

TECHNICAL SPECIFICATION

**TENDER DOCUMENT FOR CONSTRUCTION OF GUJARAT
BIOTECHNOLOGY UNIVERSITY (GBU) - GUJARAT**

TenderNo.

Client

Architect

GBU



Construction of Gujarat Biotechnology University

at

Gandhinagar (Gujarat)

Tender No.

Technical Specifications Part2

INDEX**GENERAL TECHNICAL SPECIFICATIONS FOR ELECTRICAL SYSTEMS**

SL. No.	Descript	Page – No.
A	Fire Fighting	4-21
B	Electrical	22-282
1.	General Conditions -Electrical & Low Voltage Works	22-32
2	11 KV VCB Panel Board	33-40
3	11 KV HT Cable	41-41
4	LT Panel- TTA	42-55
5	LT Panel – Non TTA	56-68
6	Lt Cables	69-71
7	Cable Tray	72-72
8	11 KV RMU	73-86
9	Sandwich Bus Ducts/Rising Main	87-89
10	APFC Panel	90-102
11	Earthing & Lightning Protection System	103-105
12	Internal Electrification	106-118
13	11 / 0.433 KV Oil Filled Transformer	119-125
14	D. G. Sets	126-150
15	Fire Alarm System	151-159
16	Closed Circuit Television System	160-175
17	External Street Lighting	176-181
18	EPABX System	182-201
19	LAN System	202-241
20	Solar PV System	242-246
21	Lifts	247-252
22	Operation & Maintenance	253-282
C	HVAC	283-296

FIRE FIGHTING TECHNICAL SPECIFICATIONS ITEM NO. 272-312**2.1 Internal Hydrant (Landing Valve)**

Landing valve shall be of the type approved by the relevant fire authority applicable as per Indian standard or equivalent. The landing valve shall comply with the requirements of IS 5290 or approved equivalent. Landing valve shall be fitted to a Tee connection on the wet riser at the landing.

Outlet shall be fitted with a removable SS plug secured by a chain with hand wheel.

Landing valves at lower floors shall incorporate SS Orifice plates to limit the maximum pressure as required by NBC-2016/Fire Authority.

At each landing and other locations as shown on the drawings one single headed SS landing valves (connected to the Fire Riser) with 63 mm dia outlet and 80 mm inlet (I.S.5290). Each landing valve shall be with one shut off butterfly valve.

The valve shall have flanged inlet and instantaneous type outlets and shall be fixed at a height of 1000 mm from the finished floor.

Contractor shall provide for each internal fire hydrant station two numbers of 63 mm dia. 15 m long reinforced rubberized fabric hose pipes with SS male and female instantaneous type coupling machine wound with SS wire (hose to I.S. 636 Type 2 and couplings to I.S. 903 with I.S. Certification), fire hose reel with 20 mm hose 30-meter-long, SS branch pipe with nozzle I.S. 903 and SS Fire man's axe as per NBC 2016. one 6 kg ABC and one 4.5 kg Co2 fire extinguisher.

2.2 First Aid Hose Reel Equipment

First aid hose reel shall comprise reel, hose guide fixing bracket, hose tubing globe valve, stop cock and shut off nozzle. This shall conform to IS: 884 -1969. The hose tubing shall conform to IS: 1532 - 1969.

Hose tubing shall be 20mm dia and 30 m long. The nozzle and globe valve shall be of 20mm size.

The reel shall be of rigid construction using heavy duty CRCA steel. It shall rotate freely on leak proof bearings and be fitted with pivoted nylon rollers to allow easy run-out of the hose.

Hose reel shall be connected directly to the wet riser and installed in the Fire Hose Cabinet.

The approved shutoff nozzle shall be 5mm bore. It shall be adjustable for jet or spray pattern with complete shut-off.

Fire Hose Cabinets for all internal as well as external fire hydrants shall be provided. Hose cabinets shall be fabricated from 2mm CRCA Sheet of fully welded construction hinged double front door partially glazed with L&K locking arrangement, stove enameled finish in Fire red colour with 100 mm high letters "FIRE HOSE" painted on it prominently.

Branch line from Wet riser to Hose Reel shall incorporate SS Orifice plate to limit the maximum pressure as required by NBC/Fire Authority.

2.3 Hose Pipe, Branch Pipes and Nozzles

2.4.1 Hose Pipe

Hose pipes shall be rubber lined woven jacketed and 63mm in diameter. They shall conform to type 2 (Reinforced rubber lined) of IS: 636 - 1979. The hose shall be sufficiently flexible and capable of being rolled.

Each run of hose pipe shall be complete with necessary SS coupling at the ends to match with the landing valve or with another run of hose pipe or with branch pipe. The coupling shall be of instantaneous spring lock type.

2.4.2 Standard Branch Pipes

Branch pipe shall be of SS 63mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle.

Branch pipes shall be conform to IS: 903 -1985

2.4.3 Nozzle

The nozzle shall be SS 16mm in (Internal) diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe, with nozzle spanner.

Nozzles shall be conform to IS: 903 -1985

2.4.4 Fire Hose Cabinet

Fire Hose Cabinet will accommodate the landing valve, hose pipe, hose reel fire man axe, portable extinguisher etc. This shall have lockable, centre opening, glazed doors as per Indian standards or equivalent.

Fire Hose Cabinet may be provided of steel frame structure.
The hose cabinet shall be painted red and stove enameled.

2.4.5 Fire Brigade Connections

Stainless Steel collecting head with three or four 63 mm instantaneous type inlets with built in check valves and 150 mm diameter outlet connected to the fire tank, wet riser or sprinkler riser shall be provided for each building. Collecting head shall be installed on a stand post and provided with horizontal C.I. reflux valve. Etched Stainless Steel label plates with 100 mm high letters shall be provided at each fire brigade connection. The plates should be firmly fixed to the Fire Brigade connection and support system. Fire Brigade inlet connections must be provided in accessible locations generally in front side of the premises and must be free of traffic and parking and other obstructions.

2.4 MS Pipes & Fittings

2.5.1 Pipes

All fire pipes within and outside the building in underground / exposed locations shall be as follows:

MS pipes 150 mm dia. and below confirming to IS: 1239 part-1, minimum 5.4 mm thick heavy grade, C class.

MS pipes 200 mm dia. and above confirming to IS: 3589, minimum 6.35mm thick, grade 330.

All pipes above ground and in exposed locations shall be painted with two coat of zinc chromate primer and two or more coats of synthetic enamel paint of approved shade.

M.S. pipes when buried underground shall be painted with two coats of approved primer and wrapped with one/two layer of 4 mm thick PYPKOTE sheet or equivalent as per manufacturer's specifications

All underground pipes are to be laid not less than 1m below ground level.

2.5.2 Fittings

(a) All GI and MS fittings shall be as per IS 1239 part-2 – For Infrastructure.

Pipe fittings viz, tees, bends, couplings, flanges, reducers etc. and all such connecting device that are needed to complete the piping work in its totality.

Socket welded for up to 50 mm dia pipe.

(b) For Internal Pipes: -

Above 50 mm pipes fittings shall be joined with grooved fitting and couplings (UL Listed & FM Approved). Grooving on pipe shall be done using Grooving machine of same manufacturer as Grooved fittings.

Forged steel fittings of approved type with "V" groove for welded joints will be used in exceptional cases only with approval of CLIENT CONSULTANT. 37.5 bevel end should be provided for grooving. When two pipes will be joint, it will be 75 degree and gap between both pipes should be checked properly with tapper gauge as directed by CLIENT CONSULTANT.

Welded joints shall be permitted as an exception with approval of CLIENT CONSULTANT.

Welder should be 6G certified.

Fabricated fittings shall not be permitted under normal circumstances.

All fittings shall be able to withstand a pressure of 150% of the maximum working pressure.

2.5 Jointing

2.6.1 Joints Screwed and V Groove

Joint for GI and Grooved Fittings steel pipes and fittings shall be metal to metal joints using Teflon tapes on threads for pipes up to 50mm diameter. Only forged socket screwed fittings to be used. All fittings shall have manufacturer's trade mark stamped on it.

Fabricated fittings shall not be used under any circumstances.

For pipes and fittings jointed with forged screwed fittings, care shall be taken to remove burr from the end of the pipe after cutting by a round file.

Pipes above 50 mm shall be joined with grooved fittings.

2.6.2 Grooved End Fittings

Fittings shall be cast of ductile iron with grooved ends for direct connection into grooved piping systems (UL Listed & FM Approved):

- 1) Mechanical Couplings: UL Listed & FM Approved Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure-responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A- 449 and A-183, minimum tensile strength 110,000 psi (758450 kPa).

Standard rigid joints Housings shall be cast with offsetting, angle pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13

Couplings should not require Torque while tightening up to 12" & Tongue & Recess Coupling are not allowed.

- 2) Grooved End Fittings: UL Listed & FM Approved Fittings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12 (Fire Lock®), forged steel conforming to ASTM A- 234, Grade WPB 0.375" wall (9,53 mm wall), or fabricated from Std. Wt. Carbon Steel pipe conforming to ASTM A-53, Type F, E or S, Grade B. Fittings provided with an alkyd enamel finish or hot dip galvanized to ASTM A-153. Zinc electroplated fittings and couplings conform to ASTM B633.
- 3) Bolted Branch Outlet: UL Listed & FM Approved Branch reductions on 2"(DN50) through 8"(DN200) header piping. Bolted branch outlets shall be manufactured from ductile iron conforming to ASTM A-536, Grade 65-45-12, with synthetic rubber gasket, and heat-treated carbon steel zinc plated bolts and nuts conforming to physical properties of ASTM A-183

For valves connection, coupling shall be used as per approved makes to make connection especially in pump room.

2.6.3 Welded Joints (Exceptions only)

Use Fittings of approved type with "V" groove end for welded joints in 50mm diameter and above, in case grooved fitting can't be used.

Joints between MS pipes and fittings shall be made with the pipes and fittings having groove and fittings.

Welded joints are not permissible normally.

2.6 Flanges

Flanges shall be provided on both ends of any fabricated fittings e.g. bends tees etc. of 50 mm dia or larger diameter wherever necessary. Generally, usage of flanged fittings shall be avoided unless necessarily required.

Flanges shall be provided for jointing all types of valves, appurtenances, pumps, connections with other type of pipes to water tanks and other places necessary and required as good for engineering practice.

Flanges shall be as per ASME/ANSI B16.5 with appropriate number of G.I. nuts and bolts, 3 mm insertion neoprene gasket complete.

Unions are to be provided on pipes lines 50 mm and below, near valves and assemblies and as required as per site conditions. All Unions when used shall be with socket welded ends. Usage of unions shall be avoided wherever the pressure exceeds 7 kg/cm² and break up flanges are recommended at these locations.

All couplings and fittings shall be provided by a single source supplier.

2.7 Valves

Valves shall be of same manufacturer for all systems, including valves furnished with equipment.

For flanged valves, companion flanges are to be provided of same PSI rating/class of valve being used.

All valves are to be provided with rating not less than 16kg/cm² working pressure for fire systems or as indicated otherwise.

Valves to be provided as required for complete isolation of equipment, branches from the main lines, arranged so as to give complete and regulation control of piping systems throughout the building. Valves to be provided with neat appearance and grouping, so that all parts are easily accessible for maintenance.

Each valve are to be marked at the factory with the following minimum information, engraved, stamped or cast on each valve or metal tag permanently attached to the valve.

1. Manufacturer's name.
2. Catalogue or Figure number.

3. Size and pressure class.
4. Arrows shall indicate direction of flow on check, globe, angle, non-return eccentric plug and butterfly valves.
5. Valves shall be ISI marked.

All the valves up to 50mm dia. shall be of gunmetal/bronze body with screwed ends and shall be provided with unions on both the sides for removal and repair, unless instructed otherwise.

All the valves above 50mm dia shall be of CI body with flanged ends and shall be provided with flanges on both the sides for removal and repair, unless instructed otherwise.

Wherever possible, install valves accessible from floor level. Provide operating handles for all valves and cocks. Provide adequate clearance for easy operation.

Face to Face dimensions of the valves shall be as per ASME/ANSI B 16.10.

2.8 Check Valve

All check valves 50mm and smaller shall be of bronze body and disc, threaded ends or as required by the piping system in which they are installed.

All check valves 65mm and larger shall be of cast iron body with stainless steel trim and shall be of flanged end as required by the piping system in which they are installed.

All check valves shall be swing check type.

2.9 Butterfly Valve

Butterfly valves 80mm dia. and above shall be Cast Iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both directions with accompanying flanges and steel handle.

Butterfly valves shall be of best quality conforming to IS: 13095 of PN20 class with position indicator.

Provide wafer type C.I. double flanged butterfly valves of required sizes and of rating.

Butterfly valves shall be high performance valves manufactured of ductile iron body SS-316 stainless disc and stainless steel stem with EN-8/ SS-410 shaft.

Joints for double flanged butterfly valves shall be made with suitable tail/socket pieces on the pipeline and flanges joints made with appropriate number of bolts, nuts and washers with 3 mm thick insertion rubber gasket.

Provide the following butterfly valve accessories:

Valves 150 mm and smaller shall have nine position levers.

Position indicator on all butterfly valves.

For valves without full access provide enclosed extension stems to allow operation.

2.10 Sluice Valve

Sluice Valves (80 mm dia. and above) shall be C.I. double flanged sluice valves with rising stem. Each sluice valve shall be provided with wheel in exposed positions and cap top for underground valves. Contractor shall provide suitable operating keys for sluice valves with cap tops.

Sluice valves shall be of approved makes conforming to IS: 780/PN16 class.

Sluice valves shall be high performance valves manufactured of ductile iron body, SS-316 stainless disc and stainless steel stem with EN-8/ SS-410 shaft

Joints for double flanged sluice valves shall be made with suitable tail/socket pieces on the pipeline and flanges joints made with appropriate number of bolts, nuts and washers with 3 mm thick insertion rubber gasket.

2.11 Safety Relief and Pressure Reducing Valves

All safety and relief valves to be properly rated and installed in accordance with relevant standards.

Use bellow type pressure reducing devices or orifice plates judiciously to limit the pressure in the high pressure areas as per the requirements and keep the pressure within the permissible and operable limits in compliance to fire authority in the entire system.

2.12 Air Valve

25 mm dia. screwed inlet C.I. single acting air valve shall be necessarily provided on all high points in the system.

2.13 Installation Testing Valve

Alarm valve shall be provided in the sprinkler system, to indicate the flow of water in the sprinkler system.

Installation Testing Valves assembly shall be installed on the sprinkler system.

Contractor shall submit detailed shop drawings showing the exact location, details of installation of the valve and alarm complete in all respects.

Installation valve shall comprise of a cast/ductile iron sluice valve with gunmetal trim, pressure gauge, pressure relief valve, double seated clapper check valves as alarm valve with pressure gauge, test valve and orifice assembly and drain pipe with pressure gauge, bye pass on check valve to regulate differential pressure and false alarm, turbine water gong including all accessories necessary and required and as

supplied by original equipment manufacturer and required for full and satisfactory performance of the system.

2.14 Orifice Plates

Orifice Plates fabricated made of 6mm/8mm thick stainless steel of required size shall be provided to reduce pressure at strategic locations as per requirements and as per relevant I.S. code. The Contractor shall submit detailed hydraulic calculations for the orifice plates for approval before installation as per location & pressure condition.

2.15 Drain Pipe

80 mm dia black steel pipe confirming to IS: 1239 (heavy class) with gunmetal full way valve for draining any water in the system in low pockets shall be provided.

Flange and blind flange shall be provided after the valve to ensure accidental opening of drain valve.

2.16 Testing of Valves

Test valve bonnets for tightness. Test and operate the valves from closed-to-open-to-closed position while valve is under test pressure.

Test automatic valves including solenoid, pressure relief valves, safety valves and temperature and pressure relief valves for proper operation at settings indicated.

Ensure that valves are field checked for packing and lubricated.

Test all valves, air relief valves, safety relief valves, safety valves and temperature and pressure relief valves three times.

2.17 Strainers

Strainers shall be bucket type with CI/MS body of class 150. The flanged ends shall be confirming to Indian Standard and it shall have perforated S/S (AISI-304) sheet with large screen area.

Vendor to submit the strainer flow graph for approval.

It shall be of compact shape and size as per approval and should be easy to install and repair.

2.18 Hangers and Supports

All hangers, supports, anchors, inserts and guides shall be in accordance with the British Standard BS 3974, MSS SP-58, MSS SP-59, RAL-GZ 656 or equivalent and to the relevant NFPA Standards

Dielectric Protection. Furnish acceptable protection or copper plated hangers between ferrous and nonferrous metal pipe and hangers on all water piping.

All supports used for firefighting system shall be UL listed and FM approved.

Horizontal Piping Hangers

Provide one of the following types of hangers for horizontal piping manufactured by one of the approved makes.

Provide clevis type supports.

Provide sprinkler type supports.

Provide trapeze hangers where several pipes can be installed parallel and at the same level, and fabricate from structural steel shapes.

Use roller chairs or pipe-roll stands where provision for expansion is required.

Spacing shall not be farther than the closest interval required for any size pipe supported thereby, or as necessary to prevent damage or failure to the structure.

Where there is doubt of the structural capacity for concentrated loads necessary structural calculations shall be carried out and the load distributed sufficiently.

Floor Supports:

Contractor to fabricate galvanized steel frame to suit the site conditions to the Engineer's approval.

