fibreglide, Lubron;
- Urethane polymers either as a solid bushing or as a lining for metallic backing, e.g. Thordon.

The Contractor shall demonstrate that his selection has operated satisfactorily for at least 10 years in a similar application, or has performed satisfactorily in extended and rigorous laboratory tests.

1.1.15.8 Insulating Oil

1.1.15.8.1

The insulating oil shall conform to the requirement of IS 335, BS 148 or IEC Publication No. 298. No inhibitors shall be used in the oil.

1.1.15.8.2

Sufficient quantity of oil of uniform quality throughout, necessary for first filling of all tank and coolers at the proper level along with 10% extra oil for topping up shall be supplied in non-returnable containers suitable for outdoor storage.

1.1.15.8.3

The Contractor shall despatch the transformer in an atmosphere of nitrogen. Necessary arrangement shall be ensured by the Contractor to take care of pressure drop of nitrogen during transit and storage till the completion of oil filling during erection. A gas pressure-testing valve with necessary pressure gauge and adapter valve shall be provided. One cylinder of Nitrogen shall also be provided with each transformer to maintain the required pressure of nitrogen during transportation, in case it becomes necessary.

1.1.15.8.4

The Contractor shall warrant that the oil furnished is in accordance with the following specification or its equivalent.

Sl. No.	Characteristics	Requirement	Method of test
1.	Appearance	Clear, transparent and free from suspended matter sediment	
2.	Density at 20°C Max.	0.89 g/cm^3	IS 1448
3.	Kinematic viscosity at 27°C Max.	27 CST	IS 1448
4.	Interfacial tension at 27°C Min.	0.04 N/m	IS 6104
5.	Flash point Penskey Marten (closed) Min.	140°C	IS 1448
6.	Pour Point Max.	-10°C	IS 1448
7.	Neutralization value (Total acidity), Max.	0.03 mg KOH/g	IS 335 Appendix A
8.	Corrosive sulphur (in terms of classification of copper strip)	Non-corrosive	IS 335 Appendix B
9.	Electric strength (breakdown voltage) for new untreated oil, Min.	60 kV (rms). If the above value is not attained, the oil shall be treated.	IS 6792
10.	Dielectric dissipation factor (tan delta) at 90°C Max.	0.002	IS 6262
11.	Specific resistance (Resistivity)		

Sl. No.	Characteristics	Requirement	Method of test
	a)at 90°C Min.	$35x10^{12}$ Ohm-cm	IS 6103
	b)at 27°C Min.	$1500x10^{12}$ Ohm-cm	IS 6103
12.	Oxidation stability:		
	a)Neutralisation value after oxidation, Max.	0.40 mg/KOH/g	IS 335 Appendix C
	b)Total sludge after oxidation, Max.	0.10 % by weight	IS 335 Appendix C
13.	Presence of oxidation inhibitor	The oil shall not contain anti-oxidant inhibitors	IS 335 Appendix D
14.	Water content, Max.	50 ppm	IS 2362

1.1.16 Workmanship

1.1.16.1 General Specifications

1.1.16.1.1

All parts shall be manufactured true to drawing dimensions. All tolerances shall be defined on the Contractor's drawings for both manufacturing and installation purposes.

1.1.16.1.2

Fabrication tolerances shall conform to AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings. Machining tolerances, allowances and gauges shall conform to ANSI Standard B4a - Tolerances, Allowances and Gauges for Metal Fits.

1.1.16.1.3

Holes shall be drilled full size or drilled under size and reamed during shop assembly. Punched holes will only be permitted in plates 20 mm or less in thickness provided all such holes are subsequently reamed full size during shop assembly.

1.1.16.1.4

Surface finishes shall be indicated on the shop drawings in accordance with ANSI B46.1 - Surface Roughness, Waviness and Lay. Compliance with the specified surface finish will be determined by sense of feel and by comparison with standard roughness specimens in accordance with ANSI B46.1.

1.1.16.2 Welders Qualifications

Welders shall be qualified in accordance with the following codes:

a) for fabrication of pressure containing parts: ASME Boiler and Pressure vessel Code Section IX - Welding and Brazing Qualifications and, Section VIII Part UW - Requirements for Pressure Vessels Fabricated by Welding.

b) for fabrication of structural steel parts: AWS Standard DI.175, Section 5B A - Qualification Procedure.

1.1.16.3 Welding

1.1.16.3.1 General Specifications

The Contractor shall specify clearly on all relevant drawings the amount and type of material for each type of weld. The Contractor shall also provide detailed drawings showing joint preparation required for each type of welding to be carried out at Site and in the place of manufacture.

1.1.16.3.2 Preparation of Base Materiel

The parts to be joined by electric welding shall be cut precisely to the correct size by machine methods suitable for the type of weld to be used and to allow the proper penetration and good fusion of the weld with the base metal. The cut surfaces shall not have visible defects such as scabs, superficial defects caused by shearing or torch cutting operations or any other damaging defect. The surfaces of the edges to be welded shall be free from rust, oil, grease and other foreign matter. All welds exposed to water flow shall be ground to a smooth and even surface flush with the adjacent plate.

1.1.16.3.3 Lamination

Any plate in which lamination has been discovered after cutting shall be rejected unless the laminated portion of plate is local and can be cut out and replaced by welding of a new sound plate in the cut out area. In such cases, the KSEBL's approval for repairs will be required. Where such repairs are authorized, the welds of the repairs shall be ground smooth to assure neat appearance.

1.1.16.3.4 Electrodes

The Contractor shall indicate on all detailed drawings the type, size and material of electrodes he proposes to use for shop and/or field welding. Field welding electrodes shall be provided by the Contractor.

1.1.16.3.5 Welded Fabrications and Residual Stress Relief

All parts manufactured using welding methods, except those in which the stresses are not important, shall be designed, manufactured and inspected according to the ASME 'Boiler and Pressure Vessel Code', Section VIII –'Requirements for Unfired Pressure Vessels Fabricated by Welding' or equivalent. Welds shall be balanced insofar as practical to minimize distortion and residual stresses. The requirements of welding methods shall be submitted for approval.

1.1.16.4 Non-destructive Tests

1.1.16.4.1 Standards

Unless otherwise requested by the Contractor and approved by the KSEBL, all non-destructive testing of materials shall be carried out in accordance with the following specifications:

1	Radiographic methods	ASME Section VIII, div.1 UW51 (welds) ASTM E446, E186 and E280 (castings)
2	Ultrasonic methods	ASME Section VIII, Appendix 12 (welds) ASTM A418 and A388 (forgings)
3	Magnetic particle methods.	ASTM E709
4	Liquid penetrant methods.	ASTM E165

The Contractor shall supply the KSEBL with procedure sheets and test data confirming the effectiveness and validity of each method he proposes to use.

All inspection and non-destructive testing requirements must be clearly specified on the drawings.

1.1.16.4.2 Radiographic Inspection

Radiographic inspection with X-ray machines or radioactive isotopes will be permitted. Limitations on the use of each method are outlined in ASTM and ASME standards. X-ray machines shall be used in preference to isotope cameras whenever possible. Single control Kilovolt-Milliampere X-ray machines shall not be used without the express approval of the KSEBL.

Final decision on acceptability shall rest with the KSEBL. Radiographic plates will only be accepted if they comply with the conditions specified in the ASME Code, Section VIII. All welds, which are rejected on the basis of the ASME Code, Section VIII or other, shall be repaired or replaced by an acceptable weld.

1.1.16.4.3 Ultrasonic Inspections

Ultrasonic Inspection of cast, forged and welded parts will be acceptable if an inspection program is presented together with evidence to prove the validity of the proposed method, all subject to the KSEBL's prior approval. Whenever radiographic inspection of welds is not possible, such as certain angular and back-plated welds, the Contractor shall demonstrate the validity of ultrasonic methods by inspecting a test sample, which has been prepared by identical methods and checked by radiography.

Ultrasonic testing shall only by acceptable if carried out with equipment of recognized brand. Welds, castings and forgings shall be inspected by direct contact of the probe with the surface. Under special conditions, ultrasonic inspection by immersion of forged parts may be required. Whenever angled probing is used, the angle of incidence shall be suitable for the thickness of the part, and shall be as recommended in ASTM and ASME standards. Equipment shall be calibrated regularly on a test sample prepared as described above, or on a test sample containing flaws similar to those being sought. The ultrasonic method shall not be used until technical literature describing the process, proposed methods, equipment sensitivity, probes, etc... is submitted to the KSEBL together with proof of competence of the Contractor's technicians.

Inspection reports and supporting drawings, sketches or photographs shall be submitted to the KSEBL, together with all details needed to reproduce accurately any ultrasonic test at any time. The final decision on acceptance rests with the KSEBL.

1.1.16.4.4 Complementary Inspection

Complementary inspections of castings, forgings and welded joints may be carried out using liquid penetrant and magnetic particle methods. These methods shall conform to the requirements of ASTM E709 and ASTM El65.

These methods are only acceptable for detection of flaws on the surfaces of components or on welds. Striations and irregularities shall be removed before testing.

For liquid penetrant testing, the surface shall be conditioned or effectively cleaned before the application of the penetrant.

Magnetic particle examination shall be so conducted that surface deterioration or burning does not occur at electrode contact points. Current intensity and duration of application and orientation of the magnetic field shall be as specified in the standards. A magnetic field meter shall be used regularly. Provision shall be made for demagnetisation of components if residual magnetism is a potential problem. Final acceptance rests with the KSEBL.

1.1.16.4.5 Special Inspection

For all components fabricated with segments joined by full penetration butt welds, the inspection requirements shall be specified on the drawings and submitted for the KSEBL's approval. Ultrasonic inspection shall be done when radiographic inspection cannot be performed and/or where the design standards allow it. Non-destructive testing shall be performed after heat treatments.

When the verifications specified on the drawings are partial, the Contractor shall perform these at the locations specified by the KSEBL. When defects are found, the necessity of repair will be evaluated by the KSEBL allowing for the level the stresses may reach in that spot and for the severity of the defects.

The repair work shall be done by gouging to defect-free metal, as conformed by a non-destructive inspection. Repair welding will be allowed only if the defect has been eliminated to the satisfaction of the KSEBL. The repaired welds will be checked again according to a procedure approved by the KSEBL.

1.1.17 Ladders and Platforms

1.1.17.1 Floor Plate

Floor plates shall be chequered steel plates with a minimum plate thickness excluding raised pattern of not less than 10 mm. Edges of plates shall be planed and joints shall be cut where practicable so as to maintain continuity of pattern.

1.1.17.2 Ladders and Stairways

Steel ladders or stairways shall be provided where necessary to afford access for operation and maintenance of the equipment. Ladders shall not exceed about 7.5 m in length and suitable platforms with handrails shall be provided between each length. Where a ladder does not extend above a floor or platform level, hand-grips or other suitable means of support shall be provided. Protective cages shall be provided for ladders longer than 4.5 m. Ladder rungs shall not be less than 20 mm diameter and stringers not less than 400 mm apart. Stairways shall be provided with handrails and shall have a slope not greater than 45º.

1.1.17.3 Handrails

Handrails shall be provided wherever necessary for the safety of personnel. The handrails shall consist of at least two horizontal tubular members approximately 35 mm in diameter,

mounted on tubular or flat bar upright. The handrail shall be approximately 1100 mm above finished floor level. The handrails and supports shall be designed to withstand vertical and horizontal uniformly distributed loads of 750 Nm applied simultaneously on the top of the railing. Openings in the handrails shall be closed by removable chains.

1.1.18 Piping

1.1.18.1 General Specifications

1.1.18.1.1

Piping, joints, hangers and supports shall conform to the ANSI Specifications B31.1. Pipes, which connect with piping supplied by the KSEBL, shall be terminated by a flange or by a pipe union. Welded connections at termination points will not be allowed. Oil and air piping shall be of steel. Oil piping greater than 25 mm nominal bore shall be of seamless high quality steel pipe conforming to minimum API-5L GR.B or equivalent grade as per process requirement, whereas pipes less than 25mm bore shall be of stainless steel.

1.1.18.1.2

Unless otherwise specified, water piping, fittings and valves shall be made of the following materials:

Location	Diameter	Material
Exposed	50 mm and above	Steel
	Less than 50 mm	Stainless steel, Copper-Nickel
	Less than 25 mm	Stainless steel
Embedded	50 mm and above	Stainless steel
	Less than 50 mm	Stainless steel, Copper-Nickel
	Less than 25 mm	Stainless steel

1.1.18.1.3

Embedded pipes less than 50 mm in diameter shall be enclosed in a conduit for protection during concrete placement.

1.1.18.1.4

The minimum steel pipe wall thickness shall be the "normal" or "standard" wall thickness as stated in the applicable standards.

1.1.18.2 Piping Details

1.1.18.2.1

The entire piping system shall be prefabricated in the shop, insofar as practicable, leaving

only such joint connections as may be necessary for assembly or possible subsequent dismantling for repair and consistent with the requirements of shipment. Pipes below 50 mm in diameter shall be fitted with screwed or socket type welding fittings.

1.1.18.2.2

Unless otherwise stated, all piping shall be designed for a "nominal pressure" PN 10. All piping shall be tested with 1.5 times the design/nominal pressure. All required piping shall be furnished complete with flanges, joints, expansion joints, gaskets, packing, valves, drains, vents, pipe suspensions, supports, etc... Flanged connections or joints shall be provided only as required for transport, installation or for reasons of dismantling for repair. Metric (DIN)-flanges shall be used throughout.

1.1.18.2.3

Adequate clearance shall be given to parallel pipes to allow for easy maintenance without disturbing other lines. All overhead piping shall have a minimum clearance of 2.00 m from operating floors and platforms.

1.1.18.2.4

Where required water piping shall be provided with anti-condensation insulation.

1.1.18.2.5

Pipes over 50 mm in diameter shall be flanged. Alternatively, Victaulic type couplings may be used where approved by the KSEBL. Junction of copper to ferrous pipes shall be made with bronze adapters. Wherever feasible, long radius pipe bends shall be used in place of pipe fittings. Plugged drain holes shall be provided at low points in each pipe run. Necessary provisions such as suitable location, long stems, etc...,shall be made so that all valves can be conveniently operated from floor level.

1.1.18.2.6

All necessary studs, bolts, screws, cold finished nuts, washers, gaskets, packing, supports, etc...,required in connection with the field assembly of the piping systems shall be designed and supplied by the Contractor.

1.1.18.2.7

Piping shall be painted in different colours to indicate their contents. The colours to be used shall comply with the KSEBL’s standard colour code as detailed below:

- High Pressure Oil - Dark Red

- Drainage Oil - Golden Yellow
- High Pressure Grease - Orange Red
- High Pressure Water - Smoke Grey
- High Pressure Air - Oxford Blue
- Low Pressure Air - Sky Blue
- Cooling Water Inlet - Dark Green
- Cooling Water Outlet - Opaline Green
- CO_2 - Pure Red

1.1.18.2.8

All valves, pumps, etc... shall be connected to the pipe work by sufficient flanges or spherically seated unions to allow their easy removal for servicing or replacement. No screwed or compression fittings shall be used within partitions, walls, or in inaccessible positions.

1.1.18.2.9

Pipes shall be cut by saw or pipe cutters and all burrs removed by reaming, Gas cutting will be permitted only if the pipe ends are ground clean and to shape for welding.

1.1.18.2.10

Pipes which pass through openings in walls, floors, etc... shall be clear of such openings. Any such holes or openings shall be cleanly and neatly cut or sleeved to a size sufficient to accommodate the pipe with reasonable clearance to allow for movement due to expansion.

1.1.18.2.11

Sleeves, in concrete shall be either non-metallic, i.e. PVC or polyethylene, or of the same material as the pipe to pass through the sleeve.

1.1.18.2.12

All pipes shall be supported / restrained / anchored in order to contain the forces/moments at the terminal point nozzles within permissible limits as well as not to cause any undue localized stress and deflection / sagging anywhere along the piping length. For the above purpose standard support attachments such as clamps, saddle plates, braces, angles/cleats, guides etc... and support components such as hangers, rods, turn buckles, spring boxes etc... shall be used by the contractor.

1.1.18.2.13

Un-galvanized steel piping shall be painted on the exterior to prevent rusting. The paint treatment shall be of the same system as used for the turbine exterior. Paint damaged during erection and commissioning shall be repaired prior to Handing-Over.

1.1.18.3 Hangers and Supports

All pipe work and accessories shall be mounted and supported in a safe and neat manner. All brackets, stays, frames, hangers and supports for carrying and staying the pipes, including their fasteners shall be included in the supply and completed by the Contractor at the Site. Pipes and fittings shall be supported at or near flanges wherever possible. All heavy valves and other mountings shall be supported independently of the pipes to which they connect, to the satisfaction of the Engineer-in-Charge. Supports for brackets shall be by means of steel inserts cast into the concrete substructure or substantial clamps to the superstructure. Drilling for expansion anchors in concrete or welding to the superstructure will normally not be permitted, however, if inevitable, same will be permitted only without affecting the existing structure / concrete. Where hanger rods are proposed for piping, they shall be vertical without bends or offsets and provided with lateral bracing to resist earthquake-generated forces. Vertical runs shall be supported by means of pipe clamps or collars and horizontal runs shall be provided with flexible joints where the pipe crosses contraction joints. Chain or strap hangers shall not be used. Hangers and supports shall be painted unless they are for copper tubing, in which case they shall be copper plated. All piping shall be supported so as to avoid pockets, which will not completely drain.

1.1.18.4 Cleaning and Shipping

Pipes and fittings shall be thoroughly cleaned before being shipped. Oil piping shall be acid pickled and flushed. Pipes shall be suitably protected against corrosion in transit and storage. Oil piping shall have a protective coating applied to prevent corrosion occurring during transport and storage. For shipping, the ends of oil pipes shall be equipped with end protectors and plugged to prevent ingress of water. All other pipes shall be positively protected against ingress of foreign matter.

1.1.18.5 Testing

The Contractor shall shop test all pipelines to 50% above their maximum working pressure and shall supply all labour, materials, test media, pumps, plugs, gauges and other equipment necessary to make the complete test at site. Hydraulic piping shall be pressure tested after erection as site. The pressure shall be maintained without loss for one hour.

The lubricating oil piping shall be pressure tested after erection at a pressure 50% greater than maximum pump pressure. The pressure shall be maintained without loss for one hour. Piping systems shall be flushed clean prior to and after the testing. Piping shall be tested and flushed using the same media for which the system is designed. Where practicable, piping may also be tested in sections, in which case temporary supports and end caps shall be fitted.

Oil pipe work internal bores shall be chemically cleaned and passivated prior to use. Water, air and drain piping shall be blown through with high pressure air and flushed with water prior to use.

1.1.19 Pumps

1.1.19.1

Materials of the pumps shall be:

- Casing - Cast steel
- Impeller - stainless steel
- Shaft - stainless steel
- Sleeves - stainless steel
- Wear rings - bronze
- Keys - stainless steel

1.1.19.2

The impeller diameters shall be neither maximum nor minimum impeller size for the selected pump size.

1.1.19.3

The pumps shall withstand corrosion and wear by abrasive matters within reasonable limits.

1.1.19.4

Shafts sealed by packing glands shall be fitted with sleeves. Seals shall be exchangeable without extensive disassembly of the pump. Leakage water shall be directed to suitable drainage facilities.

1.1.19.5

The size of the pump motor shall be 15 % higher than the maximum power required by the pump at any operation point.

1.1.19.6

For any pump, the overall pump-motor efficiency for the specified rated head and discharge shall not be less than 60%.

1.1.20 Gauges and Instruments

1.1.20.1

Scales of all gauges and instruments shall be graduated in metric (ISO) units.

1.1.20.2

Provisions shall be made for all gauges and instruments to be suitably located so that they can be conveniently read from floor level. Where this is not possible, permanent platforms shall be provided by the Contractor.

1.1.20.3

All mechanical parts of instruments shall be suitably protected against shocks and vibrations, heat, humidity and splash water, etc... Pressures gauges shall be provided with a damping liquid, e.g., glycerine, to compensate vibrations. Pressure gauges without damping means are not permitted, unless approved by the Engineer-in-Charge.

1.1.20.4

All gauges and instruments shall be tested by the Contractor, including those used during commissioning at site, using suitable means to demonstrate their proper functioning and to confirm factory calibration and contact settings.

1.1.21 Design and Stresses

1.1.21.1

The design, dimensions and materials of all parts of the Work shall be such that they will not suffer damage under the most adverse service conditions. Mechanisms shall be so constructed as to avoid sticking due to rust or corrosion. Equipment weighing more than 50 kg shall be provided with lifting lugs.

1.1.21.2

The Contractor shall be responsible for an adequate design. Except as otherwise specified, the principal stresses in the materials used shall not exceed the values given in the following table under maximum normal operating conditions:

Material	Tension	Compression	Shear
Carbon cast steel	83 MPa	83 MPa	Note 1
Plate steel for principal parts	Note 2	Note 2	Note 1
Alloy cast steel and other miscellaneous materials	Note 3	Note 3	Note 1

Note 1 60% of the allowed tension stress

Note 2 25% of the ultimate strength or 50% of the yield strength, whichever is lesser (not to exceed 120 MPa)

Note 3 20% of the ultimate strength or 33% of the yield strength, whichever is the lesser.

1.1.21.3

At runaway speed and under testing conditions, stresses up to a maximum of $^{2}/_{3}$ (two-thirds) of the yield point will be acceptable for the rotating parts of the turbine, generator, exciters etc... For other materials used in the manufacture of the generator and exciter etc... the maximum stresses due to the most serve operating conditions shall not exceed one-third of the yield point nor one-fifth of the ultimate strength of the material. For temporary overloads, unit stresses not exceeding one-half the yield point stress will be permitted.

1.1.21.4

The equipment shall be designed for operation in an earthquake zone. Each part of the Work shall be strong enough and sufficiently well connected to resist total operating stresses, including any stresses resulting from an earthquake with a ground acceleration of 0.1 g in both in the Vertical and Horizontal direction. The forces being caused by earthquake including hydraulic loads, which may occur additionally, shall be taken into account for the computations.

1.1.21.5

Complete information regarding maximum unit stresses used in the design shall be provided by the Contractor.

1.1.21.6

The Work shall be designed to:

- Operate in a stable way under all operating conditions, including load, net head, voltage and frequency variations, and it shall be free from resonance, vibration and pressure surges judged detrimental by the KSEBL,
- Minimize the risk of fire and any consequential damage;
- Prevent accidental contact with live parts;
- Be capable of continuous operation or as required with minimum attention and maintenance under the conditions prevailing in a power station in a tropical climate;
- Limit noise levels to 70dB at a distance of 5 m unless otherwise specified.
- Natural frequency of the machine be kept well away (higher) from the magnetic frequency of 100 Hz (twice the generator frequency). The natural frequency must be much away from multiple of runner blades passing frequency.
- Vibration detectors or eccentricity meters on turbines and generators should be provided for alarm and shut down.
- For mercury contacts, Anti vibration type mercury switch be used.

1.1.22 Tropicalisation

1.1.22.1 General Specifications

In choosing materials and their finishes, due regard shall be given to the humid tropical conditions under which the Work is to operate, and tropical grade materials should be used. In general, metals such as iron and steel shall be painted or coated with protective coatings or treated by an approved method to prevent corrosion. Core laminations shall be lacquered or compounded heavily. Steel screws, nuts, bolts, etc...,when used shall be of galvanized or chromium plated. To the extent possible contact of dissimilar metals shall be avoided, else suitable method shall be used to reduce the potential difference between the two metal parts to eliminate by-metallic corrosion.

Adhesives, sealants, etc..., shall be carefully selected to avoid moisture condensation. Use of wood shall be avoided completely. Filter media, fabrics, cork, paper, etc...,where used shall be impregnated and adequately treated with an approved fungicide.

Some relaxation of the following provisions may be permitted where Work is hermetically

sealed but it is preferred that tropical grade materials should be used wherever possible.

1.1.22.2 Metals

Iron and steel shall generally be painted or galvanized as appropriate. Indoor parts may alternatively have chromium or copper-nickel plated or other approved protective finish. Small iron and steel parts (other than rustles steel) of all instruments and the metal parts of relays and mechanisms shall be treated in an approved manner to prevent rusting. Cores, etc...,which are built up of laminations or cannot for any other reason be anti-rust treated, shall have all exposed parts thoroughly cleaned and heavily enamelled, lacquered or compounded. When it is necessary to use dissimilar metals in contact, these shall, if possible, be so selected that the potential difference between them in the electrochemical series is not greater than 0.5 V. If this is not possible the contact surfaces of one or both of the metals shall be electroplated or otherwise finished in such a manner that the potential difference is reduced to within the required limits, or, if practicable, the two metals shall be insulated from each other by an approved insulating material or a coating of approved varnish compound.

1.1.22.3 Screws, Nuts, Springs, Pivots etc...

The use of iron and steel shall be avoided in instruments and electrical relays wherever possible. Steel screws, when used, shall be zinc, cadmium or chromium plated, or when plating is not possible owing to tolerance limitations, shall be of corrosion-resisting steel. Instrument screws (except those forming part of a magnetic circuit) shall be of brass or bronze. Springs shall be of non-rusting material, e.g. phosphor bronze or nickel silver, as far as possible.

1.1.22.4 Fabrics, Cork, Paper etc...

Fabrics, cork, paper and similar materials, which are not subsequently to be protected by impregnation, shall be adequately treated with an approved fungicide. Sleeves and fabrics treated with linseed oil or linseed oil varnishes shall not be used.

1.1.22.5 Wood

The use of wood in equipment shall be avoided so far as possible. When used, woodwork is to be of thoroughly seasoned teak or other approved wood, which is resistant to fungal decay and shall be free from shakes and warp, sap and wane, knots, faults and other blemishes. Woodwork shall be suitably treated to protect it against the ingress of moisture and from the growth of fungus and termite attack, unless it is naturally resistant to these

causes of deterioration. Joints in woodwork shall be dovetailed or tongued and pinned as far as possible. Metal fittings where used shall be of non-ferrous material. Wood screws shall be of dull nickel plated brass or of other approved finish.

1.1.22.6 Adhesives

Adhesives are to be specially selected to ensure the use of types that are impervious to moisture, resistant to mould growth, and not subject to the ravages of insects. Synthetic resin cement only shall be used for joining wood. Casein cement shall not be used.

1.1.22.7 Rubber

Neoprene and similar synthetic compounds, not subject to deterioration due to the climatic conditions, shall be used for gaskets, sealing rings, diaphragms, etc... instead of the standard rubber-based materials.

1.1.23 Finishes

1.1.23.1 Galvanizing

1.1.23.1.1

Materials to be galvanized shall be of the full dimensions shown or specified and all punching, cutting, drilling, screw tapping and the removal of burrs shall be completed before the galvanizing process commences. Galvanizing shall be done by the hot dip process with spelter, not less than 98% of which must be pure zinc. No alternative process may be used without the approval of the KSEBL. No components shall be galvanized which are likely to come into subsequent contact with oil. Bolts shall be completely galvanized including the threads, but the threads shall be left uncoated in the case of nuts.

1.1.23.1.2

The zinc coating shall be uniform, clean, smooth and as free from spangle as possible. In the case of component parts, the zinc coating shall weigh not less than 610 gm of zinc per square metre of the area covered and be not less than 0.09 mm in thickness.

1.1.23.1.3

All galvanizing shall comply with the requirements of IS 2633 or relevant ASTM standards. The KSEBL may select for test as many components to be weighed after pickling and before and after galvanizing as they may think fit. All galvanized parts shall be protected from injury to the zinc coating due to differential aeration and abrasion during the periods of

transit, storage and erection. The preparation of galvanizing and the galvanizing itself shall not adversely affect the mechanical properties of the coated material.

1.1.23.2 Chromium Plating

The chromium plating of the Work shall comply with the requirements of the relevant ASTM standards.

1.1.24 Anti-corrosion Measures

1.1.24.1 Materials

1.1.24.1.1 General Specifications

Materials shall be approved by the KSEBL. Materials shall be of first grade and used strictly in accordance with the Specifications and the manufacturers' written directions as approved by the KSEBL.

Detailed or special requirements are covered below in these Specifications. In general, materials and paint systems, which meet the following specifications, shall be used.

1.1.24.1.2 Cement Latex Milk

The cement latex milk shall consist of ten parts Portland cement (by weight), five parts of water and one part of modified latex emulsion.

1.1.24.1.3 Primer

Where specified shall be zinc-rich inorganic coating in conformity with SSPC PS 12.00-68T Red lead based primers shall not be used.

1.1.24.1.4 Coal Tar Epoxy

This shall be of the two package cold curing type, one package containing resin and the other the curing agent. Coal Tar Epoxy shall conform to SSPC-PS11.01.

1.1.24.1.5 Aluminium Paint

Aluminium paste for aluminium finish paint coat shall conform to ASTM Specification D962, Type II, Class B. Aluminium paint shall conform to SSPC-Paint 101-64T.

1.1.24.1.6 Rust Preventive Coating

Shall be gasoline soluble and shall conform to SSPC PS8.01-64T Type D.

1.1.24.1.7 Alkyd Enamel

Shall conform to SSPC-Paint 104.

1.1.24.1.8 Vinyl Paint

Shall conform to SSPC-PS4.02 or SSPC-PS4.04.

Items 1.1.24.1.7 and 1.1.24.1.8 above are acceptable alternatives for non-immersed steel.

1.1.24.2 Surface Preparation for Protective Coating

1.1.24.2.1

The interior and exterior surfaces that will not be embedded in concrete shall be cleaned as specified and in accordance with SSPC-SP-10 for steel surfaces immersed in water and in accordance with SSPC-SP-6 for non-immersed steel surfaces.

1.1.24.2.2

Exterior surfaces which will be embedded in concrete shall be cleaned by power tool cleaning in accordance with SSPC-SP3-63.

1.1.24.2.3

Grease and oil deposits shall be removed by wiping the surfaces with a clean cloth dipped in mineral solvent.

1.1.24.2.4

After dry-blast cleaning, the surface shall be dusted off or blown off with compressed air free of detrimental oil and water.

1.1.24.2.5

Surfaces to be painted shall be completely dry, clean and free from moisture at the time of painting.

1.1.24.3 Extent of Protective Coating

1.1.24.3.1

After surface preparation for each component, the surface shall be protected using the paints specified in the following manner. Paint shall be applied in accordance with SSPC-PA 1-64.

a) Steel Immersed in Water

Immersed steel surfaces shall be shop painted with 3 coats of coal tar epoxy paint.

Each coat shall be applied to a minimum dry film thickness of 0.125 mm. The paint for each coat shall be tinted so as to give distinct and easily visible colour difference to facilitate inspection. Areas adjacent to field welds shall be left unpainted and shall be protected for shipment by application of one coat of rust preventive coating.

b) Non-immersed Surfaces

Except where otherwise specified all non-immersed steel surfaces shall be painted with one shop coat of primer. The primer shall be applied to a minimum dry film thickness of 0.075 mm. Areas adjacent to field welds shall be left unpainted and shall be protected for shipment by application of one coat of rust preventive coating.

The shop intermediate coat will have a dry film thickness of not less than 0.04 mm. The intermediate coat shall be tinted to a colour contrasting with the shop and field prime coats.

The field finish coat will be applied to a minimum dry film thickness of 0.04 mm.

c) Embedded Surfaces

Embedded surfaces and all attachments to the embedded parts shall receive one coat of Cement Latex Milk.

1.1.24.4 Shop Protective Coating Application

1.1.24.4.1

The shop paint application shall be carried out in accordance with SSPC-PA-1. Except where otherwise specified, shop painting shall be:

a) Immersed steel - 3 coats of coal tar epoxy paint;

b) Non-immersed steel - one prime coat and one intermediate coat;

c) Machined Surfaces - one coat anti-rust compound;

d) Embedded steel - one coat cement latex milk;

e) Field Weld Areas - one coat anti-rust compound;

f) Generator Instrument Cubicles, Gauge Panels and Terminal Boxes:

- Steam Phosphate treatment - one coat alkyd metal primer with dry film thickness 0.025 mm;
- Interior - one coat white enamel with dry film thickness 0.025 mm;

- Exterior - one coat glossy alkyd paint with dry film thickness 0.025 mm.

1.1.24.4.2

Certain mechanical and other electrical auxiliary equipment (pumps, motors, cabinets, etc...) may be shop painted with primer and finish coats with the prior approval of the KSEBL.

1.1.24.5 Field Procedure Coating Application

Site painting and site repair to shop painting will be carried out by the Contractor and Contractor shall provide the following:

a) all paint needed for the following to work at Site:
   - Immersed steel, at welds - 3 coats of coal tar epoxy paint;
   - Non-immersed steel - final coat (after prime coat and intermediate at welds, if applicable);
   - Surfaces and other appurtenances not shop painted which are rendered inaccessible after completion of erection - intermediate and finish coat (before erection).

b) 25 litres of each type of paint used for shop painting for Site repair,

c) 25 litres of each type of paint provided for Site painting for the Owner's subsequent use.

1.1.24.6 Colours

KSEBL will specify the final paint colours to be provided by the Contractor for the various Work components after award of Contract.

1.1.25 Electrical Requirements

1.1.25.1 General

This section of the specification covers the general technical requirements of **Electrical systems** to be provided under the scope of this tender contract. The provision of specific and detailed technical requirements given in other sections of this tender document shall take precedence over these general specifications in case of contradictions between these general specifications and the specific and detailed specification of other sections.

Following shall be considered while planning the general arrangement / layout of the plants:

- All outdoor equipment / devices are to be weather protected.

- All outdoor electronic instruments / devices are to be mounted in a weather proof housing with glass visor.

1.1.25.2 General Design Requirements

1.1.25.2.1

All equipment shall be of approved and reliable design. The highest extent of uniformity and inter-changeability shall be realized. The design shall facilitate easy maintenance and repair of the components.

1.1.25.2.2

The equipment shall be pre-assembled to the highest possible extent in the manufacturer works, e.g. wiring of panels, desks, etc..., including installation of internal components.

1.1.25.2.3

The contractor shall assume full responsibility for a coordinated and adequate design of all equipment specified and shall ensure that such equipment conforms to the best engineering practice for the operating conditions specified. When requested by the Engineer-in-Charge, the Contractor shall furnish complete information as to the maximum stress and other criteria used in the design.

1.1.25.2.4

All equipment shall be tropicalized and suitable for the prevailing climatic conditions on site. Open air installed equipment, if required by the KSEBL shall be protected against sun radiation by means of adequate metal covers.

1.1.25.2.5

Unless otherwise specified, all the electrical equipment shall be designed for tropical conditions with minimum class - B insulation according to relevant standards, except for motors, which shall have class - F insulation with class - B temperature rise.

1.1.25.2.6

The equipment shall operate satisfactorily under load, voltage and frequency variations as well as under short circuit and transient conditions within specified ratings and guarantee limits.

1.1.25.2.7

All electrical connections and contacts shall be amply dimensioned to carry continuously the specified currents without undue heating and shall be secured by bolts or set screws of ample size, fitted with lock nuts or lock washers. Lock nuts shall be used on stud connections carrying current.

1.1.25.2.8

All metal jointing surfaces and all moving, rubbing or wearing surfaces shall be machined or ground.

1.1.25.2.9

Means shall be provided for the lubrication of all bearings and of any mechanism or moving part. The lubricating points shall be easily accessible and in a conspicuous position.

1.1.25.2.10

All apparatus shall be designed to obviate the risk of accidental short circuits due to animals, birds and vermin.

1.1.25.2.11

All live, moving and rotating parts shall be adequately secured in order to avoid danger to the operating staff. All electrical components shall be electrically earthed.

1.1.25.2.12

All apparatus shall be so designed that water / oil / dust cannot collect at any point.

1.1.25.2.13

All interior surfaces including contactor or relay coils shall be treated in an approved manner to prevent mould growth; such treatment shall in no way interfere with the satisfactory operation of the equipment, either electrically or mechanically.

1.1.25.2.14

Copper employed for current carrying parts in the Works shall be electrolytic copper having a purity of not less than 99.9% and conductivity as per the relevant standard.

1.1.25.2.15

Cast iron shall not be used for any part of the equipment liable to fracture due to stress or shock. All mechanisms subject to action of atmospheric agents shall be constructed of stainless steel, brass or gun metal to prevent sticking due to rust or corrosion.

1.1.25.2.16

Electrical Equipment shall be designed to prevent ingress of vermin, dust and dirt. Where wiring, piping or ductwork passes through openings in equipment housings, such openings shall be constructed to prevent ingress of vermin. Wiring and piping enclosures and ductwork shall also be vermin proof.

1.1.25.2.17

Thermostat-controlled anti-condensation heaters shall be fitted in generator housing, cubicles or panels containing control and / or relay equipment, whether or not they are ultimately to be in an air-conditioned zone. They shall also be installed in all outdoor junction boxes. The heaters shall be suitable for 230 V AC, 50 Hz operation with sufficient capacity to raise the internal ambient temperature by 5ºC. The design shall be such that when the equipment is in service with the heaters energized, the maximum permitted rise in temperature for the equipment shall not be exceeded.

1.1.25.2.18

The construction of panels and the location of heaters shall be such that an effective circulation of air is ensured. Equipment shall be provided with suitable drainage for condensation and shall be designed to be free from pockets where moisture can collect. Cable entries shall be sealed type.

1.1.25.2.19

All outdoor equipment whose performance is affected by the atmospheric temperature such as motors, compressors, etc... shall be weatherproof and protected by a sun canopy.

1.1.25.2.20

Separate trenches for power and control cables shall be provided as far as possible.

- Optimum routing and arrangement of all the cables shall be done.
- No cables shall be buried under foundations.

1.1.25.2.21

Regular cleaning of the panels as per the instruction of KSEBL's engineer till handing over of the set to customer is to be carried out by the contractor free of cost.

1.1.25.2.22

Suitable lifting eyes and forcing off bolts shall be provided where required or where they will be useful for erection and dismantling.

1.1.25.3 Clearances

The layout of the Equipment on the site shall provide for ready access for operation and maintenance whilst the remaining sections of Equipment are alive. Working clearance provided between isolated Equipment and nearest live metal work shall be as per Indian Electricity Rules and Relevant Standards.

1.1.25.4 Power Supplies (Low Voltage)

1.1.25.4.1

Equipment and devices requiring electric power shall conform with the following power supply parameters:

(1) 415V, 3-phase 50Hz, 4-wire for power

(2) 240V, single phase, 50 Hz for lighting, indication, and anti-condensation heaters and Alarm.

(3) 110V D.C. for essential indication, controls, protection, alarms, closing and tripping supplies etc...

(4) 48V DC for Communication etc...

1.1.25.4.2

The Contractor shall clearly indicate voltage, current and power requirements for each item of equipment.

1.1.25.4.3

Unless otherwise specified in this Specification or any appropriate Standard Specification, all electrical equipment shall be suitable for reliable operation at frequencies and voltages over the following ranges.

1.1.25.4.4

Voltage variations:

AC - 90% to 110% of nominal

DC - 75% to 120% of nominal

1.1.25.4.5

Frequency variations are between 47.5 Hz and 51 Hz.

1.1.25.4.6

Equipment furnished shall withstand the voltages and frequencies unbalanced continuously without damage, overheating, undue vibration or degradation beyond that expected for normal balanced three phase operation.

1.1.25.4.7

The single line diagram of the auxiliary system is indicated on the main single line diagram included in the tender drawings. The Contractor shall supply and connect all Control, Protection, Annunciation, signalling and power supply cabling required between various equipment and the low voltage AC and DC distribution panels and MCC's supplied under this Contract.

1.1.25.4.8

Double-pole switches shall be used to break single-phase A.C. mains supplies.

1.1.25.4.9

Following practices shall be adopted for DC supply:

- 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.

1.1.25.5 Current Ratings

The current ratings of the electrical equipment / devices shall be in accordance with relevant standard unless otherwise approved. The current ratings, if specified, are the

continuous current ratings required at the site under specified maximum operating temperature conditions.

Every current carrying part of the equipment shall be capable of carrying its site rated current continuously, without assistance from any forced cooled ventilation or air conditioning plant, under the site conditions as specified, and in no condition shall the permitted temperature rise be exceeded.

1.1.25.6 Electrical Equipment Protection Classification

All electrical equipment enclosures shall comply with the relevant Standard.

If not specified otherwise in the relevant specification the electrical equipment enclosures shall be designed to meet the following protection degrees.

A) Electrical Rotating Equipment

- Indoors located in ventilated areas - IP44
- Outdoors located - IP54
- Indoor / Outdoor located but in areas Where water spray / splashing is possible - IP65

B) **Electrical (non-rotating) equipment** (Switch gears, panels, lights etc.)

- Indoors located in the A/C or Ventilated areas - IP32
- Indoor located in non-ventilated areas - IP52
- Indoor / Outdoor located where heavy condensation is possible - IP54 with measures as per IEC 60528
- Indoor / Outdoor located but in areas where water spray / splash is possible - IP65

All luminaries installed in the areas where operation conditions and surroundings can lead to accumulation of gases, vapours or danger of explosion shall be of explosion proof. All luminaries installed in the enclosures where operation conditions may lead to high temperature surroundings shall be designed to withstand such temperatures.

1.1.25.7 Protection against Live Contacts

All live parts of the electrical equipment, which could be reached by hand, shall be

protected against direct contact by means of insulation or by special design and construction such as shields, shrouds, etc... Measures may be taken to prevent the occurrence or persistence of excessively high potentials on conductive parts of electrical equipment induced by faults in insulation.

Protection against direct contact must be ensured by suitable method when the switch-gears or control panels have been opened up for operation or maintenance. Suitable grounding equipment shall be provided for the discharge of high potential attained when the protective devices are withdrawn. Suitable protective grounding grid of copper shall be provided as a protection for conductive parts.

1.1.25.8 Electric Motors

1.1.25.8.1

The Contractor shall be fully responsible for determining that the motor duty cycle, rating, performance, tests and mechanical arrangements are all entirely relevant and suitable for compliance with all standards for the application in the power station and environmental and site conditions specified.

1.1.25.8.2

All the equipment driven by the electric motors shall give their rated performance even at a power supply frequency of 47.5 Hz.

1.1.25.8.3

The preferred type of AC motor is squirrel cage, totally enclosed, fan cooled, 1.0 service factor or single-phase motor under 0.5 HP where Contractor's standard type are acceptable subject to approval. Motors above 0.5 HP shall be 3 phase, if AC supplied. Motors shall be sized so that calculated horsepower requirements do not exceed 85% of nameplate ratings. 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.

1.1.25.8.4

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.

1.1.25.8.5

The stator insulation shall be Class F or a higher class, but in each case temperature rises shall be limited to Class B where practicable on full continuous rated load. It shall be suitable for operation in damp locations and for fluctuations in temperature.

1.1.25.8.6

All motors shall be of the totally enclosed fan-cooled type, protection class IP54 according to IEC Recommendation 144. Cable termination points shall be of class IP55. They shall have a closed internal cooling air circuit re-cooled by an external cooling air circuit drawn from the opposite side of the driving end.

1.1.25.8.7

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

1.1.25.8.8

Ball or roller bearings, lubricated for life, shall be used, and the ball or roller-locating cage shall not be in contact with the races. Lubrication devices shall be provided for the bearings. 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 shaft motors shall have approved thrust bearings.

1.1.25.8.9

The terminal box shall be weatherproof and firmly fixed to the motor frame. The terminal studs shall be sized to be adequate for the current duty required and marked in accordance with applicable Standards. Terminal boxes shall have approved cable adapter plates, sealing chambers or conduit entries. 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, this shall be

clearly indicated

1.1.25.8.10

The arrangement of the terminal box shall be such as to facilitate installation of cables, and allow interchanging of any two phase leads, without disturbing the sealing compound, if this is used at cable terminations.

1.1.25.8.11

Where practicable, the motor end cover remote from the driving end shall have a removable plug to allow the speed to be checked by means of a portable tachometer.

1.1.25.8.12

All motors supplied under this Contract shall be finished with its combination of magnetic starting contactors with disconnect switches and thermal overload devices which shall be mounted on or adjacent to pumping unit.

1.1.25.8.13

A permanently attached connection diagram shall be mounted inside the terminal box cover.

1.1.25.8.14

Motors having a mass of 10 kg or more shall be fitted with appropriate lifting lugs.

1.1.25.8.15

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.

1.1.25.8.16

All precautions shall be taken to avoid any type of corrosion.

1.1.25.9 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.

1.1.25.10 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

1.1.25.11 Starters and Contactors

1.1.25.11.1

Motor starters shall be equipped with short circuit protection and local disconnecting devices. Preferably all starters shall be of one manufacturer. The control circuit voltage shall be obtained from a 415 / 230 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.

1.1.25.11.2

Starters and contactors shall be suitable for direct on-line starting up to 50 kW, uninterrupted electrical duty and above 50 kW Star Delta starter shall be provided. They shall be installed in ventilated enclosures for indoor installation and weatherproof enclosures for outdoor installation unless otherwise approved by the KSEBL. 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.

1.1.25.11.3

Starters and contactors shall be capable of satisfactory operation, without injury, for a period of 5 minutes at a voltage 25% below nominal, at nominal frequency.

1.1.25.11.4

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

1.1.25.12 Moulded Case / Miniature Circuit Breakers

Moulded / Miniature circuit breakers shall be used instead of fuses and shall provide better protection and control under emergency and short circuit conditions.

Moulded case circuit breakers shall be of two or three pole 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.

Miniature circuit breakers shall have suitable fault rating and shall comply with the requirements of IEC or equivalent standard and shall be of the high impedance design contained in an enclosure of high impact insulating material with ventilated deionising arc chutes. The circuit breaker shall be equipped with thermal and magnetic overload trips, shall have a trip free mechanism and have a tripping characteristic of 0.01 seconds at 7 times full load current.

Miniature circuit breakers shall be rated for the ambient temperatures prevailing at site and shall have the trip devices correctly calibrated, both according to the manufacturer's instructions. The selection and grading of the MCB’s shall be as approved.

They shall be clearly labelled, both on the panels and the associated wiring diagrams.
MCB’s shall be connected to enable all or any of the control circuits to be isolated for maintenance purposes. For DC circuits, isolation shall be provided on both poles. All MCB’s shall be provided with required no of Auxiliary switches / Alarm contacts for MCB tripped indication.

1.1.25.13 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. Contacts shall have a minimum rating of 10A over a range of 6 to 600V.

Relays shall be of approved type complying with relevant specifications and shall have approved characteristics and be flush mounted in dust proof cases. Relay cases shall generally be finished in bright black enamel. Classification shall comply with appropriate standard.

Relays contacts shall be suitable for making and breaking the maximum current they are required to control. Separate contacts shall be provided for alarm and trip functions.

Each relay shall be provided with at least two spare normally open and one spare normally closed contact.

Relays where appropriate, shall be provided with flag indicators of approved type phase coloured where applicable. Flag indicators shall be of the hand-reset pattern and shall be capable of being reset without opening the case. Where two or more phase elements are included in one case, separate indicators shall be provided for each element. Relays of the hand reset type shall be capable of being reset without opening the case.

Where adjustments of settings are required, the design of the relays shall be such that the adjustment can be carried out during operation without taking the relays out of service.

Approved Test Plugs shall be provided on the relay panels for the testing of protective relays and associated circuits.

To minimize the effect of electrolysis, relay coils operating on DC shall be so connected that the cells are not continuously energized from the positive pole of the battery.

Relays shall be provided with clearly inscribed labels at the front describing their application, rating and wiring diagram, in addition to the general information.

Protective relays shall be rated to match the designed system fault ratings and comply with classification type C to IEC 60292, where applicable.

Trip relay, where specified shall be of the high speed mechanically latching type with electrical resetting facilities and a common trip relay resetting push button, as required.

Under voltage protection relays should be of self-resetting type unless otherwise required. Relays shall be thermally matched such that the operating time do not exceed the thermal withstand time of the relay.

1.1.25.14 Control Switches and Push Buttons

Control switches for electrically operated Circuit breakers shall be of pistol grip type arranged to operate clockwise when closing the circuit breaker and anti clockwise when opening them. They shall be designed to prevent accidental operation and interlocked to prevent two successive operations in the `Close' direction. All control switches and push buttons shall be in accordance with relevant IS or equivalent standard.

Switches for the other apparatus shall be operated by shrouded push buttons or to have handles of the Spade / Oval type, the pistol grip type being reserved for circuit breaker operation only. Control, reversing selector and test switches shall be mounted, constructed and wired so as to facilitate the maintenance of contacts without the necessity for

disconnecting wiring.

Control switches for circuit breakers and for motor operated setting devices, e.g. governor control, field rheostat control, etc...,shall be non-locking type with spring return to the `neutral' position. Such switches shall be controlled by independent springs; the use of contact springs alone for restoring not being acceptable. Switches for special applications like Synchronising Selector shall be Keyed one (Lockable type) as required by the application philosophy.

All push buttons shall be of the non-retaining type made of non-hygroscopic material, non-swelling and fitted to avoid any possibility of sticking. All push buttons provided for remote stopping of motor control gear and all emergency stop push buttons shall be of the **`hold-in' / Stay-put** type requiring to be reset by being pulled out, or by a separate release device, which may be, associated `Start' push button. The Emergency Push buttons shall be red coloured and provided with a cover, preferably in Red Colour. The contacts of all switches and push buttons shall be strong and to have a positive wiping action when operated.

All control switches shall be provided with labels complying with the specification in addition to clear indication as to the direction of each operation, for example, `Open', `Close', `Raise', `Lower', etc...

1.1.25.15 Pilot Devices

1.1.25.15.1

Pilot devices such as selector switches, push-button stations and thermostats shall be of heavy-duty type, and where mounted outdoors they shall be housed in weatherproof enclosures specially designed for the environment.

1.1.25.15.2

Electrical contacts for control, alarm and shut-down shall have a capacity of not less than 5 A at 110 V DC.

1.1.25.16 Anti-condensation Heaters

Any major items of electrical equipment which are liable to suffer from internal condensation due to atmospheric or load variations shall be fitted with heating devices suitable for electrical operation at 230 volt AC 50 Hz single phase of sufficient capacity to raise internal ambient temperature by 5^{o} C.

Heaters in rotating electrical machines shall be switched on automatically by opening of the starter or breaker or vice versa. Heaters in switchgear / MCC cubicles, control cubicles, panels, desks etc... shall be controlled automatically by adjustable thermostat. The heaters shall be covered by metallic mesh to avoid accidental contacts and heater terminals shall be adequately shrouded. Each heater shall have built in over temperature protection.

The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the apparatus is in operation.

1.1.25.17 Plugs and Sockets

Plugs and sockets shall meet relevant Indian Standards.

1.1.25.18 Indicating Lamps and Fittings

The Indicating lamps shall be of LED type. Indicating lamps fitted to the faces of switch and instrument cubicles or panels shall be adequately ventilated. Lamps (**bunched LED type**) shall be easily removed and replaced from the front of the panel by manual means not requiring the use of extractors. The material holding the lamp glass shall be of an approved finish and to be easily removable from the body of the fitting so as to permit access to the lamp and lamp glass.

The lamps shall be clear and are to fit into an accepted standard form of lamp holder. The rated lamp voltage should be 10% in excess of the auxiliary supply voltage, whether AC or DC. Alternatively, if approved, low voltage lamps with series resistors could be provided, if proved to be of long life.

The lamps glasses shall be translucent and in standard colours, red, green, blue, white and amber and shall comply with relevant IS / IEC or equivalent standard. The colour shall be in the glass and not an applied coating and the different coloured glasses shall be interchangeable.

Transparent synthetic materials may be used instead of glass.

Unless otherwise specified all lamp colours shall conform to the following practice

Red	Energized or operative position.
Green	De energized or inoperative position.
Amber	Fault or abnormal condition.
White	Healthy or normal condition.

Blue Control Supply monitoring / Signal used with label.

1.1.25.19 Auxiliary Switches

Where appropriate, each item of plant shall be fitted with all necessary auxiliary switches, contactors and mechanisms for indication, protection, metering, control, and interlocking supervisory and other service. Auxiliary switches shall conform to relevant Standard.

All auxiliary switches, whether they are in use or not in the first instance, shall be wired up to a terminal board on the fixed portion of the plant and shall be arranged in the same sequence on similar equipment.

Auxiliary switches mechanically operated by the circuit breakers, contactors, isolators, etc... shall be to the approval and contacts mounted in accessible positions clear of the operating mechanism of the circuit breaker, contactor, isolator, etc..., and they shall be adequately protected against accidental electric shock.

Auxiliary switches shall be provided to interrupt the supply of current to the trip coil of each circuit breaker and contactor immediately after the breaker or contactor has opened. These auxiliary switches shall make before the main contacts, during a closing operation.

The contactors or all auxiliary switches shall be robust and shall have positive wiping action when closing. Provision shall be made for extension of the switches and terminal boards when needed.

A minimum of four spare auxiliary switches, two normally open, two normally closed shall be provided for each circuit breaker, Isolator and contactor for KSEBL’s use.

1.1.25.20 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.

1.1.25.20.1 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 Pt100.

The use of dial-type contact thermometers shall be restricted to bearing metal and oil temperature measuring.

1.1.25.20.2 Pressure Measurement

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 1.5 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.

1.1.25.20.3 Level Measurement

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.

1.1.25.20.4 Electrical Measurement

All Electrical instruments shall be of flush mounted design, dust and moisture-proof.

Indicating instruments shall be flush mounted and shall comply with the latest standards applicable. All indicating meters shall be Digital Multi-function Meters (DMM) of Class 0.2S capable of displaying various parameters like voltage, current, MW, MVAR, MWh, MVARh, power factor, frequency etc... The Digital Multi-function Meters shall be provided in

duplicate. The LED digits shall be of sufficient size so as to have easy readability from the operator work table. The Digital Multi-function Meters shall have communication facility as per latest protocols which shall be finalised during detailed engineering in consultation with KSEBL.

Energy meters shall be suitable for unbalanced systems and accuracy of energy meters should be of 0.2S 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 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.

1.1.25.20.5 Position Measurement

Position transmitters for continuous position indication and measuring transducers shall have an output current of 4-20 mA and auxiliary supply voltage (if required) 48 V D.C.

1.1.25.20.6 Limit Switches

Limit switches shall be mounted suitable for easy adjustment and for rigidly locking in position after being adjusted. They shall be of heavy-duty rating and have two change-over contacts suitable for 48V D.C. Operation.

Switch fixings shall be positive and shall be unaffected by vibration. At the same time they should be capable of easy adjustment to suit changing parameters of the associated plant.

Particular attention shall be paid to potentially harmful environmental conditions, including water, oil, dust, dirt, temperature variations and differential expansions.

1.1.25.20.7 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.

1.1.25.21 Distribution Boards and Isolators

1.1.25.21.1

Distribution boards shall be provided throughout the plant for local distribution of lighting,

small power and welding supplies. The welding supply boards shall be completely separate, but the lighting and small power circuits may use a common distribution board.

1.1.25.21.2

Distribution boards shall be of 440V AC, 110V DC rating and conform to relevant standard and shall have an insulation withstand level 1 kV, AC, 1-2 kV DC respectively. All distribution boards shall be of the approved weatherproof enclosure type as specified elsewhere in the specification and shall be arranged so that the door or cover can be locked in the closed position.

1.1.25.21.3

Distribution boards shall be capable of with-standing without injury the mechanical and electrical stresses set up by fault currents for twice the period required to disconnect such fault on any circuit.

1.1.25.21.4

Distribution boards shall be provided with removable top and / or bottom knockout type gland plates for the outgoing cables corresponding to the circuit capacity of the distribution board. A suitable brass, grounding stud running throughout the length of distribution board shall be provided at top and / or bottom as required.

1.1.25.21.5

Indoor distribution boards shall be of sheet steel of 2 mm thickness with either a galvanized or enamelled finish. The finish colour of all indoor distribution boards shall be chosen to match the adjacent switchboards.

1.1.25.21.6

Outdoor distribution boards shall be of sheet steel with galvanized finish. The boards will be painted and the finish colour shall be to the approval of the KSEBL.

1.1.25.21.7

Neutral bars shall be drilled for an appropriate number of ways relative to the size of the board.

1.1.25.21.8

Barriers or fireproof insulation material shall protect the metal surface adjacent to any live

part and all spaces between phases.

1.1.25.21.9

Switch fuse units or isolators connected on the incoming side of distribution board shall be mechanically attached to the board with solid copper electrical connections between the units. A suitable insulated barrier shall be supplied to prevent copper or carbon dust released under fault conditions passing from one unit to the other.

1.1.25.21.10

The current rating of the bus bars in each distribution board shall not be less than the sum of maximum current rating of all outgoing circuits. The neutral connection for each circuit is to be direct to the neutral bus bar.

1.1.25.21.11

The distribution boards shall be either single pole or triple pole and neutral types and shall be equipped with means to provide over current protection to each circuit. This protection may comprise a miniature circuit breaker, which shall be removable without exposing live connections.

1.1.25.21.12

The cables feeding the distribution boards shall be connected directly to the incoming isolator or neutral bar as appropriate unless otherwise indicated by the specification.

1.1.25.21.13

Cabling to distribution boards shall generally be bottom entry. However, for indoor boards top entry may be permitted subject to the approval of the KSEBL. Cables entry to distribution boards shall be through cable glands and completely sealed after cable entry.

1.1.25.21.14

In cable compartments all live parts shall be covered after cable connection. Distribution board compartments shall be segregated from each other. Each bus section shall have coloured signalling lamps one for each of the control supplies (AC or DC) separately to indicate that these supplies are healthy.

1.1.25.21.15

Distribution boards for use on DC system shall be double pole types equipped with

adequately rated MCB's.

1.1.25.21.16

Approved type labels shall be fitted externally on the front cover of each distribution board describing its function with a suitable designation for easy identification of the equipment.

1.1.25.22 Terminal Blocks

1.1.25.22.1

Terminal blocks shall be mounted in an accessible position with the spacing between adjacent blocks not less than 200 mm and the space between the bottom blocks and the cable gland plate not less than 250 mm. Sufficient terminals shall be provided to allow for the connection of all incoming and outgoing cables including spare conductors and drain wires. In enclosed cubicles, the terminal blocks shall be inclined towards the door for facilitating terminations. All terminations of the Field cables or inter-equipment cables shall be terminated in the terminal block on the side facing the door for easy access. Terminal Blocks shall be logically grouped, indelibly marked and provided with removable plastic shrouds.

1.1.25.22.2

The 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. Terminals for Current circuits shall be Stud Type with nuts, washers and lock nuts or lock washers.

1.1.25.22.3

The terminal blocks shall be provided with shorting links and paralleling links where applicable, and mounted identification numbers and / or letters.

1.1.25.22.4

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

1.1.25.22.5

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

1.1.25.22.6

415 / 240 V AC circuit terminals shall be segregated from other terminals and shall be fitted with non-inflammable transparent plastic covers to prevent contact with any live parts. Warning labels with red lettering shall be mounted thereon in a conspicuous position. Segregation of different Voltage levels within the terminal blocks shall be achieved using barriers. Voltage levels shall be clearly identified by labels. Terminal Blocks associated with external sources of supply shall be fully shrouded and fitted with a danger-warning label. All connections shall be made at the front of the terminal board and no live metal shall be exposed at the back.

1.1.25.22.7

20% of all types of terminals shall be supplied as spare.

1.1.25.23 Panel Wiring

1.1.25.23.1

Wire colours shall comply with relevant standard, viz.:

- Colour of Wire Circuit Particulars
- Red -Red phase connections in current and voltage transformer circuits only.
- Yellow -Yellow phase connections in current and voltage transformer circuits only.
- Blue -Blue phase connections in current and voltage transformer circuits only.
- Green / Yellow connections to earth.
- Black AC neutral connections, earthed or unearthed, connected to the secondary circuit of current and voltage transformers. AC connections other than those above and connections in AC / DC circuits.
- Grey Connections in DC circuits.

Wiring diagrams must indicate wire colours. For back-wired panels all diagrams shall be drawn as viewed from the back of panel. For front wired panels all diagrams shall be drawn as viewed from the front.

1.1.25.23.2

All wires shall be fitted with numbered ferrules of approved type at each termination, double ferrules shall be provided wherever applicable.

1.1.25.23.3

All panel wiring shall be neatly fixed on the sides of the cubicles and shall be carried out with 650 / 1100 V grade stranded tinned copper wire, PVC insulated, fire proof and suitably

lugged. Unless otherwise approved, no insulated wire shall have less than three strands and each strand shall not be less than 0.91 mm in diameter. If single conductor is approved for instrument wiring, annealed copper of circular cross section shall be used and the diameter of the copper shall not be less than 2 mm. **All instrumentation wiring shall be of screened cables**.

1.1.25.23.4

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.

1.1.25.23.5

All panel wiring shall be taken to approved terminal boards. The relay and control cubicles shall be supplied complete with necessary terminal glands and end boxes for terminating the multi-core cables.

1.1.25.23.6

Electrical wiring and instruments shall be so located that leakage of oil or water cannot affect them.

1.1.25.23.7

Bus wiring between control panels etc...,shall be provided under this contract and shall be fully insulated and to be completely segregated from the main panel wiring.

1.1.25.23.8

All metallic cases of instruments, control switches relays etc...,mounted on control panels or in cubicles, steel or otherwise, shall be connected by means of bare copper conductors of not less than 4.5 mm^2 section to the nearest earth bar.

1.1.25.24 Small Wiring

1.1.25.24.1

All control panel wiring, secondary control wiring in circuit breakers, motor starters, control gear, etc...,shall be carried out in a neat and systematic manner with cables supported clear of the panels and other surfaces at all points to obtain free circulation of air.

In all cases, the sequence of the wiring terminals shall be such that the junction between multi core cables and the terminals are effected without crossover. Insulating bushes shall be provided where necessary to prevent the chafing of wiring.

1.1.25.24.2

All panel wiring shall conform to the requirements of relevant standards.

1.1.25.24.3

Except for rack-mounted equipment, each panel conductor shall be individually identified at both ends through a system providing ready and permanent identification, utilizing slip-on ferrules approved by the KSEBL. Paper ferrules are not acceptable.

1.1.25.24.4

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

1.1.25.24.5

All wires directly connected to Trip circuits / Tripping switches etc.. shall employ markers having a red background and with the label “TRIP”, engraved on it in white.

1.1.25.24.6

Sensitive control circuits shall be effectively shielded against extraneous signals and interference.

1.1.25.24.7

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 and shall not be jointed between terminal points.

1.1.25.24.8

Splices or tee connections are not acceptable. Wire runs shall be neatly arranged inside the panels and adequately supported by either clamping of loomed runs or in PVC wiring troughs. Trunking fill shall not exceed 75% of its capacity. Self-adhesive fixings are not acceptable. The self-supporting arrangement for wiring, if used, shall be such that they are not liable to cause permanent physical damage to the conductor or insulation. Whenever possible, unused areas of the panels shall be kept free of wiring to facilitate the installation of future equipment. With the exception of wiring direct to specific equipment, all wiring shall be located on side of the panels.

1.1.25.24.9

All wires shall be terminated with approved pin crimped terminations.

1.1.25.24.10

CT secondary shall be earthed at one point through a removable link. Each of the CT circuit shall be in separate cables.

1.1.25.25 Bus bars, Bus ducts and Connections

1.1.25.25.1 Bus bars

Bus bars, bus ducts and connections shall comply with relevant IEC or equivalent standards and shall be electrolytic copper, unless otherwise approved by the KSEBL.

The bus bars, assemblies and connections of equipment for service up to 11KV shall be of a type, which does not rely solely on air for insulation purposes. The covering material shall be non-deteriorating at the rated short - time maximum temperature of the bus-bars and shall have such thickness as is required to withstand rated line to line voltage between bus-bar and a conducting object on the exterior of the covering material for a period of not less than 60 seconds.

The bus-bars and bus ducts shall be capable of carrying the full rated current continuously without exceeding the maximum temperature specified in the relevant standard, under site ambient conditions.

The bus-bars and their connections, and insulation materials as appropriate shall be capable of withstanding, without damage, the thermal and mechanical effects of a through fault current equivalent to the short -time rating of the switchgear.

Facilities to the approval of the KSEBL's Engineer shall be provided to accommodate thermal expansion of the bus bars and associated components including the insulating medium if appropriate.

Bus bars shall be contained in a separate completely enclosed compartment within the general casing of switchgear. Bus-bar barriers shall be provided between switchgear equipment to prevent the spreading of ionised gases in the event of a fault. Main and auxiliary bus bars shall be covered with insulating sleeves to safely prevent internal bus bar faults and spreading of arcs. All bus-bar connections and joints shall be silver-plated.

The fixed plug-in contacts of bus bars shall be protected by automatically closing shutters if the corresponding switchgear is removed.

Access to bus bars and the connections directly connected thereto shall be gained only by the removal of covers secured by bolts or screws. Such covers shall be clearly and indelibly marked "BUS-BARS".

Bus bars shall be extensible at both ends; such extension shall entail the minimum disturbance to bus bar compartments.

Bus bars shall be of uniform cross-sectional area throughout the length of a switchboard and shall not be of a varying (tapered) section.

1.1.25.25.2 Bus ducts

Bus ducting, where it passes through walls, shall have provision for weather sealing.

Where bus ducting is located outdoors it shall be weather and dust protected to IP55.

Each bus ducting shall be equipped with a Silica Gel breather.

The Contractor is required to confirm in his tender whether or not any bus ducts included, require sun-shade due to the ambient conditions and must demonstrate that such sun - shades, where provided, are adequately supported.

Where the bus duct interconnects the transformer at one end and to the switchgear at the other end, flexible copper braids shall make such connections.

Where necessary, expansion joints shall be provided in the run of the bus ducting.

Drawing must be submitted with the tender showing the run of bus ducting, the details of the connections to the transformer, the switchgear and expansion joints.

1.1.25.25.3 Conduits

Conduit, accessories and trunking installation shall comply with the latest issue of the standards.

Exposed conduits shall be of galvanized rigid steel, and shall run parallel to the structural lines. Suitable conduit fittings and covers shall be used. Standard circular boxes or machined face heavy-duty steel adaptable boxes with machined heavy type lids shall be used throughout. For outdoor mounting all boxes shall be galvanized, weatherproof and fitted with external fixing lugs. The conduit shall be fastened using malleable iron pipe straps at spacing not greater than 500 mm. Minimum conduit size shall be 20 mm.

Supports for conduit, cables and fittings supplied under this Contract shall be removable and clamped to the building structure, wherever possible, in preference to being directly connected by bolting, screwing, welding, etc... Cable trays in the powerhouse substructure

shall be fastened to steel inserts cast into the concrete. Conduits shall be supported on heavy galvanized spacer saddles so as to stand off at least 6mm from the fixing surface.

Bends in conduit shall be made cold and the radius of bends shall not be less than nine times the conduit diameter. No bend shall be permitted to flatten the conduit. The use of running threads, solid elbows and solid tees will not be permitted.

Wherever the conduit crosses a structural expansion / contraction joint, approved expansion fittings and couplings with bonding jumpers shall be provided. Flexible metallic conduit shall be used where relative movement is required between the conduit and connected apparatus, and a separate copper connection provided to maintain earth continuity.

Where conduit is terminated so that the bare end of the conduit is exposed the conduit end shall be fitted with a brass bush. Conduit ends shall be carefully reamed to remove burrs. Draw-in boxes shall be provided at intervals not exceeding 10m in straight-through runs.

Conduit runs shall be in either the vertical or horizontal direction unless otherwise approved and shall be arranged to minimize accumulation of moisture. Provision for drainage shall be made at the lowest points of each run.

All conduits run in any circuit are to be completed before any cables are pulled in. The maximum number of cables in any conduit shall be in accordance with the latest issue of the Regulations for the Electrical Equipment of the Buildings.

1.1.25.26 Cubicles, Desks and Control Panels

1.1.25.26.1

Unless otherwise specified, panels, desks and cubicles, shall be of floor mounted and free standing construction and be in accordance with the specified enclosure classification. All control and instrumentation panels in any one location shall be identical in appearance and construction. Cubicle 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.

1.1.25.26.2

Cubicles shall be fitted with close fitting, gasketted, hinged lift-off doors capable of being opened through 180 degrees. The doors shall be provided with integral lock and master key. Door sealing materials shall be provided suitable for the specified site conditions. Cubicles and cubicle doors shall be rigidly constructed such that, for example, door

mounted emergency trip contacts can be set so that mal-operation will not be possible due to any vibrations or impacts as may reasonably be expected under normal working conditions.

1.1.25.26.3

Cubicles and panels shall be provided with removable Steel gland plates located to provide adequate working clearance for the termination of cables (at least 250mm from the floor of the cubicle). Under no circumstances shall the floor or roof plate be used as a gland plate. The cables and wiring shall enter from bottom or top as approved or directed by the KSEBL.

1.1.25.26.4

The cubicles and panels shall be adequately ventilated, if required, by screened vents or louvers, which shall be so placed as not to detract from the appearance. All Panels, desks and cubicles shall be vermin proof. All cable entries to equipment shall be sealed against vermin as soon as possible after installation and connecting-up of the cables to the approval of the KSEBL. All cubicles, desks and panels shall be provided with a natural air circulation ventilation system. All control equipment shall be designed to operate without forced ventilation. Dust protection where appropriate shall be provided.

1.1.25.26.5

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. For a set of panels, inter-panel bus wiring shall be routed through apertures in the sides of panels and not via external multi-core cabling looped between the panels.

1.1.25.26.6

Unless stated otherwise, cubicles and panels, whether individually mounted or forming part of a set, shall be provided with a internal ground bus with 40 mm x 5 mm copper bar extending throughout the length on to which all panel earth connection shall be made. Each end of this bus shall be drilled and provided with suitable studs or holes to the approval of KSEBL, for connecting to the main station grounding system, using cables ranging from 70 to 100 sq. mm and for possible future extension.

Earth connection between adjacent panels shall be achieved by extending the bar through the panel side and not by interconnecting external cabling.

1.1.25.26.7

The standard phase arrangement when facing the front of the motor control centres and switchboards shall be RYB from left to right, from top to bottom and front to back. All instruments, devices, buses and other equipment involving three phase circuits shall be arranged and connected in accordance with the standard phase arrangement, where possible. Electrical clearances shall conform to applicable standards and shall not require the cutting away of adjacent framework.

1.1.25.26.8

Instruments, control buttons 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.

1.1.25.26.9

Cubicles and panels shall be securely fastened down to the floor and braced against lateral movement induced by earthquake forces. Panels shall be mounted on an approved form of anti-vibration mounting whenever necessary.

1.1.25.26.10

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 Contractor.

1.1.25.26.11

Control panels and cubicles shall be supplied with door operated interior lights, socket outlets and jacks with provision for connection to the station telephone system and is clearly labelled with the Circuit Name at front and rear, with an additional label inside the panel.

1.1.25.26.12

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 KSEBL. The interior of all cubicles and panels shall have a mat white finish unless specified otherwise. Overall height, excluding cable boxes, shall not exceed 2.5m. Operating handles and locking devices shall be located within the operating limits of 0.75m and 1.8m above floor level. The location for indicating instruments and meters shall be 1.5m above floor level, unless otherwise

specified elsewhere in the specification.

1.1.25.26.13

Panels shall be suitably designed to permit future extension wherever appropriate or specified.

1.1.25.26.14

Panel sections accommodating equipment at voltages higher than 110V shall be partitioned off and the voltage clearly labelled. Labels permanently attached to the panel and adjacent to the equipment concerned shall identify each relay and electronic card within panels. Where instruments are terminated in a plug and socket type connection both the plug and the socket shall have permanently attached identifying labels.

1.1.25.26.15

Instrument and control devices shall be easily accessible and capable of being removed from the panels for maintenance purposes. Termination, wiring and cabling shall be in accordance with relevant clauses of the specification.

1.1.25.27 Junction and Marshalling Boxes

1.1.25.27.1

Junction and marshalling boxes shall be of substantial sheet steel construction, having enclosure classification as specified and fitted with external fixing lugs and finished painting as specified. The boxes shall allow ample room for wiring, with particular regard to the routing of wires from the point of entry. Outdoor boxes shall be weather proof and shall have anti condensation finish and all boxes shall be designed such that any condensed water cannot affect the insulation of the terminal boards or cables. No cables shall be terminated into the top of outdoor boxes unless specifically approved by the KSEBL.

1.1.25.27.2

Each box shall be complete with suitably inscribed identification labels.

1.1.25.27.3

All necessary gland plates are to be provided. Every unused outlet shall be sealed. Unused screwed entries shall be sealed by means of a tamper proof screwed plug.

1.1.25.27.4

All box covers are to be arranged for padlocking and padlocks with keys shall be supplied.

1.1.25.27.5

All boxes shall be provided with adequate grounding bars and terminals.

1.1.25.28 Interconnections / Contact Terminal Points

1.1.25.28.1

The Contractor shall supply and supervise the installation of all interconnecting wiring between various items of the Work, except where otherwise specified. The Contractor shall be responsible for making all terminal connections where equipment supplied under this Contract connects with equipment existing or provided under other Contracts and the Contract includes waiting upon other contractors as may be necessary. The contract includes the termination and connection of all cables, which are supplied under this Contract.

1.1.25.28.2

Unless otherwise specified, all cables for external connections will be supplied and installed complete with cable glands by the Contractor. The Contractor shall ensure the correct functioning of related equipment and instrumentation.

1.1.25.29 Equipment Grounding

1.1.25.29.1

All equipment including pipe work, structural work, and non current carrying metalwork supplied under this Contract in or on which is fitted any type of electrical equipment, shall be provided with two separate grounding terminals, suitable for connection by means of copper strip or stranded copper strip or stranded copper conductor to the station grounding system. The Contractor shall supervise connection of the earthing conductors to these terminals as approved or directed by the KSEBL.

If required a suitable earth grid of copper strip shall be provided around the plant for terminating the equipment and works. The provisions for grounding are to be such that no reliance is to be placed on the conductivity of metal-to-metal joints without the use of special connectors.

VT and CT neutral or common lead shall be earthed at one place at the terminal blocks

where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.

1.1.25.29.2

Unless specified otherwise, earthing conductors from the station earthing bus to the equipment should be provided by the Contractor.

1.1.25.30 Alarm Contacts

1.1.25.30.1

All alarm contacts shall be of galvanically isolated Form C type.

1.1.25.30.2

Where required, relays should be provided as contact multipliers.

1.1.25.31 Electronic Equipment

All components and assemblies shall meet the requirements of the appropriate sections of the IS standards or equivalent and in particular those sections which refer to equipment stored and operated in a tropical environment.

1.1.25.31.1 Electronic Equipment Grounding

Electronic equipment shall be provided by specially insulated grounding bus-bar connected to a single point of the main grounding grid by two parallel conductors so that no fault current or circulating current will flow in electronic grounding system. All electronic equipment and panels shall be grounded through the electronic bus bar provided.

1.1.26 Rating Plates, Name Plates, Labels & Signs

The size of Rating / nameplates & labels and the height of lettering shall be suitable for the equipment, and is subject to the approval of the KSEBL.

Suitable metallic warning signs and labels shall be provided for the plant items where danger or possibility of danger exists or there is prohibition of certain action. Such warning signs shall be in red and white colour combination and shall be affixed in a clearly visible location. Where required by the KSEBL a list of precautions and procedures to be adopted when emergency or danger occurs shall be affixed. Such list shall be on a yellow coloured back ground with black coloured, lettering of minimum 6mm.

Enclosure with risk of fire or excessive heat or excessive noise shall be provided with appropriate warning signs and labels. Enclosures, which are protected with fire protection by CO_2 or Halon, shall be provided with warning labels with first aid instructions.

1.1.26.1

A rating plate of non-corrodible material and of approved size shall be permanently attached to each major and auxiliary item of Work in a conspicuous position. Major equipment nameplates shall be of stainless steel and shall be fixed to the apparatus with non-busting screws. This plate shall be permanently engraved in English with the designed full load ratings, rated voltage, temperature rise, class of insulation, frequency, serial number, type number, date of manufacture, and other identification deemed necessary to provide complete information of the plant / equipment. Where required by the KSEBL, diagram plates shall also be supplied. The English language and metric or SI units shall be used for the plates.

1.1.26.2

All items of plant shall be provided with a non-hygroscopic material nameplate or label designating the service and identification number of the equipment or device in English language. The engraving shall be of a contrast colour to the base material colour or as approved. The pumps, engines, compressors, motors, transformers, breakers, panels, etc...,shall be provided with a stainless steel rating plate (minimum 2mm thickness) engraved with details indicating all the basic parameters and circuit diagrams. The identifying inscription shall be approved by the KSEBL or conform to that designated in the appropriate sections of this Specification. Devices shall be identified by nameplates on both front and rear of all desks, panels, cubicles etc... In case of circuit breakers, starters, etc...,white transparent plastic material with lettering engraved on the back and filled with black material can also be provided. The minimum size of lettering shall be not less than 3mm high. All equipment inside cubicles, panels, boxes, etc...,must be properly labelled with their item number. This number shall be the same as indicated in the pertaining documents (wiring diagrams, equipment lists, etc...). Sticker type labelling shall not be accepted.

1.1.26.3

Nameplates or labels manufactured for indoor panels shall be of non-hygroscopic laminated plastic material with white plate and black engraving. The materials used shall

be non-fading, non-aging and suitable for tropical conditions. The minimum size of lettering shall be not less than 3mm high.

1.1.26.4

Items of the plant which are subject to handling or which are of castings such as valves etc... shall be provided with an engraved chrome plated brass / stainless steel label, 3 mm thick with the engraved lettering filled with enamel.

1.1.26.5

The proposed material of the labels, the size, the exact label inscriptions as well as proposals for the arrangement shall be submitted to the KSEBL for approval.

1.1.26.6

Labels written in English 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 dial plate or switch plate, no label is required.

1.1.26.7

The label must be fixed close to the instruments in such a way that easy identification is possible. Fixing on the dial glass of instrument shall not be accepted. The wordings shall conform to the wording used in engineering documents and shall be submitted for approval of the KSEBL.

1.1.26.8

All devices and components shall be identified by their identification numbers. Cubicles and similar units shall also bear this identification number on the rear side if rear access is maintained.

Warning Labels

i. Warning labels shall be made of polycarbonate board with letters engraved in Malayalam and English. For indoor equipment such as circuit breakers, starters, etc... warning labels made of plastic material with suitably contrasting colours and engraved lettering shall be provided as described below.

ii. LV switchboards shall have white base with 5 cm black letters reading “MAINS 415 / 240 VOLTS”.

iii. MV / LV switchboards and transformers shall have white warning labels with 7.5 cm letters reading “DANGER-11000 VOLTS or 415/240 VOLTS” in RED.

Labels for cables

i. Each cable when completely erected shall have permanently attached to it at each end and at intermediate positions as may be considered necessary by the KSEBL, non-corrodible labels detailing identification number of the cable, voltage and conductor size.

ii. The cable identification number shall comply with those of the cable schedule, which shall be prepared by the Contractor for the actually laid cables.

iii. All cables in cable pits and at entry to building blocks shall be labelled utilizing the above-mentioned type of labels.

1.1.27 Packing and Transport

Each item shall be packed properly or protected for shipment and transport from manufacturer works to the site and storage on the Site. The packing or protection used shall remain serviceable for a period of at least one year at site.

Where practicable, all indoor items such as electric motors, switches and control gear, instruments and panels, machine components etc..., shall be 'cocooned' or covered in polyethylene sheeting, sealed at the joints and enclosures provided internally with an approved desiccators.

1.1.27.1

Each equipment shall be shipped completely assembled and shall be provided with lifting devices for attachment of crane slings to facilitate its handling. Components which could be damaged during shipment shall be packed separately, and shall carry complete identification. Packages shall not exceed 3 m x 3 m. Drying agent shall be included in each package and crating shall be airtight. All cases, packages etc...,shall be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and the correct position of the slings and shall bear an identification mark relating them to the appropriate shipping documents. All marking shall be either of water proof material or protected by shellac or varnish to prevent obliterations in transit.

1.1.27.2

Packing shall be done for sea transport to India and shall be suitable for long term storage.

1.1.27.3

Suitable precautions shall be taken to ensure that pipe, tube and pump open ends are protected from ingress of dirt and moisture and external damage. All flanges shall be fitted with protective blanks, secured by a number of bolts not less than 50% of the number of bolts holes with a minimum of four. All rotating machines shafts and bearings shall be supported properly for protection from movement likely to occur in transit.

1.1.27.4

Spare parts or materials shall be packed in the specified manner and delivered in approved cases suitable for storing such parts and material over a period of several years.

1.1.27.5

The KSEBL's representative may inspect and approve the packing before the items are dispatched. The contractor shall inform the KSEBL when the packing is ready. Such inspection will not exonerate the Contractor from any loss or damage due to faulty packing. Equipment shall be despatched only after getting despatch clearance from the KSEBL / Engineer-in-Charge after approval of test reports submitted by the Contractor after factory acceptance tests.

1.1.27.6

After the completion of erection / installation the Contractor shall deliver all the empty packages, cases, cable drums etc... to the KSEBL's stores in an approved manner.

1.1.28 Concreting and Erection Supervision

1.1.28.1 General Supervision Requirements During Concreting of Embedded Parts

The Contractor shall attend concreting as required in the relevant section of the current document in addition to the following requirements:

i. The Contractor shall supervise the placing of anchor bolts to be embedded in the foundation concrete and shall satisfy himself that these are accurately positioned, securely anchored in the concrete and are adequate to hold down the associated parts of the Work while these are being embedded in concrete. The Contractor shall carry out all measures necessary to ensure

that parts to be embedded in concrete are securely held in position and in particular will ensure that tie rods are evenly tensioned to the correct degree by means of turn-buckles and that the anchors are properly welded to form a complete ring and are not left as open hooks.

ii. Embedded parts shall be designed to permit a concrete pouring without affecting the laid out parts.

iii. During concrete pours, vibrators will not be allowed to touch any metal part embedded in the concrete, and the concrete will be placed evenly and neither dumped nor discharged from chutes in such a manner as to disturb the embedded parts.

iv. Where possible, the Contractor will keep the interior of the embedded parts wet by water spray to prevent expansion by the heat of hydration. Grouting of voids will not be undertaken sooner than 7 days after concreting the embedded parts.

1.1.28.2 General Supervision Requirements During Erection

i. General Specifications

The Contractor shall ensure that the Work is correctly installed in accordance with the approved erection drawings and procedures, provided by him.

ii. **Layout, Measurements and Datums**

The Contractor shall layout basic building lines and establish datums, and shall be responsible for the proper performance of the Work.

iii. Erection Marks

All equipment and their sub-assemblies and accessories such as piping frame works, supports etc... which are to be installed at site shall be marked with distinguishing identification marks or numbers. Where the surface of the material require anti-corrosive treatment, impress marks shall be used.

iv. Erection & Checking at site

All work at site shall be carried out in such a manner as not to obstruct the operations of any other contractor or the running equipment at the site. In case of any interconnections are required with the existing plant / equipment or with the works of other contractors, the Contractor shall make the same with prior approval.

The Contractor shall obtain from the KSEBL / KSEBL's representative details of the parts, which he wishes to inspect, but such inspection shall in no way exonerate the Contractor from any of his obligations. The Contractor, if requested by the KSEBL's representative, shall open up for inspection before erection any equipment, which has been delivered to the site partly / fully assembled. Contractor shall reassemble the equipment after inspection.

The Contractor shall keep the site on which he erects or stores plant, reasonably clean.

On completion of the works, the site is to be left clean and tidy and obtain necessary clearance from the responsible KSEBL's representative. **Any damage done to the existing buildings, structures and plant or property belonging to the KSEBL shall be made good at the Contractor's expense**.

1.1.29 Inspection, Tests on Completion and Commissioning

Approval of assemblies, tests, inspections, related procedures etc... and acceptance of pertinent test and inspection certificates, or waiving of inspections or tests, shall in no way relieve the Contractor of his contractual obligations for finishing the Works in accordance with the provisions of the Specifications.

1.1.29.1 General Specifications

i. Testing, pre-commissioning, & commissioning will involve, though not limited to these: setting / adjusting, testing, proving, trial runs, etc... of various equipment and systems installed.

ii. During erection, commissioning and trial operation, the Contractor shall perform at suitable intervals all inspections and tests in the presence of the Engineer in order to prove the orderly execution of the works in accordance with the Contract. Unless otherwise specified, all costs for testing at site and of the works and charges associated with it shall be borne by the Contractor. This includes the measuring devices, properly calibrated, and any pertinent accessories, which shall be made available by the Contractor for the entire duration of the tests. The Contractor shall delegate his experts to perform the tests at site.

iii. Testing and commissioning of all Work at site will be in accordance with detailed programs and procedures prepared by the Contractor and approved by the KSEBL. Such programs and procedures shall include all tests specified in this Specification.

Wherever equipment supplied under several Contracts is tested together as a unit, the KSEBL will coordinate the preparation of test programs and procedures, and the execution of the tests among the respective Contractors.

iv. The contractor shall perform various activities during pre-commissioning, Integrated Testing, post-commissioning stages of equipment covered under this tender specification. Field testing and commissioning shall be carried out by the Contractor prior to the acceptance of the Work or part of the Work. All tests shall be witnessed by the KSEBL .

v. The Contractor shall provide at site all experienced personnel (engineers and technicians), test equipment, instruments, wiring, tools and plant, accessories etc... required to carry out the tests and record their results in a satisfactory manner. The Contractor shall calibrate all necessary test instruments and equipment, and include calibration records in the respective test reports.

vi. In cases where doubt exists regarding the tests, the KSEBL may request repetition of such tests.

vii. Contractor shall earmark separate manpower for respective area of testing and shall not be disturbed / diverted for other work. The contractor’s commissioning group shall work as per the instruction of KSEBL’s Representative and they shall coordinate day-to-day activity with other agencies at site. The testing activity may have to be repeated till satisfactory results are obtained.

viii. The KSEBL reserve the right to witness any tests both at factory and at site. The Contractor shall advise the KSEBL at least 10 working days prior to the start of such tests.

ix. The Contractor shall be responsible for satisfying himself as to the correctness of the electrical and mechanical connections to all plant supplied under the Contract before such plant is brought into commission or operation.

x. The contractor shall immediately attend to the defect noticed during tests, trial runs, pre-commissioning, commissioning such as loose components, undue noise or vibration, strain on connected equipment etc... Readjustment and realignment as called for shall be done as per KSEBL’s Representative’s instructions.

xi. The contractor shall carry out any other tests as desired by KSEBL's Representative on erected equipment covered under the scope of this contract during testing, pre-commissioning and commissioning, to demonstrate the completion of any part or whole of work performed by the contractor. During this period, though KSEBL's staff will also be associated in the work, the contractor's responsibility will be to arrange for complete requirement of men and required tools and plants, consumables, scaffolding and approaches etc..., till such time the commissioned unit is taken over for operations.

xii. The scope of testing & commissioning of electrically operated actuators for valves, dampers, gates etc...,will include but not limited to meggering, providing loop wire on actuator terminal block, adjustments of mechanical / electrical or electronic position transmitters, setting of limit / torque switches, cable checking, internal wiring checking, local / remote operation from MCC & MMI package, replacement of limit / torque switches if required.

1.1.29.2 Commissioning Test

i. Commissioning acceptance tests shall be carried out, on all generating units to verify the rating characteristics of generating units and other equipment's in accordance to relevant standards. The complete field acceptance test reports shall be prepared by the Contractor and submitted to KSEBL for approval.

ii. The test run on generating units shall be carried out as per relevant provisions of IEC standards.

iii. Before issuing the "Taking-Over Certificate", the revised copies of the Operation and Maintenance Manual shall be submitted together with the specified number of complete sets of drawings of the Works as completed. The Works shall not be considered complete for purposes of taking over under the terms of the General Conditions of the Contract until the above documents have been supplied by the Contractor.

1.1.29.3 Trial Run

i. Immediately upon completion of commissioning, the plant shall be kept on trial operation during which period all necessary adjustments shall be made while operating over the full load-range enabling the plant to be made ready for performance and guarantee tests. The plant, i.e., complete equipment, shall be on Trial operation for a period of one month. The trial operation shall be considered

successful, provided that each item of the equipment can operate continuously at the specified operating characteristics, for the period of trial operation.

ii. For the period of trial operation, the time of operation with any load shall be counted. Minor interruptions not exceeding 3 (three) hours, at a time, caused during the continuous operation shall not affect the total duration of trial operation. However, if in the opinion of the KSEBL's Engineer, the interruption is long, the trial operation shall be prolonged for the period of interruption.

iii. The trial operation report comprising of observations and recordings of various parameters to be measured in respect of the above trial operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during trial run, shall also include the dates of start and finish of the trial operations and shall be signed by the representatives of both the parties. The report shall have sheet, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the trial operation. Based on the observations, necessary modifications, repairs to the plant shall be carried out by the Contractor to the full satisfaction of the purchaser to enable the latter to accord permission to carry out the performance and guarantee tests on the plant. However, minor defects, which do not endanger the safe operation of the equipment, shall not be considered as reasons for withholding the aforesaid permission.

iv. During the trial run the Contractor shall make familiar the Purchaser's personnel with the equipment, the operation and maintenance of the Works and its auxiliaries to such extent that thereafter the duties can be assigned to the Purchaser's trained personnel.

v. If any defects or irregularities affecting the safety or reliability of the Works should arise during the trial run, the trial run shall be interrupted and started again after such defects or irregularities have been corrected by the Contractor at his own cost.

1.1.29.4 Performance and Guarantee Tests

i. The final test as to the performance and guarantees shall be conducted at site, by the contractor, through an MNRE (Ministry of New and Renewable Energy) approved agency, in presence of the Department representative. Such tests will be commenced, within a period of 15 (fifteen) days after successful completion of Trial Operations. Any extension of time beyond the above 15 (fifteen) days shall be mutually agreed upon.

ii. These tests shall be binding on the Contract to determine compliance of the

equipment with the performance guarantees.

iii. The available instrumentation and control equipment will be used during such tests and the contractor will calibrate all such measuring equipment and devices as far as practicable. However, immeasurable parameters shall be taken in to account in a reasonable manner, for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable.

iv. Any special equipment, tools and tackles required for the successful completion of the performance and guarantee tests shall be provided by the contractor.

v. The guaranteed performance figures of the equipment shall be proved by the contractor during these performance and guarantee tests. Should the results of these tests show any decrease from the guaranteed values, the contractor shall modify the equipment as required to enable it to meet the guarantees. In such case, performance and guarantees tests shall be repeated within one month, from the date the equipment is ready for retest and all cost for modifications including labour, materials and the cost of additional testing to prove that the equipment meet the guarantees, shall be borne by the contractor.

vi. All the costs for the pre-commissioning test, trial operation, performance and guarantee test including the consumables, arranging test set-up, test equipment and accessories, measuring devices etc... shall be borne by the contractor.

1.1.29.5 Tests on Materials

i. The materials, parts and assemblies shall be tested to comply with the ASTM Standards or other standards specified and shall be in accordance with the best commercial methods applicable to the relevant type and class of work. The tests and trials shall be recorded and certified by the Contractor.

ii. The test records for materials shall identify the component parts in which the materials are to be used and the certificate shall be prepared in such a way that it can be easily determined if the applicable Specifications or standards have been complied with.

iii. All radio-graphs, test specimens and test records shall become the property of the KSEBL.

iv. Load tests on crane hooks, steel wire ropes, chains and other lifting devices, etc... shall be considered as material tests.

1.1.30 Test Reports

i. Test reports shall indicate the tests performed, instruments used, names of test

personnel and provide for witnesses' signatures. They shall be numbered and dated.

ii. The Contractor shall compile records and reports on each and every test specified under this Contract and bind such test documents in the same manner as the Operation and Maintenance Manuals.

1.1.31 Operation and Maintenance Manual

1.1.31.1

For the guidance of the KSEBL's operating and maintenance staff, the Contractor shall prepare and furnish 6 copies of operation and maintenance manual for all the Work. Of these, 2 copies shall be given in advance before starting the erection works. Balance 4 copies shall be submitted after incorporating all corrections for the final as-built condition.

1.1.31.2

The manual shall include but shall not necessarily be limited to the following:

- Technical and design data;
- General description of components;
- Operating instructions;
- General information (including sequence of operations if applicable);
- Specific information (dealing with any unusual feature or safety precautions);
- Maintenance instructions fully describing all aspects of preventive and repair maintenance, including maintenance schedule and repair procedures, a detailed lubrication chart showing all lubrication points, lubricant grades required and a lubrication schedule;
- Adjustments (and assembly) including design clearances and settings where applicable;
- All drawings, diagrams, material and parts list;
- All pertinent bulletins and instructions prepared by the various manufacturers of component parts.

1.1.31.3

If the complete text is unduly bulky, then the manual shall be appropriately subdivided and produced in a multi-volume form.

1.1.31.4

Final manuals shall be reproduced as a book or books of approximately quarto size generally in the form of the title page to this document except that the references to Specification, Conditions of Contract, Drawings, etc...,will be replaced by "Operating and Maintenance Instructions". The name of the main Contractor but not that of any subcontractor may also be inscribed upon the cover after the description of the Work. A brief description of the Work is to be inscribed upon the spine of the cover and, if the instructions are contained in several books, these are to be marked with the appropriate volume number. The drawings and diagrams shall be the latest revision of the approved drawings, reproduced to a convenient size and bound into the volume. Insertion of loose drawings into cover pockets is not acceptable.

1.1.31.5

Any additional information, data or changes found necessary during commissioning should be sent to the KSEBL for insertion in the manuals.

1.1.32 Spare Parts, Special Tools and Site Consumables

A) Spare Parts

The Contractor shall provide a list of recommended spare parts and special tools with the respective unit prices to KSEBL's approval and supply sufficient parts, as per approved list, to assure satisfactory operation for at least five years. All spare parts and accessories shall be electrically and mechanically identical to corresponding parts in the equipment supplied and shall be suitably packed and clearly marked, ready for long term indoor storage.

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 KSEBL’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 recommend by them in addition to the list given in particular specifications and offer the price of the same separately in schedule of prices for spares. Wherever the quantity of spares is given as set / sets, it will be taken as quantity for all the generating units. Sufficient quantity of spares will be included for parts which are more prone to frequent wear and tear and can be replaced easily without involving long shutdown.

The Contractor shall provide 5%, but at least two pieces of all types of bolts, screws, nuts, washers, spanner rings and cotters. The quantity may be taken from the surplus handed over to the Purchaser after completion of the installation as described under the chapter "Fasteners." of this Section.

Mandatory Spares: All spares required during the Defects liability period, needs to be compulsorily provided by the Contractor and a list is also to be provided by the Contractor. It is also specified that any spare other than that specified in the list is necessitated during the defects liability period, the same will be deemed to have been included in the mandatory list and will have to be provided free of cost by the Contractor.

Recommended Spares: The Contractor shall provide a list of spares with unit rates that may be required for a two year period after the defects liability period. Based on the list, KSEBL may issue separate order for the needed spares, based on the rates quoted by the Contractor.

B) Tools

The scope of work shall include all customary and special tools, as well as auxiliary devices including lifting devices, ropes, etc... necessary for total assembly and disassembly of all parts of the supplied Works. Furthermore, all accessories for maintenance shall be supplied and included in the Tender. The total price for tools and devices as required by this article shall be included in the Total Tender Price. The special lifting devices and tools designed and supplied for the project, can be

used by the Contractor during erection and will be handed over to Purchaser in good working condition without any wear and tear. However, normal tools and appliances supplied shall not be used for erection purposes by the contractor and shall be handed over in new condition. All ropes, slings, small hoists and winches etc... shall be handed over in new condition.

All lifting devices and wire ropes slings to be used at site shall be tested at works and test certificate shall be supplied to the Engineer-in-Charge.

Suitable toolboxes shall also be included in the delivery. An itemized list and description of all provided tools, auxiliary devices, etc... shall be included in the Tender. The KSEBL shall be entitled to take over from the Contractor the entire erection tools, appliances, instruments at mutually agreed conditions.

Each set of tools and appliances to be supplied under the contract shall be arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the quantity and type of tools and appliance. If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be split into multiple boxes.

All tools and appliances shall be clearly marked outside its packing with its description, identification number and reference manual number. Each toolbox shall be painted black, fitted with a pad lock and clearly marked in white letters with the name of the item of equipment for which the tools or appliances are intended.

The Contractor shall open all the toolboxes at the Site stores for inspection by the KSEBL's representative. The Contractor shall be responsible for all such unpacking and subsequent re-labelling and re-packing.

C) Consumables

Scope of work shall include all site consumables like welding electrodes, brazing materials, insulating materials, sealants, cleaning agents, paints and varnishes, grinding wheels/discs, fasteners and raw materials etc... in fairly sufficient quantity so that erection and commissioning activity is not held up for want of these items.

For all items under this Contract, the Contractor shall deliver 5 % of the quantity of painting material, but at least one litre, in new sealed containers, for later repair works other than the Contractor's.

Lubricating oils, insulating oils and greases etc... required for first filling in the plant and equipment supplied by the Contractor under this Contract shall be supplied in quantity 10 % (ten percent) higher than the actual capacity for first filling. These items shall be supplied as per site requirement and shall not be stocked with main

equipment.

1.1.33 Safety

During erection and commissioning the Contractor shall provide all reasonable measures to ensure safety of all personnel and plant. The Contractor shall comply with all safety codes and security regulations prevailing in the KSEBL's plants and those specified in **Vol-2 – Conditions of Bid and Contract**.

All statutory requirements regarding safety provisions, where applicable, stipulated in the following Acts and rules / regulations made there under, as amended from time to time, shall be complied with:

(a) The Electricity Act 2003.

(b) The Building and Other Construction Workers Act, 1996 and rules made thereunder.

(c) The Factories Act, 1948 and rules made there under.

(d) Central Electricity Authority (Safety requirements for construction, operation and maintenance of electrical plants and electric lines) Regulations.

(e) Central Electricity Authority (Measures relating to Safety and Electricity Supply), Regulations as and when notified by the Authority.

(f) Central Electricity Authority (Technical Standards for construction - 2010)

(g) Indian Electricity Rules, 1956 till Central Electricity Authority (Measures relating to Safety and Electricity Supply), Regulations are notified by the Authority.

(h) In addition, stipulations made under following Acts and rules/regulations made thereunder, as applicable, shall also be complied with:

- The Explosives Act, 1884
- The Explosive Substance Act, 1908.
- The Indian Boilers Act, 1923 and Indian Boiler Regulations, 1950
- The Motor Vehicle Act, 1988
- The Petroleum Act, 1934
- The Public Liability Insurance Act, 1991
- The Static and Mobile Pressure Vessel (unfired) Rules, 1981
- The Workman's Compensation Act, 1923
- The Water (Prevention and Control of Pollution) Act, 1974
- The Air (Prevention and Control of Pollution) Act, 1981
- The Environment Protection Act, 1986
- Battery Management and Handling Rules, 2001
- Bio Medical Waste (Management and Handling) Rules, 1998

- Chemical Accident (Emergency, planning, preparedness and response) Rules, 1996.
- Explosive Rules, 1983
- Gas Cylinder Rules, 1984
- Hazardous Wastes (Management and Handling) Rules 1989
- Petroleum Rules, 1976
- Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
- Ozone Depleting Substances Rules, 2000

(i) Any other rules and regulations in this regard

(j) Any specific approvals, permits, clearances issued by any authority under different statutes.

1.1.33.1

The operation of any items of energized Work / Plant shall be subject to a "Permit to Work" system in a form agreed between the Contractor and the KSEBL in accordance with the KSEBL's standard safety regulations for such work. While the Work / Plant is still under the control of the Contractor the permit to work shall be endorsed by the Contractor / Contractor's authorized representative. Permits to operate on Work / Plant, which has been handed over, shall be under the control of the KSEBL / KSEBL’s representative.

1.1.33.2

All safety precautions have to be observed while laying the cables in the trench. After completing the work, the trench has to be cleaned and covers put back into position. The contractor, if required, shall do de-watering of trenches.

1.1.33.3

The contractor shall provide all the necessary scaffolding materials, temporary structures and necessary safety devices etc..., during pre-assembly, erection, testing and commissioning of the hydro sets.

1.1.33.4

The Contractor shall observe all statutory safety ordinances, regulations and laws, which are in effect at the Site.

1.1.34 Training of KSEBL's Personnel

The contractor shall impart training at least for a period of one month from the date of

successful commissioning of the project on operation and maintenance of the plant. The KSEBL's personnel / officers / staffs may be associated for the purpose of training right from the stage of installation of the equipment. Such training shall be imparted at free of cost to the engineer / staff / officers to enable them to make themselves conversant in the operation and maintenance of plants and equipment.

1.1.35 Taking Over of the Project

After conclusion of the training period of KSEBL's Personnel as specified in Clause 1.1.34 above, the contractor shall give due notice to the Engineer-in-Charge about successful operation of the plant and conclusion of the training period. Thereafter KSEBL shall take over the project formally subject to fulfilment of all relevant requirements in the terms of the agreement.

1.1.36 Special Notes

1.1.36.1

The Contractor shall inspect the road and ascertain the possibility of transporting heavy equipment. If necessary, the equipment shall be supplied in split up condition to suit the transport requirements.

1.1.36.2

The bidder shall include all equipment, materials, tools, consumables etc... required for the complete and satisfactory installation, testing, commissioning and operation of the units, feeders etc... even if they are not specifically mentioned in these specifications.

1.1.36.3 Deviations from Technical Specifications

All deviation from General Technical Requirements and Technical Specifications given in the following sections should be clearly brought out at one place in the "List of Deviations" from Technical Specifications clearly bringing out the financial commitment. Any deviation not clearly mentioned in the List of Deviations, but described elsewhere in the equipment description shall not be acceptable. After award of contract, the contractor has to fulfill all the requirements of technical specifications except the deviations clearly spelt out with financial commitment and accepted by the KSEBL.

Whenever a Contractor deviates from these specifications, he shall furnish the data called for in the Technical Data Schedules and give a summary of and the reasons

for all deviations in the "List of Deviations". Failure to accomplish this may cause the rejection of his Tender, especially when a major deviation is involved.

SECTION: I

SUB-SECTION: C3

TECHNCIAL SPECIFICATION

(ELECTRICAL PORTION)

	ELECTRICAL EQUIPMENT SPECIFICATION FOR HVAC 3X25MW KUTTIYADI HEP RMU	SPECIFICATION NO. VOLUME NO. : **II-B** SECTION : **C** REV NO. : **00** DATE : 12.08.21 SHEET : 1 OF 3

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 two signed and stamped copies of the following shall be furnished by the bidder as technical offer:

a) A copy of this sheet "Electrical equipment Specification for HVAC" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
b) List of Erection and Commissioning spares.
c) List of Erection & Maintenance tools & tackles.
d) Electrical load requirement

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

4.0 List of enclosures :

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.

5.0 The stipulations of specification (in decreasing order) Section-C(customer specification), Datasheet-A, followed by those of Section-D, shall prevail in case of any conflict between the stipulations of specification Section-C (customer specification), Datasheet-A and Section-D.

6.0 In case of conflict between any two clauses within the section, stringent of the two shall be considered.

REV: 00 DATE:12.08.21

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR
PACKAGE: HVAC

PROJECT:

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	Vendor	Vendor	1. 415 V AC/240 V AC supply 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, fibre optical etc.	Vendor	Vendor	
5	Cable trays, accessories & cable trays supporting system	Vendor	Vendor	
6	Cable glands and lugs for equipments supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
7	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer approval at contract stage.
8	Lighting	BHEL	BHEL	
9	Equipment grounding & lightning protection	Vendor	Vendor	
10	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer approval at contract stage.
11	Mandatory spares	Vendor	-	Vendor to quote as per specification.
12	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle.	Vendor	-	As per specification
13	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
15	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing & cable routing for C & I systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies.

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR
PACKAGE: HVAC

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
16	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable trays routing details. Electrical equipment layout drawing shall be to BHEL approval.
17	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

- Exterior - one coat glossy alkyd paint with dry film thickness 0.025 mm.

1.1.24.4.2

Certain mechanical and other electrical auxiliary equipment (pumps, motors, cabinets, etc...) may be shop painted with primer and finish coats with the prior approval of the KSEBL.

1.1.24.5 Field Procedure Coating Application

Site painting and site repair to shop painting will be carried out by the Contractor and Contractor shall provide the following:

a) all paint needed for the following to work at Site:
   - Immersed steel, at welds - 3 coats of coal tar epoxy paint;
   - Non-immersed steel - final coat (after prime coat and intermediate at welds, if applicable);
   - Surfaces and other appurtenances not shop painted which are rendered inaccessible after completion of erection - intermediate and finish coat (before erection).

b) 25 litres of each type of paint used for shop painting for Site repair,

c) 25 litres of each type of paint provided for Site painting for the Owner's subsequent use.

1.1.24.6 Colours

KSEBL will specify the final paint colours to be provided by the Contractor for the various Work components after award of Contract.

1.1.25 Electrical Requirements

1.1.25.1 General

This section of the specification covers the general technical requirements of **Electrical systems** to be provided under the scope of this tender contract. The provision of specific and detailed technical requirements given in other sections of this tender document shall take precedence over these general specifications in case of contradictions between these general specifications and the specific and detailed specification of other sections.

Following shall be considered while planning the general arrangement / layout of the plants:

- All outdoor equipment / devices are to be weather protected.

- All outdoor electronic instruments / devices are to be mounted in a weather proof housing with glass visor.

1.1.25.2 General Design Requirements

1.1.25.2.1

All equipment shall be of approved and reliable design. The highest extent of uniformity and inter-changeability shall be realized. The design shall facilitate easy maintenance and repair of the components.

1.1.25.2.2

The equipment shall be pre-assembled to the highest possible extent in the manufacturer works, e.g. wiring of panels, desks, etc..., including installation of internal components.

1.1.25.2.3

The contractor shall assume full responsibility for a coordinated and adequate design of all equipment specified and shall ensure that such equipment conforms to the best engineering practice for the operating conditions specified. When requested by the Engineer-in-Charge, the Contractor shall furnish complete information as to the maximum stress and other criteria used in the design.

1.1.25.2.4

All equipment shall be tropicalized and suitable for the prevailing climatic conditions on site. Open air installed equipment, if required by the KSEBL shall be protected against sun radiation by means of adequate metal covers.

1.1.25.2.5

Unless otherwise specified, all the electrical equipment shall be designed for tropical conditions with minimum class - B insulation according to relevant standards, except for motors, which shall have class - F insulation with class - B temperature rise.

1.1.25.2.6

The equipment shall operate satisfactorily under load, voltage and frequency variations as well as under short circuit and transient conditions within specified ratings and guarantee limits.

1.1.25.2.7

All electrical connections and contacts shall be amply dimensioned to carry continuously the specified currents without undue heating and shall be secured by bolts or set screws of ample size, fitted with lock nuts or lock washers. Lock nuts shall be used on stud connections carrying current.

1.1.25.2.8

All metal jointing surfaces and all moving, rubbing or wearing surfaces shall be machined or ground.

1.1.25.2.9

Means shall be provided for the lubrication of all bearings and of any mechanism or moving part. The lubricating points shall be easily accessible and in a conspicuous position.

1.1.25.2.10

All apparatus shall be designed to obviate the risk of accidental short circuits due to animals, birds and vermin.

1.1.25.2.11

All live, moving and rotating parts shall be adequately secured in order to avoid danger to the operating staff. All electrical components shall be electrically earthed.

1.1.25.2.12

All apparatus shall be so designed that water / oil / dust cannot collect at any point.

1.1.25.2.13

All interior surfaces including contactor or relay coils shall be treated in an approved manner to prevent mould growth; such treatment shall in no way interfere with the satisfactory operation of the equipment, either electrically or mechanically.

1.1.25.2.14

Copper employed for current carrying parts in the Works shall be electrolytic copper having a purity of not less than 99.9% and conductivity as per the relevant standard.

1.1.25.2.15

Cast iron shall not be used for any part of the equipment liable to fracture due to stress or shock. All mechanisms subject to action of atmospheric agents shall be constructed of stainless steel, brass or gun metal to prevent sticking due to rust or corrosion.

1.1.25.2.16

Electrical Equipment shall be designed to prevent ingress of vermin, dust and dirt. Where wiring, piping or ductwork passes through openings in equipment housings, such openings shall be constructed to prevent ingress of vermin. Wiring and piping enclosures and ductwork shall also be vermin proof.

1.1.25.2.17

Thermostat-controlled anti-condensation heaters shall be fitted in generator housing, cubicles or panels containing control and / or relay equipment, whether or not they are ultimately to be in an air-conditioned zone. They shall also be installed in all outdoor junction boxes. The heaters shall be suitable for 230 V AC, 50 Hz operation with sufficient capacity to raise the internal ambient temperature by 5ºC. The design shall be such that when the equipment is in service with the heaters energized, the maximum permitted rise in temperature for the equipment shall not be exceeded.

1.1.25.2.18

The construction of panels and the location of heaters shall be such that an effective circulation of air is ensured. Equipment shall be provided with suitable drainage for condensation and shall be designed to be free from pockets where moisture can collect. Cable entries shall be sealed type.

1.1.25.2.19

All outdoor equipment whose performance is affected by the atmospheric temperature such as motors, compressors, etc... shall be weatherproof and protected by a sun canopy.

1.1.25.2.20

Separate trenches for power and control cables shall be provided as far as possible.

- Optimum routing and arrangement of all the cables shall be done.
- No cables shall be buried under foundations.

1.1.25.2.21

Regular cleaning of the panels as per the instruction of KSEBL's engineer till handing over of the set to customer is to be carried out by the contractor free of cost.

1.1.25.2.22

Suitable lifting eyes and forcing off bolts shall be provided where required or where they will be useful for erection and dismantling.

1.1.25.3 Clearances

The layout of the Equipment on the site shall provide for ready access for operation and maintenance whilst the remaining sections of Equipment are alive. Working clearance provided between isolated Equipment and nearest live metal work shall be as per Indian Electricity Rules and Relevant Standards.

1.1.25.4 Power Supplies (Low Voltage)

1.1.25.4.1

Equipment and devices requiring electric power shall conform with the following power supply parameters:

(1) 415V, 3-phase 50Hz, 4-wire for power

(2) 240V, single phase, 50 Hz for lighting, indication, and anti-condensation heaters and Alarm.

(3) 110V D.C. for essential indication, controls, protection, alarms, closing and tripping supplies etc...

(4) 48V DC for Communication etc...

1.1.25.4.2

The Contractor shall clearly indicate voltage, current and power requirements for each item of equipment.

1.1.25.4.3

Unless otherwise specified in this Specification or any appropriate Standard Specification, all electrical equipment shall be suitable for reliable operation at frequencies and voltages over the following ranges.

1.1.25.4.4

Voltage variations:

AC - 90% to 110% of nominal

DC - 75% to 120% of nominal

1.1.25.4.5

Frequency variations are between 47.5 Hz and 51 Hz.

1.1.25.4.6

Equipment furnished shall withstand the voltages and frequencies unbalanced continuously without damage, overheating, undue vibration or degradation beyond that expected for normal balanced three phase operation.

1.1.25.4.7

The single line diagram of the auxiliary system is indicated on the main single line diagram included in the tender drawings. The Contractor shall supply and connect all Control, Protection, Annunciation, signalling and power supply cabling required between various equipment and the low voltage AC and DC distribution panels and MCC's supplied under this Contract.

1.1.25.4.8

Double-pole switches shall be used to break single-phase A.C. mains supplies.

1.1.25.4.9

Following practices shall be adopted for DC supply:

- 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.

1.1.25.5 Current Ratings

The current ratings of the electrical equipment / devices shall be in accordance with relevant standard unless otherwise approved. The current ratings, if specified, are the

continuous current ratings required at the site under specified maximum operating temperature conditions.

Every current carrying part of the equipment shall be capable of carrying its site rated current continuously, without assistance from any forced cooled ventilation or air conditioning plant, under the site conditions as specified, and in no condition shall the permitted temperature rise be exceeded.

1.1.25.6 Electrical Equipment Protection Classification

All electrical equipment enclosures shall comply with the relevant Standard.

If not specified otherwise in the relevant specification the electrical equipment enclosures shall be designed to meet the following protection degrees.

A) Electrical Rotating Equipment

- Indoors located in ventilated areas - IP44
- Outdoors located - IP54
- Indoor / Outdoor located but in areas Where water spray / splashing is possible - IP65

B) **Electrical (non-rotating) equipment** (Switch gears, panels, lights etc.)

- Indoors located in the A/C or Ventilated areas - IP32
- Indoor located in non-ventilated areas - IP52
- Indoor / Outdoor located where heavy condensation is possible - IP54 with measures as per IEC 60528
- Indoor / Outdoor located but in areas where water spray / splash is possible - IP65

All luminaries installed in the areas where operation conditions and surroundings can lead to accumulation of gases, vapours or danger of explosion shall be of explosion proof. All luminaries installed in the enclosures where operation conditions may lead to high temperature surroundings shall be designed to withstand such temperatures.

1.1.25.7 Protection against Live Contacts

All live parts of the electrical equipment, which could be reached by hand, shall be

protected against direct contact by means of insulation or by special design and construction such as shields, shrouds, etc... Measures may be taken to prevent the occurrence or persistence of excessively high potentials on conductive parts of electrical equipment induced by faults in insulation.

Protection against direct contact must be ensured by suitable method when the switch-gears or control panels have been opened up for operation or maintenance. Suitable grounding equipment shall be provided for the discharge of high potential attained when the protective devices are withdrawn. Suitable protective grounding grid of copper shall be provided as a protection for conductive parts.

1.1.25.8 Electric Motors

1.1.25.8.1

The Contractor shall be fully responsible for determining that the motor duty cycle, rating, performance, tests and mechanical arrangements are all entirely relevant and suitable for compliance with all standards for the application in the power station and environmental and site conditions specified.

1.1.25.8.2

All the equipment driven by the electric motors shall give their rated performance even at a power supply frequency of 47.5 Hz.

1.1.25.8.3

The preferred type of AC motor is squirrel cage, totally enclosed, fan cooled, 1.0 service factor or single-phase motor under 0.5 HP where Contractor's standard type are acceptable subject to approval. Motors above 0.5 HP shall be 3 phase, if AC supplied. Motors shall be sized so that calculated horsepower requirements do not exceed 85% of nameplate ratings. 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.

1.1.25.8.4

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.

1.1.25.8.5

The stator insulation shall be Class F or a higher class, but in each case temperature rises shall be limited to Class B where practicable on full continuous rated load. It shall be suitable for operation in damp locations and for fluctuations in temperature.

1.1.25.8.6

All motors shall be of the totally enclosed fan-cooled type, protection class IP54 according to IEC Recommendation 144. Cable termination points shall be of class IP55. They shall have a closed internal cooling air circuit re-cooled by an external cooling air circuit drawn from the opposite side of the driving end.

1.1.25.8.7

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

1.1.25.8.8

Ball or roller bearings, lubricated for life, shall be used, and the ball or roller-locating cage shall not be in contact with the races. Lubrication devices shall be provided for the bearings. 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 shaft motors shall have approved thrust bearings.

1.1.25.8.9

The terminal box shall be weatherproof and firmly fixed to the motor frame. The terminal studs shall be sized to be adequate for the current duty required and marked in accordance with applicable Standards. Terminal boxes shall have approved cable adapter plates, sealing chambers or conduit entries. 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, this shall be

clearly indicated

1.1.25.8.10

The arrangement of the terminal box shall be such as to facilitate installation of cables, and allow interchanging of any two phase leads, without disturbing the sealing compound, if this is used at cable terminations.

1.1.25.8.11

Where practicable, the motor end cover remote from the driving end shall have a removable plug to allow the speed to be checked by means of a portable tachometer.

1.1.25.8.12

All motors supplied under this Contract shall be finished with its combination of magnetic starting contactors with disconnect switches and thermal overload devices which shall be mounted on or adjacent to pumping unit.

1.1.25.8.13

A permanently attached connection diagram shall be mounted inside the terminal box cover.

1.1.25.8.14

Motors having a mass of 10 kg or more shall be fitted with appropriate lifting lugs.

1.1.25.8.15

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.

1.1.25.8.16

All precautions shall be taken to avoid any type of corrosion.

1.1.25.9 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.

1.1.25.10 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

1.1.25.11 Starters and Contactors

1.1.25.11.1

Motor starters shall be equipped with short circuit protection and local disconnecting devices. Preferably all starters shall be of one manufacturer. The control circuit voltage shall be obtained from a 415 / 230 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.

1.1.25.11.2

Starters and contactors shall be suitable for direct on-line starting up to 50 kW, uninterrupted electrical duty and above 50 kW Star Delta starter shall be provided. They shall be installed in ventilated enclosures for indoor installation and weatherproof enclosures for outdoor installation unless otherwise approved by the KSEBL. 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.

1.1.25.11.3

Starters and contactors shall be capable of satisfactory operation, without injury, for a period of 5 minutes at a voltage 25% below nominal, at nominal frequency.

1.1.25.11.4

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

1.1.25.12 Moulded Case / Miniature Circuit Breakers

Moulded / Miniature circuit breakers shall be used instead of fuses and shall provide better protection and control under emergency and short circuit conditions.

Moulded case circuit breakers shall be of two or three pole 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.

Miniature circuit breakers shall have suitable fault rating and shall comply with the requirements of IEC or equivalent standard and shall be of the high impedance design contained in an enclosure of high impact insulating material with ventilated deionising arc chutes. The circuit breaker shall be equipped with thermal and magnetic overload trips, shall have a trip free mechanism and have a tripping characteristic of 0.01 seconds at 7 times full load current.

Miniature circuit breakers shall be rated for the ambient temperatures prevailing at site and shall have the trip devices correctly calibrated, both according to the manufacturer's instructions. The selection and grading of the MCB's shall be as approved.

They shall be clearly labelled, both on the panels and the associated wiring diagrams.
MCB's shall be connected to enable all or any of the control circuits to be isolated for maintenance purposes. For DC circuits, isolation shall be provided on both poles. All MCB's shall be provided with required no of Auxiliary switches / Alarm contacts for MCB tripped indication.

1.1.25.13 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. Contacts shall have a minimum rating of 10A over a range of 6 to 600V.

Relays shall be of approved type complying with relevant specifications and shall have approved characteristics and be flush mounted in dust proof cases. Relay cases shall generally be finished in bright black enamel. Classification shall comply with appropriate standard.

Relays contacts shall be suitable for making and breaking the maximum current they are required to control. Separate contacts shall be provided for alarm and trip functions.

Each relay shall be provided with at least two spare normally open and one spare normally closed contact.

Relays where appropriate, shall be provided with flag indicators of approved type phase coloured where applicable. Flag indicators shall be of the hand-reset pattern and shall be capable of being reset without opening the case. Where two or more phase elements are included in one case, separate indicators shall be provided for each element. Relays of the hand reset type shall be capable of being reset without opening the case.

Where adjustments of settings are required, the design of the relays shall be such that the adjustment can be carried out during operation without taking the relays out of service.

Approved Test Plugs shall be provided on the relay panels for the testing of protective relays and associated circuits.

To minimize the effect of electrolysis, relay coils operating on DC shall be so connected that the cells are not continuously energized from the positive pole of the battery.

Relays shall be provided with clearly inscribed labels at the front describing their application, rating and wiring diagram, in addition to the general information.

Protective relays shall be rated to match the designed system fault ratings and comply with classification type C to IEC 60292, where applicable.

Trip relay, where specified shall be of the high speed mechanically latching type with electrical resetting facilities and a common trip relay resetting push button, as required.

Under voltage protection relays should be of self-resetting type unless otherwise required. Relays shall be thermally matched such that the operating time do not exceed the thermal withstand time of the relay.

1.1.25.14 Control Switches and Push Buttons

Control switches for electrically operated Circuit breakers shall be of pistol grip type arranged to operate clockwise when closing the circuit breaker and anti clockwise when opening them. They shall be designed to prevent accidental operation and interlocked to prevent two successive operations in the `Close' direction. All control switches and push buttons shall be in accordance with relevant IS or equivalent standard.

Switches for the other apparatus shall be operated by shrouded push buttons or to have handles of the Spade / Oval type, the pistol grip type being reserved for circuit breaker operation only. Control, reversing selector and test switches shall be mounted, constructed and wired so as to facilitate the maintenance of contacts without the necessity for

disconnecting wiring.

Control switches for circuit breakers and for motor operated setting devices, e.g. governor control, field rheostat control, etc...,shall be non-locking type with spring return to the `neutral' position. Such switches shall be controlled by independent springs; the use of contact springs alone for restoring not being acceptable. Switches for special applications like Synchronising Selector shall be Keyed one (Lockable type) as required by the application philosophy.

All push buttons shall be of the non-retaining type made of non-hygroscopic material, non-swelling and fitted to avoid any possibility of sticking. All push buttons provided for remote stopping of motor control gear and all emergency stop push buttons shall be of the **`hold-in' / Stay-put** type requiring to be reset by being pulled out, or by a separate release device, which may be, associated `Start' push button. The Emergency Push buttons shall be red coloured and provided with a cover, preferably in Red Colour. The contacts of all switches and push buttons shall be strong and to have a positive wiping action when operated.

All control switches shall be provided with labels complying with the specification in addition to clear indication as to the direction of each operation, for example, `Open', `Close', `Raise', `Lower', etc...

1.1.25.15 Pilot Devices

1.1.25.15.1

Pilot devices such as selector switches, push-button stations and thermostats shall be of heavy-duty type, and where mounted outdoors they shall be housed in weatherproof enclosures specially designed for the environment.

1.1.25.15.2

Electrical contacts for control, alarm and shut-down shall have a capacity of not less than 5 A at 110 V DC.

1.1.25.16 Anti-condensation Heaters

Any major items of electrical equipment which are liable to suffer from internal condensation due to atmospheric or load variations shall be fitted with heating devices suitable for electrical operation at 230 volt AC 50 Hz single phase of sufficient capacity to raise internal ambient temperature by 5^{o} C.

Heaters in rotating electrical machines shall be switched on automatically by opening of the starter or breaker or vice versa. Heaters in switchgear / MCC cubicles, control cubicles, panels, desks etc... shall be controlled automatically by adjustable thermostat. The heaters shall be covered by metallic mesh to avoid accidental contacts and heater terminals shall be adequately shrouded. Each heater shall have built in over temperature protection.

The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the apparatus is in operation.

1.1.25.17 Plugs and Sockets

Plugs and sockets shall meet relevant Indian Standards.

1.1.25.18 Indicating Lamps and Fittings

The Indicating lamps shall be of LED type. Indicating lamps fitted to the faces of switch and instrument cubicles or panels shall be adequately ventilated. Lamps (**bunched LED type**) shall be easily removed and replaced from the front of the panel by manual means not requiring the use of extractors. The material holding the lamp glass shall be of an approved finish and to be easily removable from the body of the fitting so as to permit access to the lamp and lamp glass.

The lamps shall be clear and are to fit into an accepted standard form of lamp holder. The rated lamp voltage should be 10% in excess of the auxiliary supply voltage, whether AC or DC. Alternatively, if approved, low voltage lamps with series resistors could be provided, if proved to be of long life.

The lamps glasses shall be translucent and in standard colours, red, green, blue, white and amber and shall comply with relevant IS / IEC or equivalent standard. The colour shall be in the glass and not an applied coating and the different coloured glasses shall be interchangeable.

Transparent synthetic materials may be used instead of glass.

Unless otherwise specified all lamp colours shall conform to the following practice

Red	Energized or operative position.
Green	De energized or inoperative position.
Amber	Fault or abnormal condition.
White	Healthy or normal condition.

Blue Control Supply monitoring / Signal used with label.

1.1.25.19 Auxiliary Switches

Where appropriate, each item of plant shall be fitted with all necessary auxiliary switches, contactors and mechanisms for indication, protection, metering, control, and interlocking supervisory and other service. Auxiliary switches shall conform to relevant Standard.