Wall Supports.

Provide one of the following means of supporting horizontal piping from wall:

Provide wall mounted cantilever type steel supports fabricated from galvanized structural steel of at least 240 MPa yield strength.

Galvanized steel frame designed to suit the site conditions to the Engineer's approval.

The dimensions of steel members to be used for brackets shall be suitable for the supported load and to Engineer's approval.

Vertical Piping Supports:

Vertical pipe supports shall be steel riser pipe-clamps.

Manufacturer's rated maximum loading for each size pipe shall be used (with minimum 50% safety factor) for spacing of supports.

Bolt clamp securely to pipe, reset clamp-end extension on building structure.

Beam Clamps:

Non-"C-Style" beam clamps shall be malleable iron for up to 9.5 mm hanger rods, forged-steel for hanger rod size 9.5 mm and above.

"C-Style" beam clamps shall be adjustable hanger rod type, malleable iron with set screw, jam nut, retaining clip, FM and UL approved.

Where beam configuration does not allow horizontal movement of C-clamp when set screw and jam nut are positioned, retaining clips may be omitted.

Inserts and Expansion bolts:

Furnish and set inserts in concrete forms.

For pipes 200 mm and over or equivalent group of pipes on trapeze, use two or more inserts to prevent exceeding maximum loading.

As an alternative to the above mentioned inserts the Contractor may use expansion bolts. If the Contractor uses expansion bolts, the maximum spacing between supports may need to be reduced so as not to exceed the maximum loading and the expansion bolt locations shall be determined in coordination with the structural elements.

Manufacturer:

All supports and clamps shall be from one of the approved manufacturers.

Unless otherwise indicated, all supports, clamps or frames shall be protected against corrosion by galvanizing as per ASTM B 633 or coated as per ISO 12944.

Supports/clamps or frames used outside the building shall be hot dipped galvanized as per ASTM A 123, ASTM A 153 or coated as per ISO 12944.

INSTALLATION / APPLICATION / PERFORMANCE /ERECTION

Provide hangers to support the required loads.

Hang pipe from substantial building structure. Piping shall not be hung from other piping. All rigid hangers shall provide a means of vertical adjustment after erection.

Do not suspend pipe from metal roof deck.

“C” clamps shall be installed as per manufacturer's recommendations.

HORIZONTAL PIPING SUPPORT SCHEDULE

Support horizontal piping on threaded, galvanized, hot rolled steel rod hangers.

Where proprietary hangers are being used, the threaded rod size shall be as required for the hanger.

The maximum spacing shall be based on the load carrying capacity of the hanger, after allowing a safety factory of 50% on the insulated full pipe weights.

Steel Pipe - Maximum Spacing Between Single Pipe Supports:

Nominal Pipe Size, mm												
20	25	32	40	50	65	80	100	125	150	200	250	300
Maximum Span Metres												

1.8	2.1	2.7	3.0	3.0	3.3	3.3	3.6	3.8	4.2	5.0	5.0	5.5
Minimum Rod Diameter, Millimeters												
6.4	9.5	9.5	9.5	9.5	13	13	16	16	16	19	24	28

Support steel piping 300 mm and larger at 6 m intervals or less to ensure even distribution of loading on structural members.

The spacing specified herein is included to limit deflection in the pipe to an acceptable minimum. Shorten intervals as necessary so as not to exceed the support manufacturer's maximum recommended safe load values in accordance with BS 3974.

Trapeze Hanger. Spacing shall not be farther than the closest interval required for any size pipe supported thereby, or as necessary to prevent damage or failure to the structure. Provide additional framing as required to transfer loads to adequate structure.

Supporting rods over 450 mm long shall be braced at every fourth hanger with diagonal bracing attached to the structure.

The Contractor shall select support distances such that the precast structure is not subjected to excessive point loads. The Contractor will be required to submit calculations to demonstrate that the proposed loads can be safely supported from the structure.

VERTICAL PIPING SUPPORT

Support vertical piping with steel riser clamps. Make adequate provision for expansion, contraction, and lateral stability by using sliding devices or spring-type installations. Also, account for vertical expansion and lateral movement of the building structures.

Support steel pipe at a minimum of every floor as required to relieve joint stresses.

The space between the vertical pipe supports shall be same as specified for horizontal pipe supports.

Where required, furnish and install heavy anchorage to the pipe against movement from expansion and contraction and secure the approval of the Consultant for the method of installing the anchorage before the work.

Horizontal piping shall be supported at intervals not greater than 3 m spacing and at all changes of direction.

Pipes shall be hung by means of expandable anchor fastener of approved make and design. The hangers and clamps shall be fastened by means of galvanized nuts and bolts. The size/diameter of the anchor fastener and the clamp shall be suitable to carry five times of the weight of water filled pipe plus 250 pounds' pressure.

2.19 Pressure Gauge

Pressure gauge shall be 110 mm dia gunmetal Bourden type with stainless steel isolation cock, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate level and height for easy readability. Pressure gauges shall read 0-20 Kg/sqcm.

2.20 Pipe Sleeves

Contractor has to furnish, install and be responsible for the location of proper sleeves for all pipes passing through floor, walls, partitions or other building construction. Where sleeves occur in concrete construction, they shall be set before concrete is poured.

Sleeves and anchors are to be set in a suitable manner so that they will not become displaced. Sleeves for piping passing through walls and floors in concealed spaces shall be cut flush with walls or floor. All sleeves shall be heavy duty M.S pipe, and of such a size as to permit piping and piping insulation to pass through sleeve.

Sleeves passing through foundation or exterior walls, or where seepage may occur, shall be thoroughly waterproofed by removing all loose material and caulking with oakum and lead wool tightly around pipe or exterior as well as interior surface. Finish off interior surface with cement. Finish off exterior surface with two layers of felt, mopped on with hot asphalt, making for an absolutely waterproof installation. All waterproofing must be performed before any backfilling is done.

On all pipes passing through fire rated walls and ceilings, in finished areas, and where pipes are exposed to view, furnish and install plates on each side of the wall. Plate shall be large enough to cover sleeve opening and pass insulation. Clamp plate firmly to pipe by means of setscrews.

Sleeves passing through walls and floors between rooms shall be filled from both ends of sleeve with fireproof insulation material of a fire rating equal to that of the wall or floor.

2.21 Hydrant/Valve Chambers [IN GROUND]

Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 12 mm thick cement plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box as approved or as specified in Schedule of Quantities and in drawings including excavation, backfilling complete.

Valve chambers shall be of following size: -

- I. 120 x 120 cms x 100 cms
- II. 90 x 90 cms x 100 cms

2.22 Flow Switches [Sprinkler System]

Provide REED type flow switches for

Water flow alarm switches shall be UL listed and FM approved with pneumatic retard mechanism.

Alarm switches shall be installed and coordinated with fire alarm system.

Flow switch shall be provided on sectional mains and branch lines of sprinkler systems where necessary and required and directed by the Consultant.

Flow switch should be suitable to actuate within 90 seconds of opening of a single sprinkler and shall be suitable for connection to a central Annunciation Panel. Wiring up to modem / smoke detector will be included.

2.23 Testing Assembly

Prefabricated, assembly consisting of a grooved end body, flow switch, inspectors test valve and pressure gauge.

2.24 Sprinklers [Quartz Bulb Type]

All sprinkler heads shall be UL listed and FM approved. Sprinklers shall be rated for ordinary temperatures (68 deg. C) except as required near kitchen heaters or locations where elevated temperatures may normally be expected or as otherwise indicated in the drawings or required by the local fire regulations. The temperature rating of a sprinkler should not be less than 30 deg. centigrade greater than the highest anticipated temperature of the location of the installation.

Sprinklers shall not be painted. They shall not be altered in any respect nor have any type of ornamentation or coating.

All the sprinkler shall be of conventional pendant type sprinklers. Upright sprinkler shall be mandatorily provided inside the false ceiling wherever the depth between the structural slab and false ceiling is more than 800mm. Side wall sprinklers shall also be used as per suitability.

Open Nozzles for Water Curtain

To be installed as per manufacturers. These shall be operated automatically.

2.25 Sprinkler Cabinets

Provide spare sprinkler emergency cabinet and spare stock of sprinklers heads conforming to NFPA 13. Contractor shall provide no less than 24 spare heads of each type and/or temperature rating.

Sprinkler cabinet shall be constructed of 2mm CRCA sheet with prime coat and manufacturer's baked enamel finish in color selected by the Consultant. Cabinet(s) shall be located in Fire Pump Room(s). Final location shall be as directed by Consultant in charge.

2.26 Fire Extinguishers

6kg multi-purpose ABC dry chemical type as per IS: 15683:2006 of approved make/type in red glossy polyester coated cylinder with pressure gauge and nozzle shall be used throughout.

4.5kg Carbon Dioxide as per IS: 15683:2006 of approved make/type in red glossy polyester coated cylinder with discharge horn and wall bracket shall be used in specified areas.

5kg inert Fire Extinguishers: Provide fire extinguishers in accordance with local fire authority, where indicated on the drawings, and in each mechanical, electrical equipment and elevator machine room.

2.27 Hydrant, Sprinkler, Jockey & Water Curtain Pump

Fire pumps, Sprinkler pumps & Jockey pumps, associated controllers, and transfer switches shall be provided by a single source supplier.

Pump shall be capable of delivering 150% of rated capacity at not less than 65% of rated head. Pump shall be fire authority approved and the unit shall be design proven in fire protection services.

Pump sets shall be single stage/multistage horizontal centrifugal single outlet with cast iron body and bronze dynamically balanced impellers. Connecting shaft shall be stainless steel with bronze sleeves and grease lubricated bearings.

Pumps shall be connected to the drive by means of spacer type love joy couplings, which shall be individually balanced dynamically with bearings.

The pump coupling joining the prime movers with the pump shall be provided with a sheet metal coupling guard.

All pumps shall be provided with approved type mechanical seals.

The pump and motor shall be floor mounted on a cast iron floor pedestal frame.

2.28 Electric Motor

Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps the motors should be rated not to draw starting current more than 3 times normal running currents.

Motors for fire protections pumps shall be at least equivalent to the horse power required to drive the pump at 150 % of its rated discharge and be designed for continuous full load duty and shall be design proven in similar services.

Motors shall be wound for class H insulation and winding shall be vacuum impregnated with heat and moistures resistant varnish glass fibre insulated.

Motors shall be suitable for 415+ 10% phase, 50 cycles, AC supply and shall be designed for 38 deg C temperature. Motors shall conform to the relevant I.S. Standards.

Motors shall be capable of handling the required starting torque of the pumps.

The pump shall be direct driven and the speed of the motor shall be compatible with the speed of the pump.

Technical data sheet to be provided for all pumps, equipment's and all fire components for CLIENT CONSULTANT/Consultants approval before procurement.

2.29 Diesel Engine

Diesel engine shall be of suitable multi cylinders single/twin outlets with individual head assemblies as per approved fire regulations. The engine shall be water-cooled and shall include heat exchanger and connecting piping, strainer; isolating & pressure reducing valves, by pass line complete in all respects.

Engine shall be direct ignition type matching the pump speed for direct drive and with electronic governor.

The speed of the engine shall match the pump speed for direct drive.

The engine shall be capable of being started without the use of works, cartridge heater, plugs or either at engine room temperature of 7 deg. C. and shall take full load within 15 seconds from the receipt of the signal to start.

The engine shall efficiently operate at 40 deg, ambient temperature at 50 meters above mean sea levels.

Noise level of the engine shall not exceed 90 DBA (free field sound pressure) at 3 meters mean distance.

The engine shall be self starting type up to 4 deg C and shall be provided with one 24 volts heavy duty DC battery, started, cut-out, battery leads complete in all respects. One additional spare battery shall be provided. The battery shall have a capacity of 180 to 200 ampere hours and 640 amps cold cranking amperage.

A battery re-charge of 10 to 15 amperes capacity with trickle and booster charging facility and regulator shall be provided.

The engine shall be provided with an oil bath or dry type air cleaner as per manufacturer's design.

Engine shall be suitable for running on high-speed diesel oil.

The system shall be provided with a control panel with push button starting arrangement also wired to the engine on a differential pressure gauge.

The entire system shall be mounted on a common structural base plate with anti-vibration mountings and flexible connections on the suction and delivery piping.

One self-supported one-day oil tank fabricated from 4mm thick MS sheet electrically welded with a capacity of 8 hours working load but not less than 500 liter shall be provided. Preferably in base frame of pumping set. Level indicating gauge glass on the day oil tank and low fuel level indications on the control panel shall also be provided.

One insulated exhaust pipe with suitable muffler (residential type) to discharge the engine gases to outside open air.

All other accessories, fittings & fixtures necessary and required for a complete operating engine set shall be provided.

Contractor shall provide requirements, if any, for any ventilation of the pump room.

The materials of construction for the major components are as are as follows:

Casting	: Cast iron
Impeller	: Bronze
Shaft	: EN-8
Wear Rings	: Bronze
Gland Packing	: Graphite Asbestos
Type of Bearing	: Ball bearing/ Roll Bearing
Type of coupling	: Flexible couplings

2.30 Air Vessel

Air vessel shall be minimum 450 mm dia x 2000 mm high fabricated from 10 mm M.S plate with dished ends and tested to minimum 20 kg/sq cm pressure with suitable supporting leg. Air vessel shall be provided with a 100 mm dia flanged connection from pump header, one 25 mm dia drain with one gunmetal valve and pressure relief valve.

2.31 Operating Conditions

The fire pumps shall operate on drop of pressure in the mains. The pump operating sequence shall be arranged in a manner to start the pump automatically but should be stopped manually by starter push buttons only.

Jockey pump shall start and stop through pressure switch automatically.

Jockey pump shall stop when main pump starts.

Main pumps shall start automatically on fall of pressure but stopping automatically/manual.

Diesel pump – Start Automatic – Stop Manually.

Automatic transfer switch (es) shall be factory mounted and inter wired with the fire pump controller. The controller and transfer switch shall be capable of interrupting a short circuit current at least equal to the available short circuit current in the controller supply circuit.

Ratings shall suite the electricity demand and meet the requirement of local Fire Authority.

Contacts shall be silver plated, arching type with arc barriers and arc chutes.

Accessories will be as under:

- a. Test switch in cover.
- b. Green pilot light to indicate "Normal" position.
- c. Amber pilot light to indicate "Emergency" position.
- d. Push-to-test emergency indicating pilot light with long life lamps and fuses.
- e. Adjustable time delay on retransfer to normal:
- f. 0-25 minutes plus 5 minutes unloaded running time for the generator. The time delay shall be by passed automatically upon failure of the emergency source.
- g. Number of closed auxiliary contacts shall be 1 on normal, 1 on emergency.

Isolating means shall be a manually operable, moulded case switch, horsepower rated and suitable for the interrupting of the motor locked rotor current

Provide an isolating switch ahead of the emergency input terminals of the automatic transfer switch.

Provide auxiliary contacts for remote audible and visual signals indicating that the switch is in the open position.

Withstand rating shall not be less than the transfer switch rating.

If required by the project conditions the entire assembly shall be delivered in parts and assembled in place under the supervision of the authorized manufacturer's representative.

Pump casing to spill over to the floor drain.

Fire pump flow measuring system/devices approved by local fire authority.

GENERAL CONDITIONS – ELECTRICAL & LOW VOLTAGE WORKS

1. GENERAL

A new Incite building at GBU Gandhinagar Complex and Service blocks (ESS, UGT, STP, ETP, WTP) External development etc. is proposed to be constructed at Gandhinagar Gujarat.

2. SCOPE OF WORK

The scope of work shall cover internal Electrical Installations, ESS and external electrical Installation works complete as required for Electrification of proposed Incite building of **GBU at Gandhinagar**. It shall covers designing of complete Electrical system for the entire complex, preparation of shop drawings, supply of all equipment, material, electrical Fixtures & Accessories required, installation, testing and commissioning of all electrical installations for the project for the following, but not limited to, main items/systems:

2.1 ESS & External Electrical Installation

- i. Augmentation of 11KV/ 0.433V Sub-Station - 1 Nos. comprising but not limited to following:
 - a. 11 KV VCB Panel Board
 - b. 11KV Transformers shall be with OLTC, 11/0.433kv Oil filled type Transformers shall be with ON load tap change
 - c. LT Panel with Synchronizing Relay for auto synchronizing and Auto-load management
 - d. Capacitor Panels (HPFC) with 14% detuned Harmonic filters to improve Power factor up to 0.97 (lagging).
 - e. Sandwich Bus Ducts from Transformers to LT Panel, DG Sets to LT Panel, LT Panel to HVAC Panel, LT Panel to Capacitor Panels etc.
 - f. All Associated Equipment & accessories required.
- ii. 11 kV underground Ring Main System interconnecting all Substations
- iii. DG Sets including PLC/AMF panels for Auto Synchronizing, Auto Load Management & Load sharing etc.
- iv. Lightening Protection System & Earthing Network
- v. 11 kV HT Power Cables and 1.1 kV LT power cables
- vi. Solar & Conventional Street Light System
- vii. Boom Barriers
- viii. Electrical distribution comprising of feeder cables from ESS to individual block, services, Main panel, Rising Mains etc. Separate distribution shall be provided for Lighting load, Power/AC Load & UPS load. Separate LT panels at each floor shall be provided for feeding HVAC load of AHUs, FCUs, Split ACs and Ventilation Fans.