All auxiliary switches, whether they are in use or not in the first instance, shall be wired up to a terminal board on the fixed portion of the plant and shall be arranged in the same sequence on similar equipment.

Auxiliary switches mechanically operated by the circuit breakers, contactors, isolators, etc... shall be to the approval and contacts mounted in accessible positions clear of the operating mechanism of the circuit breaker, contactor, isolator, etc..., and they shall be adequately protected against accidental electric shock.

Auxiliary switches shall be provided to interrupt the supply of current to the trip coil of each circuit breaker and contactor immediately after the breaker or contactor has opened. These auxiliary switches shall make before the main contacts, during a closing operation.

The contactors or all auxiliary switches shall be robust and shall have positive wiping action when closing. Provision shall be made for extension of the switches and terminal boards when needed.

A minimum of four spare auxiliary switches, two normally open, two normally closed shall be provided for each circuit breaker, Isolator and contactor for KSEBL's use.

1.1.25.20 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.

1.1.25.20.1 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 Pt100.

The use of dial-type contact thermometers shall be restricted to bearing metal and oil temperature measuring.

1.1.25.20.2 Pressure Measurement

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 1.5 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.

1.1.25.20.3 Level Measurement

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.

1.1.25.20.4 Electrical Measurement

All Electrical instruments shall be of flush mounted design, dust and moisture-proof.

Indicating instruments shall be flush mounted and shall comply with the latest standards applicable. All indicating meters shall be Digital Multi-function Meters (DMM) of Class 0.2S capable of displaying various parameters like voltage, current, MW, MVAR, MWh, MVARh, power factor, frequency etc... The Digital Multi-function Meters shall be provided in

duplicate. The LED digits shall be of sufficient size so as to have easy readability from the operator work table. The Digital Multi-function Meters shall have communication facility as per latest protocols which shall be finalised during detailed engineering in consultation with KSEBL.

Energy meters shall be suitable for unbalanced systems and accuracy of energy meters should be of 0.2S 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 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.

1.1.25.20.5 Position Measurement

Position transmitters for continuous position indication and measuring transducers shall have an output current of 4-20 mA and auxiliary supply voltage (if required) 48 V D.C.

1.1.25.20.6 Limit Switches

Limit switches shall be mounted suitable for easy adjustment and for rigidly locking in position after being adjusted. They shall be of heavy-duty rating and have two change-over contacts suitable for 48V D.C. Operation.

Switch fixings shall be positive and shall be unaffected by vibration. At the same time they should be capable of easy adjustment to suit changing parameters of the associated plant.

Particular attention shall be paid to potentially harmful environmental conditions, including water, oil, dust, dirt, temperature variations and differential expansions.

1.1.25.20.7 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.

1.1.25.21 Distribution Boards and Isolators

1.1.25.21.1

Distribution boards shall be provided throughout the plant for local distribution of lighting,

small power and welding supplies. The welding supply boards shall be completely separate, but the lighting and small power circuits may use a common distribution board.

1.1.25.21.2

Distribution boards shall be of 440V AC, 110V DC rating and conform to relevant standard and shall have an insulation withstand level 1 kV, AC, 1-2 kV DC respectively. All distribution boards shall be of the approved weatherproof enclosure type as specified elsewhere in the specification and shall be arranged so that the door or cover can be locked in the closed position.

1.1.25.21.3

Distribution boards shall be capable of with-standing without injury the mechanical and electrical stresses set up by fault currents for twice the period required to disconnect such fault on any circuit.

1.1.25.21.4

Distribution boards shall be provided with removable top and / or bottom knockout type gland plates for the outgoing cables corresponding to the circuit capacity of the distribution board. A suitable brass, grounding stud running throughout the length of distribution board shall be provided at top and / or bottom as required.

1.1.25.21.5

Indoor distribution boards shall be of sheet steel of 2 mm thickness with either a galvanized or enamelled finish. The finish colour of all indoor distribution boards shall be chosen to match the adjacent switchboards.

1.1.25.21.6

Outdoor distribution boards shall be of sheet steel with galvanized finish. The boards will be painted and the finish colour shall be to the approval of the KSEBL.

1.1.25.21.7

Neutral bars shall be drilled for an appropriate number of ways relative to the size of the board.

1.1.25.21.8

Barriers or fireproof insulation material shall protect the metal surface adjacent to any live

part and all spaces between phases.

1.1.25.21.9

Switch fuse units or isolators connected on the incoming side of distribution board shall be mechanically attached to the board with solid copper electrical connections between the units. A suitable insulated barrier shall be supplied to prevent copper or carbon dust released under fault conditions passing from one unit to the other.

1.1.25.21.10

The current rating of the bus bars in each distribution board shall not be less than the sum of maximum current rating of all outgoing circuits. The neutral connection for each circuit is to be direct to the neutral bus bar.

1.1.25.21.11

The distribution boards shall be either single pole or triple pole and neutral types and shall be equipped with means to provide over current protection to each circuit. This protection may comprise a miniature circuit breaker, which shall be removable without exposing live connections.

1.1.25.21.12

The cables feeding the distribution boards shall be connected directly to the incoming isolator or neutral bar as appropriate unless otherwise indicated by the specification.

1.1.25.21.13

Cabling to distribution boards shall generally be bottom entry. However, for indoor boards top entry may be permitted subject to the approval of the KSEBL. Cables entry to distribution boards shall be through cable glands and completely sealed after cable entry.

1.1.25.21.14

In cable compartments all live parts shall be covered after cable connection. Distribution board compartments shall be segregated from each other. Each bus section shall have coloured signalling lamps one for each of the control supplies (AC or DC) separately to indicate that these supplies are healthy.

1.1.25.21.15

Distribution boards for use on DC system shall be double pole types equipped with

adequately rated MCB's.

1.1.25.21.16

Approved type labels shall be fitted externally on the front cover of each distribution board describing its function with a suitable designation for easy identification of the equipment.

1.1.25.22 Terminal Blocks

1.1.25.22.1

Terminal blocks shall be mounted in an accessible position with the spacing between adjacent blocks not less than 200 mm and the space between the bottom blocks and the cable gland plate not less than 250 mm. Sufficient terminals shall be provided to allow for the connection of all incoming and outgoing cables including spare conductors and drain wires. In enclosed cubicles, the terminal blocks shall be inclined towards the door for facilitating terminations. All terminations of the Field cables or inter-equipment cables shall be terminated in the terminal block on the side facing the door for easy access. Terminal Blocks shall be logically grouped, indelibly marked and provided with removable plastic shrouds.

1.1.25.22.2

The 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. Terminals for Current circuits shall be Stud Type with nuts, washers and lock nuts or lock washers.

1.1.25.22.3

The terminal blocks shall be provided with shorting links and paralleling links where applicable, and mounted identification numbers and / or letters.

1.1.25.22.4

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

1.1.25.22.5

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

1.1.25.22.6

415 / 240 V AC circuit terminals shall be segregated from other terminals and shall be fitted with non-inflammable transparent plastic covers to prevent contact with any live parts. Warning labels with red lettering shall be mounted thereon in a conspicuous position. Segregation of different Voltage levels within the terminal blocks shall be achieved using barriers. Voltage levels shall be clearly identified by labels. Terminal Blocks associated with external sources of supply shall be fully shrouded and fitted with a danger-warning label. All connections shall be made at the front of the terminal board and no live metal shall be exposed at the back.

1.1.25.22.7

20% of all types of terminals shall be supplied as spare.

1.1.25.23 Panel Wiring

1.1.25.23.1

Wire colours shall comply with relevant standard, viz.:

- Colour of Wire Circuit Particulars
- Red -Red phase connections in current and voltage transformer circuits only.
- Yellow -Yellow phase connections in current and voltage transformer circuits only.
- Blue -Blue phase connections in current and voltage transformer circuits only.
- Green / Yellow connections to earth.
- Black AC neutral connections, earthed or unearthed, connected to the secondary circuit of current and voltage transformers. AC connections other than those above and connections in AC / DC circuits.
- Grey Connections in DC circuits.

Wiring diagrams must indicate wire colours. For back-wired panels all diagrams shall be drawn as viewed from the back of panel. For front wired panels all diagrams shall be drawn as viewed from the front.

1.1.25.23.2

All wires shall be fitted with numbered ferrules of approved type at each termination, double ferrules shall be provided wherever applicable.

1.1.25.23.3

All panel wiring shall be neatly fixed on the sides of the cubicles and shall be carried out with 650 / 1100 V grade stranded tinned copper wire, PVC insulated, fire proof and suitably

lugged. Unless otherwise approved, no insulated wire shall have less than three strands and each strand shall not be less than 0.91 mm in diameter. If single conductor is approved for instrument wiring, annealed copper of circular cross section shall be used and the diameter of the copper shall not be less than 2 mm. **All instrumentation wiring shall be of screened cables.**

1.1.25.23.4

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.

1.1.25.23.5

All panel wiring shall be taken to approved terminal boards. The relay and control cubicles shall be supplied complete with necessary terminal glands and end boxes for terminating the multi-core cables.

1.1.25.23.6

Electrical wiring and instruments shall be so located that leakage of oil or water cannot affect them.

1.1.25.23.7

Bus wiring between control panels etc...,shall be provided under this contract and shall be fully insulated and to be completely segregated from the main panel wiring.

1.1.25.23.8

All metallic cases of instruments, control switches relays etc...,mounted on control panels or in cubicles, steel or otherwise, shall be connected by means of bare copper conductors of not less than 4.5 mm^2 section to the nearest earth bar.

1.1.25.24 Small Wiring

1.1.25.24.1

All control panel wiring, secondary control wiring in circuit breakers, motor starters, control gear, etc...,shall be carried out in a neat and systematic manner with cables supported clear of the panels and other surfaces at all points to obtain free circulation of air.

In all cases, the sequence of the wiring terminals shall be such that the junction between multi core cables and the terminals are effected without crossover. Insulating bushes shall be provided where necessary to prevent the chafing of wiring.

1.1.25.24.2

All panel wiring shall conform to the requirements of relevant standards.

1.1.25.24.3

Except for rack-mounted equipment, each panel conductor shall be individually identified at both ends through a system providing ready and permanent identification, utilizing slip-on ferrules approved by the KSEBL. Paper ferrules are not acceptable.

1.1.25.24.4

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

1.1.25.24.5

All wires directly connected to Trip circuits / Tripping switches etc.. shall employ markers having a red background and with the label “TRIP”, engraved on it in white.

1.1.25.24.6

Sensitive control circuits shall be effectively shielded against extraneous signals and interference.

1.1.25.24.7

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 and shall not be jointed between terminal points.

1.1.25.24.8

Splices or tee connections are not acceptable. Wire runs shall be neatly arranged inside the panels and adequately supported by either clamping of loomed runs or in PVC wiring troughs. Trunking fill shall not exceed 75% of its capacity. Self-adhesive fixings are not acceptable. The self-supporting arrangement for wiring, if used, shall be such that they are not liable to cause permanent physical damage to the conductor or insulation. Whenever possible, unused areas of the panels shall be kept free of wiring to facilitate the installation of future equipment. With the exception of wiring direct to specific equipment, all wiring shall be located on side of the panels.

1.1.25.24.9

All wires shall be terminated with approved pin crimped terminations.

1.1.25.24.10

CT secondary shall be earthed at one point through a removable link. Each of the CT circuit shall be in separate cables.

1.1.25.25 Bus bars, Bus ducts and Connections

1.1.25.25.1 Bus bars

Bus bars, bus ducts and connections shall comply with relevant IEC or equivalent standards and shall be electrolytic copper, unless otherwise approved by the KSEBL.

The bus bars, assemblies and connections of equipment for service up to 11KV shall be of a type, which does not rely solely on air for insulation purposes. The covering material shall be non-deteriorating at the rated short - time maximum temperature of the bus-bars and shall have such thickness as is required to withstand rated line to line voltage between bus-bar and a conducting object on the exterior of the covering material for a period of not less than 60 seconds.

The bus-bars and bus ducts shall be capable of carrying the full rated current continuously without exceeding the maximum temperature specified in the relevant standard, under site ambient conditions.

The bus-bars and their connections, and insulation materials as appropriate shall be capable of withstanding, without damage, the thermal and mechanical effects of a through fault current equivalent to the short -time rating of the switchgear.

Facilities to the approval of the KSEBL's Engineer shall be provided to accommodate thermal expansion of the bus bars and associated components including the insulating medium if appropriate.

Bus bars shall be contained in a separate completely enclosed compartment within the general casing of switchgear. Bus-bar barriers shall be provided between switchgear equipment to prevent the spreading of ionised gases in the event of a fault. Main and auxiliary bus bars shall be covered with insulating sleeves to safely prevent internal bus bar faults and spreading of arcs. All bus-bar connections and joints shall be silver-plated.

The fixed plug-in contacts of bus bars shall be protected by automatically closing shutters if the corresponding switchgear is removed.

Access to bus bars and the connections directly connected thereto shall be gained only by the removal of covers secured by bolts or screws. Such covers shall be clearly and indelibly marked "BUS-BARS".

Bus bars shall be extensible at both ends; such extension shall entail the minimum disturbance to bus bar compartments.

Bus bars shall be of uniform cross-sectional area throughout the length of a switchboard and shall not be of a varying (tapered) section.

1.1.25.25.2 Bus ducts

Bus ducting, where it passes through walls, shall have provision for weather sealing.

Where bus ducting is located outdoors it shall be weather and dust protected to IP55.

Each bus ducting shall be equipped with a Silica Gel breather.

The Contractor is required to confirm in his tender whether or not any bus ducts included, require sun-shade due to the ambient conditions and must demonstrate that such sun - shades, where provided, are adequately supported.

Where the bus duct interconnects the transformer at one end and to the switchgear at the other end, flexible copper braids shall make such connections.

Where necessary, expansion joints shall be provided in the run of the bus ducting.

Drawing must be submitted with the tender showing the run of bus ducting, the details of the connections to the transformer, the switchgear and expansion joints.

1.1.25.25.3 Conduits

Conduit, accessories and trunking installation shall comply with the latest issue of the standards.

Exposed conduits shall be of galvanized rigid steel, and shall run parallel to the structural lines. Suitable conduit fittings and covers shall be used. Standard circular boxes or machined face heavy-duty steel adaptable boxes with machined heavy type lids shall be used throughout. For outdoor mounting all boxes shall be galvanized, weatherproof and fitted with external fixing lugs. The conduit shall be fastened using malleable iron pipe straps at spacing not greater than 500 mm. Minimum conduit size shall be 20 mm.

Supports for conduit, cables and fittings supplied under this Contract shall be removable and clamped to the building structure, wherever possible, in preference to being directly connected by bolting, screwing, welding, etc... Cable trays in the powerhouse substructure

shall be fastened to steel inserts cast into the concrete. Conduits shall be supported on heavy galvanized spacer saddles so as to stand off at least 6mm from the fixing surface.

Bends in conduit shall be made cold and the radius of bends shall not be less than nine times the conduit diameter. No bend shall be permitted to flatten the conduit. The use of running threads, solid elbows and solid tees will not be permitted.

Wherever the conduit crosses a structural expansion / contraction joint, approved expansion fittings and couplings with bonding jumpers shall be provided. Flexible metallic conduit shall be used where relative movement is required between the conduit and connected apparatus, and a separate copper connection provided to maintain earth continuity.

Where conduit is terminated so that the bare end of the conduit is exposed the conduit end shall be fitted with a brass bush. Conduit ends shall be carefully reamed to remove burrs. Draw-in boxes shall be provided at intervals not exceeding 10m in straight-through runs.

Conduit runs shall be in either the vertical or horizontal direction unless otherwise approved and shall be arranged to minimize accumulation of moisture. Provision for drainage shall be made at the lowest points of each run.

All conduits run in any circuit are to be completed before any cables are pulled in. The maximum number of cables in any conduit shall be in accordance with the latest issue of the Regulations for the Electrical Equipment of the Buildings.

1.1.25.26 Cubicles, Desks and Control Panels

1.1.25.26.1

Unless otherwise specified, panels, desks and cubicles, shall be of floor mounted and free standing construction and be in accordance with the specified enclosure classification. All control and instrumentation panels in any one location shall be identical in appearance and construction. Cubicle 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.

1.1.25.26.2

Cubicles shall be fitted with close fitting, gasketted, hinged lift-off doors capable of being opened through 180 degrees. The doors shall be provided with integral lock and master key. Door sealing materials shall be provided suitable for the specified site conditions. Cubicles and cubicle doors shall be rigidly constructed such that, for example, door

mounted emergency trip contacts can be set so that mal-operation will not be possible due to any vibrations or impacts as may reasonably be expected under normal working conditions.

1.1.25.26.3

Cubicles and panels shall be provided with removable Steel gland plates located to provide adequate working clearance for the termination of cables (at least 250mm from the floor of the cubicle). Under no circumstances shall the floor or roof plate be used as a gland plate. The cables and wiring shall enter from bottom or top as approved or directed by the KSEBL.

1.1.25.26.4

The cubicles and panels shall be adequately ventilated, if required, by screened vents or louvers, which shall be so placed as not to detract from the appearance. All Panels, desks and cubicles shall be vermin proof. All cable entries to equipment shall be sealed against vermin as soon as possible after installation and connecting-up of the cables to the approval of the KSEBL. All cubicles, desks and panels shall be provided with a natural air circulation ventilation system. All control equipment shall be designed to operate without forced ventilation. Dust protection where appropriate shall be provided.

1.1.25.26.5

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. For a set of panels, inter-panel bus wiring shall be routed through apertures in the sides of panels and not via external multi-core cabling looped between the panels.

1.1.25.26.6

Unless stated otherwise, cubicles and panels, whether individually mounted or forming part of a set, shall be provided with a internal ground bus with 40 mm x 5 mm copper bar extending throughout the length on to which all panel earth connection shall be made. Each end of this bus shall be drilled and provided with suitable studs or holes to the approval of KSEBL, for connecting to the main station grounding system, using cables ranging from 70 to 100 sq. mm and for possible future extension.

Earth connection between adjacent panels shall be achieved by extending the bar through the panel side and not by interconnecting external cabling.

1.1.25.26.7

The standard phase arrangement when facing the front of the motor control centres and switchboards shall be RYB from left to right, from top to bottom and front to back. All instruments, devices, buses and other equipment involving three phase circuits shall be arranged and connected in accordance with the standard phase arrangement, where possible. Electrical clearances shall conform to applicable standards and shall not require the cutting away of adjacent framework.

1.1.25.26.8

Instruments, control buttons 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.

1.1.25.26.9

Cubicles and panels shall be securely fastened down to the floor and braced against lateral movement induced by earthquake forces. Panels shall be mounted on an approved form of anti-vibration mounting whenever necessary.

1.1.25.26.10

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 Contractor.

1.1.25.26.11

Control panels and cubicles shall be supplied with door operated interior lights, socket outlets and jacks with provision for connection to the station telephone system and is clearly labelled with the Circuit Name at front and rear, with an additional label inside the panel.

1.1.25.26.12

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 KSEBL. The interior of all cubicles and panels shall have a mat white finish unless specified otherwise. Overall height, excluding cable boxes, shall not exceed 2.5m. Operating handles and locking devices shall be located within the operating limits of 0.75m and 1.8m above floor level. The location for indicating instruments and meters shall be 1.5m above floor level, unless otherwise

specified elsewhere in the specification.

1.1.25.26.13

Panels shall be suitably designed to permit future extension wherever appropriate or specified.

1.1.25.26.14

Panel sections accommodating equipment at voltages higher than 110V shall be partitioned off and the voltage clearly labelled. Labels permanently attached to the panel and adjacent to the equipment concerned shall identify each relay and electronic card within panels. Where instruments are terminated in a plug and socket type connection both the plug and the socket shall have permanently attached identifying labels.

1.1.25.26.15

Instrument and control devices shall be easily accessible and capable of being removed from the panels for maintenance purposes. Termination, wiring and cabling shall be in accordance with relevant clauses of the specification.

1.1.25.27 Junction and Marshalling Boxes

1.1.25.27.1

Junction and marshalling boxes shall be of substantial sheet steel construction, having enclosure classification as specified and fitted with external fixing lugs and finished painting as specified. The boxes shall allow ample room for wiring, with particular regard to the routing of wires from the point of entry. Outdoor boxes shall be weather proof and shall have anti condensation finish and all boxes shall be designed such that any condensed water cannot affect the insulation of the terminal boards or cables. No cables shall be terminated into the top of outdoor boxes unless specifically approved by the KSEBL.

1.1.25.27.2

Each box shall be complete with suitably inscribed identification labels.

1.1.25.27.3

All necessary gland plates are to be provided. Every unused outlet shall be sealed. Unused screwed entries shall be sealed by means of a tamper proof screwed plug.

1.1.25.27.4

All box covers are to be arranged for padlocking and padlocks with keys shall be supplied.

1.1.25.27.5

All boxes shall be provided with adequate grounding bars and terminals.

1.1.25.28 Interconnections / Contact Terminal Points

1.1.25.28.1

The Contractor shall supply and supervise the installation of all interconnecting wiring between various items of the Work, except where otherwise specified. The Contractor shall be responsible for making all terminal connections where equipment supplied under this Contract connects with equipment existing or provided under other Contracts and the Contract includes waiting upon other contractors as may be necessary. The contract includes the termination and connection of all cables, which are supplied under this Contract.

1.1.25.28.2

Unless otherwise specified, all cables for external connections will be supplied and installed complete with cable glands by the Contractor. The Contractor shall ensure the correct functioning of related equipment and instrumentation.

1.1.25.29 Equipment Grounding

1.1.25.29.1

All equipment including pipe work, structural work, and non current carrying metalwork supplied under this Contract in or on which is fitted any type of electrical equipment, shall be provided with two separate grounding terminals, suitable for connection by means of copper strip or stranded copper strip or stranded copper conductor to the station grounding system. The Contractor shall supervise connection of the earthing conductors to these terminals as approved or directed by the KSEBL.

If required a suitable earth grid of copper strip shall be provided around the plant for terminating the equipment and works. The provisions for grounding are to be such that no reliance is to be placed on the conductivity of metal-to-metal joints without the use of special connectors.

VT and CT neutral or common lead shall be earthed at one place at the terminal blocks

where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.

1.1.25.29.2

Unless specified otherwise, earthing conductors from the station earthing bus to the equipment should be provided by the Contractor.

1.1.25.30 Alarm Contacts

1.1.25.30.1

All alarm contacts shall be of galvanically isolated Form C type.

1.1.25.30.2

Where required, relays should be provided as contact multipliers.

1.1.25.31 Electronic Equipment

All components and assemblies shall meet the requirements of the appropriate sections of the IS standards or equivalent and in particular those sections which refer to equipment stored and operated in a tropical environment.

1.1.25.31.1 Electronic Equipment Grounding

Electronic equipment shall be provided by specially insulated grounding bus-bar connected to a single point of the main grounding grid by two parallel conductors so that no fault current or circulating current will flow in electronic grounding system. All electronic equipment and panels shall be grounded through the electronic bus bar provided.

1.1.26 Rating Plates, Name Plates, Labels & Signs

The size of Rating / nameplates & labels and the height of lettering shall be suitable for the equipment, and is subject to the approval of the KSEBL.

Suitable metallic warning signs and labels shall be provided for the plant items where danger or possibility of danger exists or there is prohibition of certain action. Such warning signs shall be in red and white colour combination and shall be affixed in a clearly visible location. Where required by the KSEBL a list of precautions and procedures to be adopted when emergency or danger occurs shall be affixed. Such list shall be on a yellow coloured back ground with black coloured, lettering of minimum 6mm.

Enclosure with risk of fire or excessive heat or excessive noise shall be provided with appropriate warning signs and labels. Enclosures, which are protected with fire protection by CO_2 or Halon, shall be provided with warning labels with first aid instructions.

1.1.26.1

A rating plate of non-corrodible material and of approved size shall be permanently attached to each major and auxiliary item of Work in a conspicuous position. Major equipment nameplates shall be of stainless steel and shall be fixed to the apparatus with non-busting screws. This plate shall be permanently engraved in English with the designed full load ratings, rated voltage, temperature rise, class of insulation, frequency, serial number, type number, date of manufacture, and other identification deemed necessary to provide complete information of the plant / equipment. Where required by the KSEBL, diagram plates shall also be supplied. The English language and metric or SI units shall be used for the plates.

1.1.26.2

All items of plant shall be provided with a non-hygroscopic material nameplate or label designating the service and identification number of the equipment or device in English language. The engraving shall be of a contrast colour to the base material colour or as approved. The pumps, engines, compressors, motors, transformers, breakers, panels, etc...,shall be provided with a stainless steel rating plate (minimum 2mm thickness) engraved with details indicating all the basic parameters and circuit diagrams. The identifying inscription shall be approved by the KSEBL or conform to that designated in the appropriate sections of this Specification. Devices shall be identified by nameplates on both front and rear of all desks, panels, cubicles etc... In case of circuit breakers, starters, etc...,white transparent plastic material with lettering engraved on the back and filled with black material can also be provided. The minimum size of lettering shall be not less than 3mm high. All equipment inside cubicles, panels, boxes, etc...,must be properly labelled with their item number. This number shall be the same as indicated in the pertaining documents (wiring diagrams, equipment lists, etc...). Sticker type labelling shall not be accepted.

1.1.26.3

Nameplates or labels manufactured for indoor panels shall be of non-hygroscopic laminated plastic material with white plate and black engraving. The materials used shall

be non-fading, non-aging and suitable for tropical conditions. The minimum size of lettering shall be not less than 3mm high.

1.1.26.4

Items of the plant which are subject to handling or which are of castings such as valves etc... shall be provided with an engraved chrome plated brass / stainless steel label, 3 mm thick with the engraved lettering filled with enamel.

1.1.26.5

The proposed material of the labels, the size, the exact label inscriptions as well as proposals for the arrangement shall be submitted to the KSEBL for approval.

1.1.26.6

Labels written in English 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 dial plate or switch plate, no label is required.

1.1.26.7

The label must be fixed close to the instruments in such a way that easy identification is possible. Fixing on the dial glass of instrument shall not be accepted. The wordings shall conform to the wording used in engineering documents and shall be submitted for approval of the KSEBL.

1.1.26.8

All devices and components shall be identified by their identification numbers. Cubicles and similar units shall also bear this identification number on the rear side if rear access is maintained.

Warning Labels

i. Warning labels shall be made of polycarbonate board with letters engraved in Malayalam and English. For indoor equipment such as circuit breakers, starters, etc... warning labels made of plastic material with suitably contrasting colours and engraved lettering shall be provided as described below.

ii. LV switchboards shall have white base with 5 cm black letters reading “MAINS 415 / 240 VOLTS”.

iii. MV / LV switchboards and transformers shall have white warning labels with 7.5 cm letters reading “DANGER-11000 VOLTS or 415/240 VOLTS” in RED.

Labels for cables

i. Each cable when completely erected shall have permanently attached to it at each end and at intermediate positions as may be considered necessary by the KSEBL, non-corrodible labels detailing identification number of the cable, voltage and conductor size.

ii. The cable identification number shall comply with those of the cable schedule, which shall be prepared by the Contractor for the actually laid cables.

iii. All cables in cable pits and at entry to building blocks shall be labelled utilizing the above-mentioned type of labels.

1.1.27 Packing and Transport

Each item shall be packed properly or protected for shipment and transport from manufacturer works to the site and storage on the Site. The packing or protection used shall remain serviceable for a period of at least one year at site.

Where practicable, all indoor items such as electric motors, switches and control gear, instruments and panels, machine components etc..., shall be 'cocooned' or covered in polyethylene sheeting, sealed at the joints and enclosures provided internally with an approved desiccators.

1.1.27.1

Each equipment shall be shipped completely assembled and shall be provided with lifting devices for attachment of crane slings to facilitate its handling. Components which could be damaged during shipment shall be packed separately, and shall carry complete identification. Packages shall not exceed 3 m x 3 m. Drying agent shall be included in each package and crating shall be airtight. All cases, packages etc...,shall be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and the correct position of the slings and shall bear an identification mark relating them to the appropriate shipping documents. All marking shall be either of water proof material or protected by shellac or varnish to prevent obliterations in transit.

1.1.27.2

Packing shall be done for sea transport to India and shall be suitable for long term storage.

1.1.27.3

Suitable precautions shall be taken to ensure that pipe, tube and pump open ends are protected from ingress of dirt and moisture and external damage. All flanges shall be fitted with protective blanks, secured by a number of bolts not less than 50% of the number of bolts holes with a minimum of four. All rotating machines shafts and bearings shall be supported properly for protection from movement likely to occur in transit.

1.1.27.4

Spare parts or materials shall be packed in the specified manner and delivered in approved cases suitable for storing such parts and material over a period of several years.

1.1.27.5

The KSEBL's representative may inspect and approve the packing before the items are dispatched. The contractor shall inform the KSEBL when the packing is ready. Such inspection will not exonerate the Contractor from any loss or damage due to faulty packing. Equipment shall be despatched only after getting despatch clearance from the KSEBL / Engineer-in-Charge after approval of test reports submitted by the Contractor after factory acceptance tests.

1.1.27.6

After the completion of erection / installation the Contractor shall deliver all the empty packages, cases, cable drums etc... to the KSEBL's stores in an approved manner.

1.1.28 Concreting and Erection Supervision

1.1.28.1 General Supervision Requirements During Concreting of Embedded Parts

The Contractor shall attend concreting as required in the relevant section of the current document in addition to the following requirements:

i. The Contractor shall supervise the placing of anchor bolts to be embedded in the foundation concrete and shall satisfy himself that these are accurately positioned, securely anchored in the concrete and are adequate to hold down the associated parts of the Work while these are being embedded in concrete. The Contractor shall carry out all measures necessary to ensure

that parts to be embedded in concrete are securely held in position and in particular will ensure that tie rods are evenly tensioned to the correct degree by means of turn-buckles and that the anchors are properly welded to form a complete ring and are not left as open hooks.

ii. Embedded parts shall be designed to permit a concrete pouring without affecting the laid out parts.

iii. During concrete pours, vibrators will not be allowed to touch any metal part embedded in the concrete, and the concrete will be placed evenly and neither dumped nor discharged from chutes in such a manner as to disturb the embedded parts.

iv. Where possible, the Contractor will keep the interior of the embedded parts wet by water spray to prevent expansion by the heat of hydration. Grouting of voids will not be undertaken sooner than 7 days after concreting the embedded parts.

1.1.28.2 General Supervision Requirements During Erection

i. General Specifications

The Contractor shall ensure that the Work is correctly installed in accordance with the approved erection drawings and procedures, provided by him.

ii. **Layout, Measurements and Datums**

The Contractor shall layout basic building lines and establish datums, and shall be responsible for the proper performance of the Work.

iii. Erection Marks

All equipment and their sub-assemblies and accessories such as piping frame works, supports etc... which are to be installed at site shall be marked with distinguishing identification marks or numbers. Where the surface of the material require anti-corrosive treatment, impress marks shall be used.

iv. Erection & Checking at site

All work at site shall be carried out in such a manner as not to obstruct the operations of any other contractor or the running equipment at the site. In case of any interconnections are required with the existing plant / equipment or with the works of other contractors, the Contractor shall make the same with prior approval.

The Contractor shall obtain from the KSEBL / KSEBL's representative details of the parts, which he wishes to inspect, but such inspection shall in no way exonerate the Contractor from any of his obligations. The Contractor, if requested by the KSEBL's representative, shall open up for inspection before erection any equipment, which has been delivered to the site partly / fully assembled. Contractor shall reassemble the equipment after inspection.

The Contractor shall keep the site on which he erects or stores plant, reasonably clean.

On completion of the works, the site is to be left clean and tidy and obtain necessary clearance from the responsible KSEBL's representative. **Any damage done to the existing buildings, structures and plant or property belonging to the KSEBL shall be made good at the Contractor's expense.**

1.1.29 Inspection, Tests on Completion and Commissioning

Approval of assemblies, tests, inspections, related procedures etc... and acceptance of pertinent test and inspection certificates, or waiving of inspections or tests, shall in no way relieve the Contractor of his contractual obligations for finishing the Works in accordance with the provisions of the Specifications.

1.1.29.1 General Specifications

i. Testing, pre-commissioning, & commissioning will involve, though not limited to these: setting / adjusting, testing, proving, trial runs, etc... of various equipment and systems installed.

ii. During erection, commissioning and trial operation, the Contractor shall perform at suitable intervals all inspections and tests in the presence of the Engineer in order to prove the orderly execution of the works in accordance with the Contract. Unless otherwise specified, all costs for testing at site and of the works and charges associated with it shall be borne by the Contractor. This includes the measuring devices, properly calibrated, and any pertinent accessories, which shall be made available by the Contractor for the entire duration of the tests. The Contractor shall delegate his experts to perform the tests at site.

iii. Testing and commissioning of all Work at site will be in accordance with detailed programs and procedures prepared by the Contractor and approved by the KSEBL. Such programs and procedures shall include all tests specified in this Specification.

Wherever equipment supplied under several Contracts is tested together as a unit, the KSEBL will coordinate the preparation of test programs and procedures, and the execution of the tests among the respective Contractors.

iv. The contractor shall perform various activities during pre-commissioning, Integrated Testing, post-commissioning stages of equipment covered under this tender specification. Field testing and commissioning shall be carried out by the Contractor prior to the acceptance of the Work or part of the Work. All tests shall be witnessed by the KSEBL .

v. The Contractor shall provide at site all experienced personnel (engineers and technicians), test equipment, instruments, wiring, tools and plant, accessories etc... required to carry out the tests and record their results in a satisfactory manner. The Contractor shall calibrate all necessary test instruments and equipment, and include calibration records in the respective test reports.

vi. In cases where doubt exists regarding the tests, the KSEBL may request repetition of such tests.

vii. Contractor shall earmark separate manpower for respective area of testing and shall not be disturbed / diverted for other work. The contractor's commissioning group shall work as per the instruction of KSEBL's Representative and they shall coordinate day-to-day activity with other agencies at site. The testing activity may have to be repeated till satisfactory results are obtained.

viii. The KSEBL reserve the right to witness any tests both at factory and at site. The Contractor shall advise the KSEBL at least 10 working days prior to the start of such tests.

ix. The Contractor shall be responsible for satisfying himself as to the correctness of the electrical and mechanical connections to all plant supplied under the Contract before such plant is brought into commission or operation.

x. The contractor shall immediately attend to the defect noticed during tests, trial runs, pre-commissioning, commissioning such as loose components, undue noise or vibration, strain on connected equipment etc... Readjustment and realignment as called for shall be done as per KSEBL's Representative's instructions.

xi. The contractor shall carry out any other tests as desired by KSEBL's Representative on erected equipment covered under the scope of this contract during testing, pre-commissioning and commissioning, to demonstrate the completion of any part or whole of work performed by the contractor. During this period, though KSEBL's staff will also be associated in the work, the contractor's responsibility will be to arrange for complete requirement of men and required tools and plants, consumables, scaffolding and approaches etc..., till such time the commissioned unit is taken over for operations.

xii. The scope of testing & commissioning of electrically operated actuators for valves, dampers, gates etc...,will include but not limited to meggering, providing loop wire on actuator terminal block, adjustments of mechanical / electrical or electronic position transmitters, setting of limit / torque switches, cable checking, internal wiring checking, local / remote operation from MCC & MMI package, replacement of limit / torque switches if required.

1.1.29.2 Commissioning Test

i. Commissioning acceptance tests shall be carried out, on all generating units to verify the rating characteristics of generating units and other equipment's in accordance to relevant standards. The complete field acceptance test reports shall be prepared by the Contractor and submitted to KSEBL for approval.

ii. The test run on generating units shall be carried out as per relevant provisions of IEC standards.

iii. Before issuing the "Taking-Over Certificate", the revised copies of the Operation and Maintenance Manual shall be submitted together with the specified number of complete sets of drawings of the Works as completed. The Works shall not be considered complete for purposes of taking over under the terms of the General Conditions of the Contract until the above documents have been supplied by the Contractor.

1.1.29.3 Trial Run

i. Immediately upon completion of commissioning, the plant shall be kept on trial operation during which period all necessary adjustments shall be made while operating over the full load-range enabling the plant to be made ready for performance and guarantee tests. The plant, i.e., complete equipment, shall be on Trial operation for a period of one month. The trial operation shall be considered

successful, provided that each item of the equipment can operate continuously at the specified operating characteristics, for the period of trial operation.

ii. For the period of trial operation, the time of operation with any load shall be counted. Minor interruptions not exceeding 3 (three) hours, at a time, caused during the continuous operation shall not affect the total duration of trial operation. However, if in the opinion of the KSEBL's Engineer, the interruption is long, the trial operation shall be prolonged for the period of interruption.

iii. The trial operation report comprising of observations and recordings of various parameters to be measured in respect of the above trial operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during trial run, shall also include the dates of start and finish of the trial operations and shall be signed by the representatives of both the parties. The report shall have sheet, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the trial operation. Based on the observations, necessary modifications, repairs to the plant shall be carried out by the Contractor to the full satisfaction of the purchaser to enable the latter to accord permission to carry out the performance and guarantee tests on the plant. However, minor defects, which do not endanger the safe operation of the equipment, shall not be considered as reasons for withholding the aforesaid permission.

iv. During the trial run the Contractor shall make familiar the Purchaser's personnel with the equipment, the operation and maintenance of the Works and its auxiliaries to such extent that thereafter the duties can be assigned to the Purchaser's trained personnel.

v. If any defects or irregularities affecting the safety or reliability of the Works should arise during the trial run, the trial run shall be interrupted and started again after such defects or irregularities have been corrected by the Contractor at his own cost.

1.1.29.4 Performance and Guarantee Tests

i. The final test as to the performance and guarantees shall be conducted at site, by the contractor, through an MNRE (Ministry of New and Renewable Energy) approved agency, in presence of the Department representative. Such tests will be commenced, within a period of 15 (fifteen) days after successful completion of Trial Operations. Any extension of time beyond the above 15 (fifteen) days shall be mutually agreed upon.

ii. These tests shall be binding on the Contract to determine compliance of the

equipment with the performance guarantees.

iii. The available instrumentation and control equipment will be used during such tests and the contractor will calibrate all such measuring equipment and devices as far as practicable. However, immeasurable parameters shall be taken in to account in a reasonable manner, for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable.

iv. Any special equipment, tools and tackles required for the successful completion of the performance and guarantee tests shall be provided by the contractor.

v. The guaranteed performance figures of the equipment shall be proved by the contractor during these performance and guarantee tests. Should the results of these tests show any decrease from the guaranteed values, the contractor shall modify the equipment as required to enable it to meet the guarantees. In such case, performance and guarantees tests shall be repeated within one month, from the date the equipment is ready for retest and all cost for modifications including labour, materials and the cost of additional testing to prove that the equipment meet the guarantees, shall be borne by the contractor.

vi. All the costs for the pre-commissioning test, trial operation, performance and guarantee test including the consumables, arranging test set-up, test equipment and accessories, measuring devices etc... shall be borne by the contractor.

1.1.29.5 Tests on Materials

i. The materials, parts and assemblies shall be tested to comply with the ASTM Standards or other standards specified and shall be in accordance with the best commercial methods applicable to the relevant type and class of work. The tests and trials shall be recorded and certified by the Contractor.

ii. The test records for materials shall identify the component parts in which the materials are to be used and the certificate shall be prepared in such a way that it can be easily determined if the applicable Specifications or standards have been complied with.

iii. All radio-graphs, test specimens and test records shall become the property of the KSEBL.

iv. Load tests on crane hooks, steel wire ropes, chains and other lifting devices, etc... shall be considered as material tests.

1.1.30 Test Reports

i. Test reports shall indicate the tests performed, instruments used, names of test

personnel and provide for witnesses' signatures. They shall be numbered and dated.

ii. The Contractor shall compile records and reports on each and every test specified under this Contract and bind such test documents in the same manner as the Operation and Maintenance Manuals.

1.1.31 Operation and Maintenance Manual

1.1.31.1

For the guidance of the KSEBL's operating and maintenance staff, the Contractor shall prepare and furnish 6 copies of operation and maintenance manual for all the Work. Of these, 2 copies shall be given in advance before starting the erection works. Balance 4 copies shall be submitted after incorporating all corrections for the final as-built condition.

1.1.31.2

The manual shall include but shall not necessarily be limited to the following:

- Technical and design data;
- General description of components;
- Operating instructions;
- General information (including sequence of operations if applicable);
- Specific information (dealing with any unusual feature or safety precautions);
- Maintenance instructions fully describing all aspects of preventive and repair maintenance, including maintenance schedule and repair procedures, a detailed lubrication chart showing all lubrication points, lubricant grades required and a lubrication schedule;
- Adjustments (and assembly) including design clearances and settings where applicable;
- All drawings, diagrams, material and parts list;
- All pertinent bulletins and instructions prepared by the various manufacturers of component parts.

1.1.31.3

If the complete text is unduly bulky, then the manual shall be appropriately subdivided and produced in a multi-volume form.

1.1.31.4

Final manuals shall be reproduced as a book or books of approximately quarto size generally in the form of the title page to this document except that the references to Specification, Conditions of Contract, Drawings, etc...,will be replaced by "Operating and Maintenance Instructions". The name of the main Contractor but not that of any subcontractor may also be inscribed upon the cover after the description of the Work. A brief description of the Work is to be inscribed upon the spine of the cover and, if the instructions are contained in several books, these are to be marked with the appropriate volume number. The drawings and diagrams shall be the latest revision of the approved drawings, reproduced to a convenient size and bound into the volume. Insertion of loose drawings into cover pockets is not acceptable.

1.1.31.5

Any additional information, data or changes found necessary during commissioning should be sent to the KSEBL for insertion in the manuals.

1.1.32 Spare Parts, Special Tools and Site Consumables

A) Spare Parts

The Contractor shall provide a list of recommended spare parts and special tools with the respective unit prices to KSEBL's approval and supply sufficient parts, as per approved list, to assure satisfactory operation for at least five years. All spare parts and accessories shall be electrically and mechanically identical to corresponding parts in the equipment supplied and shall be suitably packed and clearly marked, ready for long term indoor storage.

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 KSEBL’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 recommend by them in addition to the list given in particular specifications and offer the price of the same separately in schedule of prices for spares. Wherever the quantity of spares is given as set / sets, it will be taken as quantity for all the generating units. Sufficient quantity of spares will be included for parts which are more prone to frequent wear and tear and can be replaced easily without involving long shutdown.

The Contractor shall provide 5%, but at least two pieces of all types of bolts, screws, nuts, washers, spanner rings and cotters. The quantity may be taken from the surplus handed over to the Purchaser after completion of the installation as described under the chapter "Fasteners." of this Section.

Mandatory Spares: All spares required during the Defects liability period, needs to be compulsorily provided by the Contractor and a list is also to be provided by the Contractor. It is also specified that any spare other than that specified in the list is necessitated during the defects liability period, the same will be deemed to have been included in the mandatory list and will have to be provided free of cost by the Contractor.

Recommended Spares: The Contractor shall provide a list of spares with unit rates that may be required for a two year period after the defects liability period. Based on the list, KSEBL may issue separate order for the needed spares, based on the rates quoted by the Contractor.

B) Tools

The scope of work shall include all customary and special tools, as well as auxiliary devices including lifting devices, ropes, etc... necessary for total assembly and disassembly of all parts of the supplied Works. Furthermore, all accessories for maintenance shall be supplied and included in the Tender. The total price for tools and devices as required by this article shall be included in the Total Tender Price. The special lifting devices and tools designed and supplied for the project, can be

used by the Contractor during erection and will be handed over to Purchaser in good working condition without any wear and tear. However, normal tools and appliances supplied shall not be used for erection purposes by the contractor and shall be handed over in new condition. All ropes, slings, small hoists and winches etc... shall be handed over in new condition.

All lifting devices and wire ropes slings to be used at site shall be tested at works and test certificate shall be supplied to the Engineer-in-Charge.

Suitable toolboxes shall also be included in the delivery. An itemized list and description of all provided tools, auxiliary devices, etc... shall be included in the Tender. The KSEBL shall be entitled to take over from the Contractor the entire erection tools, appliances, instruments at mutually agreed conditions.

Each set of tools and appliances to be supplied under the contract shall be arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the quantity and type of tools and appliance. If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be split into multiple boxes.

All tools and appliances shall be clearly marked outside its packing with its description, identification number and reference manual number. Each toolbox shall be painted black, fitted with a pad lock and clearly marked in white letters with the name of the item of equipment for which the tools or appliances are intended.

The Contractor shall open all the toolboxes at the Site stores for inspection by the KSEBL's representative. The Contractor shall be responsible for all such unpacking and subsequent re-labelling and re-packing.

C) Consumables

Scope of work shall include all site consumables like welding electrodes, brazing materials, insulating materials, sealants, cleaning agents, paints and varnishes, grinding wheels/discs, fasteners and raw materials etc... in fairly sufficient quantity so that erection and commissioning activity is not held up for want of these items.

For all items under this Contract, the Contractor shall deliver 5 % of the quantity of painting material, but at least one litre, in new sealed containers, for later repair works other than the Contractor's.

Lubricating oils, insulating oils and greases etc... required for first filling in the plant and equipment supplied by the Contractor under this Contract shall be supplied in quantity 10 % (ten percent) higher than the actual capacity for first filling. These items shall be supplied as per site requirement and shall not be stocked with main

equipment.

1.1.33 Safety

During erection and commissioning the Contractor shall provide all reasonable measures to ensure safety of all personnel and plant. The Contractor shall comply with all safety codes and security regulations prevailing in the KSEBL's plants and those specified in **Vol-2 – Conditions of Bid and Contract.**

All statutory requirements regarding safety provisions, where applicable, stipulated in the following Acts and rules / regulations made there under, as amended from time to time, shall be complied with:

(a) The Electricity Act 2003.

(b) The Building and Other Construction Workers Act, 1996 and rules made thereunder.

(c) The Factories Act, 1948 and rules made there under.

(d) Central Electricity Authority (Safety requirements for construction, operation and maintenance of electrical plants and electric lines) Regulations.

(e) Central Electricity Authority (Measures relating to Safety and Electricity Supply), Regulations as and when notified by the Authority.

(f) Central Electricity Authority (Technical Standards for construction - 2010)

(g) Indian Electricity Rules, 1956 till Central Electricity Authority (Measures relating to Safety and Electricity Supply), Regulations are notified by the Authority.

(h) In addition, stipulations made under following Acts and rules/regulations made thereunder, as applicable, shall also be complied with:

- The Explosives Act, 1884
- The Explosive Substance Act, 1908.
- The Indian Boilers Act, 1923 and Indian Boiler Regulations, 1950
- The Motor Vehicle Act, 1988
- The Petroleum Act, 1934
- The Public Liability Insurance Act, 1991
- The Static and Mobile Pressure Vessel (unfired) Rules, 1981
- The Workman's Compensation Act, 1923
- The Water (Prevention and Control of Pollution) Act, 1974
- The Air (Prevention and Control of Pollution) Act, 1981
- The Environment Protection Act, 1986
- Battery Management and Handling Rules, 2001
- Bio Medical Waste (Management and Handling) Rules, 1998

- Chemical Accident (Emergency, planning, preparedness and response) Rules, 1996.
- Explosive Rules, 1983
- Gas Cylinder Rules, 1984
- Hazardous Wastes (Management and Handling) Rules 1989
- Petroleum Rules, 1976
- Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
- Ozone Depleting Substances Rules, 2000

(i) Any other rules and regulations in this regard

(j) Any specific approvals, permits, clearances issued by any authority under different statutes.

1.1.33.1

The operation of any items of energized Work / Plant shall be subject to a "Permit to Work" system in a form agreed between the Contractor and the KSEBL in accordance with the KSEBL's standard safety regulations for such work. While the Work / Plant is still under the control of the Contractor the permit to work shall be endorsed by the Contractor / Contractor's authorized representative. Permits to operate on Work / Plant, which has been handed over, shall be under the control of the KSEBL / KSEBL's representative.

1.1.33.2

All safety precautions have to be observed while laying the cables in the trench. After completing the work, the trench has to be cleaned and covers put back into position. The contractor, if required, shall do de-watering of trenches.

1.1.33.3

The contractor shall provide all the necessary scaffolding materials, temporary structures and necessary safety devices etc..., during pre-assembly, erection, testing and commissioning of the hydro sets.

1.1.33.4

The Contractor shall observe all statutory safety ordinances, regulations and laws, which are in effect at the Site.

1.1.34 Training of KSEBL's Personnel

The contractor shall impart training at least for a period of one month from the date of

successful commissioning of the project on operation and maintenance of the plant. The KSEBL's personnel / officers / staffs may be associated for the purpose of training right from the stage of installation of the equipment. Such training shall be imparted at free of cost to the engineer / staff / officers to enable them to make themselves conversant in the operation and maintenance of plants and equipment.

1.1.35 Taking Over of the Project

After conclusion of the training period of KSEBL's Personnel as specified in Clause 1.1.34 above, the contractor shall give due notice to the Engineer-in-Charge about successful operation of the plant and conclusion of the training period. Thereafter KSEBL shall take over the project formally subject to fulfilment of all relevant requirements in the terms of the agreement.

1.1.36 Special Notes

1.1.36.1

The Contractor shall inspect the road and ascertain the possibility of transporting heavy equipment. If necessary, the equipment shall be supplied in split up condition to suit the transport requirements.

1.1.36.2

The bidder shall include all equipment, materials, tools, consumables etc... required for the complete and satisfactory installation, testing, commissioning and operation of the units, feeders etc... even if they are not specifically mentioned in these specifications.

1.1.36.3 Deviations from Technical Specifications

All deviation from General Technical Requirements and Technical Specifications given in the following sections should be clearly brought out at one place in the "List of Deviations" from Technical Specifications clearly bringing out the financial commitment. Any deviation not clearly mentioned in the List of Deviations, but described elsewhere in the equipment description shall not be acceptable. After award of contract, the contractor has to fulfill all the requirements of technical specifications except the deviations clearly spelt out with financial commitment and accepted by the KSEBL.

Whenever a Contractor deviates from these specifications, he shall furnish the data called for in the Technical Data Schedules and give a summary of and the reasons

1.3.8 Auxiliary Electrical Equipment

1.3.8.1 Introduction

This section covers the KSEBL's basic requirements for the design, manufacture, testing at manufacturer works, standard and quality of workmanship, general finish of plant, compliance to the latest published edition (prior to the date of closing of tender) of the international standards and recommendations specified throughout the specifications, supply, insurance, delivery and storing at site, erection, site testing, commissioning, performance and reliability confirmation, warranty confirmation of the auxiliary electrical equipment for the powerhouse.

The scope shall include supply of KSEBL's requirement as above along with gland plates for all power and control cables, base frames, special tools i.e. operating handles, trolley necessary for removing the circuit breakers for maintenance etc...

The scope shall interalia include all associated devices, components, relays, contactors, switches etc... required for satisfactory operation of the switch boards as per the proposed control scheme.

The scope of supply shall include all parts, accessories, spares etc... which are essential for construction, operation and maintenance of the supplied equipment even though these are not individually or specifically stated or enumerated.

1.3.8.2 Reference Standards and Codes

Equipment shall be designed, manufactured, tested, installed and commissioned in accordance with the latest revision of applicable IS / IEC or equivalent standards.

The Contractor shall adhere to sound design and construction practices with regard to codes and material specifications in order to warrant operational safety and ease of maintenance of plants as well as simplicity of control and stability in plant operation.

- IS 1180 - Outdoor type three phase distribution transformers
- IS 1367 (Part 13) - Technical supply conditions for threaded steel fasteners.
- IS 2026 - Power transformers
- IS 3043 - Code of practice for earthing
- IS 9046 - AC contactors

- IS 10118 (Part 1 to 5) - Code of practice for selection, installation and maintenance of switchgear & control gear.
- IS 13118 - Circuit breakers.
- IS 13947 (Part 1 to 5) - Specification for low voltage switchgear and control gear.
- IEC 60298 - AC Metal-enclosed switchgear and control gear for rated voltage above 1 kV up to and including 52 kV
- IEC 60947 - Low Voltage Switchgear & Control-gear
- IEC 62271 - High Voltage AC Circuit breakers
- IEC 60044 - Instrument Transformers
- IEC 60076 - Dry Type Transformers
- IEC 60905 - Loading guide for dry type transformers
- IEC 62060 - Secondary cells and batteries – Monitoring of lead acid stationary batteries – User guide
- IEEE 484-1996 - Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications.
- IEEE 450-2002 - Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
- IEEE 485-1997 - Recommended Practice for Sizing Lead Acid Batteries
- IEEE 1184-1994 - Guide for the Selection and Sizing of Batteries for Un-Interruptible Power systems
- IEEE 1375-1998 - Guide for Protection of Stationary Battery Systems
- IEEE 1491-2005 - Guide for Selection and Use of Battery Monitoring Equipment in Stationary applications.
- CBIP Publication No.317 - Manual on Transformers.

1.3.8.3 Reference Sections

Section 1.1 - General Technical Requirements

Section 1.3.5	-	Control & Monitoring
Section 1.3.6	-	Protection
Section 1.3.10	-	Lighting & Grounding
Section 1.4.3	-	Switch-yard Equipment
Part - 2	-	Specific Requirements for the Project

1.3.8.4 Submittals and Approvals

The Contractor shall seek the prior approval of the KSEBL for the following through timely submittals.

- The design and sizing calculations for Transformers, Cables, Battery, Charger and UPS and drawings of the auxiliary electrical.
- The Contractor shall purchase equipment from reputed vendors only and the name of vendors shall be submitted for KSEBL's approval.
- Schematic drawings and circuit diagrams, operating philosophies, inter-locking logics and schemes etc... at agreed stages.
- Material certificates and test reports
- Erection, Testing and Commissioning methodology

Before delivery of equipment to site, the contractor shall submit all work test certificates / reports for approval and obtain despatch clearance from the KSEBL's representative.

1.3.8.5 Deliverable Documents

- Layout drawings of the power house showing the location of Auxiliary Equipment including LT / DC Boards, Battery & Charger, Transformers etc.., clearly indicating dimensions and all important elevations.
- Schematic drawings, circuit diagrams and specifications
- Design / Sizing calculations, Quality Assurance Plan
- A complete list giving details of equipment and auxiliaries.
- Operation and maintenance manual covering full details of repair procedure.

1.3.8.6 KSEBL's other Requirements

Other technical requirements shall be as given in Part-2 **(Specific Requirements of the Project)** of this specification. Any item of work not specifically mentioned in the specifications but which are usual and / or necessary for the satisfactory operation of the equipment / system shall be deemed to be provided by the Contractor and included in the quoted Price. All work shall be complete in all details whether such details are mentioned in the specifications or not.

The layouts of the powerhouse are given in drawings appended to the specifications.

The auxiliary electrical equipment shall consist of:

- 415V LT AC power supply system
- 110V DC power supply system
- Uninterrupted power supply system
- All special devices, tools, testing equipment etc... required for installation, testing, commissioning and maintenance of the supplied equipment.
- One set of spares required for 5 years of normal operation for each equipment.

All equipment shall be neatly arranged and shall be readily and easily accessible for operation and maintenance. Necessary walkways, handrails, ladders, chequered plates, platforms, etc... required should be provided by the contractor.

1.3.8.6.1 Scope of Work

Any item of work not specifically mentioned in the specifications but which are usual and / or necessary for the satisfactory operation of the equipment supplied shall be deemed to be provided by the Contractor and included in the quoted Price. All work shall be complete in all details whether such details are mentioned in the specifications or not.

Any ratings, if mentioned, are indicative only and are a minimum for giving a base line. The Bidder should ensure that the ratings of the various equipment are sufficient to take care of the design requirements of the equipment offered for the concerned project. Any increase in rating during detailed engineering stage will not entitle the Successful Bidder / Contractor for any extra charges. The Contractor should submit for approval the calculations for arriving at the ratings of the various equipment.

1.3.8.6.2 Description of Equipment

1.3.8.6.2.1 415V LT AC Power Supply System

The LTAC system shall, in general, comprise of the following:

- 11kV/415V or 6.6kV/415V or 3.3kV/415V, 3-phase, indoor, dry type, air cooled, two winding Unit Auxiliary transformers (UAT).
- 11kV/415V or 6.6kV/415V or 3.3kV/415V, 3-phase, outdoor type, oil filled, air cooled, two winding Station Service transformer (SST).
- 11/6.6/3.3kV, outdoor type, Vacuum / SF6 circuit breaker for the SST (if required) along with necessary control and protection as required and / or
- 11/6.6/3.3kV Indoor type VCB / SF6 Switchboard.
- 415V Main station service board (MSSB) for the powerhouse with Incomers and sufficient outlets, with interlocks provided for incomers along with auto changeover so that the system will be energised if any one incomer is live.
- 415V Unit Auxiliary Boards (UAB) for machines
- DG sets if specifically mentioned in Part-2
- Set of tools, handling devices, testing instruments for erection, testing and maintenance of the complete system
- One (1) set of spare parts sufficient for 5 years of operation
- Any other item not specified above but necessary for satisfactory operation of the system.

The LT AC system shall also include provisions for catering to the LT requirements of the future addition of units, if any.

The station auxiliary A.C. supply system shall be designed to provide a high degree of reliability, continuity of service and primarily to supply uninterrupted AC supply to station auxiliaries during normal operation and unit auxiliaries during starting and stopping of the unit.

The station supply loads for various equipment shall be determined and normal maximum demand shall be calculated at a diversity factor of 0.75. The availability of input supply shall be ensured from the sources independent of station generation. In addition, adequate provision for meeting load of auxiliaries for one unit during starting and / or during the stopping of the unit shall also be kept and for this purpose the unit auxiliary boards shall be

connected to station auxiliary boards through tie breakers.

If specifically mentioned in Part-2, Two nos. of Station Service Transformers of equal capacity; one main and other as standby shall be provided for supplying power to the station service board feeding power to the station auxiliaries. In the event of A.C. supply failure, the station load shall be supplied by diesel generating set(s) of suitable capacity connected to the station service board (SSB). The station service transformers, DG sets and station service boards shall be located at higher level.

The various auxiliary systems shall incorporate appropriate auto transfer scheme and / or manual changeover to bring in the reserve supply source as required to prevent the loss of unit(s) and to ensure the equipment safety.

Each switchgear, motor control centres (MCCs), distribution boards (DBs) shall be fed by 2x100% transformers / feeders and these shall be rated to carry the maximum load expected to be imposed.

Power supplies, buses, switch-gears, interlocks and standby supply systems for station and unit auxiliaries shall be designed in such a way that the main equipment and auxiliaries are not endangered under any operating conditions. Transformer voltage ratios, type of tap changers and tap ranges, impedances and tolerances thereon shall be so optimised that the auxiliary system voltages under various grid and loading conditions are always within permissible limits and equipment are not subjected to unacceptable voltages during operation and starting of motors. The vector groups of the generator transformers, unit auxiliary transformers and station transformers shall be so selected that the paralleling at 11/6.6/3.3kV buses shall be possible. Further, the vector group of other auxiliary transformers shall have identical vector groups.

1.3.8.6.2.1.1 Auxiliary Transformers

- Primary voltage - 11/6.6/3.3kV
- Secondary voltage - 415V
- Rated capacity - As per Part-2 - Specific requirement of the project
- Insulation level
  - high tension - 95/38 kV for 11 kV, 40/10 kV for 3.3kV
  - low tension (BIL) - 3 kV
- Winding material - Copper

trucks shall be provided either through integral earth switch or through separate ear thing truck. In case of latter arrangement, one set of different types of ear thing trucks per switchboard shall be supplied. Suitable mechanical interlock shall be provided to prevent inadvertent ear thing of any live part. Ear thing switch shall have short time (1 second) current withstand capability equal to the breaker.

All components shall be correctly rated. Use of two breakers in parallel shall not be acceptable.

Panels should be suitable for top/bottom cable entry.

Each breaker panel shall have breaker control switch of spring return type and a local / remote selector switch of stay-put type. The panel shall also have `ON', `OFF', `Spring charged', 'Trip Circuit Healthy', 'Auto-Trip' and 'Control supply healthy' indicating lamps. The lamps shall be LED (bunched) type and with built-in resistors to prevent inadvertent short circuiting.

The switchboard / panel shall have suitable arrangement to receive and distribute AC and DC supplies. Control DC supply shall be duplicated for each board. Each switchgear panel shall have thermostatically controlled space heater with switch, illumination and power plug point. All panels on front and back as well as inside shall have engraved nameplate giving circuit description and component identification.

1.3.8.6.2.1.4 415V Station Service Board (Similar specification shall be followed for HVAC switchgear)

This board shall be indoor type, metal clad, factory assembled and fully tested. Each board shall have sufficient number of air circuit breakers for incoming supplies. For supply to various loads including feeders to unit auxiliary boards, moulded case circuit breakers and motor starter equipment shall be provided. All necessary control, metering and indication shall be provided.

The interconnection between the unit auxiliary transformer, station service transformer and the station service board shall be made by means of LT power cables of sufficient rating. Similarly, connection between station service board and unit auxiliary boards shall be made by LT power cables of required rating.

Provision shall be made in the station service board for feeding to the unit auxiliary board of the future units (if any) also. The station service board assembly shall be made up of sheet steel vertical cells of standard dimensions bolted together and mounted on a common channel base to form a free-standing, self-supporting structure and completely metal enclosed. It shall be vermin and dust proof.

The vertical cell containing the incoming circuit breakers shall be divided in three separate sections from front to back. The front section includes the circuit breakers, the control and

the potential transformer compartments; control cables shall terminate in this section. The middle section forms the bus-bar compartment and the back section is for power cable terminations. The breaker compartments shall be equipped with shutters that close automatically when a breaker is disconnected.

The switchgear assembly shall have common main and ground buses and shall be equipped to accept additional future cells of motor control centre. Each frontal compartment shall be equipped with an individual hinged door. All control and power cables shall enter through the top or bottom of the incoming cell and of the feeder/motor control cells. Power cable supports shall be provided to prevent any excessive stress on power cable connection lugs. All cell openings both at top and bottom shall be equipped with removable plates for incoming cables. All cut outs shall have synthetic rubber gaskets. All non-current carrying metal works of boards / panels shall be effectively bonded to earth bus of galvanised steel extending throughout the switchboard / MCC / DB. Positive earthing shall be maintained for all positions of chassis and breaker frame.