The Electrical distribution should include - Emergency power supplying distribution system as per NBC 2016 for critical requirement for functioning of fire and

life safety system and equipment, shall be planned for efficient and reliable power and control supply to the following systems and equipment where provided:

- i. Fire pumps
- ii. Pressurization and smoke venting; including its ancillary systems such as dampers and actuators;
- iii. Fireman's Lifts (including all lifts).
- iv. Exit Signage Lighting;
- v. Emergency Lighting;
- vi. Fire Alarm System;
- vii. Public Address (PA) System (relating to emergency voice evacuation and annunciation);
- viii. Access Control System
- ix. Lighting in fire command centre and security room.
- x. Any other system as required

2.2 Internal Electrical Installations

It shall include the following items of work to be carried out simultaneously with the civil work within the buildings:

- i. Wiring for 6A Light Points and socket Outlets
- ii. Wiring for Call Bell, Fan & Exhaust Points.
- iii. Wiring for 16A/20A Power socket outlets.
- iv. Wiring for 3 Phase Power socket Outlets
- v. 1.1 KV L.T. Cables and Sub main wiring.
- vi. Rising Mains / Bus Trunking
- vii. M.V. Panels/ Floor Panels and Double Door MCB Type Distribution Boards.
- viii. Supply and Installation of LED Light fittings, fans, Exhaust Fans & fixtures
- ix. Earthing & Lighting Arrestor
- x. Telephone
- xi. Cable TV
- xii. LAN Networking
- xiii. CCTV System
- xiv. Testing and commissioning of all electrical installations

The scope of work shall also include any other item or item of work, equipment, material or accessories not specifically mentioned above but is required for the satisfactory completion & trouble free operation & maintenance of electrical equipment/work. This shall also include spares required for commissioning of the equipment/work.

The work shall be carried out as per standard specifications of PWD/CPWD/GWSSB

relevant drawings and as per item description and as per directions of Engineer In Charge.

2.3 SPECIAL CONDITIONS FOR ELECTRICAL SERVICES:

a) GENERAL

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The requirement offered by the contractor shall be complete in all respects.

- b) The contractor shall obtain all sanctions (electrical loads, approval of drawing/ ESS/ D.G.'s estimator/ approval of meter room etc. from the concerned authorities and permits required for the electrical installation work. All actual fee payable in this regard will be reimbursed against receipt/documentary evidence. On completion of work, the contractor shall obtain NOC from SEB & Director of Safety of the concerned state; a copy of the same shall be delivered to Consultant / Engineer In Charge.

The Consultant shall have full power regarding the materials or work to be got tested through independent agency at the EPC contractor's expenses in order to prove their soundness and adequacy. The contractor will rectify the defects/suggestions pointed out by Consultant / independent agency at his own expenses.

The installation shall comply in all respects with the requirements of Indian Electricity Act 1910, Indian Electricity Rules (IER) 1956 and other related Laws and Regulations as amended up to date, there under and special requirements, if any, of the State Electricity Boards etc. The bidder is liable to furnish the list of authorized licensed persons/ employed/deputed to carry out the works/perform the assigned duties to fulfill the requirement of Rule No.3 of IER 1956 as amended up to date.

2.4 DRAWINGS

i. Tender Drawings:

The tender drawings are meant to give general idea to bidder regarding the nature of scope & works to be executed. Any information/data not shown in tender drawings shall not relieve the contractor of his responsibility to carry out the work as per the specifications & terms of the EPC contract. Additional information required by the bidder/tenderer for successful completing the work shall be obtained at his end.

- ii. **Shop Drawings:** The contractor shall prepare detailed coordinated electrical shop drawing indicating Light Points, Power Points, Cal Bell points, Ceiling Fan, Exhaust Fan Points, Switch Boards, Distribution Boards (Light, Power & UPS), Lighting Fixtures, Convenience outlets, Single Line Diagram for complete HT/ LT electrical scheme, DG Sets, HT Panel, Transformers, LT Panels, Capacitor Panels, RTCC Panels, PCC Panel, UPS Units, UPS Incoming/ Outgoing panels, Lift Panels, Rising Mains, HT/ LT Cable Schedules, Solar PV System, Earth Pit Layout, Earth Strip routes, HT/ LT Cable Routes, Street Light Layout & Street Cable routes, Schematic Diagrams & Floor wise Shop Drawings for all LV works namely, Telephone, LAN, Wifi, CCTV, Access Control, Fire Alarm, Public Address System, Information Display System, Boom Barriers etc. with other relevant services and submit to the Consultant for approval or the Engineer-in- Charge before commencing the work.

GA Drawings, SLD & Control wiring diagrams, Room trench details for all HT & LT

Panels, Capacitor Panels, UPS panels, Floor Electrical Panels, Transformers, DG Sets, UPS Units, Rising Mains etc. shall be prepared & submitted. The shop drawings shall indicate all setting out details and physical dimensions of all equipment/items/components with wiring and cable details, cable schedule and routes, manhole trap and fixing details as well as for conduit indicating run and size of wire/cables, outlet/pull/junction boxes etc. with fixing details etc. for the above mentioned work. All work shall be carried out on the approval of these drawings. However, approval of these drawings shall not relieve the contractor of his responsibility for providing maintenance free and fool proof system including any missing component/accessories to meet the intent of the specifications. Contractor will submit 2 prints for preliminary approval and finally six prints for distribution. The recommended location/ position of the all equipment as shown on the layout drawings will be adhered to unless stated otherwise.

iii. **As-Built Drawings:**

On completion of the work and before issue of certificate of virtual completion, the contractor shall submit to the Consultant, 4 Sets of 'As Built' drawings (in AutoCAD & PDF format) along with soft copy of the executed works incorporating all such changes and modifications during engineering and execution along with Operation and Maintenance Manuals, Warranty & Guarantee Certificates from Original Equipment Manufacturers (OEM), authorized Suppliers & Vendors, as applicable.

These drawings must provide:

- ☐ Run and size of conduit, inspection and pull boxes including routing and locations.
- ☐ Number and size of conductor in each conduit.
- ☐ Locations and rating of sockets and switches controlling the light and power outlet.
- ☐ A complete wiring diagram as installed and schematic drawings showing all connections in the complete electrical system.
- ☐ Location of outlets of various services, junction boxes, light fixtures.
- ☐ Location of all earthing stations route and size of all earthing conductors.
- ☐ Layout and particulars of all cables.
- ☐ Location and details of Transformers, HT/ LT Panels, Feeder Pillars, capacitor control panels etc.
- ☐ UPS panel, and relay panels with description detailed control wiring diagram.
- ☐ Location of transformer and its details and control wiring diagram.
- ☐ Location of Hume pipe and manhole including HT/LT cable layout and scheduling
- ☐ Location of DG Sets, Exhaust and auxiliary equipment with schematic drawings.
- ☐ Layout of cable trays with support and their fixing details.
- ☐ Location of all earthing station, route and size of all earthing conductor.\
- ☐ Layout and particulars of rising mains with fixing details.

The contractor shall submit 2 sets of samples of each type of accessories and apparatus, proposed to be used in the installation at site for approval (drawings or samples) as required shall be submitted by contractor and the choice of selection out of the approved list lies with the Consultant. For all non-specified items, approval of the Consultant shall be obtained prior to procurement of the same.

2.5 MANUFACTURER'S INSTRUCTIONS

Where manufacturers have furnished specific instructions, relating to the material/equipment to be used on this job, covering points not specifically mentioned in this document, manufacturers' instructions should be followed.

2.6 MATERIALS AND EQUIPMENT

All the materials and equipment shall be of the approved make and design. Unless otherwise called for any approval by Consultant Engineer-in-Charge, only the best quality materials and equipment shall be used.

2.7 GENERAL DETAILS

a) Space Heaters & Lighting.

One of more adequately rated heaters thermostatically controlled with On-Off switch and fuse shall be provided to prevent condensation in any panel compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. CFL lamp shall be provided in any panel compartment.

b) Fungistatic Varnish

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

c) Ventilation Opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

d) Degree of Protection

The enclosures of the Control Cabinets, Junction Boxes and Marshalling Boxes, Panels etc. to be installed shall provide degree of protection as called for in specifications / General arrangement, whenever it is not mentioned it shall be as given below:

- ☐ Installed out door: IP-55.
- ☐ Installed indoor in air-conditioned area: IP-52.

- ☐ Installed in covered area: IP-52.
- ☐ Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP-42.
- ☐ For L.T. switchgear (AC and DC distribution boards): IP-52.

The degree of protection shall be in accordance with IS: 13947 (Part-I)/IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

2.8 Rating Plates, Name Plates and Labels

Rating Plates, Name Plates and Labels are to be provided & attached permanently in a conspicuous position to all equipment & items installed in various buildings. A rating plate of non-corrosive material engraved with manufacturer's name, year of manufacture, equipment name, diagram, type or serial number etc. together with details of the loading conditions of equipment. The rating plate of each equipment shall be according to relevant BIS & IEC norms, as applicable.

All such nameplates, instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

2.9 First Fill of Consumables, Oil and Lubricants

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, welding/ soldering/ brazing material for all copper/ G.I. earthing and essential chemicals etc. which will be required to put the equipment/ scheme covered under the scope of the specifications, into successful operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

2.10 DESIGN IMPROVEMENTS / DEVIATIONS

The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. If for any reason, Contractor wishes to deviate from specification, prior permission from Consultant will be sought.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly in the specification.

3. QUALITY ASSURANCE PROGRAMME

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 Purchaser's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Purchaser after discussions before the award of Contract. A quality assurance programme of the contractor shall generally cover

the following:

- ☒ His organization structure for the management and implementation of the proposed quality assurance programme.
- ☒ Documentation control system.
- ☒ Qualification data for bidder's key personnel.
- ☒ The procedure for purchases of materials, parts components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- ☒ System for shop manufacturing and site erection controls including process controls and fabrication and assembly control.
- ☒ Control of non-conforming items and system for corrective actions.
- ☒ Inspection and test procedure both for manufacture and field activities.
- ☒ Control of calibration and testing of measuring instruments and field activities.
- ☒ System for indication and appraisal of inspection status.
- ☒ System for quality audits.

- ☒ System for authorizing release of manufactured product to the Purchaser.
- ☒ System for maintenance of records.
- ☒ System for handling storage and delivery.
- ☒ A quality plan-detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

The Purchaser or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his Vendor's quality management and control activities.

3.1. QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit the following Quality Assurance documents within three weeks after dispatch of the equipment:

- ☒ All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication and reports including radiography interpretation reports.
- ☒ Welder and welding operator qualification certificates.
- ☒ Welder's identification list, listing welders and welding operator's qualification procedure and welding identification symbols.
- ☒ Raw material test reports on components as specified by the specification and/or agreed to in the quality plan.
- ☒ Stress relief time temperature charts/oil impregnation time temperature charts.
- ☒ Factory test results for testing required as per applicable codes/ mutually agreed quality plan/ standards referred in the technical specification.

- ② The quality plan with verification of various customer inspection points (CIP) as mutually and methods used to verify the inspection and testing points in the quality plan were performed satisfactorily.

4. INSPECTION, TESTING AND INSPECTION CERTIFICATE

- ② The major item such as HT Panel, Transformers, LT Panels, APFC Panels, DG Sets, Rising Mains/Bus Ducts, Power Cables, LAN Cables etc. shall be tested at Manufacturer works before dispatch in presense of Consultant/Department Representative.

- The Consultant or duly authorized representative shall have at all reasonable times free access to the Contractor's/ Manufacturer's premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection, if part of the works is being manufactured or assembled at other premises or works, the Contractor shall obtain permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if

found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

- ② All equipment being supplied shall conform to type tests and shall be subject to routine tests in accordance with requirements stipulated under respective sections. Bidder shall submit the type tests reports for approval. The Contractor shall intimate the Consultant the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies. If for any item type test is pending payment would be made on successful completion of type/routine test(s) actually carried out as per Consultant instructions.
- ② The Contractor shall give the Consultant thirty (30) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account. The Consultant, unless witnessing of the tests is virtually waived off, will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/ inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the presence of Consultant and he shall forthwith forward to the Consultant duly certified copies of tests in triplicate.
- ② The Consultant shall within fifteen (15) days from the date of inspection as defined shall inform in writing to the Contractor of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and make the necessary modifications accordingly.
- ② When the factory tests have been completed at the Contractor's or Sub-contractor's works, the Consultant shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Consultant, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test

certificate by the Consultant. Failure of the issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificate shall not bind the Consultant to accept the equipment should, it, on further tests after erection, is found not to comply with the Specification. The equipment shall be dispatched to site only after approval of test reports and issuance of clearance by the Consultant.

- ☐ The contractor shall arrange all necessary tools and testing facilities for inspection purpose including arrangement of air travel (inland as well as abroad), conveyance, lodging, boarding and other miscellaneous expenses etc. Consultant shall depute its inspection engineers (2 or more as decided by Consultant) after receipt of inspection call from the contractor. All such expenses incurred by the contractor towards inspection of equipment by Consultant inspection engineers shall be borne by the contractor & no extra payment whatsoever shall be paid/ reimbursed to the contractor on this account.
- ☐ For tests whether at the premises or at the works of the Contractor or of any Sub- Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be required by Consultant or this authorized representative to carry out effectively such tests of the equipment in accordance with the Specification.
- ☐ The inspection by Consultant and issue of Inspection Certificate thereon shall in no way absolve the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.
- ☐ The Consultant will have the right of having at his own expenses any other tests(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests to satisfy that the material comply with the specifications.
- ☐ The Consultant reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Contractor.

5. TESTS

5.1. Charging Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Consultant and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The pre-commissioning tests to be performed as per relevant I.S. given and shall be included in the Contractor's quality assurance programme.

5.2. Commissioning Tests

- ☐ 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, unmeasurable parameters shall be taken into account in a reasonable manner by the Contractor 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. The Contractor will apply proper corrections in calculation, to take into account conditions, which do not correspond to the specified conditions.

- ☐ All instruments, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.
- ☐ Pre-commissioning test shall be carried out as per relevant IS and/or as specified in the relevant clause.
- ☐ The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning of the equipment.

6. PACKAGING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon/truck/trailer sizes in India should be taken account of the Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Consultant takes no responsibility of the availability of any special packaging/transporting arrangement.

7. PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

8. FINISHING OF METAL SURFACES

8.1. General

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro galvanized. All steel conductors used for earthing/grounding (above ground level) shall be galvanized according to IS: 2629.

8.2. Hot Dip Galvanizing

- ☐ The minimum weight of the zinc coating shall be 700 gm/sq.m and minimum thickness of coating shall be 85 microns.
- ☐ The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and

smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

- ☒ After galvanizing drilling or welding shall be performed on the galvanized parts of the earthing materials. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.
- ☒ The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.
- ☒ Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.
 - Coating thickness,
 - Uniformity of zinc,
 - Adhesion test,
 - Mass of zinc coating.
- ☒ Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

8.3. Painting

- ☒ All sheet steel work shall be degreased, pickled, phosphate in accordance with the IS- 6005 “Code of practice for phosphating iron and sheet”. All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
- ☒ After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, staving type zinc chromate primer. The first coat may be “flash dried” while the second coat shall be shoved.
- ☒ Powder coating/electrostatic painting of approved shade shall be applied.
- ☒ The exterior color of the paint shall be as per shade no. 697 of IS-5 or as approved by Engineer-in-charge and inside shall be white or as approved by Engineer-in-charge. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments, if required.
- ☒ In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures like electrostatic

painting etc. the procedure shall be submitted along with the Bids for Consultant review and approval.

9. HANDLING, STORING AND INSTALLATION

- ☐ In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented.
- ☐ Contractor shall follow the unloading and transporting procedure at site, as well as storing, testing and commissioning of the various equipment being procured by him separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's Engineer(s) and shall extend full co-operation to them.
- ☐ In case of any doubt/ misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Consultant. Contractor shall be held responsible for any damage to the equipment consequent for not following manufacturer's drawings/instructions correctly.
- ☐ Where assemblies are supplied in more than the one section, Contractor shall make all necessary connections between sections. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.
- ☐ The Contractor shall submit to the Consultant every week, a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
- ☐ The Contractor shall be fully responsible for the equipment/material until the same is handed over to the Consultant in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Consultant, as well as protection of the same against theft, element of nature, corrosion, damages etc.
- ☐ The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment, which require indoor storage.
- ☐ The words 'erection' and 'installation' used in the specification are synonymous.
- ☐ Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.
- ☐ The minimum phase to earth, phase to phase and section clearance along with

other technical parameters for the various voltage levels shall be maintained as per relevant IS.

10. PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

11. DESIGN CO-ORDINATION

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

12. DESIGN COORDINATION MEETING

The Contractor will be called upon to attend design co-ordination meetings with the Engineer, and the Consultant / MoHFW during the period of Contract. The Contractor shall attend such meetings at his own cost at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during those discussions.

13. TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipments.

14. SAFETY CODES & PRECAUTIONS

The Contractor at his own expenses shall arrange for safety provisions as required to comply with the statutory regulations, ISI recommendations and CPWD codes.

The contractor shall provide necessary barriers, warnings, signals and other safety measures to avoid accidents. He shall indemnify Consultant against any claims arising out of negligence in this respect.