The bus bars shall be of high-strength, high conductivity copper and braced to withstand the maximum short circuit current of the system. Bus joints and taps shall be silver-plated and shall utilize anti-corrosion hardware. Buses and joints shall be designed so that the maximum temperature rise of any part does not exceed 65ºC over an ambient temperature of 40ºC. Bus-bar barriers shall be provided between switchgear equipment to prevent the spreading of ionised gases in the event of a fault. Main and auxiliary bus-bars shall be covered with insulating sleeves to safely prevent internal bus bar faults and spreading of arcs. The covering material shall be non-deteriorating at the rated short - time maximum temperature of the bus-bars and shall have such thickness as is required to withstand rated line to line voltage between bus-bar and a conducting object on the exterior of the covering material for a period of not less than 60 seconds.

All bus-bar connections and joints shall be silver-plated. Access to bus bars and the connections directly connected thereto shall be gained only by the removal of covers secured by bolts or screws. Such covers shall be clearly and indelibly marked "BUS-BARS".

Bus bars shall be extensible at both ends; such extension shall entail the minimum disturbance to bus bar compartments.

A continuous ground bus (50 mm x 10 mm [min]) of high strength, high conductivity copper shall be provided the length of the assembly and solidly bolted to the steel framework. It shall be capable of carrying the rated short circuit current of any breaker in the assembly for a period of three seconds. A compression type connector for up to 70mm^2 for grounding

copper conductor shall be provided at each end of the ground bus.

Insulating mats as per IS shall be provided in front of the Switchboard.

Adequate number of spare outlets shall also be provided.

415 V Incomer Circuit Breakers:

These circuit breakers shall conform to the following technical parameters:

- Type - Air insulated, draw-out type, motor operated (closing)
- Type of operating mechanism - Spring charged stored energy type
- No. of poles - 4
- Rated voltage - 415 V
- Rated current - As per Part-2 of this specification

The circuit breakers shall have three positions: 'Connected', 'Test', 'Disconnected' and 'Draw-out'. The breakers shall have protection for over-current and earth faults by relays connected with CT's in addition to thermal overload protection. The circuit breakers shall have the following devices and mechanisms:

- a set of main draw-out contacts;
- a set of secondary draw-out contacts;
- a safety device preventing drawing-out of circuit breakers in connected position, when closed;
- a safety device preventing connection of circuit breakers when closed;
- a safety device preventing closing of circuit breakers before the main draw-out contacts are completely connected or separated by a safe distance;
- a safety device ensuring discharging of springs when the circuit breaker is drawn out from its compartment;
- an anti-pumping device and a 110 V DC motor for automatic charging of the closing springs and an emergency handle for manual charging of the closing springs. The charging of the closing springs shall ensure a complete O-C-O cycle;
- a device to indicate that the springs are charged;
- a position indicator (closed / open);
- Pilot lights (with Bunched LED type) for Close, Open, Fault Trip, Spring charged

indication etc...

- push buttons for local and manual control (closing and tripping);
- a set of four auxiliary contacts wired to a terminal block as spare.
- Provision for Remote Operations (Close / Open) from SCADA / Control room shall be provided
- Provision for providing Close / Open, Trip Indication to SCADA / Control room.

Control, Protection and Metering

The incoming circuit breakers of the switchgear shall be suitable for remote electrical control at 110V DC from the control room. A local / remote selector switch to transfer control without interrupting the protection circuits and two sets of auxiliary contacts for remote position indication shall be provided.

The incoming circuit breakers of the switchgear shall be controlled by a switching system operating as described below. With the automatic switching system, it shall be possible to keep the preferential feeder breaker closed while the other breakers are open. A three-position selector switch, mounted on the compartment door, shall permit the choice of modes of operation 'Auto', 'Manual' or 'Off'.

Suitable mechanical and electrical interlocks shall be provided in auto-changeover circuits.

All incomer and bus coupler ACBs shall be of 4 poles. There shall be outgoing ACBs to each Unit Auxiliary Boards and common Auxiliary board. The common Auxiliary LT board shall be fed from both bus bars. All incomer, outgoing and tie feeders shall be equipped with ACBs at both ends. The incomers and bus coupler ACBs shall be properly interlocked. One outgoing ACB shall be provided as spare on both bus sections.

The Auto-Changeover operation due to mains failure shall be annunciated as a persistent alarm in the Control room / SCADA. The same shall be reset only on attaining the normal operating status of the system.

When the selector switch is in the 'Manual' position, either Incomer circuit breaker may be operated or the transfer made manually. When the selector switch is in 'Off' position, electrical control shall not be possible. Control power transformer with pull-out type primary and secondary fuses shall be mounted inside the switch-gear's instrument compartment.

Control and timing relays shall be of the plug-in type. Timing relays shall preferably be solid state. Relay coils shall be at 230 V AC, relay contacts shall be rated at 10 A minimum, 230 V AC. Other control devices such as push buttons, switches etc... shall be oil-tight, heavy

duty and equipped with identification nameplates.

Indicating instruments shall be digital red LED meters, flush mounted, with totally sealed case front. The size of display shall be minimum height of mm. The indicating instruments shall conform to IEC 51 and shall have a measuring precision of ±0.2% of full-scale value at rated voltage. These instruments shall be powered by 110 V DC supply. One energy meter should be provided in each breaker cubicle for incoming feeders.

Ammeters shall be of digital meters with 4 digits for each phase. Energy meters shall be static and shall conform to IS 722 and have an accuracy class of at least 0.2S or better. Voltmeter shall be of digital type with 4 digits.

1.3.8.6.2.1.5 415V Unit Auxiliary Boards (Similar specification shall be followed for HVAC switchgear)

These boards incorporate the auxiliary supply feeders to individual units and are fed from the station service board. The panel shall be equipped with tinned copper bus bars and a ground bus. For supply to various loads, MCCBs and motor starter equipment shall be provided. The number of circuits, branch circuit breakers and the circuit breaker ratings shall be designed according to the requirement of various unit auxiliary loads. 20% fully equipped spare outlets shall also be provided.

415V Moulded Case Circuit Breakers and Motor Starters

All outgoing feeders emanating from the unit auxiliary boards, station service boards and distribution panels shall be controlled by means of three-pole and two pole MCCB's. These circuit breakers shall have magnetic tripping on short circuit and delayed thermal tripping on overloads.

All the live parts shall be enclosed in a moulded, insulated housing of simple, compact and robust mechanism suitable for quick break and make operation. Each MCCB shall be equipped with trip-free mechanism, On / Off / Trip indication and auxiliary contact block. Mechanical tripping shall be through red `Trip' push buttons outside the panel for breakers, and through switches for other circuits.

The motor starters shall be three-pole and of combination circuit breaker magnetic air break type. Each starter shall be mounted in a separate compartment with a hinged door. Each door shall have a handle to operate the circuit breaker with a mechanical interlock to ensure that the circuit breaker is open before access into the compartment is allowed. It shall be possible to padlock the handle in the 'Open' position. All cut outs shall have synthetic rubber gaskets. All non-current carrying metal works of boards / panels shall be effectively bonded to earth bus of Copper / Aluminium extending throughout the

switchboard / MCC / DB.

The starter modules shall be of the plug-in type so that the assembly can be removed without de-energizing the MCC. Alternately the Draw Out MCCB Modules can be provided instead of plug in type. Large capacity Starter shall be connected directly to the bus without use of cables. All plug-in starters shall have tin-plated copper contact material. The circuit breakers shall have a minimum symmetrical interrupting capacity of 22kA RMS.

Motor starter contactors shall be of air break, electromagnetic type as per IS: 13947 Part-4, section-1 suitable for DOL starting of motors, and shall be of utilisation AC-3 for ordinary and AC-4 for reversing starters. DC contactors shall be of DC-3 utilisation category.

Isolating switches and MCCBs shall have door interlocks and padlocking facility.

Fuses, if provided, shall be HRC type with operating indicator. Isolating switches shall be of AC 23A category when used in motor circuit, and AC 22A category for other applications.

The temperature rise of the horizontal and vertical busbars and main bus link including all power draw-out contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 ^{0}C with silver plated joints and 40 ^{0}C with all other types of joints over an ambient of 50 ^{0}C.

All switchgear, MCCBs, DBs, panels, modules, local starters and push buttons shall have prominent engraved identification plates.

Each starter shall include the following features and components as a minimum:

- Circuit breakers shall be moulded case, three-pole, rated at 415 V with magnetic trip only. The magnetic trip shall be adjustable;
- A non-reversing, single speed, full voltage, three-pole contactor with 230 V AC coil. The contactor shall operate at 80% of rated voltage;
- One three-phase overload relay with contracts for annunciation and a reset push button mounted on the door;
- One single phase control transformer, 415-230V, 240VA with a secondary fuse according to the starter size;
- Pilot lights (with Bunched LED type) shall be provided on the door for status indication;
- Set of auxiliary contacts with 20% as Spare.
- Provision for Remote Operations (Close / Open) from SCADA / Control room shall

be provided

- Provision for providing Close / Open Indication to SCADA / Control room.

Protection

All types of relays and timers shall be subject to KSEBL's approval. They shall be flush mounted with connections from inside, and shall have transparent & dust tight cover, removable from front, draw-out type construction for easy replacement and testing facility. The auxiliary relays and timers may be provided in fixed cases. All relays and timers shall operate on available DC supply and not have any inbuilt batteries. They shall be provided with hand-reset operation indicators (flags) or LEDs with push buttons for resetting.

All equipment shall have necessary protections. However, following minimum protections shall be provided.

Motor feeders (motors rated up to 160 kW):

- Instantaneous short circuit protection on all phases
- Thermal overload protection
- Single phasing protection for motors protected by fuses.

All meters / instruments shall be flush mounted on front panel, at least 96 sq.mm size with 90 degree line scales and accuracy class of minimum 2.0. All motors of 10 kW and above shall have an Ammeter. Bus-sections have bus VT, voltmeter with selector switch, and other relays and timers required for protection. Adequate control and selector switches, push buttons and indicating lamps shall be provided. Thermostatic controlled space heaters with switches shall be provided to prevent condensation.

Current Transformers of required ratios shall be provided in the panels as per details in the protection scheme submitted for approval. CT cores rating and type shall be subject to approval by the KSEBL.

1.3.8.6.2.2 Bus-Bars and Insulators

All busbar and jumper connections shall be of high conductivity aluminium alloy / copper. They shall be adequately supported on insulators to withstand electrical and mechanical stresses due to specified short circuit currents. Busbar cross-section shall be uniform throughout the length of switchgear. Busbars and other high voltage connection shall be sufficiently corona free at maximum working voltage. Contact surfaces at all joints shall be silver plated or properly cleaned and non-oxide grease applied to ensure an efficient and trouble free connection. All bolted joints shall have necessary plain and spring washers. All

connection hardware shall have high corrosion resistance. Bimetallic connectors or any other technically proven method shall be used for aluminum to copper connections.

Busbar insulators shall be of arc and track resistant, high strength, non-hygroscopic, non-combustible type and shall be suitable to withstand stresses due to over-voltages, and short circuit current. Busbar shall be supported on the insulators such that the conductor expansion and contraction are allowed without straining the insulators.

1.3.8.6.2.3 Instrument Transformers

All current and voltage transformers shall be completely encapsulated cast resin insulated type, suitable for continuous operation at the ambient temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated load and the outside ambient temperature is 50 deg. C. The class of insulation shall be E or better.

All instrument transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to separate terminals on an accessible terminal block.

Current transformers may be multi or single core and shall be located in the cable termination compartment. All voltage transformers shall be single phase type. The bus VTs shall be housed in a separate panel on a truck so as to be fully withdrawable.

1.3.8.6.2.4 Power Cable Termination

Cable termination compartment shall have provision for termination of power cables of sizes as indicated during detailed engineering with removable undrilled gland plates. For all single core cables gland plates shall be of nonmagnetic material. Cable entry shall be from bottom.

A minimum clearance of about 600 mm shall be kept between the cable lug bottom ends and gland plates for stress cone formation for XLPE cables. Inter-phase clearance in the cable termination compartment shall be adequate to meet electrical and mechanical requirement besides facilitating easy connections and disconnection of cables. Dimensional drawing of cable connection compartment showing the location of lug, glands, CTs, gland plates etc... and the electrical clearances available shall be submitted for KSEBL's approval during detail engineering.

1.3.8.6.2.5 110V DC Supply System

The 110V DC system shall, in general, comprise of the following:

- 110V Flooded type Lead Acid battery (Plante type) of adequate capacity, complete

1.3.9 Power and Control Cables

1.3.9.1 Introduction

This section covers the KSEBL's basic requirements for the design, manufacture, testing at manufacturer works, standard and quality of workmanship, general finish of plant, compliance to the latest published edition (prior to the date of closing of tender) of the international standards and recommendations specified throughout the specifications, supply, insurance, delivery and storing at site, erection, site testing, commissioning, performance and reliability confirmation, warranty confirmation of the power and control cables complete with cable terminals and all accessories for making the systems complete in the Powerhouse and Switch-yard.

1.3.9.2 Reference Standards and Codes

The equipment shall be designed, manufactured, tested, installed and commissioned in accordance with the latest revision of applicable IS / IEC or equivalent standards.

The Contractor shall adhere to sound design and construction practices with regard to codes and material specifications in order to warrant operational safety and ease of maintenance of plants as well as simplicity of control and stability in plant operation.

- IS 7098 (Part-1) Cross linked polyethylene insulated PVC sheathed cables for working voltage up to and including 1.1kV.
- IS 7098 (Part-2) Cross linked polyethylene insulated PVC sheathed cables for working voltage from 3.3kV up to and including 33kV.
- IS 10418 Drums for cables.
- IS 8130 Conductors for insulated electric cables and flexible cords.
- IS 10877 Moulds for cast resin based straight through joints for cable for working voltage 3.3kV and above up to and including 11kV.
- IS 8308 Compression type tubular inline connectors for aluminium conductors.
- IS 8309 Compression type tubular terminals for aluminium conductors.
- IS 8438 Moulds of cast resin based straight joints of cable up to including 1.1kV.

- IS 11967 Specifications for co-axial cables.
- IS : 2062 Specification of Structural Steel for fabrication.
- IS : 513 Cold rolled low carbon steel sheets & strips.
- IS : 277 Galvanized sheet steel.
- IS : 808 Rolled Steel Beam, Channels and Angle section.
- IS : 2629 Recommended practice for hot dip galvanizing of iron and steel.
- IS : 2633 Method of testing uniformity of coating on zinc coated articles.
- IS : 800 Specification for use of structural steel in general building construction.
- IS 732 Code of practice for Electrical wiring installation.
- IS 694 PVC insulated cable for working voltages up to and including 1100 volts.
- IS 9537 Specification for conduits for Electrical Installations.
- IS 1554 PVC insulated cables upto and including 1100 volts.

Cables and other accessories complying with other internationally accepted standards such as IEC, IEEE, BS etc... will also be accepted if they ensure performance and constructional features equivalent or superior to standards listed above.

1.3.9.3 Reference Sections

Section 1.1	General Technical Requirements.
Section 1.3.5	Control and Monitoring System.
Section 1.3.6	Protection.
Section 1.4.3	Switch-yard Equipment.

1.3.9.4 Submittal and Approvals

The Contractor shall seek the prior approval of the KSEBL for the following through timely submittal.

- The Calculation for fault level and short circuit calculation for selecting the cable

size, Cable schedule.

- The Contractor shall purchase equipment from reputed vendors only and the name of vendors shall be submitted for KSEBL's approval.
- Material certificates and test reports.
- Erection, Testing and Commissioning methodology.

Before delivery of equipment to site, the contractor shall submit all work test certificates / reports for approval and obtain despatch clearance from the KSEBL's representative.

1.3.9.5 Deliverable Documents

- Layout drawings of the power house showing the detailed arrangement of cable trenches, cable racks etc...
- Design calculations for selection of cables.
- Erection, Testing and Commissioning methodology.
- Test Report / Data.

1.3.9.6 KSEBL's other Requirements

The tentative layouts of the powerhouse and switch-yard are given in drawings appended to the specifications.

The power, control, instrumentation and communication cables are required for interconnection between various equipment panels, control, protection, monitoring, interlocking, tripping, alarm, indication, annunciation, data communication of various system conditions of the power house equipment.

All cables shall be Fire Retardant Low Smoke (FRLS) type.

The cables shall be sized based on the following considerations:

- Rated current of the equipment
- The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage.
- Short circuit withstand capability.

De-rating factor for various conditions of installations including the following shall be

considered while selecting the cable size.

- Variation in ambient temperature for cables laid in air.
- Grouping of cable.
- Variation in ground temperature and soil resistivity for buried cables.

All cables shall be designed to cope with the short circuit conditions and voltage drop. Maximum short circuit current for 11 kV & 415 V systems may be taken as 40 kA and 25 kA respectively. Size of aluminium power cable shall in no case be less than 16 mm^2 Where there is requirement of cables less than 16 mm^2, copper cable of appropriate size may be used. Minimum size of the control cable for CT & PT circuit shall be 4 mm^2. Screened control cable for C&I purpose shall be minimum of 0.5 mm2 subject to verification by sizing calculation.

The cables shall be capable of satisfactory operation under a power supply system voltage variation of ± 10% and frequency variation of ± 5%. The cables shall have heat and moisture resistant properties. These shall be of type and design with proven record of power station installations.

Sufficient cores in control cables shall be kept as spare cores in cable scheduling for future use. Before charging of cables all wiring / cable shall be checked as per cable schedule Programme.

Cable lengths shall be considered in such a way that straight through cable joint is avoided.

Contractor shall be responsible for complete design of the cable network comprising of following:

a) Preparation of co-ordinated drawings for termination of cables for all equipment in power house including turbine, generator, transformer, HV & LV switchgear, D.C. cables etc...

b) Cable routing drawings and the estimation of cable quantities of different sizes.

c) Preparation of cable schedules.

d) All cable termination kits including cable termination kits for high voltage cable and cable glands for low voltage power cables and control cables.

e) Cable conduits / pipes, cable glands etc...

f) Cable identification tags for cables and wires, lugs etc...

Any other item necessary for completeness of the cable, cable laying termination system shall be supplied.

1.3.9.7 Scope of Work

The intent of scope is to provide all cabling, cable routing & termination in power house and all adjoining functional areas.

The scope of work shall be a comprehensive functional system complete in every respect including but not limited to following.

Power control cable shall comprise of:

- 1 lot – 11kV XLPE power cable (High voltage cable).
- 1 lot – 600 / 1000 volt grade power cable (Low voltage cable).
- 1 lot - Control, instrumentation and communication cables.
- 1 lot - Cable trays, supporting steel structures, cable terminals, termination kit, cable lugs, cable glands, PVC conduits, button tape (strap & stud), and cable junction boxes, hydraulic operated crimping tools and control cable crimping tools and all other accessories.
- All special devices, tools, maintenance equipment etc... required for installation, testing, commissioning and maintenance of power and control cable.
- Set of spares.

The contractor shall assess the quantity of various sizes of the power, control, instrumentation and communication cables & its accessories along with cable racks & trays including the mandatory spares required for the project. The number of cores and sizes of the cables required for various circuits shall be worked out during detailed engineering.

Any item of work not specifically mentioned in the specifications but which are usual and / or necessary for the satisfactory operation of the equipment supplied shall be deemed to be provided by the Contractor and included in the quoted Price. All work shall be complete in all details whether such details are mentioned in the specifications or not.

1.3.9.8 Power Cables

1.3.9.8.1 General

The continuous withstand temperature shall be 90°C and 70°C for XLPE and PVC cables respectively. The short circuit withstand temperature shall be 250°C and 160°C for XLPE and PVC cables respectively.

To facilitate easy identification of phases, colour scheme of red, yellow, blue for phases and black for neutral shall be adopted for power cables.

Straight through joints in the run of cables, wherever unavoidable will be made through joint boxes.. The design of the jointing boxes must ensure that the actual insulation strength between phases and to earth is greater than that of the associated cable and eliminate any possibility of moisture entering the joint or the compound surrounding the joint.

Provision shall exist for binding the sheaths of the two cables being joined solidly by approved means to ensure the electrical continuity of the sheath from one end of the cable run to other.

Full details of the Jointing Boxes and of the Joints including dimensions shall be given.

The Jointing Boxes shall comply in all aspects with the provision of the latest issue of relevant standards.

Heat shrinkable cable terminations wherever required shall be supplied. The termination kits shall be of reputed make only.

The Contractor shall supply all hardware, filling compounds, plumbing metal, tapes and other materials required for the making of these joints and terminal connections of the various size of cables given in the schedule of supply.

For termination of PVC cables inside the panels, cable lugs for the type and sizes of cables shall be offered. The cable lugs shall be made of copper tube electro tinned. Longneck crimping lugs shall be supplied for cables of size 300 mm^2 and above. The contractor shall ensure that no bimetallic action takes place between the Aluminium conductor of the cable and the cable connecting lugs by filling the lugs with suitable compound.

The cable glands made of brass duly electro tinned in order to avoid corrosion and oxidation of the surface, shall be offered. The nipple threads shall be in accordance with IS:12943. Glands shall provide neat, tight, dust and vermin proof termination. Glands shall be provided with rubber ring to hold the cables firmly when check nut is slightly tightened.

Glands shall be complete with suitable washers. Glands shall be of reputed make.

LV Power Cables of sizes over 16mm^2 & above shall have Aluminium Conductor & below 16 mm^2 shall have Copper conductors. For CT & PT connections, Copper conductor of size 4 mm^2 only shall be used.

1.3.9.8.2 XPLE Power Cables

XLPE cables for 11 kV system shall be single core un-armoured for indoor use and armoured for outdoor use, heavy duty, stranded, Aluminium conductor of suitable size and shall be provided with semi-conducting conductor shield, XLPE insulation, semi-conducting insulation shield, copper tapped metallic shield and PVC outer sheath conforming IS 7098 (Part II).

The semi-conducting conductor shield shall ensure perfectly smooth profile and avoid stress concentration. The conductor shield shall be extruded in the same operation as the insulation

The insulation shall be extruded type and manufacturing process shall ensure that insulation is free from voids. The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions. The extrusion method shall give very smooth interface between semi-conducting conductor shield and insulation.

A non-magnetic semi-conducting insulation shield shall be applied over insulation to confine electrical field to the insulation. The insulation shield shall be extruded in the same operation as the conductor shield and the insulation by triple extrusion process.

A copper tape / wire metallic shield shall be put over non-metallic insulation shield.

An extruded PVC outer sheath shall be applied over metallic shield with suitable additives to prevent attack by rodents and termites.

The cables shall be subjected to type, routine and acceptance tests as per applicable standard.

1.3.9.8.3 PVC Power Cables

All single core and multi core PVC cables for low voltage AC and DC system shall conform to IS:1554 (Part I). These cables shall be heavy duty, aluminium conductor, heat resistant PVC insulated, colour coded, laid up, un-armoured for indoor use and armoured for outdoor use, inner and outer extruded PVC sheath. The cable glands for all the unarmoured cables within the powerhouse can be of single compression type. The outer sheath shall be of

specially formulated PVC compound having oxygen index, smoke density, acid gas and flame propagation properties as applicable for standards for FRLS cables. All the materials used for conductor and insulation shall be new and of requisite quality. Necessary tests during the manufacture shall be conducted in conformity with standards.

1.3.9.9 Control Cables

The control cables shall be multi-core, colour coded, annealed, stranded high conductivity copper, single conductor, insulated with HR-PVC insulation, PVC sheathed, un-armoured FRLS type conforming to is 1554 (part I & II) / relevant IEC. Control cables going outside of power house shall also be armoured, FRLS type. The outer sheath is of specially formulated PVC compound. The conductor shall be made from stranded annealed copper to form compact conductor having a resistance within the limits specified in relevant IS / IEC.

All the cables shall carry manufacturer's data in a permanent, legible manner at an interval of at least 3 metre run. The manufacturer's data shall include the name; cable size, voltage rating together with any other information.

To facilitate easy identification of cores, multi-core control and instrumentation cables shall be colour coded by using PVC insulation of red, black, yellow, blue and grey colours in accordance with IS:1554 (Part I).

Compression type terminals would be offered for control cables. These terminals shall be suitable for crimping to the conductor. The cable lugs shall be made of copper type electro-tinned.

The cable glands shall be double compression type and shall be made of brass duly electro-tinned in order to avoid corrosion and oxidation of the surface. The nipple threads shall be in accordance with IS:12943 / IEC. Glands shall provide neat, tight, dust and vermin proof termination. Gland shall be provided with rubber ring to hold the cables firmly when check nut is slightly tightened. Glands shall be complete with suitable washers etc...

Button Tape (Strap & Stud) consists of perforated cable strapping with holes conveniently spaced for assembly and moulded studs. The strapping shall be made of NYLON Grade 220 or other elastic material to give proper performance. The studs shall be made of 'NYLON'.

Self-adhesive marker in the form of strips of any one character, which can be easily peeled from the backing cards and can be applied on the cable, shall be supplied. The strips shall

be water- proof duly marked with special formulated ink with specific thermo-setting adhesive to withstand high temperature.

Suitable plastic ring type ferrules marked with engraved indelible ink for control cables and sticker type ferrules for power cables shall be supplied. These shall be marked as per cable schedule such that each core of each cable can be identified easily.

Aluminium strip of adequate size for making tags for labels shall be supplied. Good quality PVC tapes, cotton tapes and any other accessories required for laying, termination, testing & commissioning shall be supplied conforming to relevant IS.

Cables passing through different fire zones shall be provided with fire-proof barriers with the same fire rating as the penetrated walls or partitions. The location of such barriers shall be finalized during execution work.

1.3.9.10 Instrumentation Cables

The instrumentation cables in addition to meeting the requirements of control cables shall be provided with electrostatic shielding by aluminium tape and screening by annealed tinned copper wire. Each cable shall consist of twisted pairs having an overall screen only or multiple fibres, together with drain wires, fillers, shielding, wire, armour and outer sheath in accordance with relevant IS and IEC standards.

1.3.9.11 Communication Cables

The cable shall have braided tinned Copper conductor.

1.3.9.12 Cable Routing

For the main cable ways, a system of cable racks and trays as well as cable ducts and trenches shall be provided. The power and the control cables will run on separate trays. The cables for emergency lighting, fire alarm systems, etc..., shall run on separate trays.

The power cables shall be laid on the uppermost rack to prevent spread of fire.

All cables laid by the contractor shall be terminated at both ends. The contractor shall make all electrical connections strictly in accordance with the contractor's cable schedule approved by purchaser and shall provide numbered ferrules at each connecting terminal in order to check connections without any difficulty. Terminal blocks have been provided in various panels / equipment for these terminations. One termination shall mean connecting both ends of one core of a cable to given terminal blocks. The cables shall be terminated by crimping lugs to the ends.

The cables shall be handled with care so as to avoid kinking and damage. Sufficient slack shall be allowed in each run of cable to permit contraction and expansion.

Suitable loops between gland and terminating point shall also be provided.

Contractor shall take proper care in the handling of cables against external damage of any kind. Necessary rollers etc... shall be used while pulling and laying of the cables. Purchaser shall have the right to stop the work in case of improper handling of the cables.

Cables shall be properly clamped at regular intervals with the help of non magnetic / moulded fibre glass strip clamps / PVC sleeved clamps, of suitable size. Contractor shall submit typical drawings along with tender giving proposed clamping arrangement and also give distance of clamping at bends and in regular run of cables.

Power and control cables shall be flame retardant low smoke (FRLS) type. However, fire survival (FS) cables shall be provided for certain essential auxiliaries / areas. Cables to be directly buried shall be essentially armoured type. FRLS cables and FS cables shall meet test requirements as per relevant IS, ASTM, IEC and IEEE Standards.

Derating factors for site ambient and ground temperatures, grouping and soil resistivity shall be considered while determining the size of cables.

Cable installation shall be carried out as per relevant IS and other applicable standards. Power cables and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables with higher voltage grade cables in topmost tier and control cables in bottommost tier. All cables associated with one unit shall preferably be segregated from cables of other units. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

A comprehensive philosophy of segregation/ separation of cables of different types / voltages shall be adopted for cable installation. For laying of cables in a power house, a broad based system involving cable gallery, tunnels, trenches, cable racks, shafts etc... shall be provided. In outdoor switchyards, a cable trench system shall be provided. The main considerations / practices shall be:

- Segregation and proper spacing shall be maintained.
- Control, auxiliary low voltage (upto 1.1kV) power and medium voltage (above 1.1kV and upto 66kV) power cables shall be laid in separate trays.
- Proper attention shall be given to ventilation / heat dissipation aspects particularly in case of HV cables.

1.3.9.13 Cable Markers and Cable Binding

Suitable cable markers of aluminium with punch marks shall be provided and suitably tagged to the cable permanently so that cable could be easily identified.

The contractor shall also be responsible for sealing the spare holes and panel circuits with the help of suitable blanking plates or mutually agreed method.

Each cable should be provided with a metal or plastic tag of an approved type, bearing cable reference number indicated in the cable schedule prepared by the contractor, at every 10 metres run and at both ends of the cable, adjacent to the termination as well as where cable enters or leaves the ducts.

When power cables are laid in the proximity of communication cables, the minimum horizontal and vertical separation between them shall be 600 mm. Wherever possible the power and the communication cables shall be located as far from each other as possible.

1.3.9.14 Cable Trays and Support Structure

The contractor shall fabricate and supply the mounting arrangement for the support and installation of all the cable trays on galvanized steel structure including channels, angles, rods etc... at requisite spacing in the suspended cable trays, cable trenches in turbine and generator floors, cable trenches in Switch-gear floor, Interconnection between power house & yard and all other areas requiring supporting arrangement.

The contractor shall provide embedment / anchor fasteners for fixing the supporting structures. These supporting structures shall be fabricated from structural steel members (channels, angles and rods) of the required size. The steel section for fabrication of trays and supports shall be arranged by the contractor himself and steel sections shall be SAIL / TISCO / IISCO make only.

The vertical member of the support will be of ISRO12 threaded rod or ISMC100 channel. The horizontal member of the support will be of angle ISA 50x50x6. For the threaded rod support configuration the horizontal member shall be fixed by welding to the channel.

Trays shall be of ladder type. The side channel (Runners) shall be of size 20x100x20 mm and the cross channel (Rungs) shall be of size 20x40x20 mm. The trays shall be fabricated from Hot Rolled Carbon Mild Steel (conforming to IS 1079, Grade “O”, of chemical composition C, Si, Mn, S, Ph) sheet of thickness 2mm.The length of each tray shall be of 2500mm and the spacing between the two rungs shall be 250mm at centre to centre. The rungs shall be slotted and shall be welded to the side channels. The trays shall be Hot Dip

Galvanised after Finish (as per IS 2629 / ASTM: A123-97m). The minimum zinc deposit shall be 460gms / sq.metre and the thickness shall be 56 micron minimum.

Cable trays shall be fixed with support by hold-down clamps. The clamps shall be fabricated from MS sheet of 2 mm thickness and Hot Dip Galvanised.

The contractor shall supply various tray fittings and accessories like coupler plate with fasteners, horizontal tees, vertical and horizontal elbows, vertical and horizontal adjustable connectors required for the mentioned trays. The cable trays shall be part of a modular system having available all required accessories and transition pieces from one to another direction or elevation. All accessories, fittings, elbows and tees shall be Hot Dip Galvanised after Finish. The nuts, bolts and washers shall be cadmium plated or electrolitically galvanised.

The contractor shall install the cable trays in accordance with relevant standards. The contractor's standard practice shall be furnished with the bid. The contractor shall ensure proper earthing of the trays and continuity between tray components. The necessary materials required for the earthing are in the scope of supply. The risers of the main earthing system shall be available for the connection.

For the supporting structure the threaded rod will be supported from roof through anchor fasteners whereas the channel will be supported by welding to the inserted plate (the inserted plate shall be fixed to the roof through anchor fasteners). For the trenches the supports shall be fixed to the sidewall through anchor fasteners. The distance between the two support systems will be 1500 mm. The bidder shall furnish drawings for the various supporting structure as mentioned above.

1.3.9.15 Tests

The Contractor shall submit a copy of test certificates for the type tests as stipulated in IS:1554 (Part I) and relevant IEC, carried out either in the manufacturer's works or any approved Laboratory.

Before dispatch, sample pieces of the cable shall be subjected to all type, routine, acceptance and FRLS tests at the manufacturer's works as stipulated in IS:1554 (Part I) / IEC in the presence of purchaser or his representative.

1.3.9.15.1 Type Test

The following type tests and FRLS tests shall be carried out on the cables. The purchaser may accept type test & FRLS tests certificates in lieu of tests.

a) *Tests on conductor.*

i. *Annealing test (for Cu.)*

ii. *Wrapping test (for Al.).*

iii. *Conductor resistance test.*

b) *Test for armouring wires / trips.*

i. Nominal thickness (for steel strip).

ii. Nominal diameter (for round wire).

c) *Test for thickness of insulation and sheath*

d) *Physical test for insulation and outer sheath*

i. Tensile strength and elongation at break of insulation and sheath.

ii. Ageing in air oven.

iii. Shrinkage test.

iv. Hot deformation.

v. Loss of mass in air oven.

vi. Heat shock test.

vii. Thermal stability.

e) *Insulation resistance test.*

f) *High voltage test (water immersion test).*

g) *High voltage test at room temperature.*

The following FRLS tests shall be conducted:

a) HCL gas evolution test (IEC 754.1).

b) Oxygen Index (ASTM-D-2863).

c) Temperature Index (ASTM-D-2863).

d) Smoke density test (ASTM-D-2863).

e) Flammability test (IEC 332.1).

f) Swedish Chimney test (SS 4241425).

g) Ladder test (IEEE 383).

1.3.9.15.2 Routine Tests

Routine tests and acceptance tests as per relevant standards shall be carried out on each cable in presence of the purchaser / purchaser's representative. The Contractor shall carry out including but not limited to the following routine tests:

a) Conductor resistance test.

b) High voltage test at room temperature.

c) Insulation resistance tests.

d) Annealing test (for Cu.).

e) Tensile test (for Al.).

f) Wrapping test (for Al.).

g) Test for thickness of insulation and sheath.

h) Tensile strength and elongation at break of insulation and sheath.

1.3.9.15.3 Site Tests

Before commissioning of complete system all cabling system shall be checked as per cable schedule and complete report shall be prepared by Contractor and shall be submitted.

Site test shall include:

a) Cabling checking.

b) Continuity checking.

c) Megger testing in accordance with the applicable codes and standards.

d) Resistance checking.

1.3.9.16 Crimping Tool

A crimping tool suitable for manual operation for making joints with lugs for Aluminium conductor up to size of 50 mm^2 shall be included in the offer.

A portable hydraulic crimping tool for making compression terminal on the cable conductor up to size 500 mm^2 shall also be offered.

1.3.9.17 Spares

The following spares for Power & Control Cables Including Cable Trays under this Contract, shall be supplied.

Description	Quantity
Cable 11 kV	One run of cable.
Cable “Tray of each size	5% of installed quantity.
Cable supports, hardware etc...	5% of installed quantity.

A complete set of spares recommended by the manufacturer as essential for the satisfactory and trouble free operation of the equipment as per Clause 1.1.32 under Section-1 of this specification, needed for 5 years operation of the above equipment, shall be supplied.

1.3.10 ~~Lighting~~ and Grounding

1.3.10.1 Introduction

This section covers the KSEBL's requirements for the design, manufacture, testing at manufacturer works, standard and quality of workmanship, general finish of plant, compliance to the latest published edition (prior to the date of closing of tender) of the international standards and recommendations specified throughout the specifications, supply, insurance, delivery and storing at site, erection, site testing, commissioning, performance and reliability confirmation, warranty confirmation etc... of the lighting, earthing and lightning protection systems of the electrical installations in the powerhouse.

1.3.10.2 Reference Standards and Codes

The Equipment shall be designed, manufactured, tested, installed and commissioned in accordance with the latest revision of applicable IS / IEC or equivalent standards.

The Contractor shall adhere to sound design and construction practices with regard to codes and material specifications in order to warrant operational safety and ease of maintenance of plants as well as simplicity of control and stability in plant operation.

- IS 3043 - Code of Practice for Earthing
- IS 4013 - Dust-tight Light Fittings
- IS 1944 - General Lighting
- IS 6665 - Code of practice for industrial lighting.
- IS 9583 - Emergency Lighting System
- IS 1913 - General and Safety Requirements for Luminaries
- IS 3646 - Illumination and glass index
- IS 694 - Wires
- IS 732 - Wiring installation conditions
- IS 2309 - Code of Practice for the protection of buildings and allied structure against lightning.
- IEC 62305 - Protection against Lightning
- IEC 61140 - Protection against Electric shock
- IEEE 80 - Guide for Safety AC Substation Grounding

- IEEE 665 - Guide for Generating Station Grounding
- IEEE 142 - Recommended practice for grounding of industrial and commercial power systems.

1.3.10.3 Reference Sections

Section 1.1	-	General Technical Requirements
Section 1.3.5	-	Control and Monitoring
Section 1.3.6	-	Protection
Section 1.4.3	-	Switch-yard Equipment
Part - 2	-	Specific Requirements for the Project

1.3.10.4 Submittals and Approvals

The Contractor shall seek the prior approval of the KSEBL for the following through timely submittals.

- The design data, design calculations and drawings of earthing, lighting and lightning protection systems.
- The Contractor shall purchase equipment from reputed vendors only and the name of vendors shall be submitted for KSEBL's approval.
- Material certificates and test reports
- Erection, testing and commissioning methodology

Before delivery of equipment to site, the contractor shall submit all work test certificates / reports for approval and obtain despatch clearance from the KSEBL's representative.

1.3.10.5 Deliverable Documents

- Layout drawings of the power house showing the detailed arrangement of Lighting installations, Earth mat / ground electrodes, protection systems etc... clearly indicating dimensions and all important elevations.
- Design data / calculations for lighting, grounding, lightning protection etc...
- Illumination calculations for arriving at the number of lighting fixtures for different areas & rooms.
- Typical installation details based on the above and bill of materials.

- A complete list giving details of equipment and auxiliaries.
- Operation and maintenance manual covering full details of operation and repair procedure.

1.3.10.6 KSEBL's other Requirements

Other technical requirements shall be as given in Part-2 (Specific Requirements of the Project) of this specification.

The tentative layouts of the powerhouse are given in drawings appended to the specifications.

All equipment shall be neatly arranged and shall be readily and easily accessible for operation and maintenance.

1.3.10.6.1 Scope of Work

Scope of work shall be as per Part-2, Specific requirements of the project. Any item of work not specifically mentioned in the specifications but which are usual and / or necessary for the satisfactory operation of the equipment supplied shall be deemed to be provided by the Contractor and included in the quoted Price. All work shall be complete in all details whether such details are mentioned in the specifications or not.

Earthing System

The contractor shall be responsible to take measurements to determine the soil resistivity of the site to design the ground mat. Based on measured resistivity of the site, the contractor shall make the design and the calculation of the whole grounding system of the powerhouse area, discharge area of tailrace, switchyard area and other adjoining functional areas. The contractor shall supply, install and supervise all grounding conductors, grounding rods, connection material for the complete embedded grounding system. The concreting of the embedded grounding system shall be done by the civil contractor under the supervision of the contractor for the electromechanical lot.

The contractor shall supply and install all grounding conductors, connection materials etc... for the internal connection of all equipment, steel structures and metal parts and all connection to the embedded grounding system.

The earthing system shall mainly consist of:

- An embedded earthing system in the powerhouse area.

- An embedded earthing system in the transformer bay in switch-yard area connected with the power house earthing system.
- An embedded earthing system in the discharge area of the tail-race, connected with the powerhouse earthing system.
- An interconnected above ground / above floor main earthing network at the powerhouse area, switch-yard and to the other places wherever needed shall be laid. From this earthing network, the equipment conductor shall run to all machinery, equipment and other parts, which are to be earthed.
- The earth electrode system as well as other earthing networks shall be designed and constructed for the operating voltages, the short circuit capacities and the corresponding short circuit and earth fault currents.
- Independent earthing system for electronic panels as per requirement of manufacturer.

1.3.10.6.1.1 Earthing System

The Contractor shall design the grounding system for all electrical installations in the powerhouse, transformer bay and switch-yard, based on the actual measurement of soil resistivity and earth resistance at site (minimum 10 locations as approved by the KSEBL). The method adopted for soil measurement shall be submitted to the KSEBL for approval and site measurements shall be made in the presence of KSEBL's representative. The Contractor shall measure the soil resistivity before and after excavation of soil. Detailed grounding system calculation along with all drawings and supporting calculations shall be submitted for KSEBL's approval before executing the work.

All off-site areas shall be interconnected together by minimum two parallel conductors. If separate earth mat is provided for the Powerhouse site and switch-yard due to practical difficulties like larger distance of separation, then the two mats will be joined together through 3 parallel conductors of the same cross section as those of conductors used in the mats. Contractor shall obtain all necessary statutory approvals for the system.

After construction of the grounding system, field measurement of resistance of earthing system and review of step voltage at periphery, internal step and touch voltages and investigation of transferred potential and special danger points etc... shall be done by the Contractor. Modification of the grounding system, if necessary, shall be carried out. All the field measurements shall be done as per relevant standards or guidelines under the presence of KSEBL's Engineers.

Artificial treatment of the soil shall be done, if necessary, for maintaining desired low resistance of the earthing system and KSEBL's approval shall be obtained prior to the work.

The grounding system shall be designed with the following objectives:

i. To provide low impedance path to fault currents, during ground faults, to ensure prompt and consistent operation of protective devices to effect isolation.

ii. To keep the maximum voltage gradient during ground faults along the surface inside and around the power house within safe limits.

iii. To protect the life and property from electrical shocks due to over voltage.

iv. To stabilize circuit potentials with respect to ground and limit the overall potential rise.

v. Limiting the induced capacitive transformed voltages on electronic cables, circuits, panels and other equipment to low voltage, weak current.

The grounding system of earth mat comprises of closed current conductor grid of steel laid over the excavated surface of power house and shall extend to the penstock and tailrace, if required to obtain the path of low resistance for passage of heavy currents during the fault. A number of ground rods (32 mm dia. x 3000 mm long) shall be added to the earth mat to obtain consistently lower resistance under all weather conditions. The earth mat shall be connected to the following in powerhouse.

i. The neutral point of each system / equipment through its own independent earth.

ii. Equipment framework and other non-current carrying parts.

iii. All extraneous metallic frame work not associated with equipment.

iv. The earth point of lightning arrestors; voltage transformers and lightning conductors through their permanent independent earth electrodes.

The conductor shall be of adequate cross-section to safely withstand the system fault current for time duration of fault clearance by the remotest / back up protective system. Also sufficient allowance needs to be provided for corrosion of the embedded conductor on account of chemical properties of soil and also due to galvanic action with other embedded systems.

To protect the power house building, the lightning conductor shall be provided on the top. This may be connected to the station mat by GS flat.

Requirements of Earthing:

a) Conductor Size

The earthing system (earth mat) shall consist of:

- An earthing grid of mild steel conductors of size not less than 32 mm diameter buried in the ground in powerhouse, transformer bay and switch-yard and extended suitably in required areas so that the earth resistance is maintained below 0.5 ohm. Depth of Burial of main earth conductor shall be at least 600mm below grade level. Where it crosses cable trenches, pipes, ducts tunnels, rail tracks, etc...,it shall be at least 300 mm below them.
- An interconnection of main earthing network at the powerhouse, transformer bay, switch-yard and other places, where needed.
- Risers and horizontal runners from the grounding network to each item of machinery and other parts which are to be earthed.
- The system shall be designed and constructed for the operating voltages, the design short circuit capacities and the corresponding short circuit and earth fault currents.
- Adequate protection for personnel against dangerous voltages, currents and arcs.
- All conductor joints shall be joined 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.
- Minimum corrosion rate to be considered shall be 0.25mm per year.

b) Current carrying capacity

Any conductor, electrode or connection used in the grounding system should be large enough to carry the following currents without excessive heating.

- Fault currents of magnitude and duration such as to produce maximum heating effect in the grounding system components,
- Currents caused by direct lightning strokes, or induced by a lightning stroke,
- The current that may be expected to flow in the grounding system as a result of sustained system neutral currents.

c) Control of ground potential and gradients

The grounding system should provide a low impedance path to ground for fault currents, neutral currents and lightning discharges with uniform or near uniform potentials of earth surfaces in the area under consideration. This result shall be accomplished without occurrence of hazardous potential differences between any surfaces on which a person may be standing and any surrounding structures or objects within his reach and also without the imposition of dangerous differences of potential on equipment and circuits.

In situations where the impedance is such that potentials in the vicinity cannot be kept reasonably safe, special arrangements of the grounding system should be devised.

d) Mechanical reliability

The design and installation of conductors, electrodes and connectors of the grounding system should be adequate to minimize the possibility of mechanical damage in order to maintain the reliability and continuity of the grounding system. The earthing system life expectancy shall be minimum 40 years.

e) Electrical reliability

The design and installation of the grounding should be such as to maintain the performance requirements with regard to current carrying capacity and control of ground potentials.

f) Resistance to corrosion

The design and installation should be suitable for preventing deterioration from corrosion. The installation should be compatible with the surrounding soil atmosphere.

g) Low impedance for system operation

The impedance of the grounding system should be sufficiently low to stabilize the system potential with respect to ground, to provide positive operation of the over-current devices, to improve voltage regulation and to restrict potentials to suitably low values in those circuits where the grounding system is required to carry a portion of the neutral current.

h) Provision for testing and inspection

The design of the grounding system should be such as to permit adequate testing and inspection. From the points of safety and interference, the following three basic requirements are applicable for grounding system.

- It shall provide safety for personnel by connecting to a common earth all metallic items of the plant, which could otherwise acquire a different potential in the event of an insulation breakdown.
- It shall limit the touch and step voltages and the conductive interferences that could arise from the worst-case fault condition to acceptable levels.
- It shall, by appropriate design layout, limit its own internal voltage drops and be utilized where necessary to provide screening for auxiliary cables against inductive interferences.

i) Connections

- All the metallic parts of the equipment and installations in the powerhouse, transformer bay, switch-yard, auxiliary equipment and systems etc... shall be connected to the grounding system as prescribed in the relevant standards and guidelines.
- All Junctions (crossing of the steel electrodes) while forming the earth mat and taking risers from the earth-mat for giving earth connections to equipment, steel structural conducts, cable sheaths shall be properly welded.
- Welding done shall be given a coat of black asphaltic varnish and then covered with hessian tape to avoid rusting.
- The risers taken along the main switch-yard structures and equipment structures (up to their top) shall be clamped to the structure at an interval of not more than one metre with ground connectors.
- 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, steel supporting structures etc... shall not be used as earth continuity conductor. All hinged doors shall be earthed by flexible braids of adequate size.
- 75 x 8 mm ground conductor shall run in cable trenches and shall be connected to the ground mat at an interval of 5 metres.
- The grounding electrodes shall be driven into the ground and their tops shall be welded to a clamp and the clamp together with the grounding shall be

welded to the ground conductor.

- Structures shall not be used as a means of earthing. All steel structures shall be individually 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 galvanized. The connections shall be painted with anti-corrosive paint after testing and checking.
- Transformers and L.A's and single phase potential transformer shall be provided with earth pits near them for earthing and these earth pits in turn shall be connected to the earth mat.
    - 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. Neutral earthing and body earthing of power transformers shall be connected to separate earth electrode.
    - Neutral connection earth pipe shall never be used for the equipment earthing.
    - 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.
    - A separate earth electrode shall be provided adjacent to the structures supporting Lightning Arrestors. Earth connection shall be as short and as straight as practicable. For arrestors mounted near for protecting transformers earth conductors shall be connected directly to the tank.
- An Earthing pad shall be provided under each operating handle of the isolator and operating mechanism of the circuit breakers. Operating handle of the isolator and supporting structures shall be bonded together by a flexible connection and connected to the earthing grid.
- Special attention shall be made for grounding of HV-GIS equipment (if provided), computer networks and communication equipment as per the

manufacturer's recommendations.

- The switch-yard surface area shall be covered by a layer of crushed rock of size 25 x 40 mm to a depth of 100mm.

1.3.10.6.1.2 Lighting System

A comprehensive illumination system shall be provided in the entire project i.e. all areas within the plant boundary. The system shall include lighting fixtures, distribution boards, lighting panels, junction boxes, lighting poles, receptacles, switchboards, cables and wires, conduits, poles and masts, etc... The system shall cover all interior and exterior lighting such as area lighting, yard lighting, street lighting, security lighting, etc...

Adequate illumination shall be provided as per relevant IS. Apart from normal AC illumination system, emergency AC and DC illumination at strategic locations shall also be provided. DC illumination shall be provided to enable safe movement of personnel and access to important control points during an emergency.

Energy conservation measures shall be adopted, while designing the lighting system. Sodium vapour (high pressure) or other more efficient latest technology lighting fixtures shall be preferred for outdoor lighting of areas such as switch-yards, storage yard, parking areas etc.., Automatic switching via photo electric cells can be adopted for outdoor lighting to optimise power consumption.

Metal halide fixtures shall be used for certain indoor areas such as erection bay, generator hall, machine hall, turbine pit and other high bay areas where proper colour rendition is needed and long-life is essential.

Incandescent lamps shall be used only for battery powered emergency lights and for certain places where lights shall not be turned on continuously or where fluorescent fixtures are impractical.

Design Criteria

The illumination system shall be designed on basis of best engineering practice and shall ensure uniform, reliable, aesthetically pleasing, glare free illumination. The design shall prevent glare / luminous patch seen on VDU screens, when viewed from an angle.

Power supply shall be fed from 415 / 240 V normal AC power supply, station service board, and 110 V DC supply for emergency lighting. Lighting panels shall be located at different convenient locations for feeding various circuits. These panels shall be robust in construction with lockable arrangements and MCB for different circuits.

and one bus coupler ACB. All incomer and bus coupler ACBs shall be of 4 poles. There shall be outgoing ACBs to each Unit Auxiliary Boards and common Auxiliary board. The common Auxiliary LT board shall be fed from both bus bars. All incomer, outgoing and tie feeders shall be equipped with ACBs at both ends. The incomers and bus coupler ACBs shall be properly interlocked. One outgoing ACB shall be provided as spare on both bus sections. The UAB shall be provided with one incomer from main LT Bus also.

[The scope of supply is for 4 No. of SSBs (1 for each machine and one main station service board only). One emergency feeder is also there. Emergency & SST are different feeders. Incomers required are UAT-1, UAT-2, UAT-3, UNIT 4, DG, SST & Emergency feeder. Even though the DG sets are not in scope of supply of this contract, but there shall be provision for incomer supply from DG set. The Unit 4 and UAT-4 are one and the same, but the cabling of unit-4 to Main station supply board incomer feeder is not included in scope. The type of connection of various incomers of SSB Panel is through cables only. The Emergency feeder is fed from regional source. The terms Common Auxiliary LT board & LT

415 V Switchgears		
Switchgear	Fully drawout type single front	
MCC	Fully drawout type	double front

will not entitle the Successful Bidder / Contractor for any extra charges. The Contractor should submit for approval the calculations for arriving at the ratings of the various equipment during detailed engineering.

2.2.4.1.1 LT Switchboard

The powerhouse shall be equipped with one low-tension switchboard located on the generator floor availing LT supply from the station service transformer and in the case of standstill condition of the generator from external source. There shall be separate feeders to each unit auxiliary board with sufficient protective interlocking facility. The LT Panel should be equipped with coupling facility for the segregation of LT Bus.

Sufficient number of outgoing circuits shall be provided for the auxiliary service in the station.

[The location / layout / SLD based on the specification are in the scope of this contract.]

TITLE	SPECIFICATION NO.
LV MOTORS	VOLUME II B
	SECTION D
DATA SHEET-A	REV NO. 00 DATE 12.08.21
	SHEET 1 OF 1

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	≤200KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection (Indoor/Outdoor)	:	IP54/IP55
5.0	Type of Cooling	:	TEFC/CACA/TETV
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –3%)
	c) Combined voltage & freq. variation	:	10%
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	o 110kW & Above (Breaker controlled)	:	50 kA for 1 sec
	o Below 110kW (SFU+ Contactor controlled)	:	50 KA for 0.20 sec.
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Class 'F', with temp rise limited to class B.
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	85% of rated voltage
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW
13.0	Tests	:	As per Customer motor spec. (enclosed)
14.0	Energy efficient/ Flame proof motor	:	IE3 conforming to latest edition of IS-12615

- **Also detail Customer spec. for Motors to be referred as enclosed with spec.**

DATASHEET-A

1.0 APPLICABLE STANDARDS

a)	IS: 1079	For hot rolled carbon steel sheet and strip.
b)	IS: 1730	For dimensions for steel sheet and strip.
c)	IS: 1363	Hexagon head bolts, screws and nuts.
d)	IS: 2629	For hot dip galvanising of steel & surface pre treatment.
e)	IS: 2633	For testing of zinc coating.
f)	IS: 6745	For determining of mass of zinc coating.
g)	IS: 1367 (Part-XIII)	Galvanised Coating on threaded Fasteners.
h)	IS: 1852	For Rolling and Cutting Tolerances of hot rolled steel products.
i)	IS: 9595	For Thickness of Welding.

2.0 CABLE TRAYS & ACCESSORIES

2.1	Material	:	Hot Rolled Mild Steel
2.2	Type	:	Ladder Type Perforated Type
2.3	Standard Length of Straight Length of Cable Trays	:	2.5 meters
2.4	Standard Width (mm)	:	600 450 300 150 (Ladder) 600 450 300 150 100 50 (Perforated)
2.5	Construction	:	Conforming to enclosed drawing
2.6	Bending Radius of Accessories(in mm)	:	600 mm
2.7	Tolerance in length/ Width / Height	:	+ /- 2 mm

2.8 **Thickness of the finished product shall not be less than 2.0 mm.**

3.0 FITTINGS

End connections : Through Coupler plate
(Side Coupler Plates shall be provided as part of cable tray & accessories supply with bolts, nuts, washers etc)

4.0 TRAY COVERS

a) Type	:	Non-Perforated type.
b) Material	:	Hot Rolled Mild Steel.
c) Width	:	Suitable for width of cable trays.
d) Tolerance in length/ Width / height	:	Same as cable trays.

5.0 SHEET THICKNESS before Hot Dip Galvanisation

a) For cable trays & Accessories : 2.0 mm

b) For cable tray cover : 1.6 mm

c) For Coupler plate : 2.0 mm

d) Tolerance in Thickness : + /- 0.2mm As per IS: 1852

e) Make : SAIL/TISCO/RINL/BHUSAN/JINDAL STEEL/JINDAL ISPAT/ESSAR/LLOYD/IISCO/ SAIL authorized re-rollers of SAIL

6.0 SURFACE TREATMENT

a) Pre-treatment : IS 2629 before galvanisation

b) Type : Hot dip galvanisation

c) Applicable Standard : IS 2629

d) Minimum thickness : 75 microns (minimum) for 2.0 mm thick product & 1.6 mm thick product

e) Min. weight of Zinc deposit : 610 grams per square meter for 2.0 mm thick product & 1.6 mm thick product

f) Tests for galvanizing :

(i) Weight of Zinc Coating as per IS 6745.
(ii) Thickness of Zinc Coating as per IS 4759.
(iii) Uniformity of Zinc Coating as per IS 2633.
Uniformity of coating – The coating of any article shall withstand four 1 minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.
(iv) Adhesion Test as per IS 2629.
(v) Visual inspection
The quality of cadmium/zinc plating on items with screw threads shall be inspected visually and shall be free from visible defects such as unplanted areas, blisters and modules.
(vi) In addition, the plating thickness shall be determined microscopically/chemically or electronically.

7.0 NUMBER OF COUPLER PLATES, BOLTS, WASHERS & NUTS REQUIRED FOR EACH CABLE TRAY SECTION (2.5 MTRS)

Sl. No.	NAME OF ITEM	COUPLER PLATE (nos.)	NUTS (nos.)	WASHERS (nos.)	BOLTS (nos.)
1	Cable tray of standard length 2.5 meters	4	16	32	16

NOTE: - Based on above table, no. of coupler plates, bolts, washers & nuts shall be calculated for the offered lot. Over & above the calculated quantity, additional 5% coupler plates & 10% bolts, washers & nuts shall be supplied by the bidder.