15. REGULATIONS AND STANDARDS

All equipments their installation, testing and commissioning shall conform latest Gujarat R&B/CPWD/ IS specifications in all respects. Indian Standard Code of Practice for Electrical Wiring Installation IS:732-1989. It shall also be in conformity with Indian Electricity Rules and the Regulations, National Electric Code, National Building Code 2016, ECBC, latest CPWD specifications amended up to date and requirements of the Local Electric Supply Authority. In general, all materials equipment and workmanship shall conform to the Indian Standards specifications and code. Mode of all measurement will be as per latest CPWD norms/ specifications including amendments. Some of the applicable codes/standards are as under:

- | | | |
|----|--|-------------------------|
| a) | CPWD General specifications for electrical works | Part-I (Internal) 2023 |
| b) | CPWD General specifications for electrical works | Part-II (External) 2023 |

- | | | |
|----|--|------------------------------------|
| c) | CPWD General specifications for electrical works | Part-III (Lifts & Escalators) 2005 |
| d) | CPWD General specifications for electrical works | Part-IV (Substation) 2013 |
| e) | CPWD General specifications for electrical works | Part VII (DG Sets) 2013 |
| f) | CPWD Specification/norms for measurement | Latest revision |
| g) | NEC-2023, ECBC-2017, NBC-2016 | |
| g) | High Voltage Switch gear and control gear | |
| h) | Low Voltage Switch gear and control gear | |
| i) | Degree of protection for Enclosure | |
| j) | Guide for improvement of Power Factor | |
| k) | Recommendations on Safety Procedures & Practices in Electrical Works | |
| l) | Code of practice for selection, Installation and maintenance of Transformers. | |
| m) | Code of practice for Electrical wiring Installations. | |
| n) | Oil Type Power Transformers IS/IEC62271-202:2014 | |
| | IS/ IEC 61439 (1-5) IS/IEC 60529:2001 IS 7752-Part-1 :1975 IS 5216 Part 1-2 IS | |

10028 Part-2 :1981 IS 732 IS 11171:1985

- | | | |
|----|--|--|
| h) | Guide for uniform system of marking and identification of conductor and apparatus terminals. IS 11353 -1985 | |
| i) | Low voltage switchgear and control gear assemblies IS/IEC 61439 | |
| j) | Specification for low voltage switchgear and control gear assemblies IS 8623 (Part -2- 1993) | |
| l) | Code of practice for selection, Installation and maintenance of switchgear and control gear. IS 10118 Part – 1 - 4 | |
| n) | PVC insulated (heavy duty) electric cables IS 1554 | |
| o) | PVC insulated cables for working voltages up to and including 1100V. IS 694 | |
| p) | Conduit for electrical installations IS 9537 | |
| q) | Accessories for rigid steel conduits for electrical wiring IS 3837 | |
| r) | Boxes for the enclosure of electrical accessories IS 14772 | |
| s) | General and safety requirements for luminaries IS 1913 | |
| t) | Code of practice for earthing IS 3043 | |
| u) | Electrical accessories – circuit breakers for over current protection for household and similar installations. IS 8828 | |
| v) | Low Voltage switchgear and control gear IS 13947 Part 1 – 5 | |
| w) | Residual current operated Circuit Beakers IS 12640 | |
| x) | Current Transformers IS 2705 | |
| y) | Voltage Transformers IS 3156 | |
| z) | Direct acting indicating analogue electrical measuring instruments and their | |

accessories IS 1248 part – 1 to 9

A1 Control Switches (switching device for control and auxiliary circuits including contactor relays) for voltages up to and including 1000V AC and 1200 V DC.

IS 13947 & IS 13 In case of contradiction in specification the priority of the documents shall be as follow CPWD/ IS Specifications, Drawings, Technical Specifications.

Item No:- 417-420**16.2 11 KV HT CABLES**

The quantity of 11 kV HT cable required for the following is included in the scope of work of the tender:

1. Incoming feeders from Existing HT Panel in proposed ESS. The size & runs of the HT cables shall be decided as per the Electrical Load requirements and rated short circuit capacity of Substations & HT cable Schedule shall be got approved from Engineer-In-Charge.

16.2.1 Construction

All HT cables shall be of 11 kV grade, armored, aluminum conductor, XLPE insulated, earthed & PVC sheathed cables shall be manufactured & tested in accordance with relevant IS Code Specifications.

16.2.2 11KV CABLE JOINTS/ TERMINATIONS

Terminal joints shall be carried out as per IS specifications. Heat shrink cable termination kit shall be used for terminations & straight through joints.

16.2.3 INSTALLATION OF CABLES

Cable laying in ground , Cable trays , Ducts or fixing on Wall shall be carried out as per CPWD specifications for Electrical works Part II as amended up to date. Cable route marker shall be provided at regular intervals as per CPWD specifications. Cost of cable route markers is deemed to be included in the cost of cables/cable laying.

Item No:- 414 & 443**16.3 LT PANELS- TTA****LOW VOLTAGE SWITCHGEAR AND TESTED ASSEMBLY (TTA PANELS)
(Applicable for Main LT Panel and Emergency Panels)****GENERAL**

This section covers the detailed requirements of medium voltage switchboard for 415 volts 3 phase, 50 Hz, 4 wire system.

STANDARDS & CODES

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract.

Low Voltage Switchgear Assemblies	IEC61 439-1 & 2
Low Voltage switchgear & control gear	IEC 60 947 /IS 13947: 1993
Part I	: General rules
Part II	: Circuit Breakers
Part III	: Switches, disconnectors, switch disconnectors and fuse combination units
Part IV	: Contactors and Motor starters
Part V	: Control circuit devices and switching elements

Degree of Protection of Enclosures for low voltage switchgear. IEC60529 /IS 2147: 1962

Internal arc – IEC 61641

SWITCHBOARDS**General**

The LV switchboards shall be **as per the standards IEC 61439-1 & 2**. The switchboards and the associated equipment including switchgear, control gear, Busbar supports, Busbar orientation, Busbar links etc shall be identical in construction to the assembly which has undergone the type test. The drawings of the type-tested assemblies shall be made available for inspection. Type test certificate for all panels to be furnished by the contractor.

The designs of the switchboards should be with switchgear manufacturer, and all the mechanical drawings must be available in the factory beforehand.

Switchboards shall have a short circuit level withstand as per Schedule of Quantities and drawings. Panel shall be tested of design as per Seismic Zone 5 as per ICC ES AC-156 1893 requires compliance against 3.2 g acceleration. The enclosures shall be designed to take care of normal stress as well as abnormal electro-mechanical stress due to short circuit conditions. All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP54 till 2500A above it IP42. Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 54 is retained. Suitable pressure relief devices shall be provided to minimize danger to operator

during internal fault conditions.

The Panel Should be Ethernet/RS485 ready, all ACB, MCCB and Ethernet/RS 485 Gateway Module for Energy Meter shall be connected over IP network using Din Rail Mounted Managed Ethernet Switch in such a way that all electrical panel data shall be able to be communicated to SCADA via single ethernet port from the panel.

The switchboard along with ACBs and connections should have been be type tested design at **CPRI**/Independent international test house for short circuit, temperature rise, protective earth short circuit test and dielectric tests of the ratings required.

Panel shall be rated for Impulse withstand capability not less than that of highest rating of switchgear inside the panel. For operator safety IP2 X (touch proof) protection to be available even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / Hylem sheets shall not be allowed.

Main switchboard shall be form 4b, for form of separation only metallic covers shall be used, Hylem / PVC sheets shall not be allowed, rest of the panels shall be minimum conform to form 4b design.

All ACB, MCCB of Main LT panel and Incomer MCCBS shall have inbuilt earth fault protection.

Switchboard Configuration.

The Switchboard shall be configured with Air Circuit Breakers, MCCB's, MCB's and other equipment as called for in the schedule of quantities.

The MCCBs shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.

The Switchboards shall be of adequate size with a provision of spare space to accommodate possible future additional switch gear.

The switchgear devices and the enclosure design should be of same manufacturer having valid Type Test Certificate.

All ACB / MCCB of Main LT panel shall be EDO/ Plugin type respectively.

All breakers in Main LT panel, Emergency panels and Incomers of other panels shall be of Four Pole Only.

All Tested Assemblies (TTA) (Main LT panel and panels with incomers with 800Amps and above) shall be assembled and manufactured at authorized OEMs factory and FAT shall be done at authorized OEMs premises. All electrical panels in Sub-stations, MDBs and Panels with I/C rating above 630A should be TTA panels. Panels manufactured by OEM or other Authorised manufacturers with more 5 years experience are accepted. However, the breaker type and model shall be as per NIT Specs/makes.

Constructional Features

The Switchboards shall be metal clad totally enclosed, floor mounted free-standing type of modular extensible design suitable for indoor mounting.

Switchboards construction shall employ the principle of compartmentalized and segregation

for each circuit.

Incomer and bus section panels or sections shall be separate and independent and shall not be wired with sections required for feeder. The incomer panel shall be suitable for receiving bus trunking or MV cable of size specified.

Switchboards shall be made up of requisite vertical sections, which when coupled together, shall form continuous dead front switchboards.

Switchboard shall be readily extensible on both sides by addition of vertical sections after removal of the end covers.

The switchboards shall be designed for use in high ambient temperature and humid tropical conditions as specified. Ease of inspections, cleaning and repairs while maintaining continuity of operation shall be provided in the design.

Neoprene gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 42/IP 54 as stipulated in schedule of quantities. The unused openings within the switchboards shall be closed using suitable grommets.

Degree of Protection shall be IP54 Upto 2500A and IP42 above 2500A

Special care to be taken to ensure effective earthing of the frame and doors of the switchboards

Each vertical section shall be provided with a rear or side cable chamber housing the cable end connections and power/control cable terminations. There should be generous availability of space for ease of installation and maintenance with adequate safety for working in one vertical section without coming into contact with any live parts. The design of the switchboard shall allow standard extension chambers if required to accommodate cables.

Some switchboards may be required to be installed against the wall, for such application-documented designs shall be available.

Switchboard panels and cubicles shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be fabricated from CRCA sheet steel of thickness not less than 2 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal. All busbar support, locks and hinges and panel structure should be provided by the Switchgear Manufactures.

All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned. Switchboard shall be provided with "Danger Notice Plate" conforming to relevant Indian Standards.

Internal arc tests as per IEC 61641, 0.5 sec as per system design fault level at HBB, VBB and cable chamber. Copies of the test certificates shall be submitted along with the tender.

Copies of the test certificates shall be submitted along with the tender.

Switchboard Dimensional Limitations

The overall height of the switchboard shall be limited to 2400 mm for all the Busbar ratings and type of switchboards. Panel should have integral base frame of 75mm, hence total panel height should not be more than 2475mm.

The height of the operating handle, push buttons etc shall be restricted between 300 mm and 2000 mm from finished floor level.

Other dimensional limits if any are specified separately.

Switchboard Compartmentalization

For compartmentalized switchboards, separate totally enclosed compartments shall be provided for horizontal busbars, vertical busbars, ACBs, MCCBs, and cable alloys.

The main board shall be with Form 4b Construction with metallic shrouding only, FRP is not acceptable.

Earthed metal or insulated shutters shall be provided between drawout and fixed portion of the ACB such that no live parts are accessible with equipment drawn out. Degree of protection within compartments shall be atleast IP 2X.

Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "ON" and "OFF" position.

For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.

For Some MCCB feeders for critical loads like UPS it may be required to have operation only after opening the door, all other facilities like pad lockable rotary handle to be provided for such feeder. It shall be possible to do this change during execution of order

Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating and duty. All operating device shall be located in front of switchgear only.

A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.

Separate cable compartments running the height of the switchboard in the case of front access boards shall be provided for incoming and outgoing cables.

Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top. The construction shall include necessary and adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley / cable chamber.

Switchboard Bus Bars

Busbars shall be made of high conductivity, high strength Aluminum Busbars not less than 60% conductivity shall be of rectangular cross sections , not more than 10mm thickness

better suitable for full load current for phase bus bars and half/ full rated current for neutral bus bar as per the tested design of OEM considering temperature rise and Short Circuit test reports or as stipulated in schedule of quantities. Busbar shall be suitable to withstand the stresses of fault level as specified in schedule of quantities. Main Horizontal busbar and Neutral should be in same compartment.

The bus bar system may comprise of a system of main horizontal bus bars and auxiliary vertical bus bars run in bus bar alloy on either side in which the circuit could be arranged with front access for cable entrances

The bus bars shall be supported on non-breakable, non-hygroscopic epoxy resin or glass fiber reinforced polymer insulated supports able to withstand operating temperature as per Type Test Report of at regular intervals, to withstand the forces arising from a fault level as stipulated in schedule of quantities. The material and the spacing of the Busbar supports should be same as per the type tested assembly

Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequately supported and sized to suit specific requirement. The material for auxiliary supply bus will be insulated electrolytic copper. Wires.

Clearances between phases should be in line with IEC.

Switchboard Interconnection

All connection and tap offs shall be through adequately sized connectors appropriate for fault level at location. This shall include tap off to feeders and instrument/control transformers.

For unit ratings up to 250 amps, PVC insulated 105 dg withstand, copper conductor wires of adequate size to carry full load current shall be used. The terminations of such interconnections shall be crimped. Solid connections shall be used for all rating of above 250 amps.

All connections, tapings, clamping, shall be made in an approved manner to ensure minimum contact resistance. All connections shall be firmly bolted and clamp with even tension. Before assembly joint surfaces shall be filed or finished to remove burrs, dents and oxides and silvered to maintain good continuity at all joints. All screws, bolts, washers shall be zinc plated. Only 8.8 grade nuts and bolts shall be used for busbar connections.

Drawout Features

Air Circuit Breakers shall be provided in fully draw out cubicles, unless otherwise stated. These cubicles shall be such that draw out is possible without disconnection of the wires and cables. The power and control circuits shall have self-aligning and self-isolating contacts. Mechanical latches shall be integrated in ACB at service, test and isolated position to ensure that Breaker is firmly latched in respective position. It shall not be possible to move the breaker from the position unless latch is manually operated.

Instrument Accommodation

All voltmeter and ammeter and other instruments shall be flushed mounted type of size 96 sq. mm conforming to class 1 to IS 1248 for accuracy. All voltmeter shall be protected with

MPCBs.

Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switchboard. For MCCBs, instruments and indicating lamps can be provided on the compartment doors. The current transformers for metering and for protection shall be mounted on the solid copper/aluminum busbars with proper supports.

On all the incomers of switch boards ON/OFF indicators lamps shall be provided suitable for operation on AC 230 volts supply. All lamps shall be protected by MCBs. Panel shall be rated for Impulse withstand capability equal to 12KV for ACB and 8kV for MCCB.

For Incomer and important outgoing feeders comprehensive power meters shall be provided which shall display A , V, Pf , Hz ,Kw , KVA, KVAr, Kwh , Kvarh , average and maximum values , demand values , THD on current and Voltages, Individual harmonics up to 31st level.. Also add on modules for RS485 port, programmable contacts, analogue output etc to link to SCADA system.

Wiring

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labeled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 2.5 sq. mm. Runs of wires shall be neatly bunched and suitably supported and clamped. Means shall be provided for easy identification of wires. Identification ferrules shall used at both end of wires. All control wires meant for external connections are to be brought out on a terminal board. The cables and control wires shall be suitable for withstanding 105 deg C.

Space Heaters

Anti- condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 50 C. 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 switchboard is in operation. As a general rule, the heaters shall be placed at the bottom of the cubicle.

Ventilation Fans

The Switchboard shall be provided with panel mounting type ventilation fans in each panel with switchgear rated for 4500 amp and above. The fan shall be interlocked with switchgear operation. The degree pf enclosure protection to be maintained even with Fans.

Earthing

Continuous earth bus sized for prospective fault current to be provided with arrangement for connecting to station earth at two points. Hinged doors / frames to be connected to earth through adequately sized flexible braids.

Sheet Steel Treatment And Painting

Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in

dilute sulphuric acid and a recognised phosphating process after which a coat of primer paint compactively with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50 micron thickness, of sheet approved by Engineer-in-Charge shall then be provided.

Name Plates And Labels

Suitable engraved white on black name plates and identification labels of metal for all Switchboards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

Type test reports.

Switchboard configurations offered shall be CPRI /Independent international test house tested for all the tests as per IEC61439-1 & 2 and internal arc tests. Copies of the test certificates shall be submitted with the tender.

Testing at Works

Copies of type test carried out at ACB/ MCCB manufacturers works and routine tests carried out at the switchboard fabricators shop shall be furnished along with the delivery of the switchboards. Engineer-in-Charge reserves the right to get the switchboard inspected by their representative at fabricators works prior to dispatch to site to witness the followings.

- a) Physical variation and dimensional check
- b) Verification of bill of material
- c) Functional check
- d) HV test
- e) IR test

AIR CIRCUIT BREAKER (ACB) (For Main LT Panels & Emergency Panel)

GENERAL:

ACB shall comply with standards IS/IEC 60947-1 & 2.

ACB shall have a rated operational voltage of 415V AC, rated insulation voltage of 1000 volts AC, rated impulse voltage of 12kV.

ACB shall be of 3pole or 4pole (as per BOQ), air break, molded case design for longer life along with less maintenance requirement

All ACBs shall preferably be of single frame size up to 2500A to optimize requirement for spares management.

ACB shall have a Ready to close mechanism preferably having a ready to close mechanical indication as spring charged on front of ACB. All EDO ACBs ready to close indication contact which shall be used to give a single indication via indicating lamps on panel door if ACB is ready to be closed, after checking all the given conditions (UV release energized, Shunt release de-energized, spring charged, Breaker is not "ON", Breaker has not tripped on fault, Breaker is not mechanically interlocked with other breaker and ACB is not racked in completely in-service position) ensuring safety for user and electrical distribution.

ACB shall comply with the environmental directives like RoHS.

PERFORMANCE:

ACB shall have the breaking performance $I_{cs} = I_{cu} = I_{cw} (1\text{sec}) = 65\text{kA}/50\text{kA}$ as per fault level mentioned in BOQ/SLD. Fault level shall be 50KA for LT panels and 25 KA for 3 seconds for HT Panels.

The operating mechanism of ACB shall be of the Open/Closed/Open stored-energy spring type. The closing time shall be less than or equal to 60ms, and of fast opening type with break time of breaker should be <30ms to ensure higher life of distribution cables.

ACCESSORIES & AUXILIARIES:

Shunt trip and closing coil (having common AC/DC supply upto 250V) shall be suitably continuous rated. For Incomer ACBs delayed type under voltage release shall be used to avoid nuisance tripping during voltage surges.

ACBs shall have minimum 4 change-over auxiliary contacts, available to be used for indication and interlocking, rated at minimum 10A 240/380V 50 Hz and shall be wired on chassis/cradle. There should be facility to add one more set of 4 contacts if required.

ACB shall be provided with two programmable contacts for fault/Alarm indications on panel door via LED lamps. It shall be possible to program the contacts for pre-overload alarm and pre earth alarm. Panel builder shall wire these contacts to LED lamps on panel's front door. Suitable modules shall be considered for the same.

Pre-wired Fault trip contact should be provided with Release as standard.

Indication lamps for ON/OFF/Trip/Ready to Close Spring Charge and pre earth fault to be provided on front door of ACB feeder.

Spring charge indication required for EDO ACB only

SAFETY:

Draw-out ACBs shall preferably be provided with a mechanical latch on chassis which latches the ACB at Connected-Test-Disconnected positions while racking in and racking out the circuit breaker. This feature will help the operator in placing the circuit breaker at right position inside the chassis and can help in avoiding the accident.

Interlocks:

The racking handle shall be stored on the air circuit breaker in such a manner as to be accessible without defeating the door interlocking.

TERMINATIONS:

All air circuit breaker shall be fully tropicalized as standard & suitable for terminating copper or aluminum bus bars. Both fixed & draw-out circuit breakers shall have single pole-pitch.

PROTECTIONS:

Air circuit breaker shall be provided with microprocessor release, which should be self-powered type without the need of any auxiliary power supply during normal operation of the breaker.

Wherever communication is required Breaker release will be supplied with 24V DC auxiliary power supply.

The circuit breaker control unit shall measure the true r.m.s value of the current
Circuit breaker trip unit shall have a display for measurement & protection of current, voltage, power factor and energy. It shall be possible to view last 10 trip cause on trip unit with real date and time stamping along with interrupted value. One 96x96 MFM display unit shall be provided with each circuit breaker which displays all current/voltage and energy data at panel.

All trip units provided shall have thermal memory and password protection feature as standard

All trip units shall be EMC/EMI tested

The protection release shall have following protections as standard: -

- a. Adjustable over load current (I_r) settings from 40% to 100% of rating of ACB (I_n). Over load time setting (t_r) from 0.5s, 1s, 2s, 4s.....24s as field selectable curves.
- b. Short circuit setting (I_{sd}) from 1.5 to 10 times of I_r setting, Short circuit time delay adjustable from 0 to 400msec.
- c. Instantaneous (I_i) protection with an adjustable pick-up and an OFF position.
- d. Earth fault setting adjustable in absolute Ampere with time delay settings from 0 to 400ms.

Separately powered, individual fault trip indication LEDs (For overload, short circuit, earth fault and trip unit failure. shall be available on the trip unit which shall function even if the display fails.

I2t ON / I2t OFF options shall be available for short-circuit & earth fault protections which can be used to ensure discrimination with upstream circuit breaker or fuse

The trip unit shall have integral test facility to verify the healthiness and to avoid external calibration.

All Incomer ACBs of Main LT panel shall have release with following functions :Protection for O/C, S/C, E/F and Metering/protection for Current- I_1 , I_2 , I_3 , I_n , I_{avg} , I_{max} , Voltage- V_{ph} , V_{line} , Power- KW,KVA,KVAR, Power factor, Energy –KWh, KVAh, KVARh, Demand current- Ph & Neutral, Demand power-KWh, Under & over frequency, current unbalance, reverse power, phase seq. reversal, Last 20 faults 10 events with date and time stamping, Last 10 alarms with date and time stamping, Current and Voltage Harmonics till 27th, fault current Oscillograph waveform.

All Outgoing ACBs of Main LT panel shall have release having release with following functions :Protection for O/C, S/C, E/F and Metering for RMS values of highest current, Bargraph for % loading, Ammeter, Current- I_1 , I_2 , I_3 , I_n , I_{avg} , I_{max} , Voltage- V_{ph} , V_{line} , Power- KW,KVA,KVAR, Power factor, Energy –KWh, KVAh, KVARh, Demand current-

Ph & Neutral, Demand power-KWh.

It shall be possible to change the protection settings on line and the circuit breaker need not be switched off while adjusting the settings.

All ACBs in main LT panel shall be provided with zone selective interlocking which helps in reducing the thermal and dynamic stress on installation during short circuit and ground faults. The releases shall be suitable to communicate between incomer breaker and outgoing breakers enabling zone selective interlocking. The manufacturer shall supply all equipment like ZSI module, power supply and wiring connectors to implement ZSI.

It shall be possible to view the percentage/actual loading of three phases at once on trip unit via LEDs or LCD display to help the user in identifying the current load balancing of the network. This will help in preventing the deterioration of loads affected by load balancing by identification of the balancing related issue.

All 4 Pole ACBs shall have fully rated neutral equal to rating of the breaker & shall be protected against over-load faults with provisions for settings neutral unprotected, neutral protection at $0.5I_n$ and neutral protection at $1.0 I_n$ to ensure precise neutral protection.

COMMUNICATION:

The advanced communication system needed for the project shall be able to show the basic data inside the trip unit of the ACB without using any external software. This is required for two purposes

- a) Communication testing of the circuit breakers at panel builder's shop floor and generating the communication check report
- b) Basic parameters (A, V, kWh, no. of operations etc.) viewing on Ethernet/RS 485 network from anywhere in LAN network and from any laptop, computer or smart phone
- c) Easy replacement of the Ethernet modules without the involvement of system integrators, in case the modules become faulty.

Specifications for communication

All ACBs shall be provided with individual Modbus TCP Ethernet ports modules/RS 485 for better speed of data transfer.

One display module/HMI or Breaker release for each circuit breaker, shall be able to provide following information's. It shall contain the following information about circuit breakers

- a. Metering data.
- b. Circuit breaker load profile i.e. circuit breaker has seen how much current for how many hours (e.g. Upto 70% for how many hours, Upto 90% for how many hours etc.)
- c. Circuit breaker number of ON/OFF operations and number of trip operations counter

d. It shall be possible to control the circuit breaker from the module

Panel builder shall provide circuit break communication test report having the following data

Circuit breaker communication check (Ok/Not Ok)

Circuit breaker settings at the time of communication test. Settings on the circuit breaker, at the time of communication test, shall be same as recommended by the consultant. Modbus and Modbus TCP ports

Analog and Digital inputs

It shall be able to take the data from all Modbus or Modbus TCP meters, ACB Ethernet/RS485 modules, MCCB Ethernet/RS485 modules etc. and share to SCADA or EMS Software

Each release shall be accessible via browser to view the following

- i. Current, voltage and energy data measurement
- ii. Circuit breaker number of operation measurement
- iii. Circuit breaker control (ON/OFF)
- iv. Email notifications for undesired events like circuit breaker tripping on electrical fault, circuit breaker tripping on overload/short circuit/earth fault/trip unit failure etc.
- v. It shall be possible to send the energy consumption daily reports by Email or FTP directly from inbuilt web-pages of SCADA/EMS
- vi. Circuit breaker ready to close and spring charge status
- vii. Circuit breaker settings
- viii. Circuit breaker last 20 trip and 128 minimum event history

Architecture

Each ACB release should give its data over Ethernet/RS485 and the same shall be connected to a common Ethernet network.

MOLDED CASE CIRCUIT BREAKER (MCCB) (For Main LT Panels & Emergency Panel)

GENERAL:

MCCBs shall comply with standards IS/IEC 60947-1 & 2. The breaking capacity performance certificates shall be available for category A to the above mentioned standards.

MCCB shall have a rated operational voltage (Ue) of 415V, insulation voltage (Ui) of 800 V (AC 50/60 Hz) & impulse voltage (Uimp) of not less than 8kV.

MCCBs shall be current limiting type preferably having an encapsulated double/single break design (Breaking Mechanism as per OEM) having two fixed contacts, one moving contacts and two arc chutes per pole. The design is required to minimize the effects of short circuit currents i.e. limit the let through energy and improve the life of cables.

MCCB shall not have any line load bias

MCCB shall comply with the environmental directives like RoHS.

MCCBs in main panel shall have zone selective interlocking feature. Mechanical life shall be 10000 operations

PERFORMANCE:


The MCCBs shall have a rated service breaking capacity (Ics) equal to the ultimate breaking capacity (Icu) at 415V and as per system fault levels (refer SLD).

The limiting capacity of a circuit breaker is expressed by two curves which are a function of the prospective short-circuit current (the current which would flow if no protection devices were installed): The thermal stress (A2s), i.e. the energy dissipated by MCCB during fault should be as low as possible. Cable selection to be done as per

Maximum permissible cable stresses for which manufacture should produce current limiting and energy limiting curves of MCCB's.

SAFETY:

For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries (ON/OFF/Trip Contact, Shunt, Under Voltage etc.). All poles shall operate simultaneously for circuit breaker opening, closing and tripping.

MCCBs shall be actuated by a toggle or rotary-handle that clearly indicates the three distinctive positions: ON, OFF and TRIPPED. MCCB shall clearly indicate the suitability for isolation in the name plate identified by the symbol . MCCBs shall be equipped with a "push to trip" button in front to test operation and simultaneous opening of all poles together.

MCCBs shall be designed to prevent access to live parts when the cover is removed, means main current path of the circuit breaker should be isolated from auxiliary section i.e. MCCB shall offer class -II /double insulated front face as per IEC standards 61140 and 60664-1

The electrical life of MCCBs shall be 8,000 operations up to 250A & 4000 operations up to 630A.

All MCCBs provided shall be of single frame size upto 250A to reduce the requirement of spares management.

All MCCBs termination should be done using circular lugs being bolted to MCCB, to enhance safety and reliability of the terminations. In case spreaders/rear connectors are used in between MCCB and bus bar/lugs then the spreaders shall be terminated with the MCCB connectors.

AUXILIARIES AND ACCESSORIES:

Following separate Field installable auxiliary contacts for signaling ON/OFF indication shall be provided with all MCCBs

Rotary handle shall ensure IP40 for direct type and IP 54/55 for extended Rotary handle.

MCCB shall have provision for Rear connection - MCCB mounting on a back plate with suitable holes enables rear connection. The rear connections are simply fitted to the device connection terminals.

PROTECTIONS REQUIREMENTS:

All MCCBs upto 250A shall be thermal magnetic type with adjustable overload settings from 0.67 to 1 times I_n and fixed/adjustable magnetic settings.

All MCCBs above 250A upto 630A shall be self powered microprocessor based type to have wide range of settings and advanced information over and above thermal magnetic trip units

- a. LED indication on trip unit shall be there for trip unit ON indication
- b. Test port on trip unit shall be there for testing the trip unit
- c. Overload alarm indication LED shall be there on trip unit
- d. Overload settings adjustment from 25% to 100% shall be possible. It shall also be possible to do the fine adjustment of overload settings in at least 5 steps. e.g. if overload settings selected from dial is at 250A. It shall be possible to set it at 92% or 93% or 94% or 95% or 96% etc. of 250A for accurate settings.
- e. It shall be possible to set the overload time delay from 0.5 to 10 secs at $6xI_r$
- f. Short circuit settings shall be adjustable from 1.5 to 10 times I_r . Fine adjustment of settings shall also be possible. Short circuit time delay shall be adjustable from 0.1 to 0.4 secs. It shall be possible to switch the I_2t protection ON or OFF to achieve discrimination between upstream fuse or circuit breaker
- g. Instantaneous settings shall be adjustable from $6 I_n$ to $10 I_n$
- h. Earth fault protection shall be adjustable from 20% to 70% or OFF. It shall be possible to switch the I_2t protection ON or OFF to achieve discrimination between upstream fuse or circuit breaker

In case of 4 pole microprocessor based MCCBs neutral shall be protected & adjustable as a Neutral unprotected / Neutral protected at $0.5 I_n$ / Neutral protected at I_n .

All MCCBs in main LT panel's shall have inbuilt earth fault protection shall also be provided.

All MCCBs with earth fault shall display the type of fault (overload, short circuit, earth fault, instantaneous tripping), the phase concerned and interrupted current value, on occurrence of fault. All MCCBs shall be provided with external power supply recommended by manufacturer, so that the display of the reason of fault shall also not switch OFF after the tripping of MCCB

All MCCBs with earth fault protection shall store last 10 trip histories with date and time stampings. The history shall be viewable on display modules or communication or shall be downloadable using MCCB test port.

METERING:

MCCBs with digital panel meters and CTs are acceptable, should be capable of measuring the following data

- a. ON, OFF and Trip status, total number of operations, load profile
- b. current, voltage, energy, power, power factor and THD for current and voltage
- c. Last 10 trip histories with date and time stamping.

COMMUNICATION:

The advanced communication system needed for the project shall be able to show the basic data inside the trip unit of the MCCB without using any external software. This is required for two purposes

- d) Communication testing of the circuit breakers at panel builder's shop floor and generating the communication check report
- e) Basic parameters (A, V, kWh, no. of operations etc.) viewing on Ethernet /RS485 network from anywhere in LAN network and from any laptop, computer or smart phone
- f) Easy replacement of the Ethernet/RS485 modules without the involvement of system integrators, in case the modules become faulty.

Specifications for communication

All MCCBs shall be provided with individual Modbus TCP/Ethernet ports/modules for better speed of data transfer

- e. Metering data.
- f. Circuit breaker load profile i.e. circuit breaker has seen how much current for how many hours (e.g. Upto 70% for how many hours, Upto 90% for how many hours etc.)
- g. Circuit breaker number of ON/OFF operations and number of trip operations counter
- h. It shall be possible to control the circuit breaker from the module

Item No:- (326 A-326 O) & 467**LT PANELS – Non TTA**

(Applicable for panels other than Main TTA LT Panel and Emergency Panels)

GENERAL

Medium Voltage power control centers (generally termed as switchboard panels) shall be in sheet steel clad cubicle pattern, free floor standing type, totally enclosed, compartmentalized design having multi-tier arrangement of the incomers and feeders as per details given in the schedule of quantities. The panels shall be of extensible type with provision of bus bar

extensions. All panels shall conform to the requirements of the latest addition of IS and shall be suitable for 415 V, 3 phase AC supply or 230 V single phase AC supply as required.

CONSTRUCTION

All switch board panels or power control centers of free standing type shall have a bus bar chamber at the top and the cable compartment at the bottom or as approved by the Developer/Consultants depending upon the specific requirements of the job. The space between the bus chamber and cable compartment shall be suitably compartmentalized to accommodate either air circuit breakers or molded case circuit breaker of various ratings. The cable terminations shall be carried out on the rear side of the panels for which adequate space and clamping arrangements shall be provided. Where panels have to be installed with very little access space at the rear, the cable terminations shall be carried out in suitable cable alleys provided on the front of the panel. All the live parts shall be properly shrouded with Bakelite barriers. All the equipment shall be accessible from the front. However, protection relays, KWH meters, etc. may be mounted on the rear side/front side. Arrangements and marking of bus bars, main connections and wiring shall be in accordance with latest IS code. The structure of the panel shall be robust and provided with adequate bracing's to withstand the operation of the equipment and stresses due to system short circuit. The panels shall be fabricated out of best quality heavy gauge sheet steel. The panel shall be machine pressed with punched openings for meters, indicating lamps etc. The external covers provided should have been subjected to minimum mechanical impact of IK09/10 as per IEC to ensure specified degree of protection.

The enclosure system shall be Modular in nature with bolted on construction. Enclosure parts/kits shall be interchangeable to reduce downtime during modification or maintenance work. Enclosure system and switchgear components shall be from same manufacturer.

DIMENSIONS

All power control centers shall have dimensions of not more than that given on the layout drawings. Panels arranged side by side shall have the same height and depth. The height of the panel should be limited to 2400 mm. All the operating levers, handles etc. of the highest unit shall not be at a height more than 1700 mm from F.F.L. For all incoming cables a removable gland plate will be provided in the panel and a minimum distance of 300 mm will be provided between the gland plate and the nearest terminal for proper dressing and termination of the cable. All the components of a module will be mounted on a component plate using the machine screws and taped holes (excepting the components mounted on the door). These component plates should be fixed with bolts for easy replacement. Standardization will be adopted while making these plates so that the component plates of the same size modules can be changed from one module to another. In case of panel of lengths more than 4 meters the fabrication of any single section will be limited to a maximum length of 4 meters for the purpose of shipping and shifting at the site. These sections will be assembled at the location of installation with the help of nuts and bolts. While making these sections consideration will be given to the place of sectionalizing and select the location where the minimum electrical connections are transferred from one section to another. All the hardware used in the assembly will be electroplated for protection and neat appearance.