Section-D

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
	PROJECT:		PO NO.:	DATE:
	ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. 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								
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1 & NOTE-2

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	Sign & Date	Name		Sign & Date	Name
Prepared by:		HEMA KUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:		PRAVEEN DUTTA	Reviewed by:		RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. 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,
** **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

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BIDDER/ SUPPLIER	
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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL													
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TEST REPORT		P/V	-		
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, UN-EVENNESS ETC.	TEST REPORT		P	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-	-	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%	-	MANUFACTURER'S DRG./SPEC	FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK		P/V	-		
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-		HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V	-		

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Reviewed by:		PRAVEEN DUTTA	Reviewed by:		R K JAISWAL

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Seal	

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG./ STD.	TC		P/V	-		
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
		4.INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	-	ASTM-A388	MANUFACTURER'S STD.	INSPECTION REPORT	✔	P/W	V	-	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	INSPECTION REPORT		P/V	-	-	
		2. PHYSICAL COND.	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	INSPECTION REPORT		P/V	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	INSPECTION REPORT		P/V	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	TEST REPORT		P/V	-	-	

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	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
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Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-	
		2.DIMENSION(BORE DIA, WALL THICKNESS, BDV AS RECEIVED, BDV AFTER FOLDING AT 180°	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG. .	MANUFACTURER'S DRG.	LOG BOOK		P/V	-	-	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	SAMPLE	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	TC		P/V	-	-	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	TC & VENDOR'S TEST REPORTS		P/V	-	-	

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Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	LOG BOOK		P/V	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	-	MANUFACTURER'S DRG./ APPROVED DATASHEET	MANUFACTURER'S DRG./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	APPROVED DATASHEET	APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES	LOG BOOK		P/V	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P/V	-	-	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	SAMPLE	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		4.HV/IR	MA	-DO-	100%	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	-	MANUFACTURER'S DRG/SPECS	MANUFACTURER'S DRG./ SPECS.	LOG BOOK		P	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	

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	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 5 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-	MANUFACTURER'S DRG	GOOD FINISH	LOG BOOK		P/W	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	100%	-	MANUFACTURER'S STD./ ASTM-E165	MANUFACTURER'S STD./ APPROVED DATASHEET.	LOG BOOK	✔	P	V	-	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.SHADE	MA	VISUAL	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	

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Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.IR+HV-IR	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		4.RESISTANCE	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		5.INTERTURN INSULATION	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT		P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	THREE DIPS TO BE GIVEN

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:		PRAVEEN DUTTA	Reviewed by:		R K 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 :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 7 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		4.DURATION	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
		3.HV	MA	ELECT. TEST	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	100%	-	MANUFACTURER'S SPEC./ ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-	-	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	TEST/INSPC. REPORT	✔	P	V	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		2.WORKMANSHIP	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		3.AXIAL PLAY	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	
		4.DIMENSIONS	MA	MEAS.	100%	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	

BHEL					
ENGINEERING			QUALITY		
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Prepared by:		HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:		PRAVEEN DUTTA	Reviewed by:		R K 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 :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 8 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT.TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	W*	-	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST	MA	ELECT.TEST	100%	-	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	ELECT.TEST	100%	-	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT	✔	P	W	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	-	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	ELECT. & MECH. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	TC	✔	P	V$	-	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	ELECT. & MECH. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	TC	✔	P	V$	-	$ NOTE - 2
		8. NAME PLATE DETAILS	MA	VISUAL	100%	-	IS-325/IS-12615& DATA SHEET	IS-325//IS-12615 & DATA SHEET	TEST/INSPC. REPORT	✔	P	V$	-	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	-	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC	✔	P	W$	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:		PRAVEEN DUTTA	Reviewed by:		R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 9 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / (#)	AS PER MANUFACT. STANDARD / (#)	INSPC. REPORT	✔	P	W	-	(#): REFER NOTE-8

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THE SAME IS VALID FOR 5 YEARS.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

7 PROJECT SPECIFIC QP TO BE DEVELOPED BASED ON CUSTOMER REQUIREMENT.

8 FOR EXPORT JOB, BHEL TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING TO BE FOLLOWED.

9 PACKING SHALL BE SUITABLE FOR STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.

10 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,

** **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: DOCUMENT

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:		PRAVEEN DUTTA	Reviewed by:		R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

BHEL	QUALITY PLAN (FOR LT SWGR)	CUSTOMER		PROJECT		SPECIFICATION NUMBER	
		BIDDER/VENDOR		QUALITY PLAN NUMBER	PED-506-00-Q-002, REV. 03	SPECIFICATION TITLE	
		WORKS ADDRESS		ITEM	LV SWITCHGEAR	SECTION	

Sl. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE 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
	BOUGHT-OUT ITEMS											
1.1	MATERIAL a) SECTIONS b) HARDWARES c) FLATS d) ANGLES e) CHANNELS f) SHEET STEEL FOR FABRICATION (CRCA)	1. DIMENSIONS	MA	MEASUREMENT	SAMPLE	IS-513 (94), IS-1079 (94), IS-2062 (2006)	BHEL TECH. SPEC./ APPD. DRGS / DATASHEETS	QC RECORD	3/2	-	2	
		2. SURFACE FINISH & CHECK FOR WAVINESS/ FLATNESS	MA	VISUAL	100%	-do-	NO VISUAL DEFECTS	-do-	3/2	-	2	TC FOR PLATING QUALITY TO BE PROVIDED
		3. BENDING TEST	CR	MECHANICAL	SAMPLE	-do-	IS-513 (94), IS-1079 (94), IS-2062 (2006)	TEST CERTIFICATE	3/2	-	2	
1.2	BUSBARS	1) DIMENSION	MA	MEASUREMENT	SAMPLE	BHEL SPEC./ APPD. DRGS./ IS 5082 (98) FOR AL, IS 1897 (83) & 613 (2000) FOR COPPER	BHEL SPEC./ APPD. DRGS./ IS 5082 (98) FOR AL, IS 1897 (83) & 613 (2000) FOR COPPER	QC Records	2	-	-	
		2) SURFACE FINISH	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS. IS 5082 (98) FOR AL, IS 1897 (83) & 613 (2000) FOR COPPER	BHEL SPEC./ APPD. DRGS. IS 5082 (98) FOR AL, IS 1897 (83) & 613 (2000) FOR COPPER	QC Records	2	-	-	
		3) MATERIAL GRADE	MA	VERIFICATION OF TC	1/LOT	-do-	-do-	TEST CERTIFICATE	2	-	1	
		4) CONDUCTIVITY	CR	ELECT. TEST	-do-	IS 5082 (98) FOR AL, IS 1897 (83) & 613 (2000) FOR COPPER	IS 5082 (98) FOR AL, IS 1897 (83) & 613 (2000) FOR COPPER	TEST CERTIFICATE	2	-	1	
1.3	SWITCHGEAR COMPONENTS											
	a) AIR BREAK SWITCH/ SFUs	1) MAKE, TYPE & RATING	MA	VISUAL	100%	IS-13947 Part 3 (93), APPD. DRGS/ APPD. DATASHEET	IS-13947 Part 3 (93), APPD. DRGS/ APPD. DATASHEET	QC Records	3/2	-	-	
		2) ROUTINE TESTS	MA	ELECTRICAL	100%	IS-13947 Part 3 (93)	IS-13947 Part 3 (93)	TEST CERTIFICATE	3/2	-	2	

LEGENDS
P : PERFORM
W : WITNESS
V : VERIFICATION
MA : MAJOR
CR : CRITICAL

3 : SUB-VENDOR
2 : MAIN VENDOR
1 : BHEL/CUSTOMER

NAME OF THE REPRESENTATIVE :

SIGNATURE :

DATE :

BHEL	BIDDER/VENDOR'S PARTICULARS	BIDDER/VENDOR'S COMPANY SEAL

QUALITY PLAN (FOR LT SWGR)	CUSTOMER		PROJECT		SPECIFICATION NUMBER	
	BIDDER/VENDOR		QUALITY PLAN NUMBER	PED-506-00-Q-002, REV. 03	SPECIFICATION TITLE	
	WORKS ADDRESS		ITEM	LV SWITCHGEAR	SECTION	

Sl. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE 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
	b) CT/ PT	1) OVERALL DIMENSIONS & MOUNTING ARRANGE--MENT	MA	MEASUREMENT	100%	MFR. STD.	MFR. STD.	QC Records	3/2	-	-	
		2) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/ IS-2705 (92)	BHEL SPEC./ APPD. DRGS/ IS-2705 (92)	QC Records	2	-	-	
		3) ROUTINE TESTS	CR	ELECTRICAL	100%	IS-2705 (92), APPD. DRGS/ APPD. DATASHEET	IS-2705 (92), APPD. DRGS/ APPD. DATASHEET	TEST CERTIFICATE	3	-	2,1	
	c) HRC FUSES	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/ IS-13703 (93)	BHEL SPEC./ APPD. DRGS IS-13703 (93)	QC Records	2	-	-	
	d) AC/ DC POWER & AUXILIARY CONTACTORS	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/ IS-13947 Part 4 sec 1 (93)	BHEL SPEC./ APPD. DRGS/ IS-13947 Part 4 sec 1 (93)	QC Records	2	-	-	
		2) ROUTINE TESTS	MA	ELECTRICAL	100%	IS-13947 Part 4 sec 1 (93)	IS-13947 Part 4 sec 1 (93)	TEST CERTIFICATE	3/2	-	2,1	
	e) AIR CIRCUIT BREAKER	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/ IS-13947 Part 2 (93)	BHEL SPEC./ APPD. DRGS/ IS-13947 Part 2 (93)	QC Records	2	-	-	
		2) ROUTINE TESTS	CR	TEST	100%	IS-13947 Part 2 (93)	IS-13947 Part 2 (93)	TEST CERTIFICATE	3/2	-	2,1	
	f) RELAYS - NUMERICAL	1) PHYSICAL CONDITION	MA	VISUAL	100%	NO BREAKAGES/ DAMAGES	NO BREAKAGES/ DAMAGES	QC Record	2	-	-	
		2) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS	BHEL SPEC./ APPD. DRGS	QC Records	3/2	-	-	
		3) ROUTINE TESTS	MA	ELECTRICAL	100%	IEC 60255-5 (2000), IEC 60255-6 (2001), IEC 60255-11 (79), IEC 61850	IEC 60255-5 (2000), IEC 60255-6 (2001), IEC 60255-11 (79), IEC 61850	TEST CERTIFICATE	3/2	-	2,1	

LEGENDS

P : PERFORM — **3 : SUB-VENDOR**
W : WITNESS — **2 : MAIN VENDOR**
V : VERIFICATION — **1 : BHEL/CUSTOMER**
MA : MAJOR
CR : CRITICAL

NAME OF THE REPRESENTATIVE :

SIGNATURE :

DATE :

BHEL | **BIDDER/VENDOR'S PARTICULARS** | **BIDDER/VENDOR'S COMPANY SEAL**

BHEL	QUALITY PLAN (FOR LT SWGR)	CUSTOMER		PROJECT		SPECIFICATION NUMBER	
		BIDDER/VENDOR		QUALITY PLAN NUMBER	PED-506-00-Q-002, REV. 03	SPECIFICATION TITLE	
		WORKS ADDRESS		ITEM	LV SWITCHGEAR	SECTION	

Sl. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE 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
	g) RELAYS - STATIC/ ELECTROMAGNETIC	1) PHYSICAL CONDITION	MA	VISUAL	100%	NO BREAKAGES/ DAMAGES	NO BREAKAGES/ DAMAGES	QC Record	2	-	-	
		2) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET	BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		3) ROUTINE TESTS	MA	ELECTRICAL	100%	IS 3231 (83)/ IS 8686 (77)/ RELAY MFR. SPEC.	IS 3231 (83)/ IS 8686 (77)/ RELAY MFR. SPEC.	TEST CERTIFICATE	3/2	-	2,1 *	* For BHEL/Customer, the extent of check shall be 10%.
	h) INDICATING INSTRUMENTS	1) MAKE, TYPE & RATING	MA	VISUAL	10% of each type of rating per lot	BHEL SPEC./ APPD. DRGS/DATASHEET	BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		2) ROUTINE TESTS	MA	ELECTRICAL	10% of each type of rating per lot	IS 1248 (2003)/ BHEL SPEC./ APPD. DRGS/DATASHEET	IS 1248 (2003)/ BHEL SPEC./ APPD. DRGS/DATASHEET	TEST CERTIFICATE	3/2	-	2,1	include calibration & accuracy test reports
	i) PUSH BUTTONS	1) MAKE, TYPE, COLOR & RATING	MA	VISUAL	5 samples of each type & rating per lot	IS 13947 Part 5 sec 1 (2004)/ BHEL SPEC./ APPD. DRGS/DATASHEET	IS 13947 Part 5 sec 1 (2004)/ BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		2) ROUTINE TESTS	MA	ELECTRICAL	5 samples of each type & rating per lot	IS 13947 Part 5 sec 1 (2004)/ BHEL SPEC./ APPD. DRGS/DATASHEET	IS 13947 Part 5 sec 1 (2004)/ BHEL SPEC./ APPD. DRGS/DATASHEET	TEST CERTIFICATE	3/2	-	2	
	j) CONTROL & SELECTOR SWITCHES	1) MAKE, TYPE & RATING	MA	VISUAL	5 samples of each type & rating per lot	IS 13947 Part 5 sec 1 (2004)/ BHEL SPEC./ APPD. DRGS/DATASHEET	IS 13947 Part 5 sec 1 (2004)/ BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		2) CONTACT CONFIGURATION CHECK	MA	VISUAL	-do-	-do-	-do-	QC Records	2	-	-	
		3) ROUTINE TESTS	MA	ELECTRICAL	-do-	-do-	-do-	QC Records	3/2	-	2	
	k) OLR WITH SPPR & HEAVY DUTY OLR	1) MAKE, TYPE & RATING	MA	VISUAL	10% of each type of rating per lot	IS-3231 Part 2 Sec 3 (87) / BHEL SPEC./ APPD. DRGS/DATASHEET	IS-3231 Part 2 Sec 3 (87) / BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		2) ROUTINE TESTS	MA	ELECTRICAL	10% of each type of rating per lot	-do-	-do-	TEST CERTIFICATE	3/2	-	2	

LEGENDS
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BHEL | **BIDDER/VENDOR'S PARTICULARS** | **BIDDER/VENDOR'S COMPANY SEAL**

BHEL	QUALITY PLAN (FOR LT SWGR)	CUSTOMER		PROJECT	SPECIFICATION NUMBER
		BIDDER/VENDOR		QUALITY PLAN NUMBER: PED-506-00-Q-002, REV. 03	SPECIFICATION TITLE
		WORKS ADDRESS		ITEM: LV SWITCHGEAR	SECTION

Sl. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE 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
	l) COUPLING (INTERPOSING) RELAYS [IF APPLICABLE]	1) MAKE, TYPE & RATING	MA	VISUAL	10% of each type of rating per lot	IS-3231 (87)/ BHEL SPEC./ APPD. DRGS/DATASHEET	IS-3231 (87)/ BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		2) ROUTINE TESTS	MA	ELECTRICAL	10% of each type of rating per lot	-do-	-do-	TEST CERTIFICATE	3/2	-	2	
	m) TIMER	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET	BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		2) CONTACT CONFIGURATION	MA	ELECTRICAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET	BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
	n) MCB	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET IS 8828 (96)	BHEL SPEC./ APPD. DRGS/DATASHEET IS 8828 (96)	QC Records	2	-	-	
		2) ROUTINE TESTS	CR	ELECTRICAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET IS 8828 (96)	BHEL SPEC./ APPD. DRGS/DATASHEET IS 8828 (96)	TEST CERTIFICATE	3/2	-	2	
	o) MCCB	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET IS 13947 PART 2	BHEL SPEC./ APPD. DRGS/DATASHEET IS 13947 PART 2	QC Records	2	-	-	
		2) ROUTINE TESTS	CR	ELECTRICAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET IS 13947 PART 2	BHEL SPEC./ APPD. DRGS/DATASHEET IS 13947 PART 2	TEST CERTIFICATE	3/2	-	2	
	p) CONTROL TRANSFORMER, TRANSFORMER	1) ROUTINE TESTS	MA	ELECTRICAL	100%	BHEL SPEC./ IS 12021 (87)	BHEL SPEC./ IS 12021 (87)	TEST. CERT.	3	-	2,1	
		2) TEMP. RISE TEST	MA	ELECTRICAL	1/RATING	-do-	-do-	-do-	3	-	2,1	
		3) VOLTAGE RATIO AT NO LOAD	MA	ELECTRICAL	100%	APPD. DRGS/DATASHEET	APPD. DRGS/DATASHEET	QC Records	3	-	2,1	
	q) INSULATING MATERIALS (FRP,SMC,DMC,ETC.)	1) DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUFACTURER STD.	MANUFACTURER STD.	QC Records	3/2	-	-	
		2) COMPARATIVE TRACKING INDEX CHECK	CR	ELECTRICAL	1/SIZE/LOT	IS 2824 (75)	IS 2824 (75)	TEST CERTIFICATE	3/2	-	1	
		3) HV Test	MA	ELECTRICAL	-do-	BS-2782/IS-8623 (93)	2,5 KV for 1 Min	QC Record	3/2	-	2,1	
		4) IR Test	MA	ELECTRICAL	-do-	BS-2782/IS-8623 (93)	BS-2782/IS-8623 (93)	QC Record	3/2	-	2,1	

LEGENDS
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CR : CRITICAL

BHEL

NAME OF THE REPRESENTATIVE :
SIGNATURE :
DATE :

BIDDER/VENDOR'S PARTICULARS

BIDDER/VENDOR'S COMPANY SEAL

	QUALITY PLAN (FOR LT SWGR)	CUSTOMER		PROJECT		SPECIFICATION NUMBER	
		BIDDER/VENDOR		QUALITY PLAN NUMBER	PED-506-00-Q-002, REV. 03	SPECIFICATION TITLE	
		WORKS ADDRESS		ITEM	LV SWITCHGEAR	SECTION	

Sl. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE 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
		5) FLEXURAL STRENGTH TEST	CR	MECHANICAL	AS PER SUPPLIER STD.	BS-2782	BS-2782	Supplier's TC	3/2	-	2,1	
	r) INSULATING BARRIERS & SHROUDS (FIRE RETARDANT TYPE)	1) DIMENSIONS INCLUDING THICKNESS & HV TEST	MA	ELECTRICAL	5 samples of each type & rating per lot	MFR. DRGS.	MFR. DRGS., 2.5kV FOR 1 MIN.	QC Record	3/2	-	-	
		2) FLAMMABILITY	MA	FLAME TEST	-do-	IS 6746 (94)	IS 6746 (94)	TEST CERTIFICATE	3/2	-	2	
	s) WIRES/ CABLES	1) SIZE, COLOR	MA	VISUAL	1/TYPE/LOT	IS 694 (90)	IS 694 (90)	QC Record	2	-	1	
		2) HV TEST AT 80% OF RATED VOLTAGE	CR	ELECTRICAL	1/SIZE/LOT	IS 694	IS 694	QC Record	3/2	-	2,1	
	t) GASKETS : SYNTHETIC RUBBER/ NEOPRENE RUBBER/ EPDM SPONGE RUBBER	1) MATERIAL TYPE	MA	VISUAL	MFR. STD	IS 11149 (84)	IS 11149 (84)	Supplier's TC	-	-	2,1	TYPE, DIMENSIONS & PROFILE OF THE GASKETS SHOULD BE SAME AS TYPE TESTED PANEL GASKETS
		2) DIMENSION	MA	MEASUREMENT	SAMPLE	MANUFACTURER'S DRGS.	MANUFACTURER'S DRGS.	QC Record	3/2	-	2,1	
		3) SHORE HARDNESS	CR	TEST	-do-	IS 11149 (84)	IS 11149 (84)	Supplier's TC	3/2	-	2,1	
		4) AGEING	MA	TEST	-do-	IS-3400/ BS-2752	IS-3400/ BS-2752	Supplier's TC	3/2	-	2,1	
		5) ELONGATION AT BREAK	MA	TEST	-do-	BHEL SPEC./ IS 11149 (84)	BHEL SPEC./ IS 11149 (84)	Supplier's TC	3/2	-	2,1	
		6) COMPRESSION TEST	CR	TEST	-do-	BHEL SPEC./ IS 11149 (84)	BHEL SPEC./ IS 11149 (84)	Supplier's TC	3/2	-	2,1	
		7) OZONE RESISTANCE TEST	MA	TEST	-do-	BHEL SPEC./ IS 11149 (84)	BHEL SPEC./ IS 11149 (84)	Supplier's TC	3/2	-	2,1	
	u) DIGITAL MULTIFUNCTION METER (kWH METERS) [IF APPLICABLE]	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	QC Records	3/2	-	2	
		2) ROUTINE TESTS INCLUDING CALIBRATION & ACCURACY TEST	MA	ELECT	100%	IEC 62052-11, IEC 62053-21	IEC 62052-11, IEC 62053-21	TEST CERTIFICATE	3/2	-	2,1	

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BIDDER/VENDOR'S COMPANY SEAL

	QUALITY PLAN (FOR LT SWGR)	CUSTOMER		PROJECT		SPECIFICATION NUMBER	
		BIDDER/VENDOR		QUALITY PLAN NUMBER	PED-506-00-Q-002, REV. 03	SPECIFICATION TITLE	
		WORKS ADDRESS		ITEM	LV SWITCHGEAR	SECTION	

Sl. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE 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
	v) TRANSDUCERS [IF APPLICABLE]	1) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	QC Records	2	-	-	
		2) ROUTINE TESTS INCLUDING CALIBRATION & ACCURACY TEST	MA	ELECT	100%	IS 12784 (89)	IS 12784 (89)	TEST CERTIFICATE	3/2	-	2,1	
	w) SPACE HEATER, THERMOSTAT, 3 PIN SOCKET, HOOTER	1) PHYSICAL CONDITION/ MOUNTING ARRANGEMENT	MA	VISUAL	100%	VOLTAGE/CURRENT/ WATTAGE/ NO BREAKAGE/ DAMAGE	VOLTAGE/CURRENT/ WATTAGE/ NO BREAKAGE/ DAMAGE	QC Records	2	-	-	
		2) MAKE, TYPE & RATING	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS/DATASHEET	BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
		3) FUNCTIONAL	MA	ELECTRICAL	100%	RELEVANT IS	RELEVANT IS	QC Records	2	-	1	
	x) ETHERNET SWITCH [IF APPLICABLE]	1) MAKE & TYPE	MA	VISUAL	1/TYPE/ RATING	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	TEST CERTIFICATE	2	-	1	
		2) NUMBER OF PORTS	MA	VISUAL	1/TYPE/ RATING	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	TEST CERTIFICATE	2	-	1	
	y) LAN CABLE [IF APPLICABLE]	1) MAKE	MA	VISUAL	1/TYPE/ RATING	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	TEST CERTIFICATE	2	-	1	
	z) ACB HANDLING TROLLEY	1) DIMENSIONS	MA	VISUAL	1/TYPE/ RATING	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	QC Records	3/2	-	2,1	
		2) FUNCTIONAL CHECK	MA	MECHANICAL	1/TYPE/ RATING	-do-	-do-	QC Records	3/2	-	2,1	LOTS WILL BE CLEARED BASED ON COC
	aa) BUSBAR FISH PLATES	1) DIMENSIONS	MA	VISUAL	5/TYPE/ RATING/LOT	MANUFACTURER'S STD.	MANUFACTURER'S STD.	QC Records	2	-	-	
		2) SILVER PLATING THICKNESS [IF APPLICABLE]	MA	MECHANICAL	-do-	-do-	-do-	QC Records	3/2	-	-	
		3) ADHESION	MA	MECHANICAL	-do-	-do-	-do-	QC Records	3/2	-	-	
	ab) TERMINAL BLOCK	1) MAKE, TYPE & RATING	MA	VISUAL	5/TYPE/ RATING/LOT	BHEL SPEC./ APPD. DRGS/DATASHEET	BHEL SPEC./ APPD. DRGS/DATASHEET	QC Records	2	-	-	
	ac) PAINT/ POWDER	1) MAKE, SHELF LIFE	MA	VISUAL	100%	AS PER PAINT MANF. SPECIFICATION	AS PER PAINT MANF. SPECIFICATION	QC Records	2	-	-	SHELF LIFE : 6 MONTHS

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BIDDER/VENDOR'S COMPANY SEAL

QUALITY PLAN (FOR LT SWGR)	CUSTOMER		PROJECT		SPECIFICATION NUMBER	
	BIDDER/VENDOR		QUALITY PLAN NUMBER	PED-506-00-Q-002, REV. 03	SPECIFICATION TITLE	
	WORKS ADDRESS		ITEM	LV SWITCHGEAR	SECTION	

Sl. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE 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
	IN PROCESS											
1.0	FABRICATION	1. DIMENSION	MA	MEASUREMENT	100%	APPD. DRGS/DATASHEET	APPD. DRGS/DATASHEET	INSP.REPORT	2	-	-	
		2. ALIGNMENT	MA	MEASUREMENT & VISUAL	100%	-do-	-do-	-do-	2	-	-	
		3. FINISH/ SURFACE DEFECT	MA	VISUAL	100%	-do-	-do-	-do-	2	-	-	
2.0	PRE-TREATMENT & PAINTING (POWDER COATING)	1) PRE-TREATMENT OF STEEL (7 TANK PROCESS)	MA	PROCESS	MFR. PRACTICE	MANUFACTURER'S STD.	MANUFACTURER'S STD.	QC Records	2	-	-	
		2) PAINT SHADE	MA	VISUAL	1 SAMPLE/ LOT	BHEL SPEC./ APPD. DRGS/ DATASHEET	BHEL SPEC./ APPD. DRGS/ DATASHEET	QC Records	2	-	-	
		3) PAINT THICKNESS & ADHESION	MA	MEASUREMENT	FEW PLACES	MANUFACTURER'S STD.	MANUFACTURER'S STD.	QC Records	2	-	-	
3.0	PANEL ASSEMBLY	1) SHELL ASSEMBLY	MA	PROCESS	100%	INTERNAL DRGS. MEETING REQUIREMENTS OF BHEL APPROVED DRGS.	INTERNAL DRGS. MEETING REQUIREMENTS OF BHEL APPROVED DRGS.	QC Records	2	-	-	
		2) SIZE OF BUSBAR & BUSBAR FINISH	MA	PROCESS	100%	-do-	-do-	QC Records	2	-	-	
		3) COLOR CODING OF BUSBAR	MA	PROCESS	100%	-do-	-do-	QC Records	2	-	-	
		4) INSULATOR TYPE & MOUNTING	MA	PROCESS	100%	-do-	-do-	QC Records	2	-	-	
		5) BUSBAR SUPPORT DISTANCE & TIGHTNESS OF BOLTS FOR MAIN BUS-BARS & BUSBAR JOINTS	MA	PROCESS	100%	MFR. DRAWINGS	MFR. DRAWINGS	QC Records	2	-	-	
		6) MAIN, CONTROL & AUXILIARY BUSBAR CLEARANCES	MA	PROCESS	100%	INTERNAL DRGS. MEETING REQUIREMENTS OF BHEL APPROVED DRGS.	INTERNAL DRGS. MEETING REQUIREMENTS OF BHEL APPROVED DRGS.	QC Records	2	-	-	
4.0	MODULE ASSEMBLY	1) COMPONENT IDENTIFICATION	MA	PROCESS	100%	MFR. DRAWINGS	MFR. DRAWINGS	QC Records	2	-	-	

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	QUALITY PLAN (FOR LT SWGR)	CUSTOMER		PROJECT		SPECIFICATION NUMBER	
		BIDDER/VENDOR		QUALITY PLAN NUMBER	PED-506-00-Q-002, REV. 03	SPECIFICATION TITLE	
		WORKS ADDRESS		ITEM	LV SWITCHGEAR	SECTION	

Sl. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE 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
		2) COMPONENT LAYOUT, MOUNTING & DIMENSIONS	MA	PROCESS	100%	MFR. DRAWINGS	MFR. DRAWINGS	QC Records	2	-	-	
		3) INCOMING & OUTGOING POWER CONTACT ASSEMBLY & ALIGNMENT, CONTROL CONTACTS ASSEMBLY	MA	PROCESS	100%	MFR. DRAWINGS	MFR. DRAWINGS	QC Records	2	-	-	
		4) POWER CIRCUIT WIRE/ STRIP TERMINATION & CLEARANCES	MA	PROCESS	100%	MFR. DRAWINGS	MFR. DRAWINGS	QC Records	2	-	-	
5.0	MARKING/LABELLING	1. CORRECTNESS	MA	VISUAL	100%	-do-	-do-	INSPN REPORT	2	-	-	
		2. ADHESION/ FIXING	MA	VISUAL	100%	-do-	-do-	-do-	2	-	-	
6.0	PRE-FINAL INSPECTION	1. ALIGNMENT	MA	VISUAL	100%	BHEL SPEC. & RELEVANT. STD.	BHEL SPEC. & RELEVANT. STD.	TEST CERTIFICATE.	2	-	-	
		2. PERFORMANCE	CR	ELECTRICAL	100%	-do-	-do-	-do-	2	-	-	
		3. IR & HV	CR	ELECTRICAL	100%	-do-	-do-	-do-	2	-	-	
7.0	FINAL INSPECTION	1. PHYSICAL BLEMISHES	MA	VISUAL	100%	BHEL SPEC.	BHEL SPEC.	INSP. REPORT	2	1	-	
		2. ALIGNMENT	MA	VISUAL	100%	IS-8623	IS-8623	-do-	2	1	-	
		3. DIMENSIONS INCLUDING SHEET STEEL THICKNESS	MA	MEASUREMENT	100%	IS-3427	IS-3427	-do-	2	1	-	
		4. PAINT SHADE	MA	VISUAL	100%	BHEL SPEC.	BHEL SPEC.	-do-	2	1	-	
		5. PAINT THICKNESS	MA	MEASUREMENT	FEW PLACES	APPD. DRG/ APPD .DATASHEET/ RELEVANT IS	APPD. DRG/ APPD .DATASHEET/ RELEVANT IS	-do-	2	1	-	
		6. PAINT ADHESION	MA	MECH. TESTS	-do-	APPD. DRG.	APPD. DRG.	-do-	2	1	-	
		7. VERIFICATION OF B.O.M. INCLUDING **CABLE GLANDS & LUGS**	MA	VISUAL	100%	-do-	-do-	-do-	2	1	-	
		8. INTER CHANGEABILITY	MA	MECHANICAL	10%	BHEL SPEC./ APPD. DRG.	BHEL SPEC./ APPD. DRG.	-do-	2	1	-	

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BIDDER/VENDOR'S PARTICULARS

BIDDER/VENDOR'S COMPANY SEAL

BHEL	QUALITY PLAN (FOR LT SWGR)	CUSTOMER		PROJECT		SPECIFICATION NUMBER	
		BIDDER/VENDOR		QUALITY PLAN NUMBER	PED-506-00-Q-002, REV. 03	SPECIFICATION TITLE	
		WORKS ADDRESS		ITEM	LV SWITCHGEAR	SECTION	

Sl. No.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE 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
		9. BREAKER OPERATION AT SERVICE, TEST & ISLOLATED POSITION	CR	ELECTRICAL	100%	BHEL SPECIFICATION	BHEL SPECIFICATION	-do-	2	1	-	
		10. EARTHBUS DIMENSIONS EARTHING OF DRAWOUT MODULES, DOOR ETC.	MA	MECHANICAL	100%	BHEL SPECIFICATION	BHEL SPECIFICATION	-do-	2	1*	-	* For BHEL/Customer, the extent of check shall be 10%.
		11. ROUTINE TESTS	CR	ELECTRICAL	100%	BHEL SPEC./APPD. DRGS	BHEL SPEC./APPD. DRGS	-do-	2	1	-	
		12. IR TEST BEFORE & AFTER HV TEST	MA	ELECTRICAL	100%	IS 8623 (93)	IS 8623 (93)	-do-	2	1	-	
		13. FUNCTION PERFORMANCE	CR	ELECT. & MECH. TESTS	1	-do-	-do-	-do-	2	1	-	
		14. TYPE TESTS										
		a) TEMPERATURE RISE TEST	CR	ELECTRICAL	1/ITEM	-do-	-do-	-do-	2	-	1**	** REFER NOTE "A & B" BELOW.
		b) DEGREE OF PROTECTION TEST	CR	MECHANICAL	1/ITEM	-do-	-do-	-do-	2	-	1**	** REFER NOTE "A & B" BELOW.
		c) SHORT TIME CURRENT TEST	CR	ELECTRICAL	1/ITEM	-do-	-do-	-do-	2	-	1**	** REFER NOTE "A & B" BELOW.
		d) TYPE-2 COORDINATION TEST	MA	ELECTRICAL	AT LEAST 5 SAMPLE RATINGS	BHEL SPEC./ APPD. DRGS	BHEL SPEC./ APPD. DRGS	-do-	2	-	1**	** REFER NOTE "A & B" BELOW.
		15. INTERLOCKS, PROTECTION & METERING	CR	SECONDARY INJECTION	100%	-do-	-do-	-do-	2	1	-	
		16. EASE OF WITHDRAWAL & INSERTIOIN	MA	MECHANICAL	100%	-do-	-do-	-do-	2	1	-	
		17. ACCESSIBILITY OF COMPONEN & SAFETY (SHROUDING)	MA	VISUAL	100%	BHEL SPEC./ APPD. DRGS	BHEL SPEC./ APPD. DRGS	-do-	2	1	-	
		18. WIRING NEATNESS & FIRMNESS	CR	PULLING	SAMPLE	-do-	-do-	-do-	2	1	-	
		19. BUS BAR TIGHTNESS	MA	MECHANICAL	SAMPLE	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	-do-	2	1	-	
		20. MAIN, CONTROL & AUXILIARY BUSBAR CLEARANCES	MA	PROCESS	100%	INTERNAL DRGS. MEETING REQUIREMENTS OF BHEL APPROVED DRGS.	INTERNAL DRGS. MEETING REQUIREMENTS OF BHEL APPROVED DRGS.	-do-	2	1	-	

NOTES

- **A** **TEST CERTIFICATES TO BE FURNISHED FOR VERIFICATION BY ENGINEERING.**
- **B** **CONDUCTION OF TESTS TO BE DONE IF REQUIRED BY BHEL TECHNICAL SPECIFICATION & TEST CERTIFICATES FOR THE SAME TO BE FURNISHED FOR VERIFICATION BY ENGINEERING.**
- **C** ONLY APPROVED MAKE OF COMPONENTS ARE TO BE USED.
- **D** FUNCTIONAL/PERFORMANCE CHECKS TO BE CONDUCTED ON ENTIRE BOARD AND ALL POWER SUPPLIES SWITCHED ON.
- **E** PACKING SHALL BE SUCH THAT DURING TRANSPORTATION NO DAMAGE IS CAUSED TO THE SWITCHGEAR.

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	NAME OF THE REPRESENTATIVE :	
	SIGNATURE :	
	DATE :	

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 1 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
1.0	**RAW MATERIALS**													
1.1	**Aluminium /Copper Rods**	**GENERAL :**												
	(Conductor/ Armour Wire)	1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample / Batch	IS:8130 (Al), IS:613 (Cu)	IS:8130 (Al), IS:613 (Cu)	Test Cert.	✓	P/ V	V	-	
		2. Elec. Properties	MA	Electrical Tests	Sample/ Batch	Sample / Batch	-do-	-do-	-do-	✓	P/ V	V	-	
		SPECIFIC CHECKS:												
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P	V	-	
		b) Grade	MA	-do-	-do-	-do-	IS:8130 (Al), IS:613 (Cu)	IS:8130 (Al), IS:613 (Cu)	-do-	✓	P	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	**XLPE Compound for insulation**	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample / Batch	IS 7098-I	IS 7098-I	Test Cert.	✓	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:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	18/03/20	KUNAL GANDHI			Reviewed by:			
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/03/2020	RITESH KUMAR JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 2 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		2. Elec. Properties	MA	Electrical Tests	Sample/ Batch	Sample / Batch	-do-	-do-	-do-	✓	P	V	-	
		SPECIFIC CHECKS:												
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P/ V	V	-	
		b) Type/ Grade	MA	-do-	-do-	-do-	-do-	-do-	-do-	✓	P/ V	V	-	
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	-do-	-do-	-do-	✓	P/ V	V	-	
1.3	**PVC Compound (for sheath)**	**GENERAL:**												
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample / Batch	IS 5831	IS 5831	Test Cert.	✓	P/ V	V	-	
		2. Elec. Properties	MA	Electrical Tests	Sample/ Batch	Sample / Batch	-do-	-do-	-do-	✓	P/ V	V	-	
		3. FRLS Properties (as applicable)	CR	Chemical/ Environ.	Sample/ Batch	Sample / Batch	Approved datasheet	Approved datasheet	-do-	✓	P/ V	V	-	
		SPECIFIC CHECKS:												

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR 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-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 3 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P	V	-	
		b) Type/ Grade	MA	-do-	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✓	P	V	-	
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	✓	P	V	-	
1.4	**Fillers (as applicable)**	1. Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	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

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	Vikas 18.03.2020	VIKAS KUMAR SINGH	Checked by:	Kunal Gandhi 19/3/20	KUNAL GANDHI		
Reviewed by:	Manish 18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR 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-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 4 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6					*	**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
														component of cable)
		2. Type/ Grade	MA	-do-	-do-	-do-	Appd. Data Sheet	Appd. Data Sheet	-do-	✓	P/ V	V	-	
1.5	**Galvanised steel wire/strip for Armour (as applicable)**	**GENERAL:**												
		1. Make	MA	Verify	Manufacturer std.	Manufacturer std.	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P	V	-	
		2. Dimension	MA	Measurement	-do-	-do-	Appd. Data Sheet	Appd. Data Sheet	-do-		P/ V	-	-	
		3. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample*	Sample*	-do-	-do-	-do-	✓	P/ V	V	-	
		4.Galvanization Quality	MA	Galv.Tests	-do-	-do-	IS 3975	IS 3975	-do-		P/ V	-	-	
1.6	**Wooden Drum**	1. Phy. & Constructional checks	MA		Mfr's Plant Std.	Mfr's Plant Std.	IS 10418	IS 10418	Test Cert.	✓	P	V	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI		
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR 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-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 5 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9	*	**			
		2. Anti termite treatment	MA	Chem.	Mfr's Plant Std.	Mfr's Plant Std.	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	Approved drg	Test Cert.	✓	P	V	-	# If required, as per spec.
		2. Surface finish	MA	Visual	-do-	-do-	-	Surface shall be smooth	-do-	✓	P	V	-	
2.0	**IN PROCESS**													
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	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI		
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL		

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Doc No:			
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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 6 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					6					*	**		
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N
		3. % of Elongation	MA	Mechanical	-do-	-do-	IS 8130	IS 8130	-do-	✓	P	V	-	
2.2	**Stranding of wires**	1. No. of wires	MA	Counting	Plant Mfg. Std.	Plant Mfg. Std.	Appd. Datasheet	Appd. Datasheet	Inspection Report/ Test report	✓	P	V	-	
		2. Resistance	CR	Electrical	-do-	-	-do-	-do-	-do-	-do-	P	-	-	
		3. Sequence, lay length & Direction	MA	Visual, Meas.	One Sample of each size/ lot	-	Mfrs Std.	Mfrs 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 of each size/ lot	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
2.3	**Core Insulation (XLPE)** (No repair permitted)													

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI		
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR 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-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 7 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6					*	**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
		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. Eccentricity & Ovality #	CR	Measurement	One Sample of each size/ lot	One Sample of each size/ lot	Mnfr's Std	Mnfr's Std	-do-	✓	P	V	-	
		3. Insulation Thickness	CR	Measurement	-do-	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
		4. Dia over insulation	MA	Measurement	-do-	-	-do-	-do-	-do-		P	-	-	
		5. Tensile Strength & % Elongation	MA	Mechanical	100%	-	IS:1554-I, IS:5831	IS:1554-I, IS:5831	-do-		P	-	-	
		6. Spark Test or Water immersion test	CR	Electrical	100%	-	Mnfr's Std	Mnfr's Std	-do-	Mnfr's Std	P	-	-	
2.4	**Core Laying**	1. Dia over laid up core	MA	Measurement	One Sample of each size/ lot	-	Appd. Datasheet	Appd. Datasheet	Inspection Report/ Test report		P	-	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI		
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
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	Sign & Date	Name	Seal
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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
BHEL		CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
		PROJECT:		PO NO.:	
		ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 8 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		2. Sequence of lay & direction	MA	Visual & Meas.	-do-	-	IS 7098-I & Mfr. Std.	IS 7098-I & Mfr. Std.	-do-		P	-	-	
						-								
2.5	**Inner Sheath Extrusion (as 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/ lot	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
		3. Dia over inner sheath	MA	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
2.6	**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	-	-	
		2. Lay length / Direction	MA	Visual & Meas.	-do-	-	Mfr. Std.	Mfr. Std.	-do-		P	-	-	
		3. Dia over armouring	MA	Measurement	-do-	-	Appd. Datasheet	Appd. Datasheet	-do-		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:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI			Reviewed by:			
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 9 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6					*	**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
		4. Coverage	MA	Measurement	-do-	-	-do-	-do-	-do-		P	-	-	
2.7	**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 each size/ lot	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
		3. Dia over outer sheath	MA	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		4. Embossing/ Sequencial Marking	MA	Visual	100%	-	Approved data sheet	Approved data sheet	-do-		P	-	-	
3.0	**Final Inspection (INTERNAL)**	**1. Routine Test (Refer Note-H)**	CR	Electrical Tests & Measurement	100%	100%	#	#	-do-	✓	P	V	V	#: Refer Annexure-A to QP

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI		
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
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Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 10 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6					*	**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
4.0	**Final Inspection (EXTERNAL)**	**1. Finish & Length (Cable & cable drum)**	MA	Visual	One drum in each Lot	One drum in each Lot	Appd. Datasheet	Free from Porosity, Bulging, Burnt particles, lumps, cuts & scratches	Inspection Report/ Test report	✓	P	W	W	
		2. Dimension	MA	-do-	IS 7098-I	IS 7098-I	Appd. Datasheet	Appd. Datasheet	-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 (Refer Note-H)	CR	Phy, Elect. Tests & FRLS Tests	Sample #	Sample #	#	-do-	-do-	✓	P	W	W	
		6. Type Tests (Refer Note-H)	CR	Physical & Electrical Tests	Sample #	Sample #	-do-	-do-	-do-	✓	P	W	W	

BHEL						BIDDER/ SUPPLIER	
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Prepared by:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI		
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 11 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6					*	**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
5.0	**Packing**	**End sealing / Polythene wrapping**	MA	Visual	100%	100%	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	W		

NOTES:

A. Joints in conductors & armour shall be as permitted by IS:8130 & IS:7098-I respectively.
B. No repair of core insulation permitted.
C. Cable ends shall be sealed.
D. Record of raw material, process & all stages shall be certified by Vendors QC and are liable to audit check by purchaser.
E. Fillers/dummy cores etc. Shall be as per BHEL specification.
F. Wherever extent of check for stage is mentioned as 'sample' & not defined in QP, the same shall be as per vendors sampling plan agreed by purchaser.
G. Vendor shall furnish compliance certificate to the inspection agency confirming the packing as per IS/ BHEL specification.
H. For lists of routine tests, acceptance tests & type tests refer annexure to QAP.
I. 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.
J. Cable manufacturer to maintain all quality records identified as per all QP stages enumerated below whether it is identified for BHEL verification or witness or not.
K. BHEL reserves the right to perform repeat test, if required.
L. Photographs of cable to be despatched shall be sent to BHEL purchase group for review prior to issue of mdcc.
M. Project specific QP to be prepared in line with this standard QP.
N. In case of export jobs, sea worthy packing as per BHEL technical specification shall be carried out.

LEGENDS:

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:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI			Reviewed by:			
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 12 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9	*	**			

*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:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI		
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL		

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

610531/2021/PS-PEM-MAX

BHEL	ANNEXURE-A TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER:
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E002, R02	SPECIFICATION TITLE:
	SHEET 1 OF 3	SYSTEM: CABLE	ITEM: LT XLPE POWER CABLE	DOC. NO.

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 of cable for every lot and type of cable (CU/AL conductor)
   b) FRLS & Flammability Test to be conducted only on one sample/ lot.

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 (Clause 15.2.2) of IS: 7098 Part-I.

3. Flammability Test to be conducted only on one sample/ lot.

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 / lot.

Note: LOT shall be considered as per IS: 7098 Part-I, appendix-B.

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 acceptance test***
II.	Tensile test	For aluminium conductor only (Not applicable for compacted circular or shaped conductor)	T, A	IS 10810 Pt 2	
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	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	18/3/20	KUNAL GANDHI
Reviewed by:		MANISH SHUKLA	Reviewed by:		RITESH KUMAR

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

610531/2021/PS-PEM-MAX

	ANNEXURE-A TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER:
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E002, R02	SPECIFICATION TITLE:
	SHEET 2 OF 3	SYSTEM: CABLE	ITEM: LT XLPE POWER CABLE	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
2.0	**Tests for Armour Wires/Strips**				
I.	Measurement of dimensions	Applicable for Aluminium wire & GS wire/Strip	T,A	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 XLPE Insulation & PVC sheath**				
I.	Test for thickness	Applicable for XLPE insulation, PVC inner sheath & PVC outer sheath	T, A	IS 10810 Pt 6	
II.	Tensile strength and elongation test at break	Applicable for XLPE 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 XLPE 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 XLPE insulation & PVC outer sheath only	T	IS 10810 Pt 12	
VIII.	Thermal stability test	For PVC outer sheath only	T	IS 10810 Pt 60	
IX.	Hot set test	For XLPE insulation only	T, A	IS 10810 Pt 30	
X.	Water absorption (gravimetric) test	For XLPE insulation only	T	IS 10810 Pt 33	
4.0	**Improved Fire performance (FR-LSH) Tests**				

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ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	19.03.2021	VIKAS KUMAR SINGH	Checked by:	19/3/21	KUNAL GANDHI			Reviewed by:			
Reviewed by:		MANISH SHUKLA	Reviewed by:		RITESH KUMAR			Approved by:			

610531/2021/PS-PEM-MAX

BHEL	ANNEXURE-A TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER:
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E002, R02	SPECIFICATION TITLE:
	SHEET 3 OF 3	SYSTEM: CABLE	ITEM: LT XLPE POWER CABLE	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
I.	Oxygen index test	For PVC outer sheath only	T, A	IS 10810 Pt 58 / ASTMD 2863/ NES 715-I	Applicable for Inner Sheath also, if the same is indicated in Datasheet-A
II.	Smoke density test	For PVC outer sheath only	T	IS 10810 Pt 63 / ASTMD 2843	
III.	Acid gas generation test	For PVC outer sheath only	T, A	IS 10810 Pt 59 / IEC-754-1	
IV.	Temperature Index Test	For PVC 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 Datasheet-A
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	For complete cable	T, A, R	IS 10810 Pt 45	
II.	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 Datasheet-A
8.0	**Anti-Fungal Test**	For PVC outer sheath only	A	--	
9.0	**Special Tests**				
I.	Hydrolytic Stability Test	For complete cable	**	ASTM D 3137:81	Test applicable if indicated in Datasheet-A
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						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	18.05.2021	VIKAS KUMAR SINGH	Checked by:	19/5	KUNAL GANDHI		
Reviewed by:		MANISH SHUKLA	Reviewed by:		RITESH KUMAR		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
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Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 1 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
RAW MATERIAL														
	Copper Rods	**GENERAL:**												
		1. Physical properties	MA	Physical Tests	Sample/Batch	Sample /Batch	IS 613	IS 613	Test Certificate	√	P/V	V	-	
		2. Elec. Properties	MA	Electrical Tests	Sample/Batch	Sample /Batch	-do-	-do-	-do-	√	P/V	V	-	
		SPECIFIC CHECKS:												
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	COC	√	P	V	-	
		b) Grade	MA	-do-	-do-	-do-	IS 613	IS 613	Test Certificate	√	P	V	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI		
Reviewed by:	28/2/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 2 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		c) Resistivity	MA	Electrical Tests	Manufacturer std.	Manufacturer std.	IS 613	IS 613	Test Certificate	√	P	V	-	
	PVC Compound (for insulation)	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/Batch	Sample/Batch	IS 5831	IS 5831	Test Certificate	√	P/V	V	-	
		2. Elec.Properties	MA	Electrical Tests	Sample/Batch	Sample/Batch	-do-	-do-	-do-	√	P/V	V	-	
		SPECIFIC CHECKS:												

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI		
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	2/21 28/2/2020	R.K. JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 3 OF 19

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	**			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9					
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	COC	√	P	V	-	
		b) Type/ Grade	MA	-do-	-do-	-do-	Approved datasheet	Approved datasheet	-do-	√	P	V	-	
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	√	P	V	-	
	Fillers (as applicable)	1. Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	COC	√	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 resistant. (as applicable)	CR	Chemical/ Environ.	-do-	-	Appd. Data Sheet	Appd. Data Sheet	-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:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 4 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
	Galvanised steel wire/strip for Armour (if applicable)	**GENERAL :**												
		1. Make	MA	Verify	Manufacturer std.	Manufacturer std.	Manufacturer approved source	Manufacturer approved source	Inspection report/ Test Certificate	√	P	V	-	
		2. Dimension	MA	Measurement	-do-	-	Approved datasheet	Approved datasheet	-do-	√	P/ V	-	-	
		3. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample*	-	-do-	-do-	-do-	√	P/ V	-	-	* Sample from each armour size/Batch/ Lot
		4.Galvanization Quality	MA	Galv.Tests	-do-	-	IS 3975	IS 3975	-do-	√	P/ V	-	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI		
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 5 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
	PVC compound for Sheath	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/Batch	Sample/Batch	IS 5831	IS 5831	Inspection report/ Test Certificate	√	P/V	V	-	
		2. Elec.Properties	MA	Electrical Tests	Sample/Batch	Sample/Batch	-do-	-do-	-do-	√	P/V	V	-	
		3. FRLS Properties (as applicable)	CR	Chemical/ Environ.	Sample/Batch	Sample/Batch	Approved datasheet	Approved datasheet	-do-	√	P/V	V	-	
		SPECIFIC CHECKS :												

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
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Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL			Approved by:			

610531/2021/PS-PEM-MAX

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 6 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	COC	√	P	V	-	
		b) Type/ Grade	MA	-do-	-do-	-do-	Approved datasheet	Approved datasheet	-do-	√	P	V	-	
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	√	P	V	-	
	Wooden drums	1. Phy. & Constructional checks	MA	Visual	Mfr's Plant Std.	Mfr's Plant Std.	IS 10418	IS 10418	Inspection report/ Test Certificate	√	P	V	-	
		2. Anti-termite treatment	MA	Chem.	-do-	-do-	Mfr's Plant Std.	Mfr's Plant Std.	COC	√	P	V	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	24/2/2020	KUNAL GANDHI		
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL		

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 7 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
	Steel drums (If applicable)	1. Dimension	MA	Meas.	Mfr's Plant Std.	Mfr's Plant Std.	Approved drawing of steel drum	Approved drawing of steel drum	Inspection report	√	P	V	-	
		2. Surface finish	MA	Visual	-do-	-do-	Surface shall be smooth	Surface shall be smooth	Inspection report	√	P	V	-	
	IN PROCESS													
	Wire Drawing & Annealing	1. Size	MA	Dimensional	Mfr's Plant Std.	Mfr's Plant Std.	Approved Data Sheet	Approved Data Sheet	Inspection report	√	P	V	-	
		2. Surface finish	MA	Visual	-do-	-do-	Surface shall be smooth	Surface shall be smooth	-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:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 8 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		3. % of Elongation	MA	Mechanical	-do-	-do-	IS 1554 Pt-1./ IS 8130 & Approved Data Sheet	IS 1554 Pt-1./ IS 8130 & Approved Data Sheet	-do-	√	P	V	-	
	Tinning (Conductor)	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	-	
	Stranding of wires	1. No.of wires	MA	Counting	Mfr's Plant Std.	Mfr's Plant Std.	Approved Data Sheet	Approved Data Sheet	-do-	√	P	V	-	
		2. Resistance	CR	Electrical	-do-	-	-do-	-do-	-do-	√	P	-	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	24/2/2020	KUNAL GANDHI		
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	24/2/2020	R.K. JAISWAL		

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
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	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 9 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		3. Sequence, lay length & Direction	MA	Visual, Meas	one Sample of each size/lot	-	Mfrs Std	Mfrs 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 of each size/lot	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	
	Core Insulation (No repair permitted)	1. Surface finish	MA	Visual	100%	100%	Free from bulging	Free from bulging	Inspection report	√	P	V	-	
		2 Insulation thickness	CR	Measurement	one Sample of each	-	Appd.data sheet	Appd.data sheet	-do-	√	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:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 10 OF 17

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	C/N					M	C	N	
					size/lot									
		3. Concentricity #	CR	Measurement	-do-	-do-	Mfrs Std	Mfrs Std	Inspection Report	√	P	V	-	# To be checked at starting & finish end of Extruded Length
		4 Dia over insulation	MA	Measurement	-do-	-	Approved Data Sheet	Approved Data Sheet	-do-	√	P	-	-	
		5. Core identification	MA	Visual	100%	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	
		6. TS & % Elongation	MA	Mechanical	100%	-	IS 1554 Pt-1/ IS 5831	IS 1554 Pt-1/ IS 5831	-do-	√	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:	28-12-2020	DEVENDRA SINGH	Checked by:	28/12/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 11 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		7. Spark Test or Water immersion test	CR	Electrical	100%	-	Mfr's Std.	Mfr's Std.	-do-	√	P	-	-	
	Core laying	1. Dia over laid up core	MA	Measurement	one Sample of each size/lot	-	Approved Data Sheet	Approved Data Sheet	-do-	√	P	-	-	
		2. Sequence of lay and lay length & direction for laid up core	MA	Visual meas	one Sample of each size/lot	-	IS 1554 Pt-1	IS 1554 Pt-	-do-	√	P	-	-	
		3.Core identification	CR	Visual	one Sample of each size/lot	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	

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Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 12 OF 17

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	C/N				D	M	C	N	
	Inner Sheath Extrusion (if applicable)	1. Surface finish	MA	Visual	100%	-	Surface shall be smooth	Surface shall be smooth	-do-	√	P	-	-	
		2. Sheath thickness	CR	Measurement	One sample of each size/lot	-	Approved Data Sheet	Approved Data Sheet	-do-	√	P	-	-	
		3.Dia over inner sheath	MA	Measurement	-do-	-	Approved Data Sheet	Approved Data Sheet	-do-	√	P	-	-	
	Armouring (if applicable)	1. No.of wires/Strips	MA	Counting	At the start of the process	-	Mftr's Std	Mftr's Std	-do-	√	P	-	-	
		2. Lay Direction	MA	Visual	-do-	-	IS 1554 Pt-1	IS 1554 Pt-1	-do-	√	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:	20-02-2020	DEVENDRA SINGH	Checked by:	20/2/20	KUNAL GANDHI			Reviewed by:			
Reviewed by:	29/02/2020	MANISH SHUKLA	Reviewed by:	29/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 13 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		3. Lay Length	MA	Visual, Meas.	At the start of the process	-	IS 1554 Pt-1	IS 1554 Pt-1	-do-	√	P	-	-	
		4. Coverage	MA	Measurement	-do-	-	Approved data sheet	Approved data sheet	-do-	√	P	-	-	
		5. Dia over armouring	MA	Measurement	-do-	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	
	Outer Sheath Extrusion	1. Surface Finish	MA	Visual	100%	-	Surface shall be smooth	Surface shall be smooth	-do-	√	P	-	-	
		2.Sheath thickness	CR	Measurement	One sample of each size/lot	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
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Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 14 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	** M	C	N	
1	2	3	4	5	6		7	8	9					
		3. Dia over outer sheath	MA	Measurement	One sample of each size/lot	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	
		4. Marking/ Colour / Embossing	MA	Visual	One sample of each size/lot	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	
	Final Inspection (Internal)	1.Routine Test (Refer Note-H)	CR	Electrical Test & measurement	100%	100%	IS 1554-I & Appd. Datasheet	IS 1554-I & Appd. Datasheet	Test Report	√	P	V	√	#: Refer Annexure-A to QP
	Final Inspection	1. Finish	MA	Visual, Measurement	See Remark	See Remark	IS 1554 Pt-1/ Appd. Data Sheet	Free from Bulging, Burnt particles, lumps, cuts & scratches/ Approved data sheet	Test Report	√	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:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 15 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		2. Length	MA	Visual, Measurement	See Remark	See Remark	IS 1554 Pt-1/ Appd. Data Sheet	BHEL Spec./ Data Sheet	Test Report	√	P	W	W	
		2. Dimensions	MA	Measurement	As per IS	As per IS	IS 1554 Pt-1/ Appd. Data Sheet	Appd. Data sheet	Test Report	√	P	W	W	
		3. Armouring - Coverage No.of Wires/Strips	MA	Visual & Meas.	-do-	-do-	IS 1554 Pt-1/ Appd. Data Sheet	IS 1554 Pt-1/ Appd. Data Sheet	Test Report	√	P	W	W	'Refer Annexure-I to QP for sampling plan.
		4. Marking/Colour Coding	MA	Visual	-do-	-do-	IS 1554 Pt-1/ Appd. Data Sheet	IS 1554 Pt-1/ Appd. Data Sheet	Test Report	√	P	W	W	
		6. Acceptance Tests (Refer Note-H)	CR	Phy & Elect. Tests FRLS Test	Sample #	Sample #	#:	#:	Test Report	√	P	W	W	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	28.02.2020	DEVENDRA SINGH	Checked by:	28/2/20	KUNAL GANDHI		
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. 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 : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 16 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		7. Type & FRLS Tests (Refer Note-H)	CR	Measurement	sample	sample	#:	#:	Test Report	√	P	W	W	
	Packing	Sealing Identification	MA	Visual	100%	100%	As per IS	As per IS	Test Report	√	P	W	-	

NOTES: -	
(A)	JOINTS IN WIRE SHALL BE AS PERMITTED BY MFRS STANDARD. VENDOR TO CERTIFY THE SAME.
(B)	NO REPAIR OF CORE INSULATION PERMITTED
(C)	CABLE ENDS SHALL BE SEALED AS PER VENDOR'S SPECIFICATION.
(D)	RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER.
(E)	FILLERS/DUMMY CORES ETC. SHALL BE AS PER APPROVED DATA SHEET
(F)	WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS 'SAMPLE' & NOT DEFINED IN QP, THE SAME SHALL BE AS PER VENDORS SAMPLING PLAN.
(G)	VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER IS/ BHEL SPECIFICATION.
(H)	FOR LISTS OF ROUTINE TESTS, ACCEPTANCE TESTS & TYPE TESTS REFER ANNEXURE TO QAP.

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:	28/02/2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	24/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 17 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			

(I)	BHEL RESERVES THE RIGHT FOR CONDUCTING REPEAT TEST, IF REQUIRED.
(J)	AFTER PACKING AND PRIOR TO ISSUE OF MDCC, PHOTOGRAPHS OF COMPLETE CABLE (TO BE DISPATCHED) SHALL BE SENT TO BHEL-PURCHASE GROUP FOR REVIEW.
(K)	PROJECT SPECIFIC QP SHALL BE DEVELOPED BESED ON CUSTOMER REQUIREMENT.

LEGENDS:
*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA 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, **D:** DOCUMENTATION

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

610531/2021/PS-PEM-MAX

BHEL	ANNEXURE-I TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER: PE-RC-999-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E003, R1	SPECIFICATION TITLE:
		SYSTEM	ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	DOC. NO.

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 of cable for every lot of cable.
   b) FRLS & Flammability Test to be conducted only on one sample/ lot.

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 (control cable).

3. Flammability Test to be conducted only on one sample/ lot.

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 / lot.

NOTE

LOT shall be defined as per IS: 1554 Part-I (control cable).

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
1.0	**Tests for Conductor**				
I.	Annealing test	For copper conductor	**T, A**	IS 10810 Pt 1	*In process records shall be furnished to inspector at the time of inspection.*
II.	Resistance test	For copper conductor	**T, A, R**	IS 10810 Pt 5	
2.0	**Tests for Armour Wires/Strips**				
I.	Measurement of dimensions	Applicable for GS wire/Strip	**T,A**	IS 10810 Pt 36	
II.	Tensile test	Applicable for GS wire/Strip	**T, A**	IS 10810 Pt 37	

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Prepared by:		DEVENDRA SINGH	Checked by:		KUNAL GANDHI			Reviewed by:			
Reviewed by:		MANISH SHUKLA	Reviewed by:		R.K. JAISWAL			Approved by:			

610531/2021/PS-PEM-MAX

	ANNEXURE-I TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER: PE-RC-999-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E003, R1	SPECIFICATION TITLE:
		SYSTEM	ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC 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
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 Datasheet-A**
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	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 Datasheet-A**
8.0	**Anti-Fungal Test**	For PVC outer sheath only	A	--	
9.0	**Special Tests**				
I.	Hydrolytic Stability Test	For complete cable	**	ASTM D 3137:81	**Test applicable if indicated in Datasheet-A**
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.

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ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		DEVENDRA SINGH	Checked by:		KUNAL GANDHI			Reviewed by:			
Reviewed by:		MANISH SHUKLA	Reviewed by:		R.K. JAISWAL			Approved by:			

610531/2021/PS-PEM-MAX

	ANNEXURE-I TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER: PE-RC-999-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E003, R1	SPECIFICATION TITLE:
		SYSTEM	ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC 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
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 GS wire/Strip	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	For G. S. wires/Strip only	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	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 10	
V.	Hot deformation test	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 15	
VI.	Heat shock test	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 14	
VII.	Shrinkage test	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 12	
VIII.	Thermal stability test	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 60	
4.0	**Improved Fire performance (FR-LSH) Tests**				
I.	Oxygen index test	For PVC 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 PVC outer sheath only	T, A	IS 10810 Pt 63 / ASTMD 2843	
III.	Acid gas generation test	For PVC outer sheath only	T, A	IS 10810 Pt 59 / IEC-754-1	
IV.	Temperature Index Test	For PVC outer sheath only	T	IS 10810 Pt 64 / ASTMD 2863	

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ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		DEVENDRA SINGH	Checked by:		KUNAL GANDHI			Reviewed by:			
Reviewed		MANISH	Reviewed by:		R.K.			Approved			

Document Title :- Quality Plan of Screened Control Cable (1.1KV)

Prepared By :-

Vikas. 23.01.2020.

(Vikas Kumar Singh.)
Dy. Mgr. (Elect)

Priyanka 23.01.2020

Priyanka Agrawal.
(Dy. Mgr. / Elect)

Devendra Singh 23.01.2020.

Devendra Singh.
(Dy. Mgr / Elect)

Checked By:-

Abhishek 23.01.2020

Abhishek.
(Mgr. / Elect.)