BUS BARS

The bus bars shall be suitable for 4 wire, 415 Volts, 50 Hz, system. The main bus bar shall be made of high conductivity electricity conductor grade electrolytic AL 91E Aluminum and shall be liberally sized. In case of copper bus bar it shall be electrically conductor grade electrolytic copper and at the time of joining of two copper buses tinning will be done on the copper strips ends to a length equal to the lap length of the joint plus one each. The bus bars shall have uniform cross section throughout. The bus bars shall be capable of carrying the rated current at 415 Volts continuously. The bus bar will run in a separate bus bar chamber using bus insulators made of non-deteriorating, vermin proof, non hygroscopic materials such as epoxy fiber, reinforced polyester or molding compound. The interval between the two insulators will be designed after considering:

- a. Strength and safe load rating of the insulator,
- b. The vibrating force generated during a fault,
- c. A Factor of safety of 1.8
- d. A set of insulators at both ends of the bus.

The size of the bus bar calculations must be approved by the consultants. The bus bars shall be designed to withstand a temperature rise of 45o above the ambient. To limit the temperature rise in the bus bar chamber a set of louvers can be provided at strategically places considering the air circulation. The louvers provided will have a brass wire mesh covering from inside with more than 100 openings per sq. inch. The overall temperature of bus bar shall not exceed 85°C in any case. A current density of 1.0 Amps/Sq. mm shall not be exceeded for Aluminum bus bars.

All the bus bars shall be insulated with PVC heat shrinking sleeves suitably throughout (except at joints) the length. The electro galvanized high tensile steel nuts, bolts, plain or spring washers of suitable size will be used in connecting the various section of the bus bar. A minimum of 1.6 times the width of bus bar will be the lapping length of each joint.

EARTHING

The panels shall be provided with an aluminum or copper earth bus of suitable size running throughout the length of the switchboard. Suitable earthing eyes/bolts shall be provided on the main earthing bus to connect the same to the earth grid at the site. Sufficient number of star washers shall be provided at the joints to achieve earth continuity between the panels and the sheet metal parts.

INTERLOCKING

The panels shall be provided with the following interlocking arrangement.

- a. The door of the switch-fuse compartments is so interlocked with the switch drive or handle that the door can be opened only if the switch is in 'OFF' position. De-interlocking arrangement shall also be provided for occasional inspection.
- b. It shall not be possible for the breaker to be withdrawn when in 'ON' position.
- c. It shall not be possible for the breakers to be switched on unless it is either in fully inserted positions or for testing purposes in fully isolated position.
- d. The breaker shall be capable of being raked in to 'testing' 'isolated' and 'maintenance' positions and kept locked in any of these position.

- e. A safety latch to ensure that the movement of the breaker as it is withdrawn, is checked before it is completely out of the cubicle shall be provided.

PROTECTION & INSTRUMENTATION

Protection and instrumentation shall be as per standard specifications.

All ACBs, MCCBs of Main LT Panel and Incomer MCCBs shall have inbuilt Earth Fault Protection.

CONTROL WIRING

The control wiring of all the panels will be done with PVC single core flexible copper wires of cross section 1.5 sq. mm and 2.5 sq. mm. All the wiring involving current transformers or circuits with currents of more than 5 Amps will be wired with 2.5 sq. mm cross section wire and the others with 1.5 sq. mm. Similarly all the interconnecting between the incoming bus and the outgoing of 100 Amps and above rating shall be done by insulated copper strips of suitable sizes and equipment below 100 Amps rating shall be wired with insulated copper conductors. All of the control wiring will be done by properly dressing all the wires in a laminar manner either in a PVC duct of liberal size or bunched together by PVC strapping tapes at a distance not exceeding 150 mm. Each wire will terminate with a copper ferule crimped to the wire. The PVC ferules will be used to identify each wire of the circuit and the same number will be marked on the drawing for the corresponding wire. Only one outgoing wire will be connected to one connector. When the control wiring is crossing from fixed parts to moving parts such as door etc. the wire will be run in PVC sleeve of suitable size and the same will be mechanically clamped at both the ends i.e. one end of the fixed part and the other on the moving part. Under no circumstances the wiring should be under any kind of stress for which sufficient length of control wiring in the PVC sleeve should be provided. All the potential circuits shall be protected by fuses mounted near the tap off point from the main connections.

SURFACE TREATMENT

The each part of the fabricated panel will be subjected to seven tank treatment and all sheet metal accessories and components of power control centers and switchboard panels shall be thoroughly cleaned, degreased, de-rusted and hot dip phosphatized before red oxide primer is applied. The panel shall be stove enameled gray shade finish and the Interior surfaces of the panel shall be painted to an off-white shade.

ENCLOSURE

The panel enclosure shall be totally dust and vermin proof and shall be suitable for indoor installation. All the cubical will be adopted with front located, outward openings, lockable doors having hidden hinges and a bolted back cover both using no deteriorating neoprene rubber gasket. Enclosure design shall be in accordance with degree of protection IP 54 as per latest IS code. All the nut bolts handles, meters, knobs etc. appearing from outside of the panel should be in symmetry so as to give a neat appearance.

NAME PLATE

The panel as well as the feeder compartment doors shall be provided with name plate giving the switchboard/feeder descriptions as indicated on the drawings. The above shall be mounted in metal holder with a clear plastic sheet on inside surface of the front door.

TESTING

The power control centers shall be tested at factory after assembling of all components and completion of all interconnections and wiring. Tests shall be conducted in accordance with the requirements of BS:3659.

Insulation Test

- a. Insulation of the main circuit, i.e. the insulation resistance of each pole to the earth and that between the poles shall be measured.
- b. Insulation resistance to earth of all secondary wiring should be tested with 1100 Volt magger. Insulation test shall be carried out both before and after high Voltage test. High Voltage Test A High Voltage test with 2.5 KV for one minute shall be applied between the poles and earth. Test shall be carried out on each pole in turn with the remaining poles earthed, all units raked in position and the breakers closed. Original test certificate shall be submitted along with panel.

STORING, ERECTION AND COMMISSIONING

The panels shall be stored in a well ventilated, dry place, with a suitable polythene covers shall be provided for necessary protection against moisture.

Erection

Switch boards shall be installed on suitable foundation. Foundation shall be as per the dimensions supplied by the panel manufacturer. The foundation shall be flat and leveled. Suitable grouting holes shall be provided in the foundation. Suitable MS base channel shall be embedded in foundation on which the panel can be directly installed. The switch boards shall be properly aligned and bolted to the foundation by at least four bolts. Cables shall be terminated on the bottom plate or top plate as the case may be, by using high quality brass compression glands. The individual cables shall then be led through the panel to the required feeder compartments for necessary terminations. The cables shall be clamped to the supporting arrangement. The switchboard earth bus shall be connected to the local earth grid.

Pre-commission Tests

Panels shall be commissioned only after the successful completion of the following tests.

The tests shall be carried in the presence of Developer/Consultant or their representatives.

All main and auxiliary bus bar connections shall be checked and tightened.

All wiring termination and bus bar joints shall be checked and tightened.

Wiring shall be checked to ensure that it is according to the drawing.

All wiring shall be tested for insulation resistance by a 1000 Volts magger.

Phase rotation tests shall be conducted

Suitable injection tests shall be applied to all the measuring instruments to establish the correctness and accuracy of calibration and working order.

All relays and protective devices shall be tested for correctness of settings and operation by introducing a current generator and an Ammeter in the circuit.

METERING, INSTRUMENTATION AND PROTECTION

Ratings, type and quantity of meters, instruments and protective devices shall be as per Bill of Quantities.

Current Transformers

CTs shall conform to latest IS codes in all respects. All CTs used for medium Voltage application shall be rated for 1 kV. CTs shall have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be 0.5 to 1 and for protection class 10. CTs shall be capable of withstanding magnetic and thermal stresses due to short circuit faults. Terminals of CTs shall be paired permanently for easy identification of poles. CTs shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each CT shall be provided with rating plate indicating:

- Name and make
- Serial number
- Transformation ratio
- Rated burden
- Rated Voltage
- Accuracy class

CTs shall be mounted such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

Potential Transformer

PTs shall conform to latest amendment up to to date IS Codes.

Measuring Instruments

Direct reading electrical instruments shall conform to latest IS codes in all respects. Accuracy of direct reading shall be 1.0 of Voltmeter and 1.5 for Ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between -100C and +5000C. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from outside. Direction of deflection shall be from left to right. Selector switches shall be provided for Ammeters and Volt meters used in three phase system.

AIR CIRCUIT BREAKER (ACB) (For Panels other than Main LT Panels & Emergency Panel)

GENERAL:

ACB shall comply with standards IS/IEC 60947-1 & 2.

ACB shall have a rated operational voltage of 415V AC, rated insulation voltage of 1000 volts AC, rated impulse voltage of 12kV.

ACB shall be of 3pole or 4pole (as per Design/Requirement), air break, molded case design for longer life along with less maintenance requirement.

All ACBs shall preferably be of single frame size up to 2500A to optimize requirement for spares management.

ACB shall have a Ready to close mechanism preferably having a ready to close mechanical indication on front of ACB.

All EDO ACBs ready to close indication contact which shall be used to give a single indication via indicating lamps on panel door if ACB is ready to be closed, after checking all the given conditions (UV release energized, Shunt release de-energized, spring charged, Breaker is not "ON", Breaker has not tripped on fault, Breaker is not mechanically interlocked with other breaker and ACB is not racked in completely in service position) ensuring safety for user and electrical distribution.

ACB shall comply with the environmental directives like RoHS .

ACB Should give ON, OFF, Trip, Ready to close data over Modbus to BMS/SCADA.

PERFORMANCE:

ACB shall have the breaking performance $I_{cs} = I_{cu} = I_{cw}$ (1sec) = 50kA or as per Design calculation/SLD.

ACB shall have minimum Mechanical and electrical life as per OEM Design.

The operating mechanism of ACB shall be of the Open/Closed/Open stored-energy spring type. The closing time shall be less than or equal to 60ms, and of fast opening type with break time of breaker should be <30ms to ensure higher life of distribution cables.

ACCESSORIES & AUXILIARIES:

Shunt trip and closing coil (having common AC/DC supply upto 250V) shall be continuous rated. For Incomer ACBs delayed type under voltage release shall be used to avoid nuisance tripping during voltage surges.

ACBs shall have minimum 4 change-over auxiliary contacts, available to be used for indication and interlocking, rated at minimum 10A 240/380V 50 Hz and shall be wired on chassis/cradle. There should be facility to add one more set of 4 contacts if required Pre wired Fault trip contact should be provided with Release as standard.

Indication lamps to be provided on front door of ACB feeder shall be as shown below:

- Spring charge indication required for EDO ACB only

SAFETY:

Draw-out ACBs shall preferably be provided with a mechanical latch on chassis which latches the ACB at Connected-Test-Disconnected positions while racking in and

racking out the circuit breaker. This feature will help the operator in placing the circuit breaker at right position inside the chassis and can help in avoiding the accident.

The racking handle of the breaker shall be stored on the air circuit breaker in such a manner as to be accessible without defeating the door interlocking.

TERMINATIONS:

All air circuit breakers shall be fully tropicalized as standard & suitable for terminating copper or aluminium bus bars. Both fixed & draw-out circuit breakers shall have single pole-pitch.

PROTECTIONS:

Air circuit breaker shall be provided with microprocessor release, which should be self-powered type without the need of any auxiliary power supply during normal operation of the breaker.

The circuit breaker control unit shall measure the true r.m.s value of the current

Circuit breaker trip unit shall have a Graphical 4 Line LCD/OLED display for measurement of current and voltage. It shall be possible to view last 20 trip histories with real date, time stamping and interrupted fault value.

All trip units provided shall have thermal memory as standard

All trip units shall be EMC/EMI tested

The protection release shall have following protections as standard: -

- a. Adjustable over load current (I_r) settings from 40% to 100% of rating of ACB (I_n). Over load time setting (t_r) from 0.5s, 1s, 2s, 4s.....24s as field selectable curves.
- b. Short circuit setting (I_{sd}) from 1.5 to 10 times of I_r setting, Short circuit time delay adjustable from 0 to 400 msec.
- c. Instantaneous (I_i) protection with an adjustable pick-up and an OFF position.
- d. Earth fault setting adjustable in absolute Ampere with time delay settings from 0 to 400ms. Separately powered, individual fault trip indication LEDs (For overload, short circuit, earth fault and trip unit failure) shall be available on the trip unit which shall function even if the display fails. I2t ON / I2t OFF options shall be available for short-circuit & earth fault protections which can be used to ensure discrimination with upstream circuit breaker or fuse.

The trip unit shall have integral test facility to verify the healthiness and to avoid external calibration.

It shall be possible to change the protection settings on line and the circuit breaker need not be switched off while adjusting the settings.

All ACBs in shall surely be provided with zone selective interlocking which helps in reducing the thermal and dynamic stress on installation during short circuit and ground faults. The releases shall be suitable to communicate between incomer breaker and outgoing breakers

enabling zone selective interlocking. The manufacturer shall supply all equipment like ZSI module, power supply and wiring connectors to implement ZSI.

It shall be possible to view the percentage/actual loading of three phases at once on trip unit via LEDs or LCD display to help the user in identifying the current load balancing of the network. This will help in preventing the deterioration of loads affected by load balancing by identification of the balancing related issue.

All 4 Pole ACBs shall have fully rated neutral equal to rating of the breaker & shall be protected against over-load faults with provisions for settings neutral unprotected, neutral protection at 0.5In and neutral protection at 1.0 In to ensure precise neutral protection.

MOLDED CASE CIRCUIT BREAKER (MCCB) (For Panels other than Main LT Panels & Emergency Panel)

GENERAL:

MCCBs shall comply with standards IS/IEC 60947-1 & 2. The breaking capacity performance certificates shall be available for category A to the above-mentioned standards.

MCCB shall have a rated operational voltage (U_e) of 415V, insulation voltage (U_i) of 800 V (AC 50/60 Hz) & impulse voltage (U_{imp}) of not less than 8kV.

MCCBs shall be current limiting type. The design is required to minimize the effects of short circuit currents i.e. limit the let through energy and improve the life of cables.

MCCB shall not have any line load bias


MCCB shall comply with the environmental directives like RoHS.

PERFORMANCE:

The MCCBs shall have a rated service breaking capacity (I_{cs}) equal to the ultimate breaking capacity (I_{cu}) at 415V and as per system fault levels (refer SLD).

The limiting capacity of a circuit breaker is expressed by two curves which are a function of the prospective short-circuit current (the current which would flow if no protection devices were installed): The thermal stress (A^2s), i.e. the energy dissipated by MCCB during fault should be as low as possible. Cable selection to be done as per Maximum permissible cable stresses for which manufacture should produce current limiting and energy limiting curves of MCCB's.

SAFETY:

For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries (ON/OFF/Trip Contact, Shunt, Under Voltage etc.). All poles shall operate simultaneously for circuit breaker opening, closing and tripping. MCCBs shall be actuated by a toggle or rotary-handle that clearly indicates the three distinctive positions: ON, OFF and TRIPPED. MCCB shall clearly indicate the suitability for isolation in the name plate identified by the symbol .

MCCBs shall be equipped with a “push to trip” button in front to test operation and simultaneous opening of all poles together.

MCCBs shall be designed to prevent access to live parts when the cover is removed , means main current path of the circuit breaker should be isolated from auxiliary section i.e. MCCB shall offer class -II/ double insulated front face as per IEC standards 61140 and 60664-1

The electrical life of MCCBs shall be 8,000 operations up to 250A & 4000 operations up to 630A.

All MCCBs termination shall be done using circular lugs being bolted to enhance safety and reliability of the terminations. In case spreaders/rear connectors are used in between MCCB and bus bar/lugs then the spreaders shall be terminated with the MCCB connectors.

AUXILIARIES AND ACCESSORIES:

Following separate Field installable auxiliary contacts for signaling different functions shall be provided with all MCCBs

- a. open/closed position contact
- b. trip signaling contact
- c. Electrical fault trip signaling contact

Rotary handle shall ensure IP40 for direct type and IP 54/55 for extended Rotary handle.

MCCB shall have provision for Rear connection - MCCB mounting on a back plate with suitable holes enables rear connection. The rear connections are simply fitted to the device connection terminals.

PROTECTIONS REQUIREMENTS:

MCCBs shall have thermal magnetic trip units upto 250A and microprocessor trip units above 250A.

Thermal magnetic trip units shall have variable overload settings from 0.8 to 1 Ir and fixed/adjustable short circuit settings

Microprocessor trip units shall have variable overload settings from 0.5 to 1 Ir and variable short circuit settings from 2 to 10Ir

In case of 4 pole microprocessor based MCCBs neutral shall be protected & adjustable as a Neutral unprotected / Neutral protected at 0.5 In/ Neutral protected at In.

MCCB's should be provided with auxiliary contacts for signaling different functions, as: open/ closed position, fault signal and shunt trip coil for remote/emergency tripping of MCCB.

Where ever it is required based on electrical distribution network need, MCCB shall have inbuilt Earth Fault Protection. MCCB Earth Fault Protection should have following settings and features:

- a. Selection of Ir MCCB rating
- b. Earth fault sensitivity selection from 20% – 60% In.
- c. The time delay selection in case of Earth Fault from 0.5 to 3 Sec/ instantaneous.

- d. There shall be a separate fault differentiation indication (LED) for Over current and Earth fault. Indication for over current and earth fault tripping shall be extended to the panel door via indication lamps
- e. Separate LED shall be there to show healthiness of earth fault protection system
- f. EF protection module shall be suitable for 3P 4W system. It shall take the input from neutral for correct earth fault protection.
- g. Earth fault module shall have auxiliary contacts for earth fault signaling.

MEASURING INSTRUMENTS, METERING & PROTECTION

☐ GENERAL

Direct reading electrical instruments shall be in conformity with IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between -10 degree Centigrade to + 50 degree Centigrade. All meters shall be of flush mounting type of 96mm square or circular pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instrument glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three-phase supply.

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The

ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

16.5.1 DIGITAL AMMETERS

Ammeters shall be standard digital type. The ammeters shall be calibrated as per the latest edition of IS:1248. Ammeters shall be instrument transformer operated, and shall be suitable for 5A secondary of instrument transformer. The scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

16.5.2 DIGITAL VOLTMETERS

Voltmeters shall be standard digital type. The ammeters shall be calibrated as per the latest edition of IS:1248. The range for 415 volts, 3 phase voltmeters shall be 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the system. The voltmeter shall be provided with protection fuse of suitable capacity.

16.5.3 CURRENT TRANSFORMERS

Current transformers shall be in conformity with IS: 4201 - 1983 as amended up to date in all respects. All current transformers used for medium voltage applications shall be rated for 1kV. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated acceptable minimum class of various applications shall be as given below:

Measuring : Class 0.5 to 1
Protection : Class 5P10.

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

All Current Transformer shall be Cast resin type

16.6 MISCELLANEOUS

- ☐ Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.
- ☐ Indicating lamps shall be of the filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamp covers, bulbs & lenses shall be easily replaced from the front.
- ☐ Push buttons shall be of the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.

ENERGY METERS.

HT Panels

Power Quality Analyser - High end power quality analyser with Class 0.2 active energy Accuracy with Sag/Swell - Waveform capture and Individual harmonics monitoring upto 63rd. Power Quality analyser needs to be capable of Disturbance direction detection with onboard dual Ethernet Port communication OR Meters of approved makes/manufacturers with ethernet port shall be acceptable.	
Basic Parameters	* Current, voltage, frequency * Active, reactive, apparent power Total and per phase * Power factor Total and per phase * Current measurement range (auto ranging) 0.05 - 10A
Energy Parameters	* Active, reactive, apparent energy * Settable accumulation modes
Demand Parameters	* Current Present and max. values * Active, reactive, apparent power - Present and max. values

	<ul style="list-style-type: none"> * Predicted active, reactive, apparent power * Synchronization of the measurement window * Setting of calculation mode - Block / sliding
Power Quality Parameters	<ul style="list-style-type: none"> * Total Harmonic Distortion Current and voltage * Individual harmonics - Upto 63rd * Waveform capture * Detection of voltage swells and sags * Disturbance Direction detection
Sampling Rate / Cycle	Minimum 256 Samples / Cycle
Data Recording	512MB of standard non-volatile memory. 10 MB of standard non-volatile memory dedicated to capture billing data, events, and waveforms. Logs of Min/max of instantaneous values, Event logs, Trending/ forecasting, SER (Sequence of event recording).
Class Accuracy	Active Energy - Class 0.2S IEC 62053-22 , Reactive Energy Class - 0.5S IEC 62053-24, Power Factor - Class 0.5 as per IEC 61557-12
PQ Standards	PQ compliance reporting as per IEC 61000-4-30 Class S, - IEC 62586 PQI-S
Communication	Onboard Dual Ethernet port for daisy chaining over Ethernet. Meters need to have Modbus Mastering capability by connecting Slave devices over RS485 port
Time Synchronization	GPS clock (RS485) or IRIG-B (digital input) to +/- 1 millisecond.
Digital IO	Standard: 3 digital status inputs for Breaker ON/OFF/ Trip monitoring & 1 KY (form A) energy pulse output for interfacing with other systems. Expandable DI/DO, ADI/ADO capability
Display	Bright LCD color display with meter dimension 96 X 96 mm only

FOR LT PANEL other than Main LT Panels

Multifunction Meter - Multifunction meters with Power and harmonics monitoring capturing abnormalities in the system with date and time stamp	
Basic Parameters	<ul style="list-style-type: none"> * Current - Average line current of 3-phase, per-phase, and calculated neutral current * Voltage Average voltage of L-L, L-N parameters, and per-phase * Frequency * Displacement power factor Average and per-phase signed * True power factor Average and per-phase signed * % unbalance among the phase for I, V L-N, V L-L
Energy & Power	* Real, reactive, and apparent power Total and per-phase value

Parameters	* Accumulated Active, Reactive and Apparent Energy, Received and Delivered registers , Net and absolute energy values, time counters
Demand Parameters	* Current average, Active power, Reactive power, Apparent power - Present, Last, Predicted, Peak, and Peak Date Time * Demand sync methods Thermal, Timed, Command Sync, and Clocked Sync * Demand calculation mode Sliding, fixed and rolling block * Demand intervals - settable from 1 to 60 minutes
Power Quality Parameters	THD as per IEC 61557-12 for THD and individual harmonics up to 15th over communication
Sampling Rate / Cycle	Minimum 64 Samples / Cycle
Class Accuracy	Active energy - Class 0.5S as per IEC 62053-22
Communication	RS 485 port Modbus RTU and disabling RS485 port against unauthorized access.
Calibration LED	configurable from 1 to 9999000 pulses/k_h (kWh, kVAh, or kVARh)
Min/Max values	instantaneous parameters with timestamp
Display	Bright red color LED display with meter dimension 96 X 96 mm only

Item No:- 343-346 & 421- 424 & 461-464

16.7 LT CABLES

☐ GENERAL

LT Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications as per given below. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums.

Total number of runs and size of LT power cables shall be designed so that the distribution losses do not exceed 3% of the total power usage in the system as per ECBC norms.

CODES OF PRACTICE GUIDE		
S.NO.		
1	IS 694 : 1990 IEC 60227 - 1 to 5 : 1979	PVC insulated cables for working voltages up to and including 1100 V

2	IS 694 : 2010	Polyvinyl chloride insulated sheathed and unsheathed cables with rigid and flexible conductor for rated voltages up to and including 450/750 V : Part general requirements(fourth revision)
3	IS: 7098: 1988 (Part-I)	XLPE insulated (heavy duty) electric cables. For working Voltages up to and including 1100 V (third revision)
4	IS 4288 : 1988	PVC insulated (heavy duty) electric cables with solid aluminium conductors for voltages up to and 1100 V (second revision)

☒ **CABLE CONDUCTOR MATERIAL**

- a) The LT Power cables shall be XLPE insulated, PVC sheathed, **copper conductor armoured** cable for sizes **up to & including 16 sqmm**, unless otherwise stated.
- b) For LT Power cable sizes above 16 sqmm, cables shall be XLPE insulated, PVC sheathed, Aluminium conductor armoured cables, unless otherwise stated.
- c) LT Control cables shall be XLPE insulated PVC sheathed type copper conductor armoured cables, unless otherwise stated.
- d) All LT Power & Control cables shall conform to IS: 7098: 1988 (Part-I) with up to date amendments.

☒ **INSTALLATION OF CABLES**

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of Engineer In Charge. Cable laying shall be carried out strictly as per CPWD specifications.

☒ **INSPECTION**

All cables shall be inspected at site and checked for any damage during transit.

☒ **JOINTS IN CABLES**

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

☒ **LAYING CABLES IN GROUND**

Cables shall be laid by skilled experienced workmen, using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 meter. Cables shall be laid at depth of 0.75 meters below ground level for LT Cables and 1.20 meter below ground level for HT cable. A cushion of sand total of 250 mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench

or alongside a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall be preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 meter long loop shall be provided at both ends of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation, tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

☐ **CABLE ROUTE MARKERS:**

Cable route marker shall be provided at regular intervals as per CPWD specifications. Cost of cable route markers is deemed to be included in the cost of cables/cable laying.

☐ **PROTECTION OF CABLES:**

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cable is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic shall be protected by running them through Hume Pipes of suitable size. Hume Pipes for road crossing of the cables shall be laid at a depth of 1000 mm.

☐ **EXCAVATION & BACK FILL**

All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surfaces, road ways, side walks, curbs, wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-in-Charge.

☐ **LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/ CEILING**

Cable shall be laid on perforated M.S. Cable tray/ladders. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/saddles. Care shall be taken to avoid crossing of cable.

☐ **CABLES ON HANGERS OR RACKS**

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required. Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be

designed to keep provision of some spare capacity for future development.

② **CABLES TAGS**

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Tray tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

② **TESTING OF CABLES**

Prior to installation burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

- i. Before laying.
- ii. After laying.
- iii. After jointing.

Along with the test as prescribed in IS Code, cross sectional area shall also be checked. On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer in Charge.

- i. Insulation Resistance Test (Sectional and overall).
- ii. Continuity Resistance Test.
- iii. Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such test

Item No:- 425

16.8 CABLE TRAY

② **Ladder Type Cable Tray**

Ladder type cable tray shall be fabricated out of double bended channel section longitudinal members with single bended channel section rungs of cross members welded to the base of the longitudinal members at a centre to centre spacing of 250 mm. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanized or painted to the desired lengths.

② **Perforated Type Cable Tray**

- i. The cable tray shall be fabricated out of slotted/perforated M.S. Sheet as channel section single or double bended. The channel section shall be supplied in convenient length and assembled at site to the desired lengths. All cable trays shall be hot dipped galvanized only as per relevant IS Codes.
- ii. Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II -External, 2023 as amended up to date. The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section.
- iii. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In

- order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.
- iv. The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II -2023. The sizes shall be specified considering the same.
 - v. The width of the cable tray shall be chosen so as to accommodate all the cable in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 800mm.
 - vi. Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. (Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part II -2023) or as amended up to date. The radius of bend, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.
 - vii. The cable tray shall be suspended from the ceiling slab with the help of 10mm dia MS rounds or 25 mm X 5 mm flats at specified spacing as per CPWD General Specification of Electrical Work Part II -2023 or as amended up to date. Flat type suspenders may be used for channels up to 450mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the PMC/Consultant to take the weight of the cable tray with the cables.
 - viii. The entire tray (except in the case of galvanized type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint. The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends. The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross- joints, etc, and paid for accordingly.

Item No:- 342

16.9 SANDWICH BUS DUCTS/TRUNKING, RISING MAINS

SCOPE:

The specification covers design, manufacturing, supply, installation, testing and commissioning of Sandwich type bus bar trunking for use as feeder bus bars for interconnection between separate electrical equipment / load centers, and for use as plug in bus bar risers and it should be suitable for 1000 Meter MSL.

GENERAL:

Bus bar Trunking shall be sandwich type construction. It shall be 3 Phase with 100% Neutral and PE conductor enclosed in GI / sheet steel (CRCA) housing.

Bus bar Trunking shall be rated for operational voltage of 690V with insulation voltage of 1000V, Rated Impulse Voltage withstand 12 KV and shall be suitable for 50Hz frequency.

Sandwich type bus bar shall be suitable for distribution application from 250A to 4000A copper/Al conductor.

Range shall be suitable for horizontal and riser application and should be complete with feeder/plug in and all accessories like expansion joints, reducers, end terminal covers etc. as recommended by the manufacturers. Standard length of bus bar shall not be less than 3000mm or as per approved OEMs design standards & plug in opening shall be provided at regular intervals with safety Cover. Special length shall be designed to connect the end piece and some special requirements.

The Plug in Busway shall be suitable for vertical and/or horizontal installation.

All indoor application shall use IP55 and for outdoor application IP65 with canopy should be used.

Busduct /Rising Main shall have mounting Brackets welded / Riveted to the housing of Bus duct/Rising Main for Installation of External earth Busbar on both the size, the earthing Contractor shall be Installed in the rising main with proper Hardware and star washer so that paint on bracket is peeled off and proper contact of earthing bus bar is insured with housing of rising mains.

SHORT CIRCUIT AND TYPE TEST:

Bus way system shall comply with following standards:

IEC 61439-1&6

All type test Reports according to above standards shall be of International Lab of repute such as CPRI/ERDA or NBL Approved equivalent.

Type test Reports shall be produced for validation before ordering for Rated Short Circuit breaking capacity for 1sec. Type test Reports confirming Mechanical Operation and Ingress Protection (IP55) of Tap Off Box of similar design in accordance with IEC-61439 are must.

Busway manufacturer shall produce a Temperature rise Type Test Report determining Rating of Busway at Ambient Temp. ref to IEC 61439 Part 1 Clause 10.10.2.3.4. Failure to submit such reports will disqualify the manufacturer. A Type Test report confirming Degree of Protection in accordance with IEC 60529 is must. The type test report ref to IS 1893 /IEEE 693 for seismic test with acceleration of Zone –V from CPRI /NABL approved independent test house is a must.

HOUSING:

The bus bar trunking housing shall be constructed of 1.6 mm thick (sheet steel, CRCA housing), IK-10 on all the sides. It shall be provided with a suitable protective finish of epoxy powder coated.

Housing shall be light in weight for ease of installation and maintenance.

The bus bar trunking housing shall be totally enclosed non-ventilated, for protection against mechanical damage and dust accumulation.

Modifications of bus bar trunking to make it totally enclosed by other than the bus bar trunking manufacturer voids the manufacturer's warranty.

For outdoor/Higher IP protection the housing made by the manufacturer shall be considered based on adequate type test reports ratifying their use in desired conditions/locations alongside a confirmation meeting the requirement of basic IP Protection sought above.

BUS BARS:

Bus bar conductors shall be high conductivity Aluminium Alloy.

Each bus bar shall be individually insulated Class F 155 Deg C)insulation.

Both feeder and plug-in bus bar trunking for all ratings shall be of sandwich construction, with no air gap between bus bars except at plug-in openings.

NEUTRAL BUS BAR:

Internal neutral conductor shall be 100%, which can meet with the requirements of various power systems in the installations.

PLUG IN OPENINGS:

On plug-in bus bar trunking there shall be three dead front, hinged cover type plug-in openings on each side of standard three meter lengths.

All openings shall be usable simultaneously.

It shall be possible to inspect the plug-in opening and bus bars prior to the installation of the plug-in unit.

PLUG-IN UNITS:

Plug-in Units circuit breaker type shall be operated with visible rotary quick make and quick-break mechanism.

All plug in units shall have MCCBs of suitable breaking capacity as per design. It should also be type tested as per IEC 61439-1&6.

PLUG-IN UNIT SAFETY DEVICES:

Plug-in unit enclosures shall make positive earth connection with the earth bus before the jaws make contact with the phase bars.

The Earthing method shall be such that it cuts through painted surfaces to make the positive earth connection.

Plug in box unit shall have an protection of IP 55 along with the housing so that there is no access to live bus bars once connected.

The plug is provided with internal interlocking mechanism to prevent the plug door being opened whilst energized, ensuring operational safety.

JOINT:

The bus bar trunking joint shall be of the on-bolt type which utilizes a high strength steel bolt(s) and washers to maintain proper pressure over a large contact surface area.

The bolt / nut shall be two-headed design to indicate when proper torque has been applied and require only a standard long handle wrench to be properly activated.

Access shall be required to only one side of the bus bar trunking for tightening joint bolts.

On bus bar trunking, it shall be possible to remove any joint connection assembly to allow electrical isolation or physical removal of a bus bar trunking length without disturbing adjacent bus bar trunking lengths.

SUPPORT OF BUS BAR TRUNKING:

Hanger spacing shall be noted on layout drawings and shall not exceed manufacturer's recommendations.

Indoor Feeder and plug-in bus bar trunking spacing of up to two meters' for horizontally mounted runs and four meters' for vertically mounted runs. Outdoor feeder bus bar trunking spacing of up to 1.2 meters' for horizontally or vertically mounted runs.

VOLTAGE DROP:

The voltage drop (input voltage minus output voltage) specified shall be based on the bus bar trunking operating at full rated current and at stabilized operating temperature.