Approved By :-

Manish Shukla 23/01/2020

Manish Shukla.
(Sr. DGM. / Elect)

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 02.	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: SCREENED CONTROL CABLES	SYSTEM:	SECTION: II	SHEET 1 OF 11

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								
INSTRUCTIONS: 1. **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.** 2. **Cable manufacturer to maintain all quality records identified as per all QP stages enumerated below whether it is identified for BHEL verification or witness or not.**														
1.0	**RAW MATERIAL**													
1.1	Copper Rods/ Wires (For Conductor & drain wire)	**GENERAL:**												
		1. Physical properties	MA	Physical Tests	Sample/Batch	Sample/Batch	IS 613	IS 613	Inspection Report/ Test Cert.		P/ V	V	-	
		2. Elec. Properties	MA	Electrical Tests	Sample/Batch	Sample/Batch	-do-	-do-	-do-		P/ V	V	-	
		SPECIFIC CHECKS:												
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.		P	V	-	
		b) Grade	MA	-do-	-do-	-do-	IS 613	IS 613	-do-		P	V	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	22.01.20	Priyanka	Checked by:	23/1/20	KUNAL GANDHI		
Reviewed by:	MANISH	MANISH	Reviewed by:	23/1/20	R K JAISWAL		

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 02.	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: SCREENED CONTROL CABLES	SYSTEM:	SECTION: II	SHEET 2 OF 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	**			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9					
		c) Resistivity	MA	Electrical Tests	Manufacturer std.		IS 613	IS 613	-do-		P	V	-	
1.2	PVC Compound (for insulation)	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/Batch	Sample/Batch	IS 5831	IS 5831	Inspection Report/ Test Cert.		P/ V	V	-	
		2. Elec. Properties	MA	Electrical Tests	Sample/Batch	Sample/Batch	-do-	-do-	-do-		P/ V	V	-	
		SPECIFIC CHECKS : a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.		P	V	-	
		b) Type/ Grade	MA	-do-	100%	100%	Approved datasheet	Approved datasheet	-do-		P	V	-	
		c) Shelf life/ Storage condition	MA	-do-	100%	100%	Compound Manufacturer std.	Compound Manufacturer std.	-do-		P	V	-	
1.3	Screen / Tapes/ Binders	1. Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	TC & IR		P/ V	V	-	
		2. Dimension	MA	Measurement	Manufacturer std.	Manufacturer std.	Manufacturer datasheet/ Approved datasheet	Manufacturer datasheet/ Approved datasheet	TC & IR		P/ V	V	-	
		3. T.S. & Elongation	MA	Physical Tests	-do-	do-	Manufacturer datasheet	Manufacturer datasheet	-do-		P/ 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:	22.01.2020	Pariyanka	Checked by:	23/1/2020	RUNAL GANDHI			Reviewed by:			
Reviewed by:	Manish	MANISH	Reviewed by:	23/1/2020	R K JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 02.	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: SCREENED CONTROL CABLES	SYSTEM:	SECTION: II	SHEET 3 OF 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	**			REMARKS
1	2	3	4	5	6		7	8	9	D	M	C	N	
					M	C/N								
		4. Chem. & Phys. Properties	MA	Chemical & Physical Tests	-do-	do-	Manufacturer std.	Manufacturer std.	-do-		P/ V	V	-	
1.4	Fillers (as applicable)	1. Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	COC/Test certificate		P	V	-	Filler material chosen shall be compatible with the temperature rating of the cable and shall have no deleterious effect on any other component of the cable
		2. Flame retardant & moisture resistant. (as applicable)	MA	Chemical/ Environ.	-do-	-do-	Appd. Data Sheet	Appd. Data Sheet	-do-		P/ V	-	-	
1.5	Galvanised steel wire/strip for Armour (if 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	-do-	-do-	Appd. Data Sheet	Appd. Data Sheet	-do-		P/ V	-	-	
		3. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample*	Sample*	-do-	-do-	-do-		P/ V	-	-	* Sample from each armour size/Batch/ Lot
		4.Galvanization Quality	MA	Galv.Tests	-do-	-do-	IS 3975	IS 3975	-do-		P/ V	-	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	22.9.2020	Priyanka.	Checked by:	23/11/2020	KUNAL GANDHI		
Reviewed by:	Manish	MANISH	Reviewed by:	23/11/2020	R K JAISWAL		

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 02.	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: SCREENED CONTROL CABLES	SYSTEM:	SECTION: II	SHEET 4 OF 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
1.6	PVC compound for Sheath	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/Batch	Sample/Batch	IS 5831	IS 5831	Inspection Report/ Test Cert.		P/ V	V	-	
		2. Elec. Properties	MA	Electrical Tests	Sample/Batch	Sample/Batch	-do-	-do-	-do-		P/ V	V	-	
		3. FRLS Properties (as applicable)	CR	Chemical/ Environ.	Sample/Batch	Sample/Batch	Approved datasheet	Approved datasheet	-do-		P/ V	V	-	
		SPECIFIC CHECKS :											-	
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.		P	V	-	
		b) Type/ Grade	MA	-do-	-do-	-do-	Approved datasheet	Approved datasheet	-do-		P	V	-	
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-		P	V	-	
1.7	Wooden drums	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.	COC		P	V	-	
1.8	Steel drums (If applicable)	1. Dimension	MA	Meas.	Mfr's Plant Std.	Mfr's Plant Std.	Approved drg	Approved drg	Inspection Report/ Test Cert.		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:	22.4.2020	Parixanka	Checked by:	23/11/2020	KUNAL GANDHE			Reviewed by:			
Reviewed by:	Manish	MANISH	Reviewed by:	23/11/2020	R K JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 02.	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: SCREENED CONTROL CABLES	SYSTEM:	SECTION: II	SHEET 5 OF 11

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	**			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9					
		2. Surface finish	MA	Visual	-do-	-do-	Surface shall be smooth	Surface shall be smooth	Inspection Report		P	V	-	
2.0	IN PROCESS												-	
2.1	Wire Drawing & Annealing.	1. Size	MA	Dimensional	Mfr's Plant Std.	Mfr's Plant Std.	Approved datasheet	Approved datasheet	Inspection Report		P	V	-	
		2. Surface finish	MA	Visual	-do-	-do-	Surface shall be smooth	Surface shall be smooth	-do-		P	V	-	
2.2	Tinning (Conductor or drain wire)	1. Size	MA	Dimensional	Plant Mfg. Std.	Plant Mfg. Std.	Mfr's Plant Std.	Mfr's Plant Std.	-do-		P	V	-	(Applicable only for tin-coated copper conductor and drain wire)
		2. Chemical test for tinning	CR	Chemical	-do-	-do-	IS 10810 - 4	IS 8130	-do-		P	V	-	
2.3	Stranding of wires	1. No. of wires	MA	Counting	Mfr's Plant Std.	Mfr's Plant Std.	Approved datasheet	Approved datasheet	-do-		P	V	-	
		2. Resistance	CR	Electrical	-do-	-do-	-do-	-do-	-do-		P	-	-	
		3. Sequence, lay length & Direction	MA	Visual, Meas	one Sample each size/lot	one Sample each size/lot	Mfr. Std	Mfr. Std.	-do-		P	-	-	
		4. Surface Finish	MA	Visual	100%	100%	Surface shall be smooth	Surface shall be smooth	-do-		P	-	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	Pooja 21.01.2020	Pooja Periyanhal	Checked by:	Kunal Gandhi 23/1/2020	KUNAL GANDHI		
Reviewed by:	Manish	MANISH	Reviewed by:	[illegible] 23/1/2020	R K JAISWAL		

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 02.	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: SCREENED CONTROL CABLES	SYSTEM:	SECTION: II	SHEET 6 OF 11

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	
		5.Dimension	MA	Measurement	one Sample of each size/lot	one Sample of each size/lot	Appd. Data Sheet	Appd. Data Sheet	-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		P	V	-	
		2 Insulation thickness (Min./ Max.)	CR	Measurement	one Sample of each size/lot	one Sample of each size/lot	Appd. data sheet	Appd.data sheet	-do-		P	-	-	
		3. Concentricity #	CR	Measurement	-do-	-do-	Mfr's Std.	Mfr's Std.	Inspection Report		P	V	-	# To be checked at starting & finish end of Extruded Length
		4 Dia over insulation	MA	Measurement	-do-	-do-	Appd.data sheet	Appd.data sheet	-do-		P	-	-	
		5. Core identification	MA	Visual	100%	100%	Appd.data sheet	Appd.data sheet	-do-		P	-	-	
		6. TS & % Elongation	MA	Mechanical	100%	100%	IS 1554/ IS 5831	IS 1554/ IS 5831	-do-		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:	22.4.2020	Priyanka	Checked by:	23/11/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:		MANISH	Reviewed by:	23/1/2020	R K JALWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 02.	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: SCREENED CONTROL CABLES	SYSTEM:	SECTION: II	SHEET 7 OF 11

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	
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 meas	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	-	-	

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:	22.4.2020	Priyanka	Checked by:	23/11/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:		MANISH	Reviewed by:	23/1/2020	R K JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 02.	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: SCREENED CONTROL CABLES	SYSTEM:	SECTION: II	SHEET 8 OF 11

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								
		4. Colour					Appd. Data Sheet	ppd. Data Sheet						
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	-	-	
		3. Lay Direction	MA	Visual	-do-	-do-	Mftr's Std	Mftr's Std	-do-		P	-	-	
		4. Lay Length	MA	Visual, Meas.	At the start of the process	At the start of the process	-do-	-do-	-do-		P	-	-	
		5. Coverage	MA	Measurement	-do-	-do-	Appd. Data Sheet	Appd. Data Sheet	-do-		P	-	-	
		6. Dia over armour	MA	Measurement	-do-	-do-	-do-	-do-	-do-		P	-	-	
2.8	Outer Sheath Extrusion	1. Surface Finish	MA	Visual	100%	100%	--	Free from Bulging, Burnt particles, lumps, cuts & scratches	-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	-	-	

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:	22.01.2020	Priyanka	Checked by:	22/1/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	MANISH	MANISH	Reviewed by:	23/1/2020	R K JAIN			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 02.	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: SCREENED CONTROL CABLES	SYSTEM:	SECTION: II	SHEET 9 OF 11

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. Dia over outer sheath	MA	Measurement	-do-	-do-	Appd. Data Sheet	Appd. Data Sheet	-do-		P	-	-	
		4. Marking/ Colour / Embossing	MA	Visual	100%	100%	Appd. Data Sheet	Appd. Data Sheet	-do-		P	-	-	Sequential be done by printing marking shall
		5. TS & % Elongation	MA	Mechanical	100%	100%	IS 5831/IS 10810 part 7	IS 5831	-do-		P	-	-	
3.0	Final Inspection (Internal)	Routine Test (Refer Note-H)	CR	Electrical test & Measurement	100%	100%	#	#	-do-		P	V	V	# Refer Annexure-A to QP.
4.0	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		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:	22.01.2020	Priyanka	Checked by:	23/1/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	Manish	MANISH	Reviewed by:	23/1/2020	R K JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 02.	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: SCREENED CONTROL CABLES	SYSTEM:	SECTION: II	SHEET 10 OF 11

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	
		2. Dimensions	MA	Measurement	As per std.	As per std.	Appd. Data sheet	Appd. Data sheet	Inspection Report		P	W	W	
		3. Armouring - Coverage	MA	Measurement	-do-	-do-	-do-	-do-	-do-		P	W	W	# Refer Annexure-A to QP.
		4. Marking/Colour/ pair identification (Cable & cable drum)	MA	Visual	-do-	-do-	-do-	-do-	-do-		P	W	W	
		5. Acceptance Tests (Refer Note-H)	CR	Phy & Elect. Tests	#	#	#	-do-	-do-		P	W	W	
		6. Type & FRLS Tests (Refer Note-H)	CR	Measurement	#	#	#	Appd. Data sheet	-do-		P	W	W	

NOTES: -	
(A)	JOINTS IN CONDUCTOR AND ARMOUR SHALL BE AS PERMITTED BY IS 8130 & IS 1554-1 RESPECTIVELY.
(B)	NO REPAIR OF CORE INSULATION PERMITTED.
(C)	CABLE ENDS SHALL BE SEALED
(D)	RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER.

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:	22.01.2020	Periyanna	Checked by:	23/11/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	MANISH	MANISH	Reviewed by:	23/1/2020	RK JAISWAL			Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-507-E004, REV 02.	DATE:
		PROJECT:		PO NO.:	DATE:
		ITEM: SCREENED CONTROL CABLES	SYSTEM:	SECTION: II	SHEET 11 OF 11

(E)	FILLERS/DUMMY CORES ETC. SHALL BE AS PER BHEL SPECIFICATION
(F)	WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS SAMPLES AND NOT DEFINED IN QP, THE SAME SHALL BE AS PER VENDORS SAMPLING PLAN AGREED BY PURCHASER.
(G)	VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER BHEL SPECIFICATION.
(H)	FOR LIST OF TYPE TESTS, ROUTINE TESTS & ACCEPTANCE TESTS; REFER ANNEXURE A TO QP.

LEGENDS:
*RECORDS, INDENTIFIED 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

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:	22.01.2020	Priyanka.	Checked by:	23/1/2020	KUNDAN GANDHI			Reviewed by:			
Reviewed by:		MANISH	Reviewed by:	25/1/2020	R K JAISWAL			Approved by:			

BHEL	ANNEXURE - I TO QP	CUSTOMER:	PROJECT TITLE: RATE CONTRACT	SPECIFICATION NUMBER: PE-RC-999-507-E005
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R1	SPECIFICATION TITLE:
	Page 1 of 5	SYSTEM	ITEM: SCREENED CONTROL CABLES	DOC. NO.

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 tests (except for Sl. no. b & c below) to be conducted on one size (2P, 4P etc.) of each type (F or G type)/ lot.
   b) Electrical & C&I tests to be conducted on each size of each type of cables /lot.
   c) FRLS & Flammability tests to be conducted only on one sample/ lot, irrespective of size/type.

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 15.2.2) of IS: 1554 Part-I.
   b) Electrical & C&I tests to be conducted on each size of each type of cables /lot.
   c) FRLS & Flammability tests to be conducted only on one sample/ lot, 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 testing shall be conducted in line with the applicable standards and as per the Manufacturing Quality Plan approved for the project for every lot offered for inspection.

D. ADS: Approved datasheet.

NOTE: LOT shall be defined as per IS: 1554 Part-1.

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	***In process records shall be furnished to inspector at the time of inspection.***

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	23.01.2020	Pushpanka	Checked by:	23/1/2020	KUNAL GANDHI		
Reviewed by:		MANISH	Reviewed by:	23/1/2020	R K JAISWAL		

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

BHEL	ANNEXURE - I TO QP	CUSTOMER:	PROJECT TITLE: RATE CONTRACT	SPECIFICATION NUMBER: PE-RC-999-507-E005
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R1	SPECIFICATION TITLE:
	Page 2 of 5	SYSTEM	ITEM: SCREENED CONTROL CABLES	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
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	
IV.	Diameter test	For conductor	T, A	ADS	
2.0	**Tests for Armour Wires/Strips**				
I.	Measurement of dimensions	Applicable for Aluminium wire & GS wire/Strip	T,A	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 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 , IS: 2633	
VIII.	Mass of Zinc coating test	For G. S. wires/Strip only	T, A	IS 10810 Pt 41	
3.0	**Physical Tests for PVC Insulation, PVC sheath.**				
I.	Test for thickness & Eccentricity	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	IS 10810 Pt 7	
(a)	Before ageing		T, A	IS 10810 Pt 7	
(b)	After ageing		T, A	IS 10810 Pt 7	
III.	Ageing in air oven	For PVC insulation & PVC outer sheath	T	IS 10810 Pt 11	
IV.	Loss of mass in air oven test	For PVC insulation & PVC outer & Inner sheath	T	IS 10810 Pt 10	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	22.01.2020	Priyanka	Checked by:	23/1/2020	KUNAL GANDHE
Reviewed by:	Manish	MANISH	Reviewed by:	23/1/2020	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

BHEL	ANNEXURE - I TO QP	CUSTOMER:	PROJECT TITLE: RATE CONTRACT	SPECIFICATION NUMBER: PE-RC-999-507-E005
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R1	SPECIFICATION TITLE:
	Page 3 of 5	SYSTEM	ITEM: SCREENED CONTROL CABLES	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
V.	Hot deformation test	For PVC insulation & PVC outer & Inner sheath	T	IS 10810 Pt 15	
VI.	Heat shock test	For PVC insulation & PVC outer & Inner sheath	T	IS 10810 Pt 14	
VII.	Shrinkage test	For PVC insulation & PVC outer & Inner sheath	T	IS 10810 Pt 12	
VIII.	Thermal stability test	For PVC insulation & PVC outer sheath	T	IS 1554-1	
IX.	Bleeding & Blooming test	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 19	
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	
4.0	**Tests for Al-Mylar Shield**				
I.	Continuity test	For Al-Mylar shield	T, A	Plant Standard	
II.	Shield thickness	For Al-Mylar shield	A	ADS	
III	Overlap test	For Al-Mylar shield	A	ADS	
IV	Constructional details, dimensions	For Al-Mylar shield	A	ADS	
V	Visual, surface finish+	For Al-Mylar shield	A	Plant Standard	
VI	Overall coverage	For Al-Mylar shield	A	Plant Standard	
VII	Noise interference test.	For Al-Mylar shield	A	ADS	
5.0	**Tests for Drain Wire**				
I.	Annealing test	For copper conductor only	T, A	IS 10810 Pt 1	***In process records shall be furnished to inspector at the time of inspection.***

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	22.01.2020	Priyanka	Checked by:	23/1/2020	KUNAL GANDHI		
Reviewed by:	Manish	MANISH	Reviewed by:	23/1/2020	R K JAISWAL		

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

BHEL	ANNEXURE - I TO QP	CUSTOMER:	PROJECT TITLE: RATE CONTRACT	SPECIFICATION NUMBER: PE-RC-999-507-E005
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R1	SPECIFICATION TITLE:
	Page 4 of 5	SYSTEM	ITEM: SCREENED CONTROL CABLES	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
II.	Tin coating test (for tinned copper)	For copper conductor only	T, A	IS 10810 Pt 4	
III.	Resistance test	For Cu Conductor	T, A, R	IS 10810 Pt 5	
IV.	Diameter test	For conductor	T, A	ADS	
6.0	**FRLS Tests**				
I.	Oxygen index test	For PVC outer sheath & Fillers only	T, A	IS 10810 Pt 58 / ASTMD 2863	**Applicable for Inner Sheath if the same is indicated in Datasheet-A**
II.	Smoke density test	For PVC outer sheath & Fillers only	T, A	ASTMD 2843	
III.	Acid gas generation test	For PVC outer sheath & Fillers only	T, A	IS 10810 Pt 59 / IEC-754-1	
IV.	Temperature Index Test	For PVC outer sheath only	T	IS 10810 Pt 64 / ASTMD 2863	
7.0	**Flammability Tests**				
I.	Flammability test for bunched cables	For complete cable	T,A	IS 10810 Pt 62/ IEC-60332 (Part-3-23, CAT B).	**Test & Category applicable as indicated in Datasheet-A**
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	For complete cable	T, A, R	IS: 10810 Pt 45	
II.	Insulation Resistance Test (Volume resistivity method)	For complete cable	T, A, R	IS: 10810 Pt 43	
III.	L/R Ratio	For complete cable	A, R	BS:5308 Part II	
IV.	Spark Test	Online Process during Extrusion of Insulation	Online	BS:5308 Part II	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:			Checked by:		KUNAL GANDHE
Reviewed by:		MANISH	Reviewed by:		R K JAISWAL

23/1/2020

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
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Reviewed by:			
Approved by:			

610531/2021/PS-PEM-MAX

BHEL	ANNEXURE - I TO QP	CUSTOMER:	PROJECT TITLE: RATE CONTRACT	SPECIFICATION NUMBER: PE-RC-999-507-E005
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R1	SPECIFICATION TITLE:
	Page 5 of 5	SYSTEM	ITEM: SCREENED CONTROL CABLES	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
V.	Thermal ageing test	For complete cable	T	IS-1554 Pt-I	
9.0	**C&I Tests**				
I.	Cross talk	For complete cable	T, A	ADS	
II.	Attenuation	For complete cable	T, A	ADS	
III.	Characteristic Impedance	For complete cable	T, A	ADS	
IV.	Mutual capacitance	For complete cable	T, A, R	ADS	
V.	Noise interference	For complete cable	T, A	ADS	
10.0	**Anti-rodent and Termite Repulsion test**	For PVC outer sheath only	A	Refer Note	**Test applicable as indicated in Datasheet-A**
11.0	**Anti-Fungal Test**	For PVC outer sheath only	A	**Self-certification by vendor for anti-fungal property.**	**Same shall be applicable as per the project requirement to be furnished later.**
12.0	**Special Tests**				
I.	Hydrolytic Stability	For complete cable	A(**)	ASTM D 3137	**Test applicable as indicated in Datasheet-A**
II.	Ultraviolet Test	For complete cable	A(**)	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: Few chippings of PVC compound are slowly ignited in a porcelain dish in a muffle furnace at about 600 deg. C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound (lead).

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	22/01/2020	Priyanka	Checked by:	23/01/2020	KUNAL GANDHI		
Reviewed by:		MANISH	Reviewed by:		RK JAISWAL		

23/1/2020

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-E005, REV. 03	DATE: 13.02.2021
	PROJECT:		PO NO.:	DATE:
	ITEM: CABLE TRAYS & ACCESSORIES	SYSTEM: CABLING	SECTION: II	SHEET 1 OF 7

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	
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	MILL TC	√	P/V	V	-	Steel shall be procured from SAIL/TISCO/RINL/ BHUSAN/JINDAL ISPAT/ESSAR/LLOYD/ IISCO/ authorised SAIL Re Rollers.
		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.DRG	APPD.DRG	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.

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	13.7.2020	SUJIT KUMAR SETHY	Checked by:	Kundan 13/07/2020	Kundan Prasad		
Reviewed by:	Manish	MANISH SHUKLA	Reviewed by:	13/7/2020	R.K. Jaiswal		

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-E005, REV. 03	DATE: 13.02.2020
	PROJECT:		PO NO.:	DATE:
	ITEM: CABLE TRAYS & ACCESSORIES	SYSTEM: CABLING	SECTION: II	SHEET 2 OF 7

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.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	-	-	
		2. SURFACE FINISH	MA	VISUAL	100%	-	IS:2629	IS:2629	QC RECORD		P	-	-	
2.3	GALVANISING	1.TEMPERATURE OF ZINC BATH	MA	MEASUREMENT	CONTINUOUS	-	IS-2629	IS-2629	QC RECORD		P	-	-	Galvanization is to be done at galvanisation plant listed in annexure-2 to quality plan.
		2.DROSS	MA	VISUAL	PERIODIC	-	IS-2629	IS-2629	QC RECORD		P	-	-	
		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	-	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	13.2.2020	SUJIT KUMAR SETHY	Checked by:	13/02/2020	Kundan Prasad		
Reviewed by:		MANISH SHUKLA	Reviewed by:	13/2/2020	R K JAISWAL		

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-E005, REV. 03	DATE: 13.02.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: CABLE TRAYS & ACCESSORIES	SYSTEM: CABLING	SECTION: II	SHEET 3 OF 7

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 FINISHED ITEMS														
3.1	(CABLE TRAY, ACCESSORIES & HARDWARES)	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	-	Overall thickness of finished product shall not be less than the thickness of cable tray & accessories defined in technical datasheet.
		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	-	Fasteners shall be of good quality as per IS 1363
		3. MARKING	MA	VISUAL	IS-2500 (PART 1) LEVEL S-4	IS-2500 (PART 1) LEVEL S-4	APPD. DRG	APPD. DRG	INSP.REPORT	√	P	W	-	Following shall be engraved/ punched on each standard length of cable tray at the center of both sides of runner: 'PEM' (length of letter 90mm & height 30mm).

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:	03.2.2020	SUJIT KUMAR SETHY	Checked by:	13/02/2020	Kundan Prasad			Reviewed by:			
Reviewed by:	Manish	MANISH SHUKLA	Reviewed by:	13/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E005, REV. 03	DATE: 13.02.2020
	PROJECT:		PO NO.:	DATE:
	ITEM: CABLE TRAYS & ACCESSORIES	SYSTEM: CABLING	SECTION: II	SHEET 4 OF 7

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 FINISHED ITEMS														
		4.RIGIDITY (FOR TRAYS)	MA	DEFLECTION TEST	2 No./ LOT/TYPE	2 No./ LOT/TYPE	APPD. DRG	APPD. DRG	INSP.REPORT	√	P	W	-	600MM wide cable tray to be tested. Maximum deflection shall not exceed 7MM on mid span on uniform loading of 100KG/M.
		5.MASS OF ZINC COATING	MA	CHEM. TEST	IS-4759	IS-4759	IS-6745	610 gms/ Sq m (for 2.0mm thick product) 460 gms/ Sq m (for 1.6 mm thick product)	INSP.REPORT	√	P	W	-	
		6.UNIFORMITY OF ZINC COATING	MA	CHEM. TEST	IS-4759	IS-4759	IS-2633	IS-2633	INSP.REPORT	√	P	W	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	13.2.2020	SUJIT KUMAR SETHY	Checked by:	Kundan 13/2/2020	Kundan Prasad		
Reviewed by:	Manish	MANISH SHUKLA	Reviewed by:	13/2/2020	RK SAHU		

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Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E005, REV. 03	DATE: 13.02.2020
	PROJECT:		PO NO.:	DATE:
	ITEM: CABLE TRAYS & ACCESSORIES	SYSTEM: CABLING	SECTION: II	SHEET 5 OF

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	
		7.THICKNESS OF ZINC COATING	MA	PHYSICAL TEST	IS-4759	IS-4759	75 MICRONS (MINIMUM), 86 MICRONS (AVERAGE) for 2.0mm thick product. 55 MICRONS (MINIMUM), 65 MICRONS (AVERAGE) for 1.6mm thick product.	75 MICRONS (MINIMUM), 86 MICRONS (AVERAGE) for 2.0mm thick product. 55 MICRONS (MINIMUM), 65 MICRONS (AVERAGE) for 1.6mm thick product.	INSP.REPORT	√	P	W	-	
		8.ADHESION	MA	MECH.TEST	IS-4759	IS-4759	IS-2629	IS-2629	INSP.REPORT	√	P	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:	13.2.2020	SUJIT KUMAR SETHY	Checked by:	13/02/2020	Kundan Prasad			Reviewed by:			
Reviewed by:	Manish	MANISH SHUKLA	Reviewed by:	13/2/2020	RK JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E005, REV. 03	DATE: 13.02.2020
	PROJECT:		PO NO.:	DATE:
	ITEM: CABLE TRAYS & ACCESSORIES	SYSTEM: CABLING	SECTION: II	SHEET 6 OF

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/ N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		9. COUPLER PLATE	MA	VISUAL	100%	100%	BHEL APPD. DOCUMENT	BHEL APPD. DOCUMENT	INSP.REPORT	√	P	W	-	INSPECTOR TO MENTION THE TOTAL NUMBER OF GUNNY BAGS/BUNDLES OF COUPLER PLATES, NUTS, BOLTS & WASHER IN THE INSPECTION REPORT. FURTHER MANUFACTURER SHALL ATTACH THE DETAIL OF TOTAL NUMBER OF GUNNY BAGS/BUNDLES OF THE RESPECTIVE ITEMS WITH PACKING LIST.
		10. NUT & BOLT	MA	VISUAL	100%	100%	BHEL APPD. DOCUMENT	BHEL APPD. DOCUMENT	INSP.REPORT	√	P	W	-	
		11. WASHER	MA	VISUAL	100%	100%	BHEL APPD. DOCUMENT	BHEL APPD. DOCUMENT	INSP.REPORT	√	P	W	-	
		12. PACKING	MA	VISUAL	100%	100%	BHEL APPD. DOCUMENT	BHEL APPD. DOCUMENT	INSP.REPORT	√	P	V	-	Refer Note - 2

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:	13.2.2020	SUJIT KUMAR SETHY	Checked by:	Kundan 13/2/2020	Kundan Prasad			Reviewed by:			
Reviewed by:	Manish	MANISH SHUKLA	Reviewed by:	13/2/2020	R K JAISWAL			Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-507-E005, REV. 03	DATE: 13.02.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: CABLE TRAYS & ACCESSORIES	SYSTEM: CABLING	SECTION: II	SHEET 7 OF

NOTES:

1. BHEL RESERVESTHE RIGHT FOR CONDUCTING REPEAT TEST IF REQUIRED.
2. PHOTOGRAPHS OF COMPLETE CABLE TRAYS AFTER PACKING TO BE SENT TO BHEL PURCHASE GROUP FOR REVIEW BEFORE ISSUING MDCC.

LEGENDS:

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

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	13.2.2020	SUJIT KUMAR SETHY	Checked by:	13/2/2020	Kundan Prasad		
Reviewed by:	Manish	MANISH SHUKLA	Reviewed by:	13/2/2020	RK JAISWAL		

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

ANNEXURE-2 to Quality Plan

(LIST OF BHEL- PEM APPROVED GALVANIZERS)

SL. NO.	ITEM	VENDOR NAME	ADDRESS
1	Galvanising	Jenco Industrial Corporation	Chincholi Bunder Khkar Road Near Link Road Devruwadi Malad (W) Mumbai 400064
2	Galvanising	National Galvanizing Company	66, Barrackpore Kamarhatt Trunck Road Calcutta-700058
3	Galvanising	Sigma Galvanising Pvt. Ltd.	Plot No.C-169, TTC, MIDC Ind Area Navin Mumbai-400705
4	Galvanising	B.P. Projects PVT LTD	167A, Vivekananda Road Kolkata-700006
5	Galvanising	Standard Galvanisers	Makardah Road, Kabar Para, Bankra, Howarah -711403
6	Galvanising	Steel Products	National Highway No. 6, Chamrail, Kona, Howrah-711114
7	Galvanising	Unitech Fabricators & Engineers Pvt. Ltd	Village- Ajab Nagar, P.O. -Molla Simlia, P.S. - Singur, Dist - Hoogly, Pin-712223
8	Galvanising	Shivam Engineers & Fabricators	A0-282-284, Industrial Area, South Side of G.T. Road, Ghaziabad, U.P.
9	Galvanising	B.G. Shirke Construction Technology Pvt. Ltd	72-76, Mundhawa, Pune - 401 036
10	Galvanising	Galbro Ispat Galvanizers Pvt. Ltd.	GUT 11 AND 12, OPP. Kudus Steel,Rolling Mill, Wada, Thane , Mumbai
11	Galvanising	Eros Metals	G-97, MIDC, Bhutibori , Nagpur
12	Galvanising	Industrial Perforation (India) Pvt. Ltd.	Ganganagr, Katakhal, Kolkata-700132
13	Galvanising	Indmark Formtech Pvt. Ltd.	Phase - 3, E - 11 / 1, M. I. D. C., Chakan, Pune - 410 501, Maharashtra, India.
14	Galvanising	Namdhari Industrial Traders Pvt. Ltd.	Village Latton Dana, Chandigarh Road, Ludhiana
15	Galvanising	Neha Galvaniser	Jalan Industrial Estate, Gate No-1, 1st Right Choise Lane, Near N.G-6, Jangalpur, PO Domjur Howrah - 700071, West Bengal, India
16	Galvanising	Patny Systems (P) Ltd.	Unit-IV, Sy No. -228/9, Plot No. 6, IP Kuchavaram, Toopran(M) Dist.-Medak, Telegana - 502336
17	Galvanising	Parmar Metal Company	Survey No.207,Veraval (Shapar) Dist. Rajkot, India.
18	Galvanising	Rukmani Electrical & Fabricators Pvt, Ltd.	Urla Industrial Area, Urla Sarora Road, Raipur– 493 221 (Chhattisgarh) Shankharidiha Baniyarah, Jalan Industrial Complex, Gate no.3, Lane no. 4, Domjur, Howrah , W.B .- 71141
19	Galvanising	DMP Projects Pvt.Ltd.	Dulagarh Industrial Park , PS-Sankrail , Howrah -711302
20	Galvanising	Vinfab Engineers India Private Limited	Gut no. 224/1 &2 Bhiwandi Wada State Highway, Village khupri, Dist. Thane,
21	Galvanising	Saral Projects & Processors	B-1, Industrial Area, Site-II, Amawan Road Rae Bareli
22	Galvanising	Brahampuri Steels Limited	172 (F) Industrial Area, Jhotwara, Jaipur-302013
23	Galvanising	Indiana Gratings PVT. LTD	F-5, MIDC Jejuri, Pune-412 303
24	Galvanising	M/s AVAIDS TECHNOVATORS PVT. LTD.	131, MATSYA INDUSTRIAL AREA, ALWAR RAJASTHAN

NOTES:

1. IT SHALL BE THE RESPONSIBILITY OF THE VENDOR TO GET THE MATERIAL GALVANIZED FROM THE ABOVE LIST WITHOUT ANY COMMERCIAL IMPLICATION TO BHEL.

19.02.2020
(Sujit Ku. Sethy)
EIC

13/02/2020

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E006, REV. 03	DATE:08.07.2022
	PROJECT:		PO NO.:	
	ITEM: CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	SYSTEM:CABLING	SECTION: II	SHEET 1 OF 3

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
1.0 RAW MATERIAL														
1.1	MILD STEEL SECTIONS (CHANNEL & ANGLES)	1. CHEM. & PHY. PROPERTIES	MA	VERIFICATION OF TC'S	100%	-	IS -2062	IS -2062	MILL TC	√	P/V	V	V	Refer Note-1
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	IS - 808	IS - 808	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	-	IS-209	IS-209	TC	√	P/V	V	V	
2.0 IN-PROCESS														
2.1	CUTTING	1.DIMENSIONS	MA	MEASUREMENT	100%	-	Refer remarks	Refer remarks	QC RECORD	√	P	V	V	Refer note-2
		2. WELDING QUALITY (IF APPLICABLE)	MA	VISUAL	100%	-	ASME SEC. IX	ASME SEC. IX	QC RECORD	√	P	V	V	Refer Note-3
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM DEFECTS & SLAG	QC RECORD	√	P	V	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	GALVANIZING	1.TEMPERATURE OF ZINC BATH	MA	MEASUREMENT	CONTINUOUS	-	IS-2629	IS-2629	QC RECORD		P/V	-	-	Refer Note-4
		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,	QC RECORD		P/V	-	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:		MANOJ KUMAR MEENA	Checked by:		KUNAL GANDHI		
Reviewed by:		MANISH SHUKLA	Reviewed by:		R. K. 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-999-507-E006, REV. 03	DATE:08.07.2022
	PROJECT:		PO NO.:	
	ITEM: CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	SYSTEM:CABLING	SECTION: II	SHEET 2 OF 3

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
								SLAG FLUX, STAIN ETC.						
3.0 FINISHED ITEMS														
3.1	**CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)**	1. DIMENSIONS	MA	MEASUREMENT	IS-2500 (PART 1) LEVEL S-4	IS-2500 (PART 1) LEVEL S-4	IS - 808	IS - 808	INSP.REPORT	√	P	W	W	Refer note-2
		2. SURFACE FINISH	MA	VISUAL	IS-2500 (PART 1) LEVEL S-4	IS-2500 (PART 1) LEVEL S-4	-	FREE FROM BURRS, SLAG, ROUGHNESS, FLUX, STAIN ETC.	INSP.REPORT	√	P	W	W	
		3.MASS OF ZINC COATING	MA	CHEM. TEST	IS-4759	IS-4759	IS-6745	610 gms/ Sq m	INSP.REPORT	√	P	W	W	
		4.UNIFORMITY OF ZINC COATING	MA	CHEM. TEST	IS-4759	IS-4759	IS-2633	IS-2633	INSP.REPORT	√	P	W	W	
		5.THICKNESS OF ZINC COATING	MA	PHYSICAL TEST	IS-4759	IS-4759	Refer remarks	Refer remarks	INSP.REPORT	√	P	W	W	Refer note-5
		6.ADHESION	MA	MECH.TEST	IS-4759	IS-4759	IS-2629	IS-2629	INSP.REPORT	√	P	W	W	
		7.PACKING	MA	VISUAL	100%	100%	BHEL APPD. DOCUMENT	BHEL APPD. DOCUMENT	INSP.REPORT	√	P	W	-	Refer Note-6

NOTES:

1. Steel shall be procured from SAIL/ TISCO/ RINL/ BHUSAN/ JINDAL ISPAT/ ESSAR/ LLOYD/ IISCO/ authorised sail re rollers.
2. Length of one member of Cable Tray Support System-Welded(Galv) shall be 5.5 mtrs to 6.5 mtrs
3. Welding is to be done by qualified welders in accordance with ASME Sec. IX Article III. WPS, PQR & WPQ to be reviewed during inspection.
4. Galvanization is to be done at BHEL approved Galvanization Plants listed in Annexure-1 to Quality Plan.
5. Thickness of zinc coating shall be 75 microns (minimum)) & 86 microns (average).

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		MANOJ KUMAR MEENA	Checked by:		KUNAL GANDHI
Reviewed by:		MANISH SHUKLA	Reviewed by:		R. K. 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-999-507-E006, REV. 03	DATE:08.07.2022
	PROJECT:		PO NO.:	
	ITEM: CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	SYSTEM:CABLING	SECTION: II	SHEET 3 OF 3

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	C/N				D	M	C	N	

6. Photographs of complete Cable Tray Support System-Welded (Galv) after packing to be sent to BHEL Purchase Group for review before issuing MDCC.
7. Project specific Quality Plan to be developed based on customer requirement.
8. BHEL reserves the right for conducting repeat test, if required.
9. For export job, BHEL specification for seaworthy packing for export job to be followed.
10. Packing shall be suitable for storage at site in tropical climatic conditions.
11. 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, **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:		MANOJ KUMAR MEENA	Checked by:		KUNAL GANDHI
Reviewed by:		MANISH SHUKLA	Reviewed by:		R. K. 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: 02.11.2020
	CUSTOMER :		QP NO.: PE-QP-999-509-E001, R2.	
	PROJECT:		PO NO.:	
	ITEM: ABOVE GROUND EARTHING MATERIALS	SYSTEM: EARTHING	SECTION: II	SHEET 1 OF 5

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N				*	**			
										D	M	C	N	
1	2	3	4	5	6		7	8	9					
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
		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%	-	APPROVED DATA SHEET / DRAWING	APPROVED DATA SHEET / DRAWING	QC RECORD	✓	P	V	-	
		2. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM DEFECTS/ SLAG	TEST/ INSPN. REPORT	✓	P	V	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:		VIKAS KUMAR SINGH	Checked by:		KUNAL GANDHI		
Reviewed by:		MANISH SHUKLA	Reviewed by:		RITESH KUMAR 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: 02.11.2020
	CUSTOMER :		QP NO.: PE-QP-999-509-E001, R2.	
	PROJECT:		PO NO.:	
	ITEM: ABOVE GROUND EARTHING MATERIALS	SYSTEM: EARTHING	SECTION: II	SHEET 2 OF 5

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N				*	**			
										D	M	C	N	
1	2	3	4	5	6		7	8	9					
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:**													Note: sample for chemical test shall be

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:		VIKAS KUMAR SINGH	Checked by:		KUNAL GANDHI		
Reviewed by:		MANISH SHUKLA	Reviewed by:		RITESH KUMAR 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: 02.11.2020
	CUSTOMER :		QP NO.: PE-QP-999-509-E001, R2.	
	PROJECT:		PO NO.:	
	ITEM: ABOVE GROUND EARTHING MATERIALS	SYSTEM: EARTHING	SECTION: II	SHEET 3 OF 5

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	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	D				
														selected by BHEL& testing shall be done at NABL/ govt. approved Lab.
3.1	MS FLATS	1. CHEMICAL COMP.	MA	CHEM. TEST	1 No./LOT /SIZE	-	IS 2026	IS 2026	LAB TC	✓	P	V	-	Sampling plan for galvanization test: Inspection shall be as per table 2 of IS 4759 and same is mentioned below:-
		2. DIMENSIONS	MA	MEASUREMENT	IS 2500 (PART 1) LEVEL S-4	IS 2500 (PART 1) LEVEL S-4	APPROVED DATA SHEET / DRAWING	APPROVED DATA SHEET / DRAWING	INSPECTION REPORT	✓	P	W	-	
		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	-	

No. of units in a Lot	No. of units to be selected in a sample	Acceptance No.
(1)	(2)	(3)
Upto 25	3	0
26-100	5	0
101-150	8	1
151-500	13	1
501-1000	20	2
1001-10000	32	3

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:		VIKAS KUMAR SINGH	Checked by:		KUNAL GANDHI		
Reviewed by:		MANISH SHUKLA	Reviewed by:		RITESH KUMAR 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: 02.11.2020
	CUSTOMER :		QP NO.: PE-QP-999-509-E001, R2.	
	PROJECT:		PO NO.:	
	ITEM: ABOVE GROUND EARTHING MATERIALS	SYSTEM: EARTHING	SECTION: II	SHEET 4 OF 5

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N				*	**			
										D	M	C	N	
1	2	3	4	5	6		7	8	9					

		4.MASS OF ZINC COATING	MA	CHEM. TEST	REFER REMARKS	REFER REMARKS	IS-6745 /APP. DATA SHEET	APP. DATA SHEET	INSP. REPORT	✓	P	W	-	10001 and above: 50: 5
		5.UNIFORMITY OF ZINC COATING	MA	CHEM. TEST	IS-4759	IS-4759	IS-2633	IS-2633	INSP. REPORT	✓	P	W	-	Note:- If the number of defective units in a lot exceeds the acceptance number as specified in col (3) of the table, the lot shall be rejected, else accepted.
		6. THICKNESS OF ZINC COATING	MA	MEASUREMENT	IS-4759	IS-4759	APP. DATA SHEET	APP. DATA SHEET	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%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-5

NOTES:
1. BHEL reserves the right to perform repeat test, if required.
2. In case of foreign supplier, all test certificates shall be furnished by the supplier, duly witnessed/ verified by supplier's TPI.

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		VIKAS KUMAR SINGH	Checked by:		KUNAL GANDHI
Reviewed by:		MANISH SHUKLA	Reviewed by:		RITESH KUMAR 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: 02.11.2020
	CUSTOMER :		QP NO.: PE-QP-999-509-E001, R2.	
	PROJECT:		PO NO.:	
	ITEM: ABOVE GROUND EARTHING MATERIALS	SYSTEM: EARTHING	SECTION: II	SHEET 5 OF 5

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N			*	D	** M	C	N	
1	2	3	4	5	6		7	8	9					

3. Photographs of items duly placed inside the box just before the final packing and Photographs of the box just before dispatch to be sent to BHEL purchase group for review before issuing MDCC.
4. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
5. Project specific QP to be developed based on customer requirement.
6. For export job, BHEL technical specification for seaworthy packing for export job to be followed.
7. Material shall be packed suitably in order to avoid damage during transit and also during storage at site in tropical climate conditions. Packing shall be suitable for storage at site in tropical climate conditions.
8. 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, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: 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:		VIKAS KUMAR SINGH	Checked by:		KUNAL GANDHI		
Reviewed by:		MANISH SHUKLA	Reviewed by:		RITESH KUMAR JAISWAL		

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

	TITLE	SPECIFICATION NO.
	MOTOR	VOLUME II B
		SECTION D
	DATA SHEET - C	REV NO. 00 DATE 29.05.15
		SHEET 1 OF 2

S. No.	Description	Data to be filled by successful bidder
A.	**General**	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	**Design and Performance Data**	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a Voltage	
6	b Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR				
			REV.	
NAME	SIGNATURE	DATE	SEAL	

	TITLE	SPECIFICATION NO.
	MOTOR	VOLUME II B
		SECTION D
	DATA SHEET - C	REV NO. 00 DATE 29.05.15
		SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	**Constructional Features**	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	**Characteristic curves/ drawings** (To be enclosed for motors of rating ≥ 55KW)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

TITLE	SPECIFICATION NO.
DATA SHEET- C	VOLUME
LV SWITCHGEAR	SECTION
	REV NO.: 00 | DATE:
	SHEET 1 OF 29

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

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

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

TITLE	SPECIFICATION NO.
DATA SHEET- C	VOLUME
	SECTION
LV SWITCHGEAR	REV NO.: 00 | DATE:
	SHEET 4 OF 29

[ ] 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

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

TITLE	SPECIFICATION NO.
DATA SHEET- C	VOLUME
	SECTION
LV SWITCHGEAR	REV NO.: 00 | DATE:
	SHEET 5 OF 29

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

TITLE	SPECIFICATION NO.
DATA SHEET- C	VOLUME
	SECTION
LV SWITCHGEAR	REV NO.: 00 | DATE:
	SHEET 6 OF 29

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	:			

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

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

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

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

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

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

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

TITLE	SPECIFICATION NO.
DATA SHEET- C	VOLUME
	SECTION
LV SWITCHGEAR	REV NO.: 00 | DATE:
	SHEET 10 OF 29

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

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

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

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

TITLE	SPECIFICATION NO.
DATA SHEET- C	VOLUME
	SECTION
LV SWITCHGEAR	REV NO.: 00 | DATE:
	SHEET 12 OF 29

	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

TITLE		SPECIFICATION NO.
		VOLUME
	DATA SHEET- C	SECTION
	LV SWITCHGEAR	REV NO.: 00 | DATE:
		SHEET 13 OF 29

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

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

	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

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

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

TITLE	SPECIFICATION NO.
DATA SHEET- C	VOLUME
	SECTION
LV SWITCHGEAR	REV NO.: 00 | DATE:
	SHEET 16 OF 29

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

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

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)

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

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	:		

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

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	:		°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**

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

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

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

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

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

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			

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

TITLE	SPECIFICATION NO.
DATA SHEET- C	VOLUME
	SECTION
LV SWITCHGEAR	REV NO.: 00 | DATE:
	SHEET 25 OF 29

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

TITLE	SPECIFICATION NO.
DATA SHEET- C	VOLUME
	SECTION
LV SWITCHGEAR	REV NO.: 00 DATE:
	SHEET 26 OF 29

		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

TITLE	SPECIFICATION NO.
DATA SHEET- C **LV SWITCHGEAR**	VOLUME SECTION REV NO.: 00 | DATE: SHEET 29 OF 29

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

STANDARD SPECIFICATION - DATASHEET-C

(FOR E, F & G TYPE CABLES)

(TO BE SUBMITTED BY SUCCESSFUL BIDDER)

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 / Cross Section area	mm/ 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		

DATASHEET C

GUARANTEED TECHNICAL PARTICULARS
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)

S.No.		Unit	Description
1.0	**General**	-	
1.1	Name of manufacturer	-	
1.2	Place of Manufacture	-	
2.0	**Standards Applicable**		
2.1	**IS: 7098 Part-I** For general specification of XLPE Cables	-	YES
2.2	**IS: 8130** For conductor material	-	YES
2.3	**IS: 5831** For material of inner sheath & outer sheath.	-	YES
2.4	**IS: 3975 / IS: 8130** For armour of 3 core/ single core cables	-	YES
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	**ASTMD-2843** For smoke density test	-	YES
2.9	**SS:424-14-75 & IEC-332-III-Cat-B & CAT-A,** **IEC-332-I/ IEEE: 383** For flammability test	-	YES
2.10	**IEC-754-1** For Acid gas generation	-	YES
2.11	Current rating of cables conforms to	-	
2.12	Short circuit rating conforms to	-	
2.13	Formula for calculating short circuit current for Different duration	-	
3.0	(a) Installation Conditions at site	deg. C	
	i) Ambient air temperature	deg. C	
	ii) Ground temperature	cm	
	iii) Depth of laying of cables buried in ground	deg. C cm/W	
	(b) Installation conditions for current rating specified at clause 6.3		
4.0	CHARACTERISTICS OF FRLS SHEATH		
	(a) Oxygen index		

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

	(b) Temperature index		
	(c) Acid gas generation		
	(d) Smoke density rating		
5.0	CABLE DRUMS		
	(a) Type & construction		
	(b) Standard drum length		
	(c) Tolerance on drum length		
6.0	INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE		
6.1	No. of cores x size		
6.2	Voltage grade (Uo/U)	kV	
6.3	Base current ratings (*) based on Cl. 3.0		
	(a) In air	Amp	
	(b) In ground	Amp	
	(c) ducts	Amp	
6.4	Short circuit rating	kA,Sec	
6.5	(a) D.C. resistance of conductor at 20 deg C	ohm/km	
	(b) A.C. resistance of conductor at 90 deg. C	ohm/km	
	(c) Reactance of cable at Normal frequency	ohm/km	
	(d) Electrostatic capacitance of cable at normal frequency	mF/km	
6.6	CONDUCTOR		
	(a) Material type & grade	-	
	(b) No & dia of wires in each core before stranding	no x mm	
	(c) Shape	-	
6.7	XLPE INSULATION		
	(a) Nominal thickness of insulation	mm	
	(b) Method of Curing	-	
6.8	PVC ST2 INNERSHEATH		
	(a) Material	-	
	(b) Thickness (min.)	mm	
	(c) Method of application	-	
	1. Multi-core cables		
	(i) With fillers		
	(ii) With out fillers	Pressure Extruded	
	2. Single core cables		
	d) Type and shape of fillers (if used)		

NAME OF VENDOR				REV.	
			SEAL		
NAME	SIGNATURE	DATE			

	e) Colour		
6.9	ARMOUR		
	(a) Material		
	(i) Single core cables		
	(ii) Multi-core cables		
	(b) Size/ dimensions		
	(c) Minimum no. of wires /formed wires		
	(d) Tolerance on formed wire dimension		
	(e) Maximum resistivity of GS formed wire		
	(f) Maximum resistivity of Aluminium round wire		
6.10	PVC ST2 FRLS OUTERSHEATH		
	(a) Nominal thickness of outer sheath	mm	
6.11	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	
6.12	Tolerance on overall diameter	(±) mm	
6.13	Minimum bending radius	x O.D	
6.14	Safe Pulling Force	kG	
6.15	Weight of cable	kg./km	
	(a) Weight of conductor	MT/km	
	(b) Weight of XLPE insulation	MT/km	
	(c) Weight of PVC (Inner Sheath, Outer Sheath & Fillers)	kg./km	
	(d) Weight of Armour (As applicable)	kg./km	
6.16	Dimension of drum	mm	
6.17	Shipping weight	kg	
6.18	Cable marking on outer sheath		

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

NAME OF VENDOR				REV.	
			SEAL		
NAME	SIGNATURE	DATE			

DATA SHEET C

GUARANTEED TECHNICAL PARTICULARS
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)

S NO.	PARTICULARS	
1	Name of manufacturer	
2	Place of manufacture	
3	No of cores X Nominal area of conductor (mm2)	
4	Cable Type	
5	**CONDUCTOR**	
	a) Material type & grade	
	b) Shape	
	c) No. of Strands/Diameter of each strand (No. / mm)	
6	**HRPVC INSULATION**	
	a) Material	
	b) Dielectric strength kv/mm	
	c) Nominal thickness (mm)	
	d) Volume resistivity at 27° C (ohm-cm)	
	e) Volume resistivity at 70° C (ohm-cm)	
	f) Insulation resistance constant at 27° C (M ohm km)	
	g) Insulation resistance constant at 70° C (M ohm km)	
	h) Min. Tensile strength (N/mm2)	
	i) Min. Elongation at break (%)	
	j) Negative tolerance on thickness (mm)	
	k) Fictitious dia over insulation (mm)	
7	**FILLERS**	
	a) Material	
8	**INNERSHEATH**	
	a) Material	
	b) Whether FRLS	
	c) Minimum thickness (mm)	
	d) Colour of inner sheath	
	e) Fictitious dia over inner sheath (mm)	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

9	**ARMOUR**	
	a) Material	
	b) Type of armouring	
	c) Nominal size of armour (mm)	
	d) Minimum coverage	
	e) Method of jointing	
	f) Breaking load of joint	
	g) Minimum no. of wires (No.)	
	h) Armour resistance at 20 deg.C (Ohm/km) max	
	i) Max. Resistivity of GS wire (Ohm-cm) max.	
	j) Fictitious dia over Armouring (mm)	
10	**OUTERSHEATH**	
	a) Material	
	b) Whether FRLS	
	c) Thickness (mm) (Nominal)	
	d) Min. Tensile strength (N/mm2)	
	e) Min. Elongation at break (%)	
	f) Colour of Outer sheath	
	g) Tolerance on thickness in mm	
11	Permissible Voltage Variation	
12	Permissible Frequency Variation	
13	Combined Voltage & Frequency Variation	
14	Max. rated Conductor temperature	
15	Max. allowable conductor temperature during short circuit	
16	a. Continuous current carrying capacities	
	b. In Ground 30 deg.C (A)	
	c. In Duct 30 deg.C (A)	
	d. In Air 50 deg.C (A)	
	e. Depth of laying	
	f. Thermal resistivity of soil	
17	**FRLS PROPERTIES**	
	a. Oxygen Index (ASTMD 2863)	
	b. Temperature Index (ASTMD 2863-77)	
	c. Smoke density rating (ASTMD 2843)	
	d. HCL (ACID) Gas Generation (IEC 754-1)	
	e. Flammability tests	

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

18	**CABLE DRUMS**	
	a. Type & construction	
	b. Stranded drum length with tolerance on drum length	
19	Max. D.C. resistance of conductor at 20° C- Main (ohm/km)	
20	Max. A.C. resistance of conductor at 70° C- Main (ohm/km)	
21	Calculated star reactance (ohm/km)	
22	Approx. Cable Capacitance (micro F/km)	
23	Charging current at 415 V (A/km)	
24	Loss tangent (for reference only)	
25	**DIAMETERS**	
	a. Approx. dia over insulation (mm)	
	b. Approx. dia over inner sheath (mm)	
	c. Fictitious. dia under outer sheath (mm)	
	d. Approx. overall dia of cable (mm)	
	e. Tolerance on overall dia in mm	
26	Minimum bending radius	
27	safe pulling force when pulled by pulling eye N	
28	Approximate weight of cable (kg/km)	
29	Marking at every 5 meter on Outer Sheath by Embossing	
30	Marking at every 1 meter on Outer Sheath by Printing	

BHEL Approved Vendor List

Sl No	Package Name	Supplier Name
1	LT SWITCHGEAR	C and S ELECTRIC LTD.
2	LT SWITCHGEAR	TRICOLITE ELECTRICAL INDUSTRIES LTD
3	LT SWITCHGEAR	SPACEAGE SWITCHGEARS LTD.
4	LT SWITCHGEAR	GE INDIA INDUSTRIAL PVT.LTD.
5	LT SWITCHGEAR	ABB India Limited
6	LT SWITCHGEAR	SCHNEIDER ELECTRIC INDIA PVT. LTD.
7	LT SWITCHGEAR	LARSEN and TOUBRO LTD.
8	LT SWITCHGEAR	CONTROLS and SCHEMATICS LTD.
9	LT SWITCHGEAR	KMG ATOZ SYSTEMS PVT.LTD

Sl No	Package Name	Supplier Name
1	LT XLPE POWER CABLE	ASIAN GALAXY PVT. LTD.
2	LT XLPE POWER CABLE	Insucon Cables And Conductors Pvt. Ltd.
3	LT XLPE POWER CABLE	Nangalwala Industries Pvt. Ltd.
4	LT XLPE POWER CABLE	Govind Cable Industries,
5	LT XLPE POWER CABLE	KEC INTERNATIONAL LIMITED
6	LT XLPE POWER CABLE	GUPTA POWER INFRASTRUCTURE LIMITED,
7	LT XLPE POWER CABLE	SRIRAM CABLES PVT. LTD.
8	LT XLPE POWER CABLE	RAVIN CABLES LIMITED
9	LT XLPE POWER CABLE	ELKAY TELELINKS LTD.
10	LT XLPE POWER CABLE	THERMO CABLES LTD.
11	LT XLPE POWER CABLE	SPECIAL CABLES PVT. LTD.
12	LT XLPE POWER CABLE	SHIVPRIYA CABLES PVT. LTD.
13	LT XLPE POWER CABLE	APAR INDUSTRIES LTD.
14	LT XLPE POWER CABLE	KEI INDUSTRIES LTD.
15	LT XLPE POWER CABLE	CORDS CABLE INDUSTRIES LTD.
16	LT XLPE POWER CABLE	TIRUPATI PLASTOMATICS PVT. LTD.

17	LT XLPE POWER CABLE	PARAMOUNT COMMUNICATIONS LTD.
18	LT XLPE POWER CABLE	Zenium Cables Ltd.
19	LT XLPE POWER CABLE	Dynamic Cables Limited
20	LT XLPE POWER CABLE	SUYOG ELECTRICALS LTD.
21	LT XLPE POWER CABLE	Ravi Industries
22	LT XLPE POWER CABLE	GEMSCAB INDUSTRIES LTD.
23	LT XLPE POWER CABLE	Advance Cable Technologies (P) Ltd.
24	LT XLPE POWER CABLE	POLYCAB INDIA LIMITED
25	LT XLPE POWER CABLE	CMI LTD.
26	LT XLPE POWER CABLE	SBEE CABLES (INDIA) LIMITED
27	LT XLPE POWER CABLE	LASER POWER & INFRA PVT. LTD.
28	LT XLPE POWER CABLE	CHANDRESH CABLES LIMITED
Sl No	**Package Name**	**Supplier Name**
1	LT HRPVC CONTROL CABLES	KEC INTERNATIONAL LIMITED
2	LT HRPVC CONTROL CABLES	SUYOG ELECTRICALS LTD.
3	LT HRPVC CONTROL CABLES	THERMO CABLES LTD.
4	LT HRPVC CONTROL CABLES	RAVIN CABLES LIMITED
5	LT HRPVC CONTROL CABLES	DELTON CABLES LTD.
6	LT HRPVC CONTROL CABLES	SRIRAM CABLES PVT. LTD.
7	LT HRPVC CONTROL CABLES	Tempsens Instrument (I) Pvt Ltd
8	LT HRPVC CONTROL CABLES	SPECIAL CABLES PVT. LTD.
9	LT HRPVC CONTROL CABLES	GOYOLENE FIBRES (INDIA) PVT.LTD.
10	LT HRPVC CONTROL CABLES	POLYCAB INDIA LIMITED
11	LT HRPVC CONTROL CABLES	CORDS CABLE INDUSTRIES LTD.
12	LT HRPVC CONTROL CABLES	CABLE CORPORATION OF INDIA LTD.
13	LT HRPVC CONTROL CABLES	ELKAY TELELINKS LTD.

14	LT HRPVC CONTROL CABLES	GUPTA POWER INFRASTRUCTURE LIMITED.
15	LT HRPVC CONTROL CABLES	Advance Cable Technologies (P) Ltd.
16	LT HRPVC CONTROL CABLES	Zenium Cables Ltd.
17	LT HRPVC CONTROL CABLES	APAR INDUSTRIES LTD.
18	LT HRPVC CONTROL CABLES	PRESTIGE CABLE INDUSTRIES
19	LT HRPVC CONTROL CABLES	TIRUPATI PLASTOMATICS PVT. LTD.
20	LT HRPVC CONTROL CABLES	KEI INDUSTRIES LTD.
21	LT HRPVC CONTROL CABLES	UNIVERSAL CABLES LTD.
22	LT HRPVC CONTROL CABLES	PARAMOUNT COMMUNICATIONS LTD.
23	LT HRPVC CONTROL CABLES	SBEE CABLES (INDIA) LIMITED
24	LT HRPVC CONTROL CABLES	K C POWERTRACKS
25	LT HRPVC CONTROL CABLES	CMI LTD.
26	LT HRPVC CONTROL CABLES	GEMSCAB INDUSTRIES LTD.
27	LT HRPVC CONTROL CABLES	ASIAN GALAXY PVT. LTD.
28	LT HRPVC CONTROL CABLES	Insucon Cables And Conductors Pvt. Ltd.
29	LT HRPVC CONTROL CABLES	Ravi Industries
30	LT HRPVC CONTROL CABLES	Nangalwala Industries Pvt. Ltd.
31	LT HRPVC CONTROL CABLES	TORRENT POWER LTD.

Sl No	Package Name	Supplier Name
1	SCREENED CONTROL CABLES	POLYCAB INDIA LIMITED
2	SCREENED CONTROL CABLES	CMI LTD.
3	SCREENED CONTROL CABLES	Tempsens Instrument (I) Pvt Ltd
4	SCREENED CONTROL CABLES	ELKAY TELELINKS LTD.
5	SCREENED CONTROL CABLES	CORDS CABLE INDUSTRIES LTD.
6	SCREENED CONTROL CABLES	GUPTA POWER INFRASTRUCTURE LIMITED.

7	SCREENED CONTROL CABLES	THERMO CABLES LTD.
8	SCREENED CONTROL CABLES	KEI INDUSTRIES LTD.
9	SCREENED CONTROL CABLES	SUYOG ELECTRICALS LTD.
10	SCREENED CONTROL CABLES	PARAMOUNT COMMUNICATIONS LTD.
11	SCREENED CONTROL CABLES	DELTON CABLES LTD.
12	SCREENED CONTROL CABLES	Advance Cable Technologies (P) Ltd.
13	SCREENED CONTROL CABLES	SPECIAL CABLES PVT. LTD.
14	SCREENED CONTROL CABLES	T C Communication Pvt. Ltd.
Sl No	**Package Name**	**Supplier Name**
1	CABLE TRAYS & ACC.	EROS METAL WORKS (P) LTD.
2	CABLE TRAYS & ACC.	Maheshwari Electrical Mfrs. Pvt. Ltd.,
3	CABLE TRAYS & ACC.	INDUSTRIAL PERFORATION (I) PVT.LTD.
4	CABLE TRAYS & ACC.	RATAN PROJECTS & ENGINEERING CO. PVT.LTD.
5	CABLE TRAYS & ACC.	RABI ENGINEERING WORKS PVT. LTD.
6	CABLE TRAYS & ACC.	PARMAR METALS PVT.LTD.
7	CABLE TRAYS & ACC.	PATNY SYSTEMS (P) LTD
8	CABLE TRAYS & ACC.	UNITECH FABRICATORS and ENGINEERS PVT LTD
9	CABLE TRAYS & ACC.	NAMDHARI INDUSTRIAL TRADERS PVT. LTD
10	CABLE TRAYS & ACC.	Saral Industries
11	CABLE TRAYS & ACC.	RUKMANI ELECTRICAL & COMPONENTS PVT LTD
12	CABLE TRAYS & ACC.	INDMARK FORMTECH PVT. LTD.
13	CABLE TRAYS & ACC.	PENTAX FERRO INCORPORATE
14	CABLE TRAYS & ACC.	VATCO ELEC-POWER PVT. LTD.
15	CABLE TRAYS & ACC.	R.K. Engineering Works
16	CABLE TRAYS & ACC.	ADVANCE POWER PRODUCTS

17	CABLE TRAYS & ACC.	PREMIER POWER PRODUCTS (CAL) PVT. LTD.

Sl No	Package Name	Supplier Name
1	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	INDMARK FORMTECH PVT. LTD.
2	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	TJSV Steel Fabrication & Galvanizing (India) Limited
3	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	UNITECH FABRICATORS and ENGINEERS PVT LTD
4	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	JAGANNATHAN ENGINEERING WORKS
5	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	RATAN PROJECTS & ENGINEERING CO. PVT.LTD.
6	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	NAMDHARI INDUSTRIAL TRADERS PVT. LTD
7	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	PATNY SYSTEMS (P) LTD
8	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	INDUSTRIAL PERFORATION (I) PVT.LTD.
9	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	PARMAR METALS PVT.LTD.
10	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	PENTAX FERRO INCORPORATE
11	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	VSP Enterprises Pvt. Ltd.
12	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	VINFAB ENGINEERS INDIA PVT. LTD.
13	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	EROS INFRASTRUCTURES PVT. LTD.
14	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	PREMIER POWER PRODUCTS (CAL) PVT. LTD.
15	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	RABI ENGINEERING WORKS PVT. LTD.
16	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	RUKMANI ELECTRICAL & COMPONENTS PVT LTD

17	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	Saral Industries

S No.	Package Name	Supplier Name
1	ABOVE GROUND EARTHING MATERIALS	PREMIER POWER PRODUCTS (CAL) PVT. LTD.
2	ABOVE GROUND EARTHING MATERIALS	JAGANNATHAN ENGINEERING WORKS
3	ABOVE GROUND EARTHING MATERIALS	RUKMANI ELECTRICAL & COMPONENTS PVT LTD
4	ABOVE GROUND EARTHING MATERIALS	INDUSTRIAL PERFORATION (I) PVT.LTD.
5	ABOVE GROUND EARTHING MATERIALS	INDMARK FORMTECH PVT. LTD.
6	ABOVE GROUND EARTHING MATERIALS	RATAN PROJECTS & ENGINEERING CO. PVT.LTD.
7	ABOVE GROUND EARTHING MATERIALS	NAMDHARI INDUSTRIAL TRADERS PVT. LTD
8	ABOVE GROUND EARTHING MATERIALS	PATNY SYSTEMS (P) LTD
9	ABOVE GROUND EARTHING MATERIALS	RAJASTHAN METAL SMELTING CO.
10	ABOVE GROUND EARTHING MATERIALS	UNITECH FABRICATORS and ENGINEERS PVT LTD
11	ABOVE GROUND EARTHING MATERIALS	RABI ENGINEERING WORKS PVT. LTD.
12	ABOVE GROUND EARTHING MATERIALS	EROS INFRASTRUCTURES PVT. LTD.

BHEL Appoved Sub Vendor List

ITEM/SERVICE DESCRIPTION	VENDOR NAME
AC CONTACTORS	SIEMENS
AC CONTACTORS	GE-POWER
AC CONTACTORS	TELEMECHANIQUE/ SCHNEIDER ELECTRIC INDIA PVT. LTD.
AC CONTACTORS	L&T
AC CONTACTORS	BCH
AC MCCB	C&S ELECTRIC LTD.
AC MCCB	SCHNEIDER ELECTRIC INDIA PVT. LTD.
AC MCCB	SIEMENS
AC MCCB	GE-POWER
AC MCCB	L&T
AC MCCB	CROMPTON GREAVES
AIR CIRCUIT BREAKER	L&T
AIR CIRCUIT BREAKER	SIEMENS
AIR CIRCUIT BREAKER	GE-POWER
AIR CIRCUIT BREAKER	SCHNEIDER ELECTRIC INDIA PVT. LTD.
AIR CIRCUIT BREAKER	C&S ELECTRIC LTD.
AUXILIARY RELAYS	ABB

ITEM/SERVICE DESCRIPTION	VENDOR NAME
AUXILIARY RELAYS	ALSTOM LTD
AUXILIARY RELAYS	JYOTI LTD.
AUXILIARY RELAYS	OEN INDIA LTD
AUXILIARY RELAYS	SIEMENS
CABLE CLAMPS & CABLE TIES	ELECTROMAC IND.CORPN.
CABLE CLAMPS & CABLE TIES	INCAB
CABLE CLAMPS & CABLE TIES	NOVOFLEX MARKETING PVT. LTD.
CABLE GLANDS	ALLIED TRADERS & EXPORTERS
CABLE GLANDS	ARUP ENGG & FOUNDARY WORKS
CABLE GLANDS	BALIGA LIGHTING EQPT.PVT.LTD.
CABLE GLANDS	COMMET BRASS PRODUCTS
CABLE GLANDS	DOWELLS
CABLE GLANDS	ELECTROMAC INDUSTRIES
CABLE GLANDS	INCAB

ITEM/SERVICE DESCRIPTION	VENDOR NAME
CABLE LUGS	DOWELLS
CABLE LUGS	UNIVERSAL MACHINES LTD.
EARTH LEAKAGE CB	L&T
EARTH LEAKAGE CB	SIEMENS
EARTH LEAKAGE CB	GE-POWER
EARTH LEAKAGE CB	SCHNEIDER ELECTRIC INDIA PVT. LTD.
EARTH LEAKAGE CB	C&S ELECTRIC LTD.
EARTH LEAKAGE CB	ABB
EARTH LEAKAGE CB	INDO ASIAN
EARTH LEAKAGE CB	MDS SWITCHGEAR LTD
EARTH LEAKAGE CB	S&S POWER SWITCHGEAR LTD,
GI CONDUITS	
GI CONDUIT (EPOXY PAINTED)	
CONTROL SWITCHES/ SELECTOR SWITCH	KAYCEE
CONTROL SWITCHES/ SELECTOR SWITCH	GE-POWER
CONTROL SWITCHES/ SELECTOR SWITCH	ALSTOM LTD
CONTROL SWITCHES/ SELECTOR SWITCH	SCHNEIDER ELECTRIC INDIA PVT. LTD.
CONTROL SWITCHES/ SELECTOR SWITCH	M/s Shrenik & Co.

ITEM/SERVICE DESCRIPTION	VENDOR NAME
CONTROL SWITCHES/ SELECTOR SWITCH	RECOM PVT. LTD.
CONTROL TRANSFORMER/ WINDING HEATING TRANSFORMER	AUTOMATIC ELECTRIC LTD.
CONTROL TRANSFORMER/ WINDING HEATING TRANSFORMER	INDCOIL
CONTROL TRANSFORMER/ WINDING HEATING TRANSFORMER	KAPPA ELECTRICALS
CONTROL TRANSFORMER/ WINDING HEATING TRANSFORMER	LOGICSTAT
CONTROL TRANSFORMER/ WINDING HEATING TRANSFORMER	PRECISE ELECTRICALS
CONTROL TRANSFORMER/ WINDING HEATING TRANSFORMER	UNILEC ENGINEERS PVT. LTD.
CONTROL TRANSFORMER/ WINDING HEATING TRANSFORMER	M/s Newtek Electricals
LT- CURRENT TRANSFORMER	SIEMENS
LT- CURRENT TRANSFORMER	AUTOMATIC ELECTRIC LTD.

ITEM/SERVICE DESCRIPTION	VENDOR NAME
LT- CURRENT TRANSFORMER	INDCOIL
LT- CURRENT TRANSFORMER	KAPPA ELECTRICALS
LT- CURRENT TRANSFORMER	PRAGATI ELECTRICALS
LT- CURRENT TRANSFORMER	PRECISE ELECTRICALS
LT- CURRENT TRANSFORMER	SILKAANS ELECT.MFG.CO.PVT.LTD
LT- CURRENT TRANSFORMER	PRAYOG ELECTRICALS PVT. LTD.
LT- CURRENT TRANSFORMER	C&S ELECTRIC LTD.
LT- CURRENT TRANSFORMER	M/s Newtek Electricals
LT- POTENTIAL TRANSFORMER	SIEMENS
LT- POTENTIAL TRANSFORMER	AUTOMATIC ELECTRIC LTD.
LT- POTENTIAL TRANSFORMER	INDCOIL
LT- POTENTIAL TRANSFORMER	KAPPA ELECTRICALS
LT- POTENTIAL TRANSFORMER	PRAGATI ELECTRICALS
LT- POTENTIAL TRANSFORMER	PRECISE ELECTRICALS
LT- POTENTIAL TRANSFORMER	SILKAANS ELECT.MFG.CO.PVT.LTD

ITEM/SERVICE DESCRIPTION	VENDOR NAME
LT- POTENTIAL TRANSFORMER	PRAYOG ELECTRICALS PVT. LTD.
LT- POTENTIAL TRANSFORMER	M/s Newtek Electricals
DC SWITCH	GE-POWER
DC SWITCH	KAYCEE
DC SWITCH	SIEMENS
FUSE BASE	INDO ASIAN
FUSE BASE	GE-POWER
FUSE BASE	L&T
FUSE BASE	C&S ELECTRIC LTD.
FUSE BASE	SIEMENS
FUSE BASE	ABB
FUSE BASE	SPACEAGE SWITCHGEARS LTD.
FUSE BASE	SCHNEIDER ELECTRIC INDIA PVT. LTD.
FUSE BASE	ALSTOM LTD

ITEM/SERVICE DESCRIPTION	VENDOR NAME
FUSE BASE	ESSEN DEINKI
HRC FUSES	INDO ASIAN
HRC FUSES	GE-POWER
HRC FUSES	L&T
HRC FUSES	C&S ELECTRIC LTD.
HRC FUSES	SIEMENS
HRC FUSES	ABB
HRC FUSES	SPACEAGE SWITCHGEARS LTD.
HRC FUSES	SCHNEIDER ELECTRIC INDIA PVT. LTD.
HRC FUSES	ALSTOM LTD
HRC FUSES	ESSEN DEINKI
GALVANISING	Jenco Industrial Corporation
GALVANISING	National Galvanizing Company
GALVANISING	Sigma Galvanising Pvt. Ltd.
GALVANISING	B.P. Projects PVT LTD
GALVANISING	Standard Galvanisers
GALVANISING	Steel Products
GALVANISING	Unitech Fabricators & Engineers Pvt. Ltd.
GALVANISING	Shivam Engineers & Fabricators

ITEM/SERVICE DESCRIPTION	VENDOR NAME
GALVANISING	B.G. Shirke Construction Technology Pvt. Ltd
GALVANISING	Galbro Ispat Galvanizers Pvt. Ltd.
GALVANISING	Eros Metals
GALVANISING	Industrial Perforation (India) Pvt. Ltd.
GALVANISING	Indmark Formtech Pvt. Ltd.
GALVANISING	Namdhari Industrial Traders Pvt. Ltd.
GALVANISING	Neha Galvaniser
GALVANISING	Patny Systems (P) Ltd.
GALVANISING	Parmar Metal Company
GALVANISING	Rukmani Electrical & Components Pvt Ltd
GALVANISING	Rukmani Fab & Gal Pvt Ltd
GALVANISING	DMP Projects Pvt.Ltd.
GALVANISING	Vinfab Engineers India Private Limited
GALVANISING	Saral Projects & Processors

ITEM/SERVICE DESCRIPTION	VENDOR NAME
GALVANISING	Brahampuri Steels Limited
GALVANISING	Indiana Gratings PVT. LTD
GALVANISING	M/s AVAIDS TECHNOVATORS PVT. LTD
GI WIRE & FLAT	INDUSTRIAL PERFORATION (I) PVT.LTD.
GI WIRE & FLAT	INDIA ELECTRICALS SYNDICATE
GI WIRE & FLAT	INDMARK FORMTECH PVT. LTD.
GI WIRE & FLAT	PREMIER POWER PRODUCTS (CAL) PVT. LTD.
GI WIRE & FLAT	PATNY SYSTEMS (P) LTD
GI WIRE & FLAT	PASSIVE INFRA PROJECTS PVT. LTD.
GI WIRE & FLAT	RUKMANI ELECTRICAL & COMPONENTS PVT LTD
GI WIRE & FLAT	RATAN PROJECTS & ENGINEERING CO. PVT.LTD.
GI WIRE & FLAT	RABI ENGINEERING WORKS PVT. LTD.

ITEM/SERVICE DESCRIPTION	VENDOR NAME
GI WIRE & FLAT	RAJASTHAN METAL SMELTING CO.
GI WIRE & FLAT	SARAL INDUSTRIES
GI WIRE & FLAT	PARCO Engineers Pvt. Ltd.
GI WIRE & FLAT	UNITECH FABRICATORS and ENGINEERS PVT LTD
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	GE-POWER
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	ASIATIC
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	C&S ELECTRIC LTD.
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	EVERGREEN ENGG. CO.
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	TECKNIC CONTROLS

ITEM/SERVICE DESCRIPTION	VENDOR NAME
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	EX-PROTECTA LIGHTING EQUIPMENT
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	BALIGA ELECTRICALS
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	ENPRO ENGG.
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	STERLING SWGR CONTROL PVT.LTD.
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	ELEXPRO ELECTRICALS PVT/ LTD.
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	VAISHNO(HOTLINE SWGR & CONTROL)
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	JASPER ENGNIREES PVT. LTD.
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	KMG ATOZ SYSTEMS
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	UNILEC ENGINEERS PVT. LTD.
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	BCH
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	CANDS

ITEM/SERVICE DESCRIPTION	VENDOR NAME
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	SIEMENS
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	SCHNEIDER ELECTRIC INDIA PVT. LTD.
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	TECKNIC CONTROLS
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	UNITED ELECTRIC
LOCAL PUSH BUTTON STATION (NON FLAME PROOF)	M/s Shrenik & Co.
LOCAL PUSH BUTTON STATION (FLAME PROOF)	
MCB	MDS SWITCHGEAR LTD
MCB	INDO ASIAN
MCB	SCHNEIDER ELECTRIC INDIA PVT. LTD.
MCB	S&S POWER SWITCHGEAR LTD,
LV MOTORS (NON FLAME PROOF)	ABB
LV MOTORS (NON FLAME PROOF)	BHARAT BIJLEE LTD.

ITEM/SERVICE DESCRIPTION	VENDOR NAME
LV MOTORS (NON FLAME PROOF)	CROMPTON GREAVES
LV MOTORS (NON FLAME PROOF)	GE-POWER
LV MOTORS (NON FLAME PROOF)	KIRLOSKAR ELECTRIC CO LTD.
LV MOTORS (NON FLAME PROOF)	LAXMI HYDRAULICS PVT. LTD
LV MOTORS (NON FLAME PROOF)	MARATHON
LV MOTORS (NON FLAME PROOF)	NGEF
LV MOTORS (NON FLAME PROOF)	RAJINDRA ELECT INDUSTRIES
LV MOTORS (NON FLAME PROOF)	SIEMENS
TERMINAL BLOCKS	WAGO-CONTROLS
TERMINAL BLOCKS	CONNECT WELL
TERMINAL BLOCKS	ELMEX CONTROLS PVT. LTD.
TERMINAL BLOCKS	ESSEN DEINKI
TERMINAL BLOCKS	TECHNOPLAST

ITEM/SERVICE DESCRIPTION	VENDOR NAME
TERMINAL BLOCKS	M/s PHOENIX MECANO LTD.,
TERMINAL BLOCKS	ESSEN DEINKI
ENERGY METER (ANALOG)	BHEL (EDN)
ENERGY METER (ANALOG)	SIMCO ENGG. LTD
ENERGY METER (ANALOG)	RISHABH INST.PVT LTD
ENERGY METER (ANALOG)	AUTOMATIC ELECTRIC LTD.
ENERGY METER (ANALOG)	CONZERVE SYSTEMS PVT. LTD.(SCHNEIDER)
ENERGY METER (DIGITAL)	CONZERVE SYSTEMS PVT. LTD.(SCHNEIDER)
ENERGY METER (DIGITAL)	M/s Newtek Electricals

SECTION: I

SUB-SECTION: C4

TECHNCIAL SPECIFICATION

(C&I PORTION)

TECHNICAL SPECIFICATION
(CONTROL AND INSTRUMENTATION)
FOR VENTILATION SYSTEM

INDEX

S. No.	DESCRIPTION
1	TITLE SHEET
2	INDEX SHEET
3	C&I SPECIFIC TECHNICAL REQUIREMENTS
4	LIST OF DOCUMENTS/DELIVERABLES
5	GENERAL TECHNICAL SPECIFICATION
6	MEASURING INSTRUMENTS
7	DRIVE CONTROL PHILOSOPHY
8	QUALITY ASSURANCE
9	SUB VENDOR LIST

C&I SPECIFIC TECHNICAL REQUIREMENT

Specific Technical Requirements (C&I)

1. Ventilation System shall be operated from DDCMIS (BHEL's scope) for Area's/Building indicated elsewhere in the specification.
2. Interface of MCC, field Equipment, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification.
3. The Bidder shall provide complete Instrumentation for control, monitoring and operation of entire Ventilation. The requirements given are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial implication.
4. The quantity of instruments for the system shall be as per tender P &ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price/time implication.
5. Instrument installation and accessories required for the same shall be in Bidder's scope. Further, any instrument installation not covered in the specification, same shall be subject to customer and BHEL approval during detailed engineering. All instruments required for the package shall be supplied, mounted on the gauge board racks, along with accessories like impulse pipe, fittings & valve manifolds etc.
6. All field instruments enclosure shall be IP65 or better.
7. All instruments and control elements shall be terminated on JB/LCP in field and both instrument and JB/LCP are in bidder scope. Number of Junction

Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable.

8. Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication. The make/model of various instruments/items/systems shall be as per customer/BHEL approved vendor list. No commercial and delivery implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
9. All the instruments/equipment/electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply.
10. All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant.
11. Material described in the specification (for instrument, equipment, accessories etc.) are the minimum requirements, which shall be complied by bidder. Any other better material shall also be considered to suit the process and environmental conditions at site subject to owner's approval. Material, if found not suitable shall be changed by vendor without any price/time implication.
12. The contacts of equipment mounted instruments; sensors, switches etc. For external connection including spare contacts shall be wired out to suitably located junction boxes by bidder.
13. Drive control philosophy/signal exchange list attached elsewhere in the specification are tentative and shall be finalised during detailed engineering.
14. For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.
15. Number of pairs to be selected for Screen/ Control cable
    a. F-Type: 2P/4P/8P (Size : 0.5 mm2)
    b. G-Type: 2P/4P/8P (Size : 0.5 mm2)

c. Core Cable: 3CX2.5sqmm2

16. The specifications for instruments mentioned in the specification are minimum requirements. The detail specifications shall be finalized during detail engineering.
17. Bidder to furnish electrical load/UPS load data during detailed engineering
18. 415 V AC Power supply shall be provided by BHEL at a single point, further distribution to various instruments/equipment of the system shall be in bidder scope. Bidder 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. Bidder to submit the power requirement along with the bid.

LIST OF DOCUMENTS/DELIVERABLES

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT			
Sl. No.	**DRAWING NO.**	**DRAWING/DOCUMENT TITLE**	**CATEGORY**
1	PE-V9-XXX-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM WITH SET POINTS	A
2	PE-V9-XXX-145-I902	INSTRUMENT SCHEDULE WITH SET POINTS	A
3	PE-V9-XXX-145-I903	FIELD JB SCHEDULE WITH TERMINATIONS	A
4	PE-V9-XXX-145-I904	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
5	PE-V9-XXX-145-I905	QUALITY PLANS (INSTRUMENTS, etc.)	A

GENERAL TECHNICAL REQUIREMENTS

1.1.25.20 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.

1.1.25.20.1 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 Pt100.

The use of dial-type contact thermometers shall be restricted to bearing metal and oil temperature measuring.

1.1.25.20.2 Pressure Measurement

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 1.5 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.

1.1.25.20.3 Level Measurement

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.

1.1.25.20.4 Electrical Measurement

All Electrical instruments shall be of flush mounted design, dust and moisture-proof.

Indicating instruments shall be flush mounted and shall comply with the latest standards applicable. All indicating meters shall be Digital Multi-function Meters (DMM) of Class 0.2S capable of displaying various parameters like voltage, current, MW, MVAR, MWh, MVARh, power factor, frequency etc... The Digital Multi-function Meters shall be provided in

duplicate. The LED digits shall be of sufficient size so as to have easy readability from the operator work table. The Digital Multi-function Meters shall have communication facility as per latest protocols which shall be finalised during detailed engineering in consultation with KSEBL.

Energy meters shall be suitable for unbalanced systems and accuracy of energy meters should be of 0.2S 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 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.

1.1.25.20.5 Position Measurement

Position transmitters for continuous position indication and measuring transducers shall have an output current of 4-20 mA and auxiliary supply voltage (if required) 48 V D.C.

1.1.25.20.6 Limit Switches

Limit switches shall be mounted suitable for easy adjustment and for rigidly locking in position after being adjusted. They shall be of heavy-duty rating and have two change-over contacts suitable for 48V D.C. Operation.

Switch fixings shall be positive and shall be unaffected by vibration. At the same time they should be capable of easy adjustment to suit changing parameters of the associated plant.

Particular attention shall be paid to potentially harmful environmental conditions, including water, oil, dust, dirt, temperature variations and differential expansions.

1.1.25.20.7 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.

MEASURING INSTRUMENTS

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

1.1. Measuring instruments / equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment. The instrumentation vendor shall be subject to BHEL's / customer's approval. Further, all instruments shall be of proven reliability, accuracy, repeatability requiring a minimum of maintenance. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, makes / numbers as approved by BHEL / customer during detailed engineering.

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

1.3. All local gauges as well as transmitters and sensors for parameters like pressure, temperature etc. as required for the safe and efficient operation and maintenance under the scope of specification shall be provided. The necessary root valves, impulse piping, drain cock, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting / erection of these local instruments shall be furnished even if not specifically asked for. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg / Cm2.

1.5. All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments.

1. SPECIFICATION FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE

Sl. No.	Features	Essential / Minimum Requirements		
		Pr. Gauge / D.P. Gauge	Temp. Gauge	Level Gauge
1	Sensing Element and Material	Bourdon for high pressure, Diaphragm / Bellow for low pr. of 316 SS	Mercury in steel below 450 Deg.C and inert gas actuated for above 450 Deg.C of SS bulb and capillary	Tempered toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel 304 SS
3	Dial size	150 mm	150 mm	Tubular covering entire range.
4	End connection	½ inch NPT (F)	¾ inch NPT (F)	Process connection as per ASME PTC and drain / vent 15 NB ±2%.
5	Accuracy	±1% of span	±1% of span	±2%
6	Scale	Linear, 270 Deg. Arc graduated in metri units.	Linear, 270 Deg. Arc graduated in Deg. C	Linear vertical
7	Range selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale
8	Over range test	Yes	Yes	Test pr. For the assembly shall be 1.5 to the max. design pr. at 38 Deg. C.
9	Housing	Weather and dust proof as per NEMA-4	Weather and dust proof as per NEMA-4	CS/304 SS leak proof
10	Zero / Span adjustment		Provided	Provided
11	Identification	Engraved with service legend or engraved phenolic laminated tag plate	Engraved with service legend or laminated phenolic name plate	Engraved with service legend or laminated phenolic name plate
12	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel / SS as per CS / Alloy process requirement.
13	Material of Bourdon movement	316 SS / 304 SS	316 SS / 304 SS	316 SS / 304 SS

2. ELECTRONIC TRANSMITTERS

Sl.No.	Features	Essential/Minimum Requirements
1.	Type of Transmitter	Microprocessor based 2 wire type, Hart protocol compatible.
2.	Accuracy	± 0.1% of calibrated span (minimum) (upto turn down ratio of 10:1)
3.	Output signal range	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)
4.	Turn down ratio	10:1 for vacuum/very low pressure applications. 5:1 for very high pressure application. 30:1 for other applications.
5.	Stability	± 0.1% of calibrated span for six months for Ranges up to and including70 Kg/cm².
		± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm² (g).
6.	Zero and span drift	+/- 0.015% per deg.C at max span.
		+/-0.11% per deg.C at min. Span.
7.	Load impedance	500 ohm (min.)
8.	Housing	Weather proof as per IP-55 with durable corrosion resistant coating.
9.	Over Pressure	150% of max. Operating pressure
10.	Connection (Electrical)	Plug and socket type
11.	Process connection	1/2 inch NPT (F)
12.	Span and Zero	Continuous, tamper proof, Remote as well as adjustability manual from instrument with zero suppression and elevation facility.
13.	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.
		-2 valve manifold for absolute & Gauge pressure transmitters, 3-valve manifold for vacuum pressure transmitters & where DP transmitters are being used for pressure measurement and 5 valve manifold for DP/Level/Flow applicable.
		-For hazardous area, explosions proof enclosure as described in NEC article 500.
14.	Diagnostics	Self Indicating feature
15.	Power supply	24V DC ± 10%.

Notes:
LVDT type is not acceptable.

8. SOLENOID VALVES

1.	Type	Single/Double coil type, corrosion resistant type
2.	Body	SS316
3.	Internals	SS316
4.	Spring	SS316
5.	Size	½inch
6.	Class of insulation	H
7.	Electrical connection	24 V DC from BOP-DCS
8.	Connectivity	Connectivity with BOP-DCS required for operation
9.	Protection Class	IP-65

9. ELECTRONIC FLOW METER

The electronic flow meter shall include flow sensor and flow indicator cum integrator / totaliser and shall include all required accessories for satisfactory operation. The flow meter shall be based on full bore ultrasonic / electromagnetic principle and shall be electronic type of proven design, make and model acceptable to the owner. The Bidder shall submit all necessary technical literature and details of selection criteria of the instrument offered to substantiate the model selected. The Bidder shall also furnish list of similar installation along with feedback on satisfactory performance of the instruments. The flow meter shall meet or exceed the following requirement:

(a)	Output	:	4-20 mA DC Isolated output
(b)	Accuracy	:	± 0.5% of calibrated span or better *
(c)	Repeatability	:	± 0.2% of calibrated span or better
(d)	Ambient Temp. &	:	4 deg.C to 55 deg.C.
	Humidity		5% to 100% RH
(e)	Power Supply	:	240V AC ± 10%, 50 HZ ± 5%/ 24 V DC, to be arrangec by the contractor.
(f)	Protection class	:	IP-55
(g)	Flow tube		SS304
(h)	liner		Hard Rubber

The flow meter shall provide local indication for instantaneous flow. It should also be possible to get local display for daily and monthly discharge. The flow meter shall indicate totaliser / integrator to get the daily and monthly discharge as stated above.

10. LIMIT SWITCH

For offsite plant application, Limit switches shall be gold plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of DDCMIS subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP 55.

PROCESS ACTUATED SWITCHES

FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
	Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches
Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (5 m minimum, to suit application)	Capacitance types, float type, conductivity type, RF type, Ultrasonic type as per suitability to the application. .
Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS
End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard
Over range/ proof pressure	150% of maximum operating pr.	-	150% of maximum operating pr.
Repeatability	+/- 0.5% of full range		
No. of contacts	2 No.+2NC. SPDT snap action dry contact		
Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS)		
Elect. Connection	Plug in socket.		
Set point adjustment	Provided over full range.		
Dead band adjustment	Adjustable/ fixed as per requirement of application.		

Enclosure	Weather and dust proof as per IP-55, metallic housing.		
Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and packing glands	All mounting accessories
Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-
Power Supply (wherever required)	As per Contractor's Standard practice.		

Notes :-

1) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications.

3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.

4) The specifications of switches for . ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

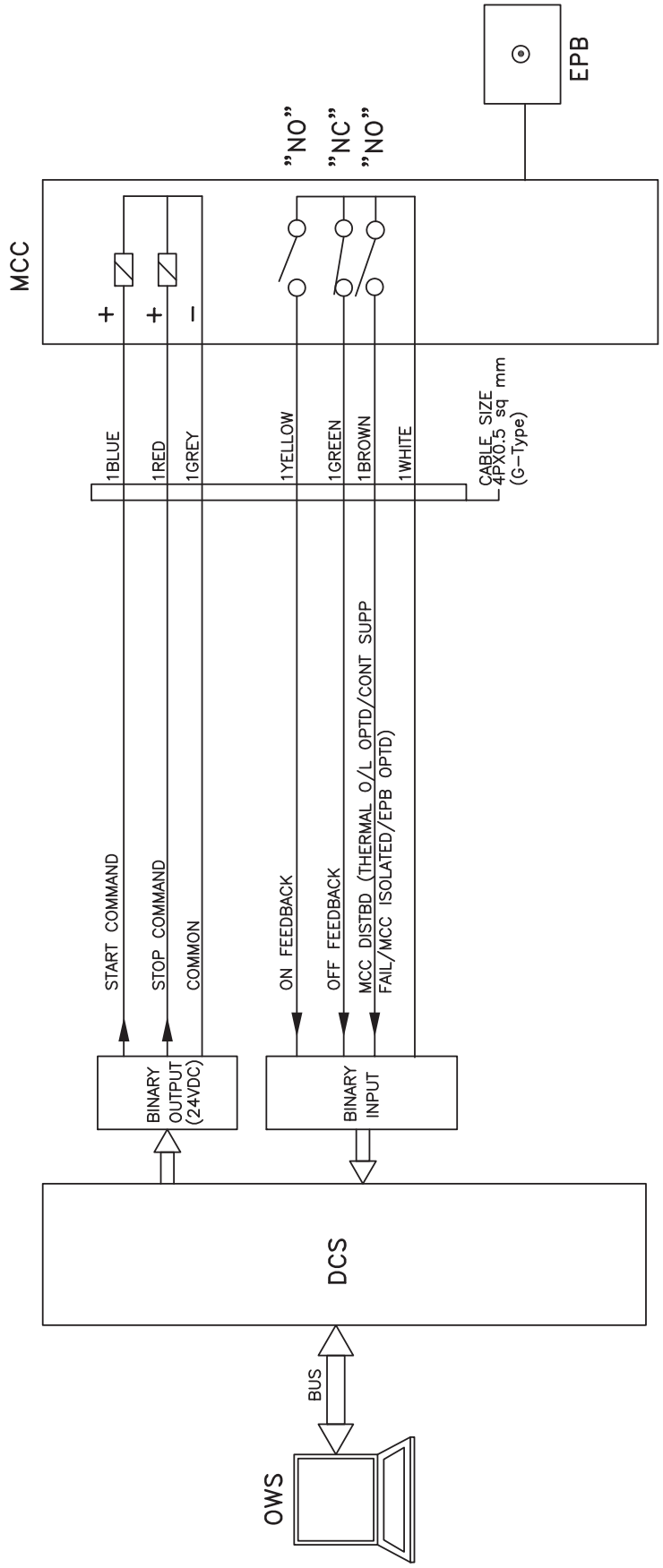
CLAUSE NO.	TECHNICAL REQUIREMENTS

10.00.00 FIELD MOUNTED LOCAL JUNCTION BOXES

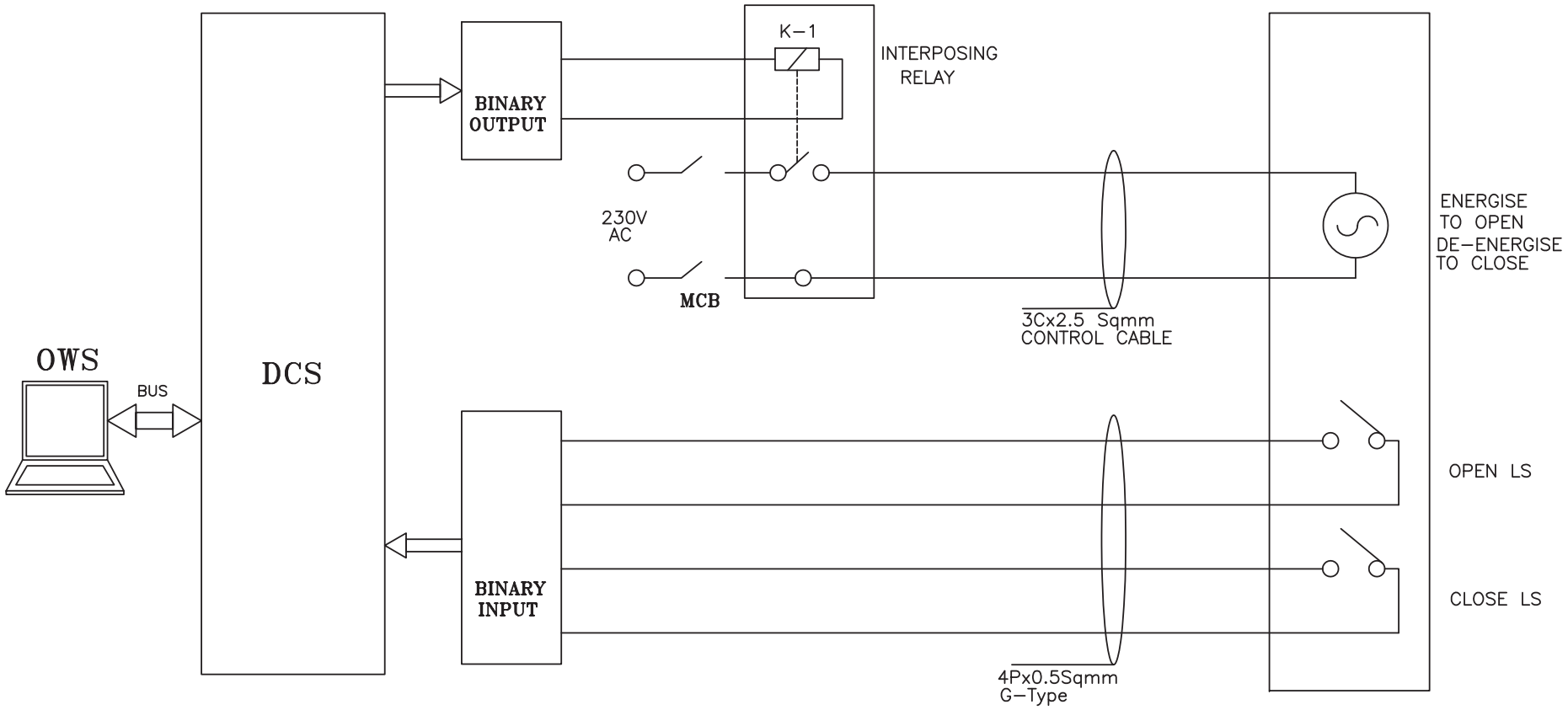
(i)	No. of ways	12/24/36/48/64/72/96/128 with 20% spares terminals.
(ii)	Material and Thickness	4mm thick Fiberglass Reinforced Polyester (FRP).
(iii)	Type	Screwed at all four corners for door. Door gasket shall be of synthetic rubber.
(iv)	Mounting clamps and accessories	Suitable for mounting on walls,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

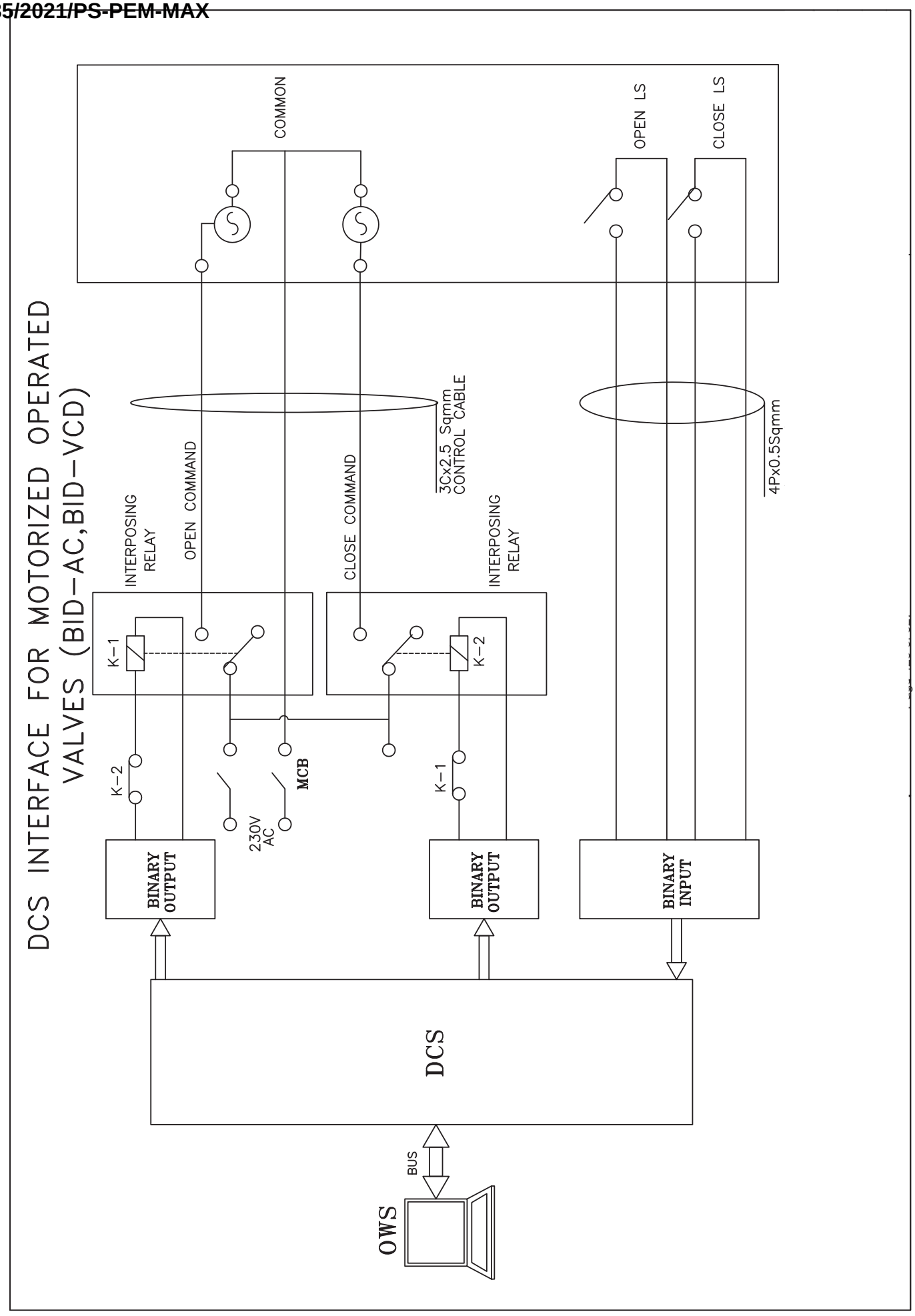
DRIVE CONTROL PHILOSOPHY

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR CONTROLLED) (LTUD)



DCS INTERFACE FOR MOTORIZED OPERATED FIRE DAMPER (BID–FD)




DCS INTERFACE FOR MOTORIZED OPERATED VALVES (BID-AC,BID-VCD)
COMMON
OPEN LS
CLOSE LS
3Cx2.5 Sqmm CONTROL CABLE
4Px0.5Sqmm
OPEN COMMAND
CLOSE COMMAND
INTERPOSING RELAY
INTERPOSING RELAY
K-1
K-2
K-2
K-1
MCB
230V AC
BINARY OUTPUT
BINARY OUTPUT
BINARY INPUT
DCS
BUS
OWS

QUALITY ASSURANCE

CLAUSE NO.	QUALITY ASSURANCE

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (if applicable)(R)	Hydro Test(R)	Material Test certificate ®
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y				
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y				
3. Pr./D.P.Switch(BS-6134)	Y	Y	Y	Y	Y	Y			
4. Electronic Transmitter(IEC-770)	Y	Y	Y	Y	Y	Y			
5. Temp. Switch	Y	Y	Y	Y	Y	Y			
6. Recorder(IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y			
7. Vertical indicators	Y	Y	Y	Y		Y			
8. Digital Indicators	Y	Y	Y	Y		Y			
9. Integrators	Y	Y	Y	Y					
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y			
12. Thermocouples (ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y			
13. RTD(IEC-751)	Y	Y	Y	Y	Y	Y			
14. Thermowell	Y		Y				Y	Y	Y

R-Routine Test A- Acceptance Test Y – Test applicable

:

TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
15. Cold junction compensation box	Y	Y	Y	Y					Y			
16. Orifice plate(BS-1042)	Y	Y	Y	Y *	Y	Y **	Y **			Y	Y **	Y
17. Flow nozzle(BS-1042)	Y	Y	Y	Y *	Y	Y	Y			Y	Y	Y
18. Impact head type element	Y	Y	Y					Y				Y
19. Level transmitter/float type switch	Y	Y	Y	Y					Y	Y	Y	Y
20. Flue Gas analyser	Y	Y	Y	Y								
21. Dust emission monitors	Y	Y	Y	Y								
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.												
** If applicable												

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) Detailed procedure of Environmental Stress screening test shall be as per Quality Assurance. Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

CLAUSE NO.	QUALITY ASSURANCE

PROCESS CONNECTION AND PIPING

TESTS / ITEMS	Visual ®	GA, BOM, Layout of component & construction feature®	Dimension ®	Paint Shade/thickness ®	Flattening,flaring,hydrotest,hardness check as per ASTM standard (A)	Component Ratings ®	Wiring ®	Make, Model, Type, Rating®	IR & HV ®	Review of TC for instrument/devices (R)	Accessability of TBs/Devices ®	Illumination,grounding ®	Tubing ®	Leak/Hydro test(A)	Chemical/physical properties of material (A)	Proof pressure test,Dismantling & reassembly test,Hydrulic impulse and vibration test (R)	Tests as per standards & specification
Local Instrument enclosure	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Local instruments racks	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Junction Box	Y	Y	Y	Y*		Y		Y	Y								
Gauge Board	Y	Y	Y	Y		Y		Y		Y			Y	Y			
Impulse pipes and tubes	Y		Y		Y			Y							Y		
Socket weld fittings ANSI B-16.11	Y		Y					Y							Y		Y
Compression fittings	Y		Y					Y						Y	Y	Y	
Instrument valves & Valve manifolds	Y		Y					Y						Y	Y		
Copper tubings ASTM B75	Y							Y									Y

*-applicable for painted junction boxes.
Note: R-Routine Test A- Acceptance Test Y – Test applicable
Note: This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

SUB VENDOR LIST

Package Name	Supplier Name	Supplier Communication Address
DIFFERENTIAL PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com
INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com
INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com
INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com
INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com
INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com
INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com
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INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com
INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com

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INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com
JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com
JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com
JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net
JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com
JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone-011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone-033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de

PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD Phone- 0120-2712016 Pincode : Email : mktg@indfos.com
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune, Phone-020-24393577, Pincode : Email : pressure@vsnl.com,
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone-09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com,
PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in
TRANSMITTERS	ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com
TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com
TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,
TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com
TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com
TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com
TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,
TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com
TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in
TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com

TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in
TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,
TRANSMITTERS	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com
TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,

SECTION: I

SUB-SECTION: D

STANDARD TECHNICAL SPECIFICATIONS

BHEL	TECHNICAL SPECIFICATION VENTILATION FANS	SPECIFICATION NO. PE-TS-413- 571-11000-A003
		VOLUME II B
		SECTION D
		REV. 00 JAN 2020
		SHEET 1 OF 4

SECTION-D

VENTILATION FANS

	TECHNICAL SPECIFICATION VENTILATION FANS	SPECIFICATION NO.PES-554-03	
		VOLUME II B	
		SECTION D	
		REV. 02	DATE: NOV 2012
		SHEET 2 OF 4	

1. GENERAL

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

2. CODE AND STANDARDS

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

2.1.1 IS:4894 -Centrifugal fans

2.1.2 IS:3588 -Electric Axial Flow fans

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

2.1.4 IS-3963 -Roof extractor units

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

2.1.6 AMCA publication 99 standards handbook

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

3. DESIGN AND CONSTRUCTION

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

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

3.3 CASING

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

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

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

3.4 IMPELLER

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

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

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

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

3.5 BEARINGS:

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

3.6 INLET CONES AND GUARDS

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

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

3.7 GUIDE VANES:

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

3.8 BASE PLATE AND VIBRATION ISOLATORS

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

3.9 HOOD AND COWL

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

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

3.10 SPEED

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

	TECHNICAL SPECIFICATION VENTILATION FANS	SPECIFICATION NO.PES-554-03	
		VOLUME II B	
		SECTION D	
		REV. 02	DATE: NOV 2012
		SHEET 4 OF 4	

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

610535/2021/PS-PEM-MAX

TITLE	SPECIFICATION NO. PE-TS-413-571-11000-A009
CENTRIFUGAL FAN **DATA SHEET - A**	VOLUME II-B SECTION D REV 00 | JAN 2020 SHEET 1 OF 2

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

TITLE	SPECIFICATION NO. PE-TS-413-571-11000-A009
CENTRIFUGAL FAN	VOLUME II-B
DATA SHEET - A	SECTION D
	REV 00 | JAN 2020
	SHEET 2 OF 2

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).

TITLE	SPECIFICATION NO. PE-TS-413- 571-11000-A001
Ventilation Fan (Axial Flow Type)	VOLUME II-B
DATA SHEET - A	SECTION D
	REV 00 | JAN 2020
	SHEET 1 OF 2

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

610535/2021/PS-PEM-MAX

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.

	TECHNICAL SPECIFICATION AIR FILTER	SPECIFICATION NO. PES- 571-11000-A006
		VOLUME II B
		SECTION D
		REV. 00 JAN 2020
		SHEET 1 OF 4

SECTION-D

AIR FILTER

	TECHNICAL SPECIFICATION AIR FILTER	SPECIFICATION NO. PES- 571-11000-A006
		VOLUME II B
		SECTION D
		REV. 00 | MAY 2019
		SHEET 2 OF 4

1. GENERAL

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

2. CODES AND STANDARDS

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

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

3. GENERAL

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

3.1 POLY FIBRE AIR FILTERS

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

3.2 DRY FABRIC AIR FILTERS

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

3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

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

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

3.4 AUTOMATIC CLEANING FILTERS

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

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

3.5 ABSOLUTE FILTERS

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

3.6 WATER REPELLANT NYLON FILTERS

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

4. INSPECTION & TESTING

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

4.1 Dimensional inspection of frame & filter media.

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

a) Gravimetric efficiency.

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

c) Efficiency as per BS EN - 779.

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

	TECHNICAL SPECIFICATION AIR FILTER	SPECIFICATION NO. PES- 571-11000-A006
		VOLUME II B
		SECTION D
		REV. 00 | MAY 2019
		SHEET 4 OF 4

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

5.1 GA Drawing.

5.2 Drawing showing material/construction detail

5.3 Installation and\service manual

5.4 Rating curves/charts

5.5 Test certificates

5.6 Elect. diagrams (when automatic cleaning type)

610535/2021/PS-PEM-MAX

TITLE

AIR FILTER

DATA SHEET - A

SPECIFICATION NO. PE-TS-407-571-11000-A006

VOLUME II-B

SECTION D

REV 00 | MAY 2019

SHEET 1 OF 1

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

Note:-

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

BHEL	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO. PES- 571-11000-A007
		VOLUME II B
		SECTION D
		REV. 00 JAN 2020
		SHEET 1 OF 8

SECTION-D

LOW PRESSURE AIR DISTRIBUTION SYSTEM

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO. PES- 571-11000-A007
		VOLUME II B
		SECTION D
		REV. 00 JAN 2020
		SHEET 2 OF 8

1. GENERAL

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

2. CODES AND STANDARDS

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

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

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

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

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

3. MATERIAL

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

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

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

4. CONSTRUCTION/FABRICATION

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

4.2 **RECTANGULAR DUCTS**

4.2.1

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

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

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

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

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

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

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

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

4.3 **ROUND DUCTS**

4.3.1

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

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

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

4.4 **DUCT SUPPORTS**

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

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

4.5 **FLEXIBLE CONNECTIONS**

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

4.6 **TRANSFORMATIONS AND BREACHES**

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

4.7 **CAULKING**

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

4.8 **EASEMENT**

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

4.9 **ACCESS DOORS**

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

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

4.10 **DAMPERS AND SPLITTERS**

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

4.10.2 FIRE DAMPERS

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

4.10.3 VANES

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

4.10.4 FLASHING

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

4.11 **DIFFUSERS AND GRILLS**

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

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

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

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

4.12 **PLENUMS AND RA BOXING**

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

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

4.13 **ACCOUSTIC LINING**

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

4.14 **PAINTING**

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

4.15 **THERMAL INSULATION**

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

5. INSPECTION AND TESTING

5.1 **INSPECTION & TESTING DURING FABRICATION**

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

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

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

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

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

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

5.2 **INSPECTION & TESTING AT SITE.**

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

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

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO. PES- 571-11000-A007
		VOLUME II B
		SECTION D
		REV. 00 JAN 2020
		SHEET 7 OF 8

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.

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO. PES- 571-11000-A007
		VOLUME II B
		SECTION D
		REV. 00 JAN 2020
		SHEET 8 OF 8

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.

TITLE

LOW PRESSURE AIR DISTRIBUTION SYSTEM

DATA SHEET - A

SPECIFICATION NO. PE-TS-413-571-11000-A007

VOLUME II-B

SECTION D

REV 00 | JAN 2020

SHEET 1 OF 2

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

NOTE:

1. Duct sheet thickness shall be as per IS-655
2. Opposed blade type volume control damper shall be provided at each supply air diffusers/grilles.
3. Bidder to provide suitable gasketing at each duct flange.
4. Fire damper shall be motor operated type, when otherwise specified under Section-C.
5. Access door in ducting system shall be provided as required.
6. MS Angle (painted) shall be used for duct supports etc.
7. Velocity thru duct shall normally not exceed 9.0 M/sec for Air conditioning system and 12 M/sec for Ventilation duct. Maximum velocity (outlet) for supply air diffuser shall not exceed 2.5 m/sec.

610535/2021/PS-PEM-MAX

8. All Grilles & diffusers shall be supported with frame. Frame etc. shall be supplied by bidder.

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08
		VOLUME II B
		SECTION D
		REV. 02 / DATE: 17.09.2012
		SHEET 1 OF 6

STANDARD TECHNICAL SPECIFICATION
FOR
THERMAL INSULATION FOR COLD SURFACES

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08	
		VOLUME II B	
		SECTION D	
		REV. 02	DATE: 17.09.2012
		SHEET 2 OF 6	

1. SCOPE

This specification covers design, manufacture, testing at manufacturers works, supply, application & finishing of insulation for cold piping, air conditioning ducting & equipment for low temperature service.

2. CODES & STANDARDS

The design, manufacture and performance of materials covered under this specification shall comply with all currently applicable statues, regulations & safety codes in the locality where the equipment/material are to be installed. The material shall also conform to the latest applicable Indian/British/American codes & standards. Nothing in this specification shall be construed to relieve the vendor of his responsibility. In particular, the material shall conform to the latest editions of the following standards :-

IS:3069: GLOSSARY OF TERMS & SYMBOLS & UNITS RELATING TO THERMAL INSULATION

materials.

2.1 IS:4671: Expanded polystyrene for thermal insulation purposes.

2.2 IS:3677: Mineral wool for thermal insulation.

2.3 IS:8183: Resin bonded mineral wool.

3. DESIGN REQUIREMENTS

3.1 The insulating material as well as protective covering shall be new & unused, non-corrosive, vermin/rodent proof and shall be guaranteed to withstand continuously & without deterioration the maximum/minimum temperatures to which they may be subjected to, under specified site conditions.

3.2 The insulation material must be light weight, strong, free from shots & coarse fibre & shall provide high insulation efficiency at low weight & coat. It should be non-hygroscopic & should not rot. It shall not settle or shake down even when subjected to prolonged vibrations.

3.3 The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.

4. APPLICATION DETAILS

4.1 The surface to be insulated shall be thoroughly cleaned and allowed to dry. Pressure/hydrostatic tests, if any, shall be carried out before application of insulation.

4.2 A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.

4.3 Hot industrial bitumen of grade 85/40 or 85/25 conforming to latest IS:702 shall be uniformly applied @ 1.5 kg/sq.m on the surface to be insulated. A similar layer shall also be applied on the inside surface & edges of the insulation. A suitable cold adhesive compound may also be used in place of bitumen.

4.4 Insulation in the form of pipe sections/rolls slabs of specified density & thickness shall be stuck to the coated surface with joints staggered & well butted & secured. The adjoining sections shall be tightly pressed together. All the joints shall be sealed with

bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.

4.5 In case of double layer application both circumferential & longitudinal joints shall be suitably staggered.

5. VAPOR SEALING & INSULATION FINISH

The insulation shall be treated for vapor sealing & weather proofing & finished as specified in DATA SHEET A The acceptable types of finishes are outlined below:-

5.1 FINISHING SYSTEM I: EXTERNAL INSULATION WITH PLASTER FINISH

5.1.1 A thick vapor seal of hot bitumen @ 2.5 kg/Sqm shall be applied on the outer surface of insulation & allowed to dry.

5.1.2 The surface shall then be wrapped with 20mm (3/4"_ hexagonal mesh of 24 SWG GI wire, butting all the joints & laced down with 22 SWG GI lacing wire.

5.1.3 12.5mm (1/2 inch) thick sand cement plaster in the ratio of (1:1) shall be applied in two layers, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.

5.2 FINISH SYSTEM II: EXTERNAL INSULATION WITH PLASTER FINISH OVER POLYTHENE.

5.2.1 The insulation shall be covered with 500 g polythene/polythene bonded Hessians (PBH) with 50mm overlap on longitudinal & circumferential joints. Overlaps shall be sealed with synthetic adhesive in case o-f polythene & liberal coat of bitumen in case of PBH:

5.2.2 The surface shall then be wrapped with 20mm (3/4") mesh of 24 SWG GI wire butting all the joints & laced down with 22 SWG GI lacing wire.

5.2.3 12.5mm thick (1/2 inch) sand cement plaster in ratio of(4:1) shall be applied in two layers, the second layer being brought to a smooth & even finish similarly as described above.

5.3 FINISH III:EXTERNAL INSULATION WITH SHEET METAL FINISH

5.3.1 The insulation shall be covered with 500g polythene with 50mm overlaps at joints which shall be sealed with synthetic adhesive or equivalent compound.

5.3.2 The polythene shall be covered with 24 gauge GI/aluminum sheet

5.3.3 25mm wide x 22 SWG GI/aluminum peripheral straps shall be fixed over the GI/aluminum sheet at 300mm centres to secure.

5.4 FINISH IV: EXTERNAL INSULATION WITH PLASTER & WATER PROOFING COMPOUND

For ducts & piping exposed to atmosphere, the finish shall be as follows:

5.4.1 A thick vapor seal of hot bitumen at 2.05 kg/sq.m shall be applied on the outer surface of insulation & allowed to dry.

5.4.2 The surface shall then be wrapped with 20mm (32/4") hexagonal mesh of 24 SWG GI Wire butting all the joints & laced down with 223 SWG GI lacing wire.

5.4.3 12.5mm thick (1/*2 inch) sand cement plaster in ratio of (4:1) shall be applied in two layers, the second layer being brought to a smooth finish with water proofing compound added to the cement.

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08	
		VOLUME II B	
		SECTION D	
		REV. 02	DATE: 17.09.2012
		SHEET 4 OF 6	

5.4.4 3 mm (1/8") thick coat of water proofing compound shall be applied & wrapped with fibre glass RP tissue. A final coat of 3mm thick water proofing compound shall then be applied over the fiberglass RP tissue & allowed to dry. Alternatively, in place of water proofing as desired above, tar felt type 3 grade 1 of IS 1322 with joints overlapped by 75mm shall be fixed & sealed with bitumen & over this 24 SWG. 25mm hexagonal GI mesh shall be fixed with 22 swig. GI lacing wire & finally bitumen paint shall be applied over wire netting.

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08	
		VOLUME II B	
		SECTION D	
		REV. 02	DATE: 17.09.2012
		SHEET 5 OF 6	

6. INSULATION OF PUMPS & VALVES

6.1 For all inspection covers & hatches on equipment, pump casing & valve bodies, flanges etc. the insulation shall be applied such as to facilitate removal with minimum damage to the insulation. This shall be achieved by encasing the insulation in 22 gauge aluminum sheet metal boxes, which shall be bolted together around the equipment to permit easy removal & replacement. Proper care shall be taken to maintain continuity of vapor seal between the static & removable partitions of the insulation.

6.2 The tenderer may offer thickness of insulation & finishes other than that specified in DATA SHEET A. However, calculations/reasons in support of alternative proposal shall be furnished for purchaser's approval.

7. INSPECTION & TESTING (REFER SPEC. NO - PES-553.00)

7.1 All necessary tests, as required to ensure that the material supplied conform to the requirements of applicable codes & standards, shall be carried out at manufacturer's works & test certificates including these for material/accessories shall be furnished for purchasers approval.

8. PAINTING

8.1 Pipe work having insulation & cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.

8.2 Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.

8.3 All painting for insulated surfaces shall conform to the requirement specified elsewhere.

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08	
		VOLUME II B	
		SECTION D	
		REV. 02	DATE: 17.09.2012
		SHEET 6 OF 6	

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

9.1 Final version of data sheet 'B' incorporating changes if any along with design data.

9.2 Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following:-

a) Thermal conductivity test.

b) Sound absorption coefficient test.

c) Corrosion test.

d) Sulphur content, moisture content, shot content, moisture absorption etc.

e) Compressive strength & cross breaking strength test.

9.3 Sketches/technical literature/sectional drgs. indicating insulation materials finish and method of application etc.

9.4 Manual dealing with safety aspects & instructions for combating fire arising out of insulation work.

9.5 Instructions on maintenance of insulation work.

	THERMAL INSULATION FOR COLD SURFCE DATA SHEET - A	VOLUME II-B	
		SECTION D	
		REV 00	DATE 17.09.2012
		SHEET 1 OF 1	

Insulation Material

Insulation	Code	Thermal Conductivity MW/cm ^{0}C	Density Kg/m^3
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 ^{0}C	At least 24 for duct insulation and 48 for acoustic lining.
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 ^{0}C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 10 ^{0}C	At least 15

Type of Insulation

S.No.	Surface	Insulation Material	Insulation Form	Thickness (mm)
i)	Supply & Return air duct for air-conditioning system	Resin bonded roll Mineral Wool (IS:8183)		25
ii)	Refrigerant Piping	a) Expanded Polystyrene	Pipe Section	75
		or		
		b) Mineral Wool	Pipe Section	75
iii)	AHU drain pipe	a) Expanded Polystyrene	Pipe Section	25
		or		
		b) Mineral Wool	Pipe Section	25
iv)	AHU drain pan coil section and fan section	a) Expanded Polystyrene	Slabs	25
		or		
		b) Mineral Wool	Slabs	25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene	Pipe Section	75
		or		
		b) Mineral Wool	Pipe Section	75
vi)	Chiller	a) Expanded Polystyrene	Slabs	100
		or		
		b) Mineral Wool	Slabs	100
vii)	Chilled Water Pumps	a) Expanded Polystyrene	Slabs	50
		or		
		b) Mineral Wool	Slabs	50
viii)	Expansion tank with pipe	a) Expanded Polystyrene	Slabs/Pipe Section	50
		or		
		b) Mineral Wool	Slabs/Pipe Section	50

SECTION: I

SUB-SECTION: E

LIST OF ANNEXURES

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM LIST OF MAKES-HVAC	SPECIFICATION No: PE-TS-471-571-11000-A001
		SECTION : I
		SUB-SECTION : E
		REV 00 / DATE: DEC 2021
		SHEET 1 OF 1

SECTION-I

SUB SECTION E

ANNEXURE-I

LIST OF MAKES-HVAC SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT)

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
2	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
3	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP
4	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
5	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
6	INSULTATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
7	BALANCING VALVE	ADVANCE
8	BUTTERFLY VALVE	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE / ADVANCE
9	NON RETURN VALVE	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
10	GATE/GLOBE VALVES	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
11	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY /JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC
12	MOTORIZED BUTTERFLY VALVE	ANERGY / / BELIMO / JOHNSON / HONEYWELL / SIEMENS
13	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
14	PIPING - ERW	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
15	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS
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
17	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
18	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)
19	STRIP HEATER	ESCORTS / RACOLD / DASPASS/ ALCO/ HEATCO / HOTSET
20	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO
21	RELIEF / PURGE VALVE	BRASSOMATIC

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT)

22	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL /RANUTROL
23	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN
24	ANTI FREEZE THERMOSTAT	RANCO / HONEYWELL / PENN / DANFOSS / INDFOSS
25	PRESSURE GAUGE	GENERAL INST CONSORTIUM / BELL / H.GURU INST P. LTD. / WAAREE INSTRUMENTS / H. GURU IND / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES/ PRECISION MASS PRODUCTS PVT. LTD. / BOSE PANDA INSTT. PVT. LTD.
26	TEMPERATURE GAUGE	H. GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA/ ASHCROFT / H GURU (SI)/ BAUMER TECHNOLOGIES/ GOA THERMOSTATIC/ GAUGE BOURDON/ BUDENBERG GAUGE/ PRECISION MASS PRODUCTS
27	LEVEL GAUGE	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR/ BLISS ANAND
28	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
29	TEMPERATURE SWITCH	INDFOSS/ SEIMENS / DANFOSS/ DK INSTRUMENTS/ SOR INC / VASU / DRESSER / TOSHNIWAL / SWITZER
30	FLOW SWITCH	SWITZER / LEVCON / DK INSTRUMENT / SBEM / V. AUTOMATE/ SIEMENS
31	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
32	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
33	SIGHT FLOW INDICATORS	SIGMA / LEVCON /V AUTOMAT / TELLACE /EUREKA / TATA HONEYWELL/BLISS ANAND/ SCIENTIFIC DEVICES/ BK EQUIPMENTS/ INSTRUMENTATION ENGINEERS
34	FLOW ELEMENT	BRISTOL BABCOCK / BALIGA /LIGHTING EQUIP /ENGINEERING SPECIALITIES /IL / MINCO/ MICRO PRECISION / STAR MECH
35	TEMPERATURE ELEMENT	GENERAL INST CONSORTIUM/ PYRO ELECTRIC /WAAREE INSTRUMENTS/ DETRIVE INST &

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLICABLE
(3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT)

		ELECTRONICS / TOSHNIWAL/ GOA INSTRUMENTS/ GAUGE BOURDON/ TECHNO INSTRUMENTS/ TEMPSENS INSTRUMENTS/ THERMAL INSTRUMENTS/ TM TECHNOMATIC/ BAUMER TECHNOLOGIES
36	FLOW METER	EUREKA / INSTRUMENTATION ENGINEERS PVT LTD / PLACKA /TRAC / FLOW STAR/ SCIENTIFIC DEVICE
37	RH SENSOR/TEMP SENSOR	HONEY WELL /JOHNSON /SIEMENS / GENERAL INSTRUMENTS
38	PLC BASED PANEL	SIEMENS / SCHENIEDER / ROCKWELL / GE INTELLIGENT / HONEYWELL AUTOMATION / ABB/ MITSUBISHI ELECTRIC
39	OWS / PC	HP / COMPAQ / DELL / HCL / IBM / LENOVO
40	PRINTER	HP / CANON / EPSON / XEROX / IBM / LEXMARK
41	UPS	HITACHI-HIREL / APC / DELTA / EMERSON / DB POWER / APLAB
42	FIBRE OPTIC CABLE	BIRLA ERICSON / FINOLEX / AKSH FIBRE
43	ANNUNCIATOR FOR PANEL	ICC / PECON/ PROCON
44	LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR	CONTROL DEVICE / SYSTEM POWER CONTROL / JACKSON / UNILEC / ELECTRIC ALLIED PRODUCT
45	METERING PUMP	SHAPO TOOLS / VK PUMPS
46	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE / DOSI ION
47	PRESSURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL / FUJI
48	TEMPERATURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL
49	ROTAMETER	CHEMTROLS SAMIL / EUREKA IND / IL / TRANSDUCERS AND CONTROL
50	BATTERY CHARGER	AMARARAJA/ CHHABI ELECTRICAL / DUBAS ENGG. / HBL POWER SYSTEM / STATCON / CALDYNE
51	BATTERY (NI -Cd)	HBL POWER / AMCO SAFT / SAFT

NOTE	
	1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED. 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
(3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT)

S.No.	Description	Makes
1.	**CENTRIFUGAL FAN**	FLAKT / KRUGGER / DRAFT AIR / HYDERABAD POLUTION CONTROL / ADVANCE VENTILATION / PATEL AIR / NICOTRA/ SK SYSTEM / MARATHON / CB DOCTOR / SARLA
2.	**AXIAL FLOW FANS/RE UNITS**	HYDERABAD POLLUTION/ SK SYSTEM / ADVANCE VENTILATION / KRUGER / NICOTRA / MARATHON / FLAKT / CB DOCTOR/ PATEL AIR /SITAL
3.	**INDUCTION MOTORS (LT)**	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP/ KIRLOSKAR/ G.E.C.
4.	**AIR FILTER**	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER /SPECTRUM / AIR TECH / PUROMATIC/ CHEMFARM/ KIRLOAKAR/ CLEAR AIR PUROFIL/ DYNA
5.	**INSULTATION MATERIAL**	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
6.	**RESIN BOUNDED FIBRE GLASS**	UP TWIGA/ CLYOL/ COOLINE
7.	**FIRE DAMPER**	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
8.	**BUTTERFLY VALVE**	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE
9.	**NON RETURN VALVE**	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
10.	**GATE/GLOBE VALVES**	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENGG
11.	**PIPING - ERW**	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
12.	**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
13.	**HUMID STAT**	JHONSON CONTROL / HONEYWELL / PENN
14.	**GRILLES/ DIFFUSERS**	MOOSA HAJI/ NUTECH/ COSMOS/ OPELLA/ CARYAIRE
15.	**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
16.	**THERMOSTATS**	H.GURU/ FIEBIG/ JAPSIN/ MICA/ PENN/ HONEYWELL
17.	**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
18.	**LEVEL GAUGE**	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR/ BLISS ANAND

VENTILATION SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS-AS APPLIACBLE
(3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT)

19.	**PRESSURE SWITCH / DP SWITCHES**	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT/ KASTURBA UDYOG/ BARKSDALE/ PRECISION MASS/ MITTAL REFRIGERATION
20.	**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
21.	**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
22.	**CONTROL PANEL**	INDUSTRIAL CONTROL & APPLIANCE/ PYROTECH /POSITRONICS / CONTROL & SWITCHGEAR /SIEMENS / L&T /GE POWER /RITTAL / HOFFMAN
23.	**SWITCHGEAR**	(MCCB, CROMPTON/ SIEMENS/ ABB/ L&T CONTRACTORS ETC.)
24.	**CABLES**	FINOLEX/ NICCO/ UNIVERSAL CABLES/ GRANDLEY/ CCI/ POLYCAB/ FORT GLOSTER
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. BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED. 2. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER. 3. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-3 & C-4 FOR ELECTRICAL AND C&I RELATED EQUIPMENT LIST OF MAKE.	

SECTION-I

SUB SECTION -E

ANNEXURE-II

MANDATORY SPARE LIST

ANNEXURE - II
LIST OF MANDATORY SPARES
3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT

S. No.	Description	UNIT
	HVAC Spares	
A	**Ventilation system**	
1	**CENTRIFUGAL FAN**	
1(a)	V-belts	1 Set
1(b)	Blower bearings	1 Set
1(c)	Blower Motor bearings	1 Set
1(d)	Gasket	1 Set
1(e)	Motor	1 No.
2	**Axial Fan Assembly (for each size)**	
2(a)	Fan bearing	1 Set
2(b)	Fan Motor bearing	1 Set
2(c)	Fan Motor	1 No.
B	**AC system**	
1	**Split AC (for each capacity)**	
1(a)	Filters	1 Set
1(b)	Expansion valve	1 Set
1(c)	Indoor Fan motor	1 No.
1(d)	Outdoor Fan motor	1 No.

Notes:

a)	Spares listed in Price Schedule is bare minimum requirement. In case any additional mandatory spares required for 5 years of successful operation of the system or those covered elsewhere in the tender specification apart from specified above, same shall be deemed to have been covered in bidder's scope of supply.
b)	One set corresponds to actual quantity of components and devices as installed for one equipment/item/assembly.
c)	All Spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is "not applicable" for particular equipment, then suitable applicable alternate spare has been offered / shall be supplied by the bidder without any financial implication."
d)	Any item which is quoted as "not applicable" by the bidder in the above list and is found to be "applicable" at a later date shall be supplied by the bidder without any commercial and delivery implication.
e)	Any cell left blank in the unpriced schedule shall be treated as "Quoted" and is included in total price.

SECTION-I

SUB-SECTION-E

ANNEXURE-III

LIST OF TOOLS & TACKLES
AND
LIST OF COMMISSIONING SPARES

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM LIST OF TOOLS & TACKLES AND LIST OF COMMISSIONING SPARES	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION: I	
		SUB-SECTION : E	
		REV 00	DATE: DEC 2021
		SHEET 2 OF 2	

SL NO	ITEM DESCRIPTION	UNIT	QTY
1	FLAT D WRENCH - 6 MM TO 32 MM (12 Pcs)	SET	1
2	BOX WRENCHES - 6 MM TO 22 MM (14 Pcs)	SET	1
3	RING SPANNER - 6 MM TO 32 MM (12 Pcs)	SET	1
4	ALLEN KEYS - 2 MM TO 10 MM	SET	1
5	CRESCENT SCREW SPANNER	NO.	1
6	SCREW DRIVER	NO.	1
7	OFFSET SCREW DRIVER	NO.	1
8	INSULATED PLIER	NO.	1
9	TORCH LIGHT FOR 2 CELL	NO.	1
10	HAMMER 1 LB	NO.	1
11	OIL CAN	NO.	1
12	POCKET THERMOMETER - 0 TO 50 DEG. C)	NO.	1
13	INSULATION TAPE ROLL	NO.	1
14	STEEL FOOT RULE - 12"	NO.	1
15	FEELER GAUGE 9 BLADES	NO.	1
16	PIPE WRENCH	NO.	1
17	FLARE NUT (1/4")	NOS.	6
18	FLARING TOOL	NO.	1
19	TUBE CUTTER	NO.	1
20	GAS CHARGING PIPE	NO.	1
21	NITOGEN CHARGING ADAPTER	NO.	1
22	FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 0 - 300 MM PSI	NO.	1
23	FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 30 - 150 MM PSI	NO.	1
24	PSYCHRO METER	NO.	1
25	LOCK WITH KEY FOR TOOL BOX	NO.	1
26	RATCHET 1/4"	NO.	1
27	MS TOOL BOX	NO.	1

NOTE: -
Above is the minimum list. Any other Tools and tackles required for the system shall also be provided by the vendor as per system / customer requirement without any commercial & Delivery implication to BHEL.

LIST OF COMMISSIONING SPARES

SL NO	ITEM DESCRIPTION	UNIT	QTY
1	FAN BELTS (each type & size)	SET	1
2	PRESSURE GAUGE (for each type and range)	NO.	1
3	TEMPERATURE GAUGE (for each type and range)	NO.	1
4	FILTER (each size)	SET	1
5	COMPRESSOR OIL	Lot	1
6	REFRIGERANT GAS OF EACH TYPE IN A NON-RETURNABLE CYLINDERS	Lot	1

NOTE: -
Above is the minimum list. Any other commissioning spare required for the system shall also be provided by the vendor as per system / customer requirement without any commercial & Delivery implication to BHEL.

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE	SPECIFICATION No: PE-TS-471-571-11000-A001
		SECTION : I
		SUB-SECTION : E
		REV 00 / DATE: DEC 2021
		SHEET 1 OF 1

SECTION-I

SUB-SECTION-E

ANNEXURE-IV

DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE

(COVERED UNDER SECTION C2-B)

SECTION-I

SUB-SECTION-E

ANNEXURE-V

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION : I	
		SUB-SECTION : E	
		REV 00	DATE: DEC 2021
		SHEET 2 OF 3	

S. NO.	BHEL DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
1	PE-V0-471-571-11000-A001	Inspection categorization Plan along with Vendor List for HVAC System	4
2	PE-V0-471-571-11000-A002	Ventilation Scheme	6
3	PE-V0-471-571-11000-A003	Data Sheet & GA Drawing for Fan Filtration Unit	10
4	PE-V0-471-571-11000-A004	Data Sheet & GA Drawing for Axial Fan	8
5	PE-V0-471-571-11000-A005	Data Sheet & GA Drawing for Filters	10
6	PE-V0-471-571-11000-A007	Data Sheet & GA Drawing for Motors	16
7	PE-V0-471-571-11000-A008	MQP FOR Centrifugal Fans	8
8	PE-V0-471-571-11000-A009	MQP FOR Fire Damper	10
9	PE-V0-471-571-11000-A010	MQP FOR Filters	10
10	PE-V0-471-571-11000-A011	Data Sheet for Split AC	8
11	PE-V0-471-571-11000-A012	Data Sheet for GI Sheet for Duct	6
12	PE-V0-471-571-11000-A013	Ventilation Duct Layout for Power House	16
13	PE-V0-471-571-11000-A014	Ventilation Fan Layout for other areas	14
14	PE-V0-471-571-11000-A015	Ventilation Fan Schedule	16
15	PE-V0-471-571-11000-A016	Demonstration Test for HVAC System	18
16	PE-V0-471-571-11000-A017	O&M Manual for HVAC System	20

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.

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION : I	
		SUB-SECTION : E	
		REV 00	DATE: DEC 2021
		SHEET 3 OF 3	

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.

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

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

h) All drawings shall be prepared as per BHEL'S title block and shall bear BHEL'S drawing no.

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

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

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

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

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

SECTION-I

SUB-SECTION-E

ANNEXURE-VI

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM FORMAT FOR OPERATION AND MAINTENANCE MANUAL	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION : I	
		SUB-SECTION : E	
		REV 00	DATE: DEC 2021
		SHEET 2 OF 4	

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

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

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM FORMAT FOR OPERATION AND MAINTENANCE MANUAL	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION : I	
		SUB-SECTION : E	
		REV 00	DATE: DEC 2021
		SHEET 3 OF 4	

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
3.8	Control philosophy /control write-ups				
4.0	**COMMISSIONING ACTIVITIES (IF NOT COVERED IN SEPARATE DOCUMENT I.E. ERECTION MANUAL, COMMISSIONING MANUAL)**				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	**OPERATION GUIDELINES FOR PLANT PERSONAL/USER/OPERATOR**				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
6.0	**MAINTENANCE GUIDELINES FOR PLANT**				

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM FORMAT FOR OPERATION AND MAINTENANCE MANUAL	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION : I	
		SUB-SECTION : E	
		REV 00	DATE: DEC 2021
		SHEET 4 OF 4	

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
	PERSONAL				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	**Statutory and other specific requirements considerations.**				
8.0	**List of reference documents**				
9.0	**Binding as per requirement**				

SECTION-I

SUB-SECTION-E

ANNEXURE-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.

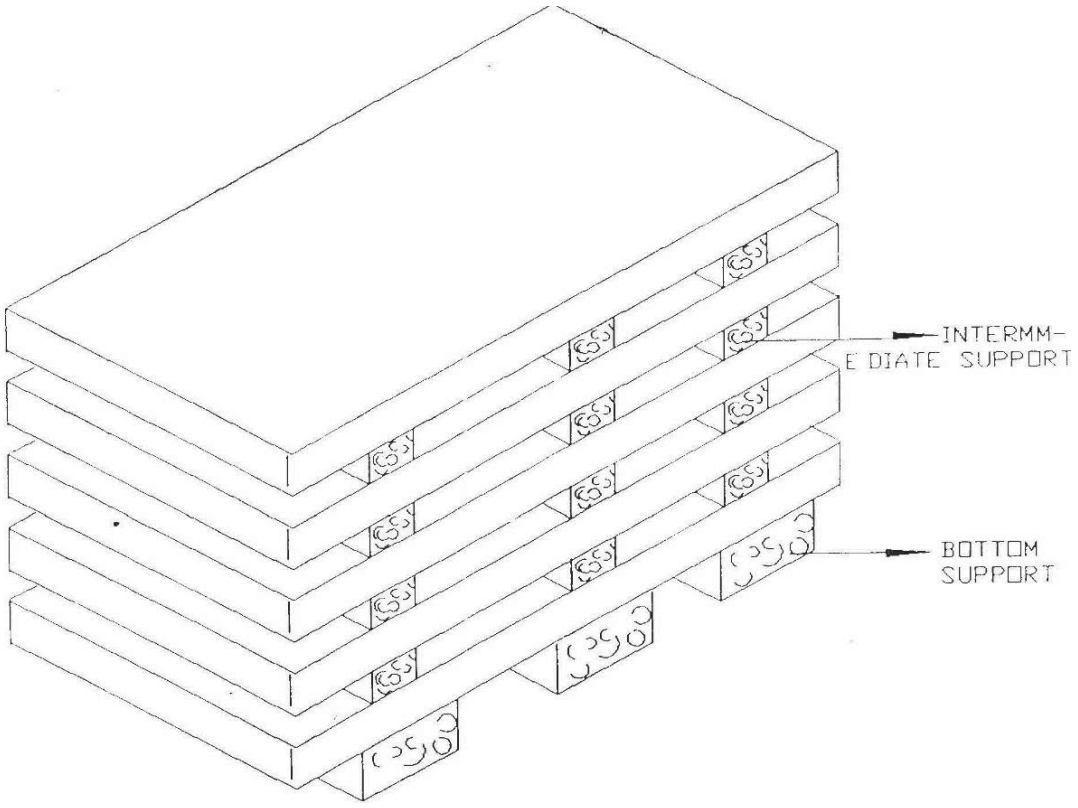


Figure – 1 – PLATE STACKING ARRANGEMENT

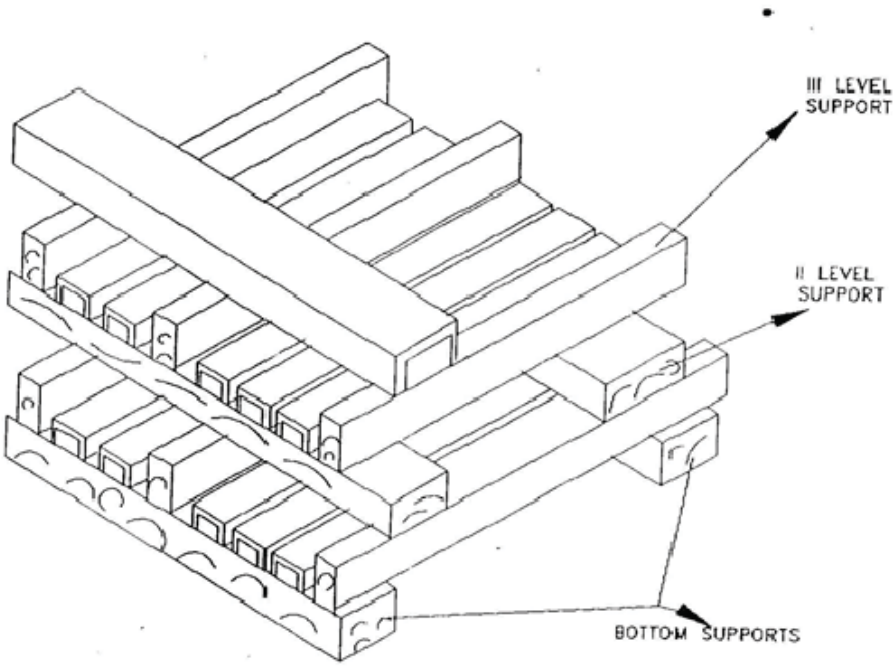


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

SECTION-I

SUB SECTION E

ANNEXURE-VIII

PAINTING SPECIFICATION & COLOUR SCHEME (COVERED UNDER SECTION C2-B)

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM PACKING PROCEDURE	SPECIFICATION No: PE-TS-471-571-11000-A001
		SECTION : I
		SUB-SECTION : E
		REV 00 / DATE: DEC 2021
		SHEET 1 OF 1

SECTION-I

SUB SECTION E

ANNEXURE-IX

PACKING PROCEDURE
(COVERED UNDER SECTION C2-B)

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION: II	
		REV. 00	DATE: DEC 2021

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 dispatch 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

3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM INSPECTION AND TESTING	SPECIFICATION No: PE-TS-471-571-11000-A001	
	SECTION : II	
	SUB-SECTION : 1	
	REV 00	DATE: DEC 2021
	SHEET 4 OF 4	

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

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION : II	
		SUB-SECTION : 2	
		REV: 00	DATE: DEC 2021
		SHEET 2 OF 2	

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

1. Compliance cum confirmation certificate
2. Un priced format for HVAC package
    a. Unpriced format for Main package, mandatory spares, tools and tackles and commissioning spares.
3. Deviation schedule /No deviation certificate in attached format 'Deviation sheet (Cost of withdrawal)'.
4. Pre-bid clarification schedule and signed copy of technical corrigenda, if any.

610535/2021/PS-PEM-MAX

SECTION: II

SUB SECTION: 3

COMPLIANCE CUM CONFIRMATION CERTIFICATE

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM COMPLIANCE CUM CONFIRMATION CERTIFICATE	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION : II	
		SUB-SECTION : 3	
		REV. NO. 00	DATE: DEC 2021
		SHEET: 2 OF 3	

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: 5

PRE-BID CLARIFICATION SCHEDULE

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM PRE-BID CLARIFICATION SCHEDULE	SPECIFICATION No: PE-TS-471-571-11000-A001 SECTION : II SUB-SECTION : 5 REV. NO. 00 | DATE: DEC 2021 SHEET: 2 OF 2

PRE-BID CLARIFICATION SCHEDULE

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

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

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

SECTION: II

SUB SECTION: 5

NO DEVIATION CERTIFICATE
(REFER ANNEXURE-II OF GCC REV 07)

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM NO DEVIATION CERTIFICATE	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION : II	
		SUB-SECTION : 5	
		REV: 00	DATE: DEC 2021
		SHEET 2 OF 3	

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

NOTES:

1. Cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. All the bidders have to list out all of their Technical & Commercial Deviations (if any) in detail in the above format.
3. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
4. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable. In absence of same, such deviation (s) shall not be considered and offer shall be considered in total compliance to NIT.
5. Bidder shall furnish price copy of above format along with price bid.
6. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
7. Bidders to note that any deviation (technical / commercial) not listed in above and asked after Part I opening shall not be considered.
8. For deviations w.r.t. Credit period, Liquidated damages, Firm prices if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VII, will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
9. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM NO DEVIATION CERTIFICATE	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION : II	
		SUB-SECTION : 5	
		REV: 00	DATE: DEC 2021
		SHEET 3 OF 3	

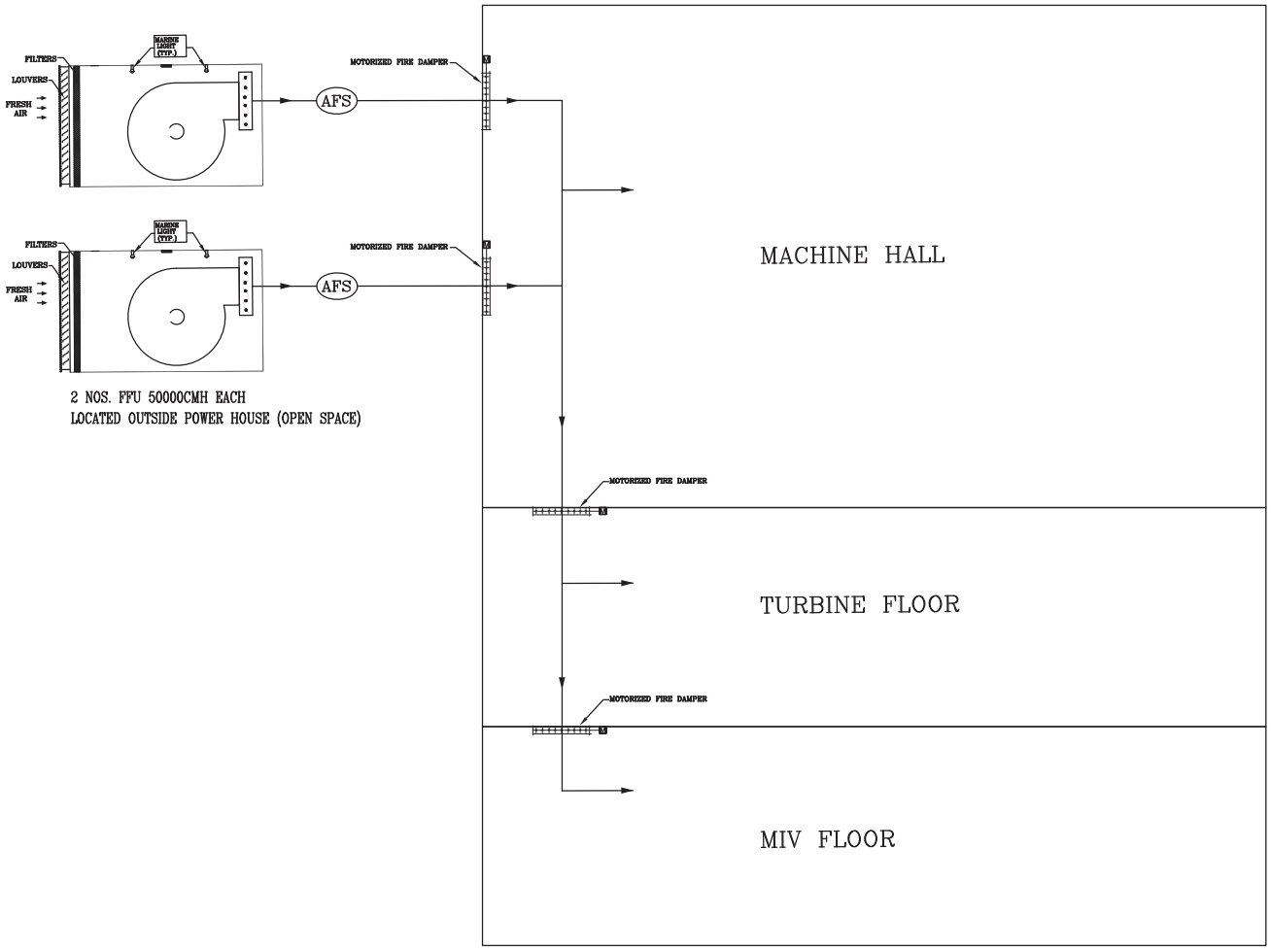
be considered.
10. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
11. Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
12. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
13. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

	3x27.5 MW KSEBL KUTTIYADI HYDRO ELECTRIC PROJECT HVAC SYSTEM TENDER DRAWINGS	SPECIFICATION No: PE-TS-471-571-11000-A001	
		SECTION : II	
		Sub Section : 7	
		REV. 00	DATE: DEC 2021

SECTION: II

SUB SECTION: 7

TENDER DRAWINGS



2 NOS. FFU 50000CMH EACH
LOCATED OUTSIDE POWER HOUSE (OPEN SPACE)

NOTES: –

1. FOR TENDER PURPOSE ONLY.
2. THIS DRAWING SHOWS THE MINIMUM REQUIREMENT. THERE CAN BE ADDITION OR DELETION.

CLIENT: KSEBL

PROJECT: 3x27.5MW KUTTIYADI HEP

CONTRACTOR : BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT, NOIDA

TITLE: VENTILATION SCHEME FOR POWER HOUSE

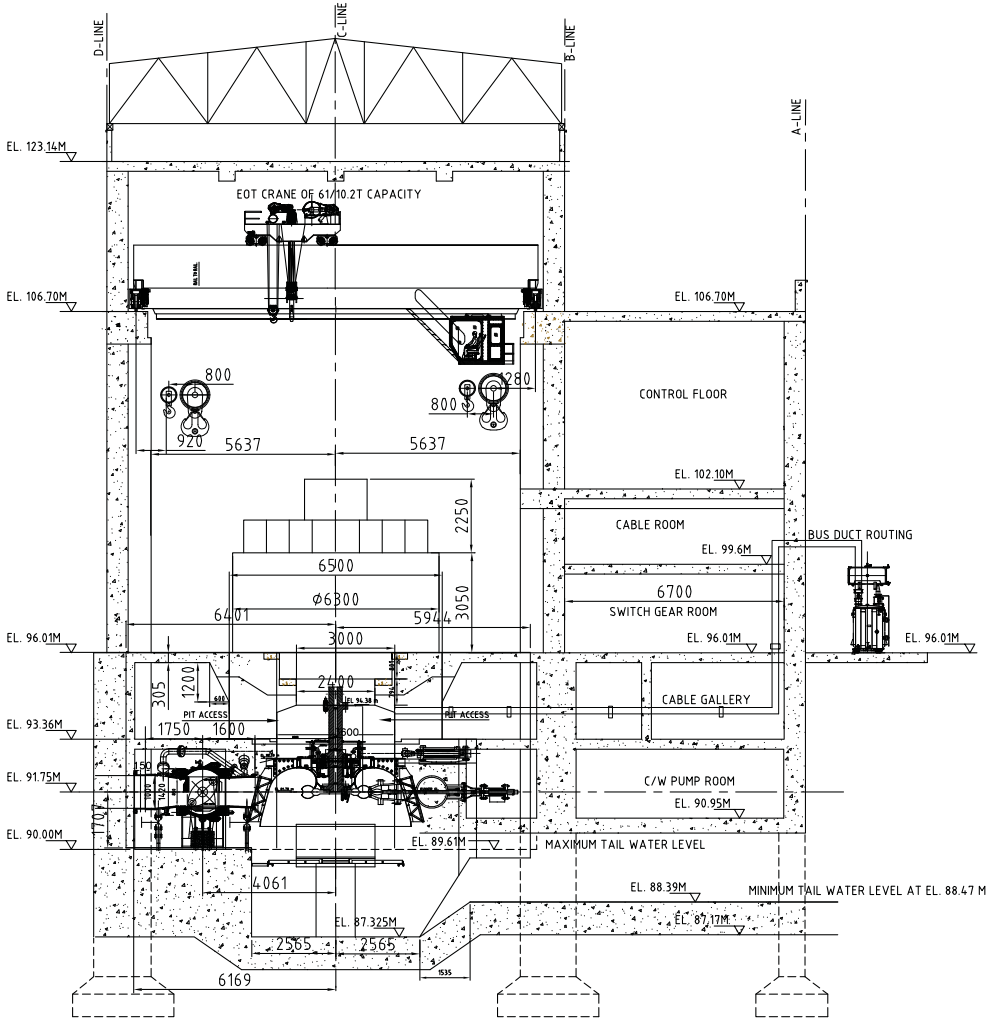
DEPT. | SCALE: NTS
SIGN
DATE
SHEET: | REV

SIZE-A2

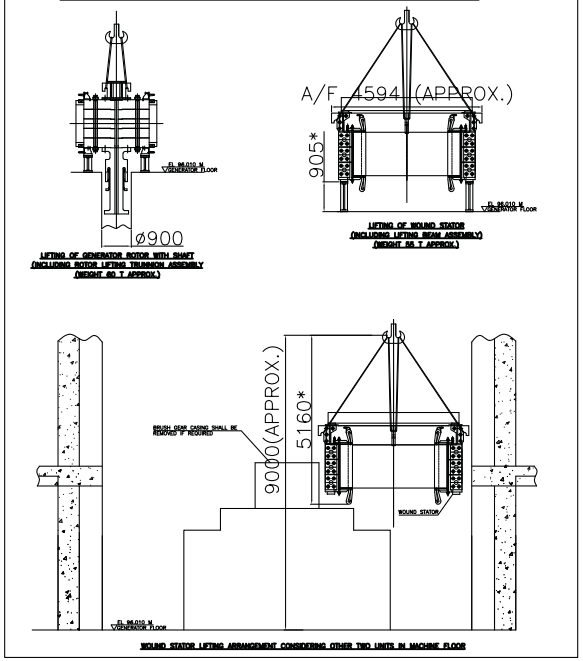
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 12000020651



HANDLING ARRANGEMENT OF GENERATOR STATOR & ROTOR



01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.

02. EQUIPMENT SHOWN AND LISTED ARE TENTATIVE AND SHALL BE FINALISED INCLUDING SIZES DURING DETAILED DESIGN.

03. ONLY EXISTING CUTOUTS ARE MARKED IN THE DRAWING. ADDITIONAL CUTOUTS SHALL BE INCORPORATED LATER AFTER DETAIL ENGINEERING OF VARIOUS SYSTEMS.

REV.	DATE	ALTERED	
		CHECKED	
		APPD.	
ZONE			

REV.	DATE	ALTERED	T. KHAN
02	23.09.21	CHECKED	DURGESH
		APPD.	R. SINGH
ZONE	REVISED AS PER CUSTOMER COMMENTS DATED 13.09.21 MARKED AT		

REV.	DATE	ALTERED	T. KHAN
01	21.07.21	CHECKED	DURGESH
		APPD.	R. SINGH
ZONE	REVISED AS PER CUSTOMER COMMENTS DATED 14.05.21 MARKED AT		

PROJECT	KUTTIYADI HYDROELECTRIC PROJECT [3X27.5MW]						
CUSTOMER	KERALA STATE ELECTRICITY BOARD LIMITED						
CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED BHOPAL						
DEPT. HPE	NAME	SIGN	DATE	UNTOL. DIMS. GR.	REF. TO AASY. DRG.	ITEM NO.	NO. OF ITEMS
CODE 415	DRN T.KHAN		20.03.21				
	CKD DURGESH		20.03.21				
	APPD R.S		20.03.21				
STATUS OF DRAWING	U			TITLE	POWER HOUSE GENERAL ARRGT. PLAN OF CROSS SECTION		
DISTRIBUTION OF PRINTS							
SUB-VENDOR NAME	WEIGHT (kg)	SCALE 1:60		BHEL DRG. NO. 12000020651		REV. 02	
				SHEET NO. 01	NO. OF SHT. 01		

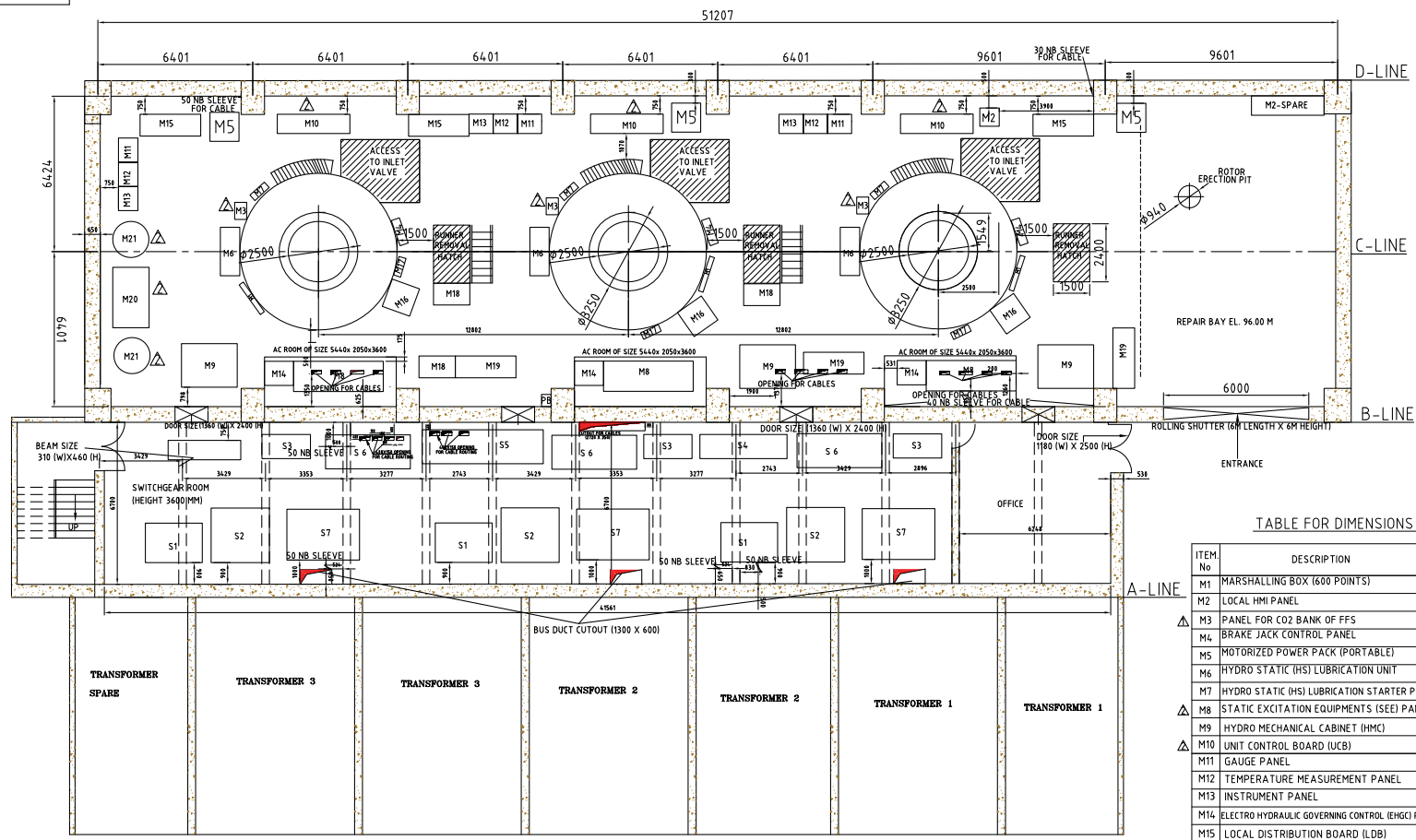
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FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 12000020654



PLAN AT EL. 96.01 M (MACHINE HALL/ GENERATOR FLOOR/ SWITCHGEAR ROOM)

TABLE FOR DIMENSIONS OF EQUIPMENTS-SWITCHGEAR ROOM (TENTATIVE):

ITEM. No	DESCRIPTION	APPROX. SIZE (mm) LENGTH	WIDTH	HEIGHT	QUANTITY PER UNIT	TOTAL QUANTITY	DIVISION
S1	EXCITATION TRANSFORMER CUBICLE (260 kVA)	2350	1625	2700	1	3	EDN
S2	POTENTIAL TRANSFORMER SURGE PROTECTOR (PTSP CUBICLE)	2400	2250	2335	1	3	RUDRAPUR
S3	DC SUB DISTRIBUTION BOARD	2000	1000	2000	1	3	HPE-ELE
S4	DC DISTRIBUTION BOARD (DCDB)	3600	1000	2000	COMMON	1	CUSTOMER
⚠ S5	STATION SERVICE BOARD (SSB)	5000	1400	2000	COMMON	1	HPE-ELE
⚠ S6	UNIT AUXILIARY BOARD (UAB)	3500	1400	2000		3	HPE-ELE
⚠ S7	UNIT AUXILIARY TRANSFORMER (UAT)	3000	2100	2950	1	3	JHANSI

TABLE FOR DIMENSIONS OF EQUIPMENTS-MACHINE ROOM (TENTATIVE):

ITEM. No	DESCRIPTION	APPROX. SIZE (mm) LENGTH	WIDTH	HEIGHT	PER UNIT	TOTAL QUANTITY	
M1	MARSHALLING BOX (600 POINTS)	1500	200	1200	1	3	HGE
M2	LOCAL HMI PANEL	800	800	2415	-	1	EDN
⚠ M3	PANEL FOR CO2 BANK OF FFS	500	700	2300	1	3	HGE
M4	BRAKE JACK CONTROL PANEL	350	1100	1200	1	3	HGE
M5	MOTORIZED POWER PACK (PORTABLE)	1000	800	2415	1	3	HGE
M6	HYDRO STATIC (HS) LUBRICATION UNIT	2000	800	800	1	3	HGE
M7	HYDRO STATIC (HS) LUBRICATION STARTER PANEL	800	300	1200	1	3	HPE
⚠ M8	STATIC EXCITATION EQUIPMENTS (SEE) PANEL	3710	1250	3025	1	3	EDN
M9	HYDRO MECHANICAL CABINET (HMC)	1800	2300	2500	1	3	HPE-GOV.
⚠ M10	UNIT CONTROL BOARD (UCB)	3000	800	2415	1	3	EDN
M11	GAUGE PANEL	1000	800	2415	1	3	EDN
M12	TEMPERATURE MEASUREMENT PANEL	1000	800	2415	1	3	EDN
M13	INSTRUMENT PANEL	1000	800	2415	1	3	EDN
M14	ELECTRO HYDRAULIC GOVERNING CONTROL (EHGC) PANEL	1200	1000	2520	1	3	HPE-GOV.
M15	LOCAL DISTRIBUTION BOARD (LDB)	2500	900	2400	1	3	HPE-ELE
M16	BRAKE DUST COLLECTOR	1200	1200	2500	1	3	HGE
M17	BRAKE DUST COLLECTOR CONTROL PANEL	800	300	1200	1	3	HGE
M18	DC LIGHTING DISTRIBUTION BOARD (DCLDB)	1500	900	2400	1	3	PEM
M19	EMERGENCY LIGHTING DISTRIBUTION BOARD (ELDB)	2500	900	2400	1	3	PEM
⚠ M20	CENTRIFUGE FILTER	1500	2500	2500	-	1	HPE-GOV
⚠ M21	OIL TANK	DIA.2000	-	4500	-	2	HPE-GOV

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. EQUIPMENT SHOWN AND LISTED ARE TENTATIVE AND SHALL BE FINALISED INCLUDING SIZES DURING DETAILED DESIGN.
03. ONLY EXISTING CUTOUTS ARE MARKED IN THE DRAWING. ADDITIONAL CUTOUTS SHALL BE INCORPORATED LATER AFTER DETAIL ENGINEERING OF VARIOUS SYSTEMS.
04. PROVISION OF SLIDING DOORS TO BE MADE FOR AC ROOM OF SEE PANEL & EHGC PANEL.

REV.	DATE	ALTERED	
		CHECKED	
		APPD.	
ZONE			

REV.	DATE	ALTERED	T. KHAN
02	23.09.21	CHECKED	DURGESH
		APPD.	R. SINGH
ZONE	REVISED AS PER CUSTOMER COMMENTS DATED 13.09.21 MARKED AT ⚠		

REV.	DATE	ALTERED	T. KHAN
01	21.07.21	CHECKED	DURGESH
		APPD.	R. SINGH
ZONE	REVISED AS PER CUSTOMER COMMENTS DATED 14.05.21 MARKED AT ⚠		

PROJECT	KUTTIYADI HYDROELECTRIC PROJECT [3X27.5MW]		
CUSTOMER	KERALA STATE ELECTRICITY BOARD LIMITED		
CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED BHOPAL		
DEPT. HPE	NAME / SIGN / DATE	UNTOL. DIMS. GR.	REF. TO AASY. DRG. / ITEM NO. / NO. OF ITEMS
CODE 415	DRN T.KHAN 20.03.21		
	CKD DURGESH 20.03.21		
	APPD R.S 20.03.21		
STATUS OF DRAWING	U		
DISTRIBUTION OF PRINTS		TITLE	GENERAL ARRGT. PLAN OF MACHINE HALL GENERATOR FLOOR & SWITCHGEAR ROOM AT EL. 96.01 M
SUB-VENDOR NAME	WEIGHT (kg)	SCALE 1:95	BHEL DRG. NO. 12000020654 / REV. 02
		SHEET NO. 01	NO. OF SHT. 01

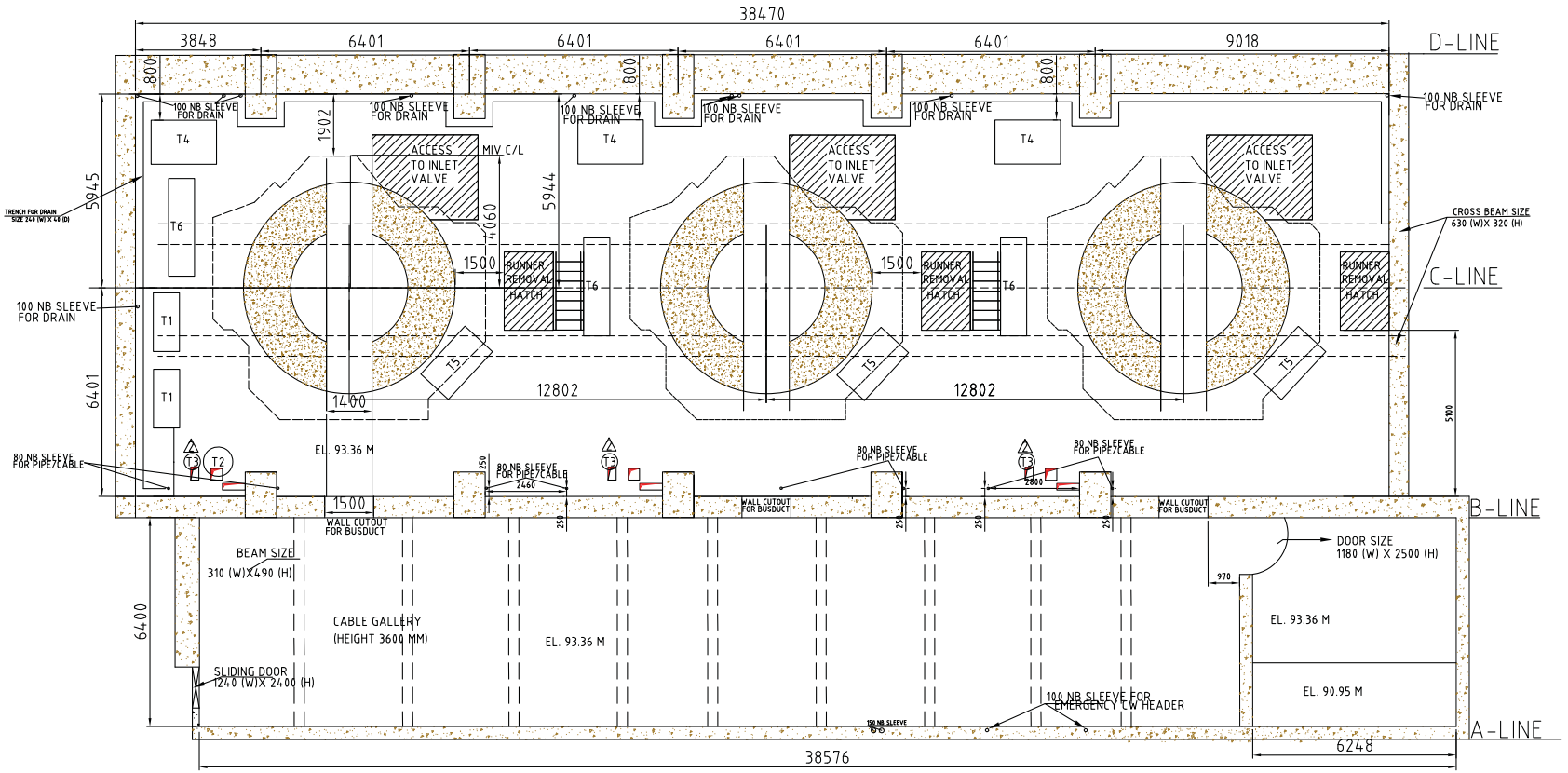
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FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 12000020653



PLAN AT EL. 93.36 M (TURBINE FLOOR)

TABLE FOR DIMENSIONS OF EQUIPMENTS-TURBINE FLOOR (TENTATIVE):

ITEM. No	DESCRIPTION	APPROX. SIZE (mm) LENGTH	WIDTH	HEIGHT	QUANTITY PER UNIT	TOTAL QUANTITY	DIVISION
T1	LP AIR COMPRESSOR	1800	1500	600	---	2	HTE
T2	AIR RECEIVER	900	---	2000	1	1	HTE
⚠ T3	AIR RECEIVER BOTTLE	500	---	1000	1	3	HTE
T4	PRESSURE PUMPING(P.P)SET, PISTON ACCUMULATOR & NITROGEN BOTTLE BANK FOR GOVERNING	1350	2010	2000	1	3	HPE-GOV
T5	NEUTRAL GROUNDING CUBICLE (NG CUBICLE)	2000	1150	1355	1	3	RUDRAPUR
⚠ T6	FIRE FIGHTING CO2 BANK FOR GENERATOR	800	3000	2000	1	3	HGE

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. EQUIPMENT SHOWN AND LISTED ARE TENTATIVE AND SHALL BE FINALISED INCLUDING SIZES DURING DETAILED DESIGN.
03. ONLY EXISTING CUTOUTS ARE MARKED IN THE DRAWING. ADDITIONAL CUTOUTS SHALL BE INCORPORATED LATER AFTER DETAIL ENGINEERING OF VARIOUS SYSTEMS.

REV.	DATE	ALTERED	
		CHECKED	
		APPD.	
ZONE			

REV.	DATE	ALTERED	T. KHAN
02	23.09.21	CHECKED	DURGESH
		APPD.	R. SINGH
ZONE	REVISED AS PER CUSTOMER COMMENTS DATED 13.09.21 MARKED AT ⚠		

REV.	DATE	ALTERED	T. KHAN
01	21.07.21	CHECKED	DURGESH
		APPD.	R. SINGH
ZONE	REVISED AS PER CUSTOMER COMMENTS DATED 14.05.21 MARKED AT ⚠		

PROJECT	KUTTIYADI HYDROELECTRIC PROJECT [3X27.5MW]				
CUSTOMER	KERALA STATE ELECTRICITY BOARD LIMITED				
CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED BHOPAL				
DEPT. HPE	NAME	SIGN	DATE	UNTOL. DIMS. GR.	REF. TO AASY. DRG. / ITEM NO. / NO. OF ITEMS
CODE 415	DRN T.KHAN		20.03.21		
	CKD DURGESH		20.03.21		
	APPD R.S		20.03.21		
STATUS OF DRAWING	U			TITLE	GENERAL ARRGT. PLAN OF TURBINE FLOOR AT EL. 93.36 M
DISTRIBUTION OF PRINTS					
SUB-VENDOR NAME	WEIGHT (kg)	SCALE 1:60		BHEL DRG. NO. 12000020653	REV. 02
				SHEET NO. 01	NO. OF SHT. 01

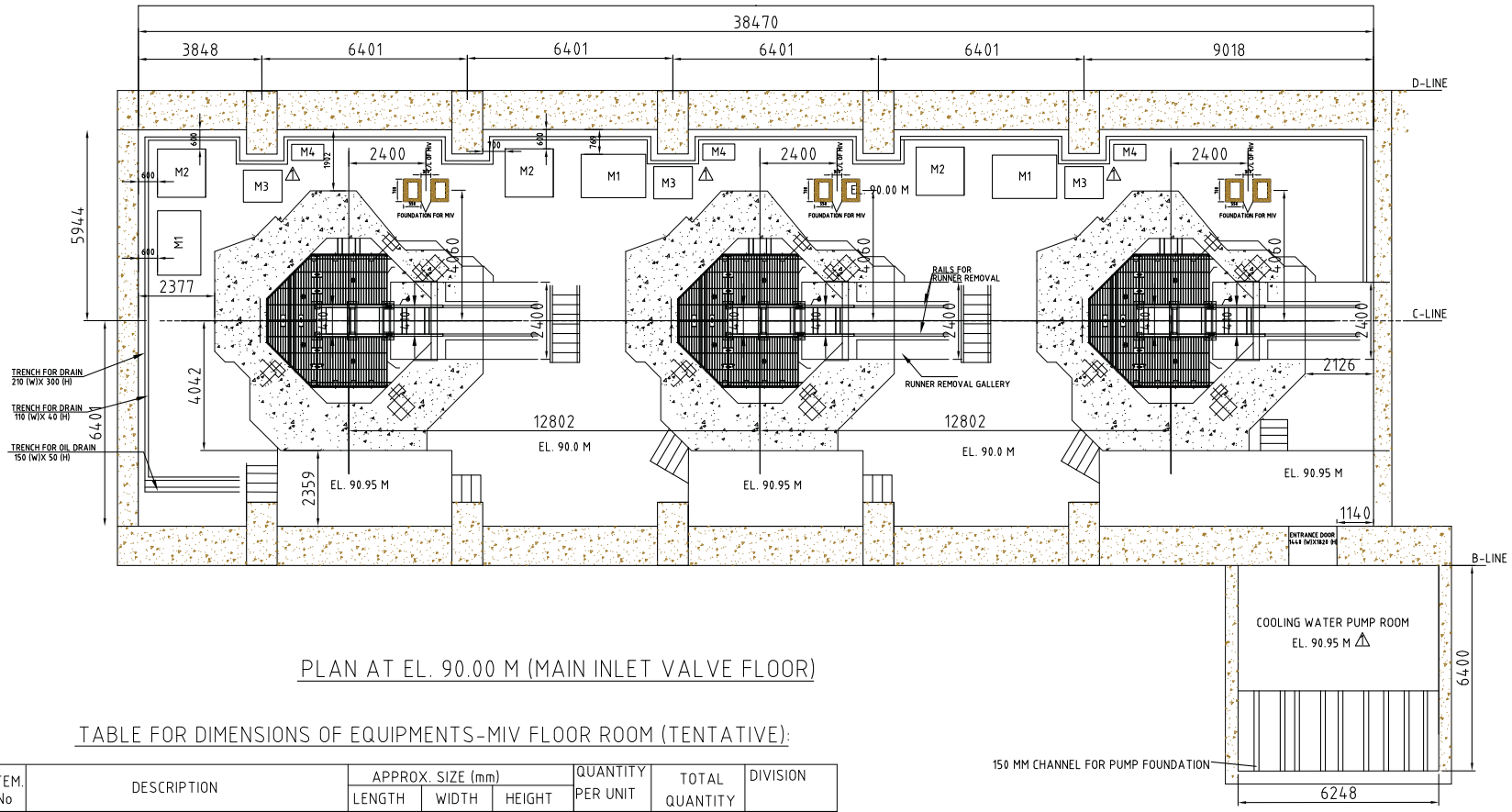
A1 SIZE

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FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 12000020652



PLAN AT EL. 90.00 M (MAIN INLET VALVE FLOOR)

TABLE FOR DIMENSIONS OF EQUIPMENTS-MIV FLOOR ROOM (TENTATIVE):

ITEM. No	DESCRIPTION	APPROX. SIZE (mm) LENGTH	WIDTH	HEIGHT	QUANTITY PER UNIT	TOTAL QUANTITY	DIVISION
M1	PRESSURE PUMPING(P P)SET, PISTON ACCUMULATOR & NITROGEN BOTTLE BANK FOR MIV	1350	2010	2700	1	3	HPE-GOV
M2	HYDRAULIC CONTROL PANEL FOR MIV	1500	1500	2400	1	3	HPE-GOV
M3	ELECTRIC CONTROL & INDICATION PANEL	1200	1000	2400	1	3	HPE-ELE
2 M4	CONTROL PANEL FOR SERVICE SEAL AND MAINTENANCE SEAL	1000	500	1000	1	3	HPE-GOV

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.

02. EQUIPMENT SHOWN AND LISTED ARE TENTATIVE AND SHALL BE FINALISED INCLUDING SIZES DURING DETAILED DESIGN.
03. ONLY EXISTING CUTOUTS ARE MARKED IN THE DRAWING. ADDITIONAL CUTOUTS SHALL BE INCORPORATED LATER AFTER DETAIL ENGINEERING OF VARIOUS SYSTEMS.

REV.	DATE	ALTERED	
		CHECKED	
		APPD.	
ZONE			

REV.	DATE	ALTERED	T. KHAN
02	23.09.21	CHECKED	DURGESH
		APPD.	R. SINGH
ZONE	REVISED AS PER CUSTOMER COMMENTS DATED 13.09.21 MARKED AT		

REV.	DATE	ALTERED	T. KHAN
01	21.07.21	CHECKED	DURGESH
		APPD.	R. SINGH
ZONE	REVISED AS PER CUSTOMER COMMENTS DATED 14.05.21 MARKED AT 2		

PROJECT	KUTTIYADI HYDROELECTRIC PROJECT [3X27.5MW]
CUSTOMER	KERALA STATE ELECTRICITY BOARD LIMITED
CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED BHOPAL

DEPT. HPE	NAME	SIGN	DATE
CODE 415	DRN T.KHAN		20.03.21
	CKD DURGESH		20.03.21
	APPD R.S		20.03.21

UNTOL. DIMS. GR. | REF. TO AASY. DRG. | ITEM NO. | NO. OF ITEMS

STATUS OF DRAWING: U

DISTRIBUTION OF PRINTS

TITLE: GENERAL ARRGT. PLAN OF MIV FLOOR AT EL. 90.00 M

SUB-VENDOR NAME | WEIGHT (kg) | SCALE 1:60

BHEL DRG. NO. 12000020652 | REV. 02

SHEET NO. 01 | NO. OF SHT. 01

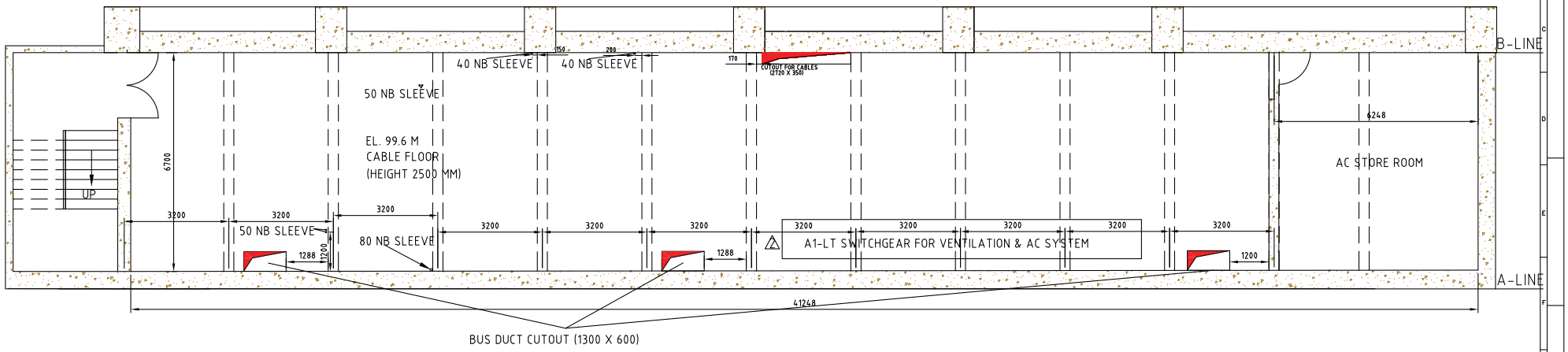
A1 SIZE

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FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DWG. NO 2000020655



PLAN AT EL. 99.60 M (CABLE FLOOR)

TABLE FOR DIMENSIONS OF EQUIPMENTS-MIV FLOOR ROOM (TENTATIVE):

ITEM. No	DESCRIPTION	APPROX. SIZE (mm) LENGTH	WIDTH	HEIGHT	QUANTITY PER UNIT	TOTAL QUANTITY	DIVISION
⚠ A1	LT SWITCHGEAR FOR VENTILATION & AC SYSTEM	11000	1200	2400	--	1	PEM

NOTES:

01. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
02. EQUIPMENT SHOWN AND LISTED ARE TENTATIVE AND SHALL BE FINALISED INCLUDING SIZES DURING DETAILED DESIGN.
03. ONLY EXISTING CUTOUTS ARE MARKED IN THE DRAWING. ADDITIONAL CUTOUTS SHALL BE INCORPORATED LATER AFTER DETAIL ENGINEERING OF VARIOUS SYSTEMS.

REV.	DATE	ALTERED	
		CHECKED	
		APPD.	
ZONE			

REV.	DATE	ALTERED	T. KHAN
02	23.09.21	CHECKED	DURGESH
ZONE		APPD.	R. SINGH

REVISED AS PER CUSTOMER COMMENTS DATED 13.09.21 MARKED AT

REV.	DATE	ALTERED	T. KHAN
01	21.07.21	CHECKED	DURGESH
ZONE		APPD.	R. SINGH

REVISED AS PER CUSTOMER COMMENTS DATED 14.05.21 MARKED AT ⚠

PROJECT	KUTTIYADI HYDROELECTRIC PROJECT [3X27.5MW]
CUSTOMER	KERALA STATE ELECTRICITY BOARD LIMITED
CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED BHOPAL

DEPT. HPE	NAME	SIGN	DATE
CODE 415	DRN T. KHAN		20.03.21
	CKD DURGESH		20.03.21
	APPD R.S		20.03.21

UNTOL. DIMS. GR. | REF. TO AASY. DRG. | ITEM NO. | NO. OF ITEMS

STATUS OF DRAWING: U

DISTRIBUTION OF PRINTS

TITLE: GENERAL ARRGT. PLAN OF CABLE FLOOR AT EL. 99.60 M

SUB-VENDOR NAME | WEIGHT (kg) | SCALE 1:60 | BHEL DRG. NO. 12000020655 | REV. 02

SHEET NO. 01 | NO. OF SHT. 01

A1 SIZE

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FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm)

DRG. NO. 12000020656

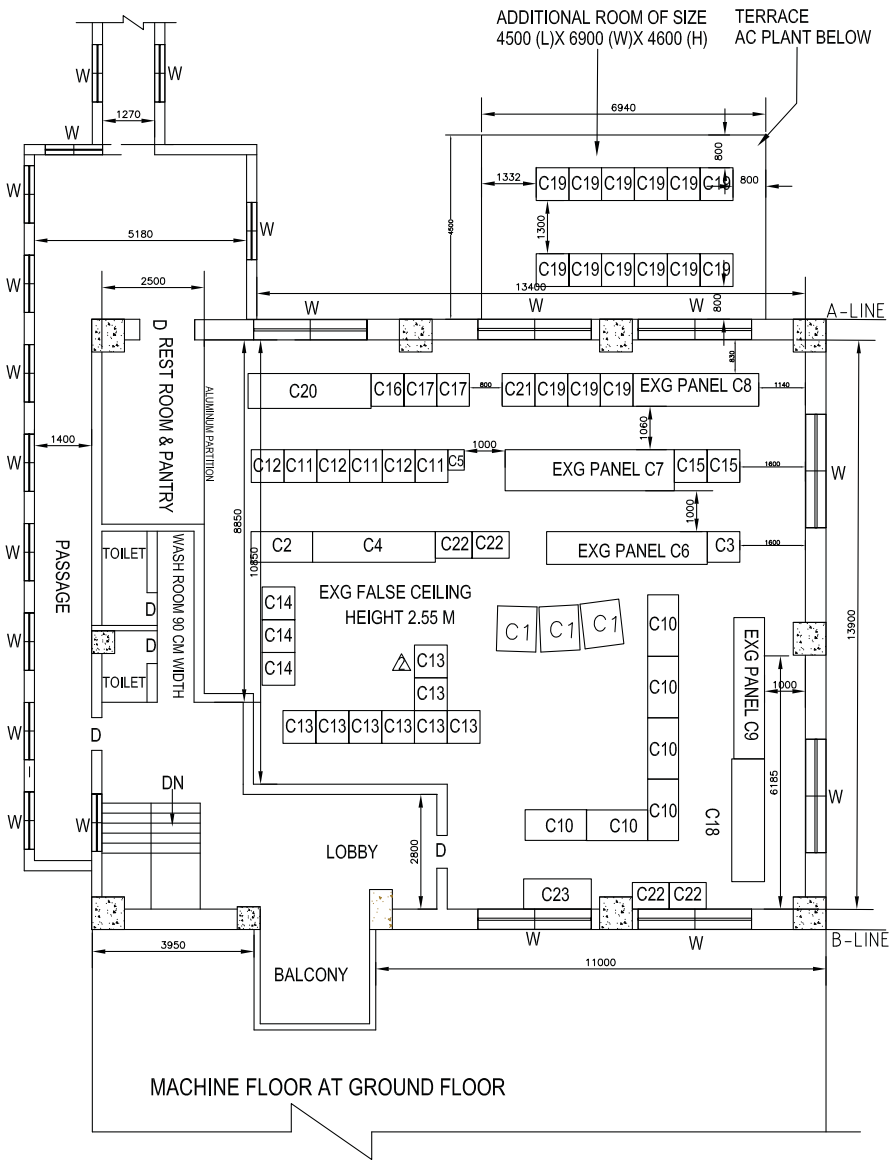


TABLE FOR DIMENSIONS OF EQUIPMENTS-CONTROL ROOM (TENTATIVE):

ITEM. No	DESCRIPTION	APPROX. SIZE (mm) LENGTH	WIDTH	HEIGHT	QUANTITY PER UNIT	TOTAL QUANTITY	DIVISION
C1	OPERATOR WORK STATION DESK	3000	1050	750	--	1	EDN
C2	RTU FOR HVAC SYSTEM	1501	750	2415	--	1	EDN
C3	HMI (SCADA) NETWORK PANEL	800	750	2415	--	1	EDN
C4	ALARM ANNUNCIATOR PANEL-COMMON	3003	750	2415	--	1	EDN
C5	LOCAL PUSH BUTTON BOARD	400	500	800	--	1	HPE-ELE
C6	EXISTING PANEL	3920	800	---	--	1	CUSTOMER
C7	EXISTING PANEL	4130	1000	---	--	1	CUSTOMER
C8	EXISTING PANEL	3070	800	---	--	1	CUSTOMER
C9	EXISTING PANEL	3450	750	---	--	1	CUSTOMER
C10	COMPUTER TABLE	1500	750	735	--	6	EDN
C11	GENERATOR RELAY PANEL-1 (GRP-1)	800	800	2230	1	3	SWE
C12	GENERATOR RELAY PANEL-2 (GRP-2)	800	800	2230	1	3	SWE
C13	110 KV LINE RELAY PANEL (LRP)	800	800	2230	--	8	SWE
C14	110 KV SIDE GT BREAKER RELAY PANEL (GTRP)	800	800	2230	1	3	SWE
C15	110/ 11 KV TRANSFORMER RELAY PANEL (TRP)	800	800	2230	--	2	SWE
C16	110KV BUS-SECTION RELAY PANEL (BSRP)	800	800	2230	--	1	SWE
C17	110KV BUSBAR RELAY PANEL(BBRP)	800	800	2230	--	2	SWE
C18	LOCAL CONTROL BOARD (LCB) FOR COMMON AUXILIARIES	3003	750	2415	--	1	EDN
C19	BAY CONTROL PANELS & LCU FOR GENERATOR TRANSFORMER BAY	800	800	2415	--	15	EDN
C20	UPS FOR HMI COMPUTERS	3000	850	2000	--	1	EDN
C21	FIRE FIGHTING PANEL	800	800	2200	--	1	PESD
C22	PRINTER TABLE	900	650	740	--	4	EDN
C23	LED DISPLAY SCREEN	1651	750	2230	--	1	EDN

REV.	DATE	ALTERED / CHECKED / APPD.
02	23.09.21	T. KHAN / DURGESH / R. SINGH
01	21.07.21	T. KHAN / DURGESH / R. SINGH

REVISED AS PER CUSTOMER COMMENTS DATED 23.09.21 MARKED AT 2

REVISED AS PER CUSTOMER COMMENTS DATED 14.05.21 MARKED AT 1

PROJECT	KUTTIYADI HYDROELECTRIC PROJECT [3X27.5MW]
CUSTOMER	KERALA STATE ELECTRICITY BOARD LIMITED
CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED BHOPAL

	NAME	SIGN	DATE
DEPT. HPE	DRN T.KHAN		20.03.21
CODE 415	CKD DURGESH		20.03.21
	APPD R.S		20.03.21

STATUS OF DRAWING: U

DISTRIBUTION OF PRINTS

SUB-VENDOR NAME

WEIGHT (kg)

UNTOL. DIMS. GR. | REF. TO AASY. DRG. | ITEM NO. | NO. OF ITEMS

TITLE: GENERAL ARRGT. PLAN OF CONTROL ROOM AT EL. 102.10 M

SCALE 1:60

BHEL DRG. NO. 12000020656 REV. 02

SHEET NO. 01 NO. OF SHT. 01

A1 SIZE