Item No:- 415

16.10 APFC PANELS including HARMONIC SUPPRESSION REACTORS

1. General

1.1 Description

Manufacture, test at Works, deliver to site, supervise installation & commissioning of Low Voltage APFC Panels including 14% detuned Harmonic Suppression Reactors

1.2 Submittals

- a) Tender Stage
 - i. Technical Data sheet & Product Catalogues.
 - ii. Type Test Certificates as per the relevant IS/IEC as mentioned below of Capacitors, Detuning Reactors, Capacitor Switching Contactors, Controller
- b) Post Ordering Stage
 - i. General Arrangement Drawings (Top view, Front view & Floor Plan including location of Gland Plate & Height of Cable Termination from floor level).
 - ii. Single line diagram.
 - iii. Design Basis.
 - iv. Nameplate information.
- c) Site Installation Stage
 - i. Submission of As-built Drawings and O&M Manual.
 - ii. Installation Instructions/ methods at the time of Installation.
 - iii. Setting values for the Automatic Power Factor Correction Relay.
- d) Type test and standards

The principal parts shall comply with the latest edition of the IS/ IEC Standards:

CAPACITORS	
IS 13340	Power Capacitors of Self-Healing Type for AC Power Systems having Rated Voltage upto 1000V.
IEC 60831-1 2014	Shunt Power Capacitors of the Self-Healing Type for AC Power Systems having a Rated Voltage up to and including 1000V.
Special Tests	Wave-Cut design of capacitors for equal charge distribution and high inrush current handling capabilities.
SWITCHGEAR INCLUDING CONTACTORS	
IEC 60947	Low Voltage Switchgear and Control gears
IS 13947-1	General requirements of switchgear and control gear for voltage not exceeding 1000 V ac
IEC 60947-1	Low Voltage Switchgear and Control gear – Part 1: General rules
IS 13947-2	LV Circuit breaker (ACB/MCB/MCCB/RCB) for voltage not exceeding 1000 V ac or 1200 V dc
IEC 60947-2	Low Voltage Switchgear and Control gear – Part 2: Circuit-breakers
IS 13947-3	Air- Break switches, Air-Break disconnecter and fuse combination unit for voltage not exceeding 1000 V ac or 1200 V dc
IEC 60947-3	Low Voltage Switchgear and Control gear – Part 3: Switches, disconnectors, switch-disconnectors, and fuse-combination units
IS 13947-4	Contactors and motor starters
IEC 60947-4-1	Low Voltage Switchgear and Control gear – Part 4-1: Contactors and motor starters

APFC RELAY	
IEC61000-4-4 Second edition 2004 07	Electrical fast transient test
IEC61000-4-11 Second edition 2004-03	Voltage dips and interruption
IEC 61000-4-2 Edition 1.2, 2001-04	Electrostatic discharge test
IEC 61000-4-5 Edition 1.1, 2001-04	High energy surge test
IEC 61000-4-6 Edition 2.1, 2004-11	Conducted radio frequency susceptibility test
IEC 61000-4-3 Edition 2.1, 2002-09	Radiated susceptibility test
IEC 61000-4-8 Edition 1.1, 2001-3	Power frequency magnetic field immunity test
IEC 61000-4-5 Edition 1.1, 2001-04	Surge susceptibility test
CISPR 11, Fifth edition, 2005-04	Conducted emission test
CISPR 22, Class A edition 4.1, 2004-06	Radiated emission test
IEC 62052-11,2003 & IEC 62053-21, 2003	Accuracy measurement
DETUNING REACTORS	
IS: 5553 (Part 5) - 1989 RA 2004	Reactors: Part 5 Tuning reactors
IEC:60076-6-2007	Power transformers – Part 6: Reactors
Special Tests	‘Turn-to-turn over-voltage test’

- e) Manufacturer of the Low Voltage APFC Panel shall be the “Authorized Partner” of the Principal & Critical Reactive Power Compensation Equipment (OEM) like Capacitor, Reactor, Capacitor Switching Contactor & Power Factor Controller. Principal component Manufacturer shall have at least more than 15 years of experience in the manufacture of the Principal Reactive Power Compensation Component, Like, Capacitors. The APFC panel principal & critical components, like, Capacitor, Reactor, Capacitor Switching Contactor, Power Factor Controller should have been Type tested in an external NABL accredited laboratory or CPRI. The Type test reports shall be made available for any Rating which shall be a representative sample for the Design, preferably of a higher rating. Considering the criticality of the Metallized Polypropylene film in the Capacitor unit, the Principal Component Manufacturer shall have in-house facility for the production of Metallized Polypropylene film. The Principal Component Manufacturer shall have in-house facility of Temperature Rise mapping chamber for demonstrating the Thermal Mapping of Major Heat dissipating equipment’s like Reactors and TSM load including facility for thermal mapping.

2.0 PRODUCTS

2.1 SAFETY AND RELIABILITY

SAFETY is of prime importance. Capacitors and controls shall be designed to minimize any risk of short circuit and to ensure personnel and operational safety during all operating conditions, inspections, and maintenance. Hence, Capacitors & Capacitor switching Contactors, critical to this, shall be ISI marked.

Even under extreme conditions of major short circuit or mal-operations there shall be no danger to persons in the vicinity of the assembly.

Capacitors shall be designed to operate safely without deterioration to performance under the ambient temperature range in the Contract Document.

The APFC system shall have advanced protection features which enhance safety & annunciation facilities in the event of occurrence of Safety related concerns.

2.2 DESIGN AND CONSTRUCTION

General

The APFC system shall be Indoor type. The KVAR mentioned is the net KVAR of Capacitor-Reactor combination at Rated Voltage. Under any circumstances, the total kVAR rating of the APFC Panel offered shall not be less than that specified in the Contract Documents.

The design of the capacitors shall take into consideration of high inrush current capacity (i.e. in the order of 400 X In) and long life expectancy of Capacitors (approx. 200,000hrs).

Enclosure and Degree of protection

The Capacitor, APFC relay, circuit breaker, busbars anti-condensation heater, indicating lamps and other ancillaries necessary for power factor correction shall be housed in an enclosure separate from the LV main switchboard.

The enclosure shall be force ventilated, self-contained, metal-enclosed type, floor mounted, flush fronted and suitable for front and rear access.

The enclosure structure shall be fabricated from sheet steel with advanced CNC facilities and shall be self supporting when assembled, uniform in height and depth from front to back. It shall be designed to withstand without any sag, deformation or warping under the loads likely to be experienced during normal operation, maintenance or maximum short-circuit conditions, and shall comply with all requirements of IEC 60439-1 for normal mechanical loads. Sheet steel used shall be not less than 1.6 mm thick.

All structural work shall be adequately protected against corrosion. The basic materials shall be properly pre-treated before the final coat(s) of resistant finishing paint is (are) applied. Manufacturer's standard colour is acceptable.

The front covers and rear covers shall be of hinged door type. The front & rear doors shall be provided with key locks. The doors shall be arranged to seal onto the board frame by means of a non-perishable dust proof gasketing. The sealing material shall be synthetic rubber and not foam. Covers shall be effectively earthed. Cover bolts or nuts shall be retained in place when undone.

The degree of protection for any assembly as per IEC 60529 shall be IP 41. The floor shall not be considered as Part of the enclosure.

All materials used in the construction and for the primary insulation shall be non-hygroscopic and have fire retardant properties and halogen free as practical. Insulating material shall have high resistance to tracking. Polychlorinated biphenyl shall not be used.

The power factor correction capacitor bank shall be suitable for mounting on a concrete floor or plinth. All necessary foundation/ channel bases shall be provided.

All operating devices shall be mounted for operation at the front of the enclosure.

Alphanumeric notation, generally in accordance with IEC ferruling norms, shall be used for identification and marking of phases, components, conductors and terminals.

Protection against Electric Shock

All components requiring maintenance shall be easily accessible.

Terminals of equipment installed on a compartment door and which can be alive when the door is opened, shall be shrouded to a degree of protection of at least IP 30.

All practicable measures shall be taken to prevent danger to personnel working on a disconnected functional unit with the capacitors still charged. Parts likely to be removed for maintenance, viz., side covers shall have retainable fastening means.

2.3 BUSBARS

Busbars shall be of high conductivity aluminum busbars in accordance with IS and of adequate rectangular cross-section to carry continuously the specified current without overheating and shall be rigidly mounted on non-hygroscopic insulators so as to withstand any mechanical force to which they may be subjected under maximum fault condition.

Busbars shall be colored in accordance with IEC 60446 at appropriate points to distinguish the phase and neutral. The main busbars shall be arranged in a horizontal plane at the top depending upon the kVAr Rating of the Panel. The busbars system shall be accessible for construction and maintenance duties. In case of a busbar short circuit, it shall be possible to clean or to replace the busbars and the support system with ease.

All busbars may not be fully insulated. However, each phase busbar shall be able to withstand at least applied AC test voltage of 2kV to ground, for a period of 60 seconds.

The earth bar of the enclosure shall be easily accessible. Proper termination facilities shall be provided for connecting the earth bar to the existing earthing system.

2.4 CAPACITORS

Capacitors shall comply with IEC 60831-1 & IEC60831-2.

The rated voltage for capacitors shall be 525 Volt 3 phase.

The Temperature Category of the Capacitor shall be -25/D, viz., -25 to + 55 Deg C.

The Capacitors shall be ISI Marked approved.

The dielectric losses at ambient temperature and rated voltage shall be less than 0.25 Watt/kVar. Capacitors shall be designed to have self-healing properties incorporating high quality polypropylene film as dielectric, vapour-coated with a special metal alloy under vacuum, in-house. The Metallized Polypropylene film shall be produced in-house under controlled environment, shall be with Slope/ Ramp metallization to ensure long life, wavecut at the edge to ensure a high inrush current capability and slit in a dust-free, environment maintained & monitored with a Particle counter. Capacitors units which do not comply with this requirement will not be accepted.

Material for the capacitor casings shall be Aluminum extruded type, rustproof, non-inflammable and shall allow the capacitors to be installed in areas with strong atmospheric pollution without suffering any of the deterioration or corrosion troubles characteristic of metal casings. The casing shall afford high electrical insulation even in the event of internal breakdown.

The three phase windings of the Capacitor shall be wound concentrically, one after the other with excellent winding precision on numerically controlled winding machines in a dust-free environment.

The Capacitors shall undergo a long drying process under high vacuum to eliminate moisture from the Capacitor element.

The Capacitors shall then be impregnated with dry, inert gas, preferably nitrogen & tested for gas leakage.

Each capacitor unit shall be fitted with discharge resistors across the capacitor terminals such as to discharge to 50V within one minute, after the Capacitor is de-energized.

2.5 APFC CONTROLLER

The control of the capacitors shall be by an automatic power factor correction relay and associated contactors.

The APFC relay shall be microcontroller based. Its controls shall be dependent on the reactive power and insensitive to EMI/ EMC concerns.

The APFC relay shall be housed in an enclosed rust-proof housing. For ease of service and maintenance, the APFC relay shall be of a design with detachable connectors. The step relay outputs shall have an individual switching capacity of at least 5A.

Zero voltage Release to prevent large capacitive current surges when the mains supply returns after an interruption and the capacitors have not been switched off, the regulator shall be equipped with a zero voltage release with the effect that upon the return of the mains supply, all capacitors remain switched off until they are discharged and the regulator has reversed to the zero position from where the step by step switching-on begins anew.

Step switching position indicators shall be incorporated in the front of the APFC Relay to indicate the number of activated step switches and there shall also be means to manually switching on or off the step switches.

Power Factor Measurement & Display -The APFC relay shall incorporate an LCD digital display to indicate the system's instantaneous power factor. The measuring range shall be 0.8 inductive to unity to 0.8 capacitive.

Method of Operation -A three-position selector switch shall be provided wired and labeled for MANUAL/OFF/AUTOMATIC operation of the power factor correction bank.

With the selector switch at manual mode, the switching on and off of the capacitor steps shall be affected by activating a separate switch as specified elsewhere. In any event, the zero-voltage release function must take precedence over the manual control to prevent capacitive current surges. With the selector switch at AUTOMATIC, the regulator shall switch on or off as many capacitor steps as are necessary without undue pendulum like switching at any particular step to reach the nominal cos phi as set. In any event, the zero-voltage release function must take precedence over the manual control to prevent capacitive surges.

4.3.1	Mounting	Flush type, mounted on base plate, inside the panel
4.3.2	Auxiliary power supply	230v AC tapped from incoming 400volt TPN through DPMCB.
4.3.3	Controller	Microcontroller based

4.3.4	Capacitor switching	In Auto mode, switching of capacitor units to achieve target PF based on actual values of kVAR & available bank size, without having a leading PF.
4.3.5	CT input	From CT's of Customer's distribution transformer secondary or Power panel incomer only
4.3.6	CT secondary current to relay	1/5 AMP
4.3.7	Target power factor setting range	Inductive 0.80 to Capacitive 0.95 in steps of 0.01
4.3.8	Display	LCD / LED on front, LCD display & LED indication. LCD display provides detailed information at closer proximity, however, LED indication of step condition will be visible even from a distance. This facilitates monitoring at a quick glance. Relay shall have digital display of Number of capacitor bank energized, actual PF, targeted PF etc.
4.3.9	Capacitor bank steps	16
4.3.10	Healthiness check of each bank	Shall be indicated in relay as 'Faulty bank'. This data shall be retrievable & re-settable.
4.3.11	No volt protection	To switch OFF all capacitors
4.3.12	Capacitor switching method	<ul style="list-style-type: none"> - Selectable, sequential/ cyclic or INTELLIGENT, - New capacitor shall switch in only when kVAR requirement is > minimum step capacity.
4.3.13	Relay features	<ul style="list-style-type: none"> - The capacitor shall be switched ON by rotation to equalize the working hours. - New capacitor shall switch in only

		<p>when kVAr requirement is > Min. step capacity.</p> <ul style="list-style-type: none"> - The relay shall display & log ON / OFF status of each capacitor unit. - The relay shall be Three phase current & voltage sensing type for compensation of PF in all 3-phases. - At any given moment, no particular phase should operate with leading power factor. - The controller shall have sufficient built in features to automatically monitor the healthiness of the system-units & give indications, if any of the capacitor is not working. - Controller shall be capable of measuring / computing the power factor on the load side and source side as to facilitate monitoring of compensated and uncompensated power factor and reduction in KVA demand. - Controller shall be designed to take 3 + 3 current inputs and 3 voltage inputs. 3 current input from source / load current and 3 current from capacitor panel. - Protections <ul style="list-style-type: none"> - Over voltage - Under voltage - No – voltage - Low load / loss of load - Capacitor current unbalance - Load current unbalance - High harmonics - Over temperature - Controller should have data logging facility with RS232/485
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		<p>communication interface & GSM communication facility</p> <ul style="list-style-type: none"> - Display of DATE, TIME, station ID - Display & log power parameters phase wise & total (load current, kVA, kW & PF). - The logger shall be with built in communication facility of RS485 / RS232 to down load all parameters on demand.
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2.5 DETUNING REACTOR: Detuning reactors shall be impregnated under vacuum and overpressure in impregnation varnish/ resin in compliance to temperature class H according to IEC 60076 and temper hardened under furnace temperature of 150 DegC.

The detuning reactors shall have insulation class T4 and operating ambient up to 40 C.

The tolerance of inductance for detuned reactor shall be with +/- 5% of the rated inductance.

Its limit of linearly shall be of 200% summation of harmonics current on rated inductance (L_n), $L=2* I_n$.

The winding material used shall be either copper or aluminum. It shall be rated to operate satisfactorily for a system voltage of 440 Volt but able to withstand a voltage test of coil to core 3kV -1 minute according to IEC 60076-6 & IS 5553.

The detuning reactor should have been Type tested according to IEC 60076-6 & IS 5553.

Special tests including 'Turn-to-turn over-voltage test' must have been conducted as a Type test, to ensure the quality and reliability of the Reactor. The detuning reactor shall be supplied with a normally closed thermostat contact to be connected in series with the power factor regulator step switching relay.

When the reactor iron core has overheated, the thermostat contact will open and thus cut off that particular step This will prevent thermal runaway of the reactors.

CONTACTORS

Capacitor switching Contactors with appropriate KVAR ratings and utilization category shall be selected for reactive capacitor switching. The contactors for this application shall conform to IEC 60947-4-1.

The Capacitor switching contactor shall be with pre-charging resistor as to limit the inrush current. The pre charging resistors shall be closed through auxiliary contacts, which shall open within few cycles of closing of main contact through a magnetic delatching arrangement so as to ensure longevity of the Contactors.

- a) The Contactors should have been Type tested to IEC 60947.
- b) The Contactors shall be UL approved.

2.7 CURRENT TRANSFORMERS

Current transformers and the connections to the reactive power regulator shall be in accordance with IS2705 / IEC 60044-1 with a saturation factor such that the regulators are not endangered all maximum fault current.

Accuracy class shall be in accordance with the Contract Documents. The short-circuit rating shall be at least 1 second it applied for short-circuit protection. Secondary circuits of all current transformers shall be earthed.

2.8 TERMINAL FOR EXTERNAL CONDUCTORS

Terminals shall be suitable for copper conductor. For outgoing control and secondary circuits, individual terminals shall be of the non-loosening, wedge type construction, obviating the use of cable lugs. They shall be constructed in such a way that direct contact between screw, bolt or nut and conductor is avoided. For the termination of internal control wiring, push-on connection with insulation support of the compression type may be used. Terminals shall be identified in accordance with the related wiring diagram, the layout shall be consistent and logical. As a standard, assemblies shall have facilities for the entry of cables or burs bars rankings. Bus bars trunking and cable entries, clamping, supporting and earthing facilities shall be provided suitable for the type, size and number as specified in the Contract Documents. For wire-armoured cable without special earthing wires in or under the armouring, metal gland plates and compression type cable glands shall be provided for earth continuity.

2.9 SECONDARY AND CONTROL WIRING AND CORE IDENTIFICATION FERRULES

Both ends of each conductor shall be provided with identification ferrules. The ferrules shall be of insulating material which shall be unaffected by oil or clamp. Characters shall be

suitably marked in black. The ferrules shall be of the continuous, ring type, not of the slip-on type. Markings shall be in accordance with the related manufacturer's drawings.

For secondary and control wiring, PVC insulated interconnection wires shall be used. The size and type of the wires to be selected shall be based on mechanical strength, voltage levels and, especially for current circuits, on the prospective current levels.

The minimum allowable cross-sectional area of the wires shall be 1.0mm^2 . Wires with a cross section of 1.5mm^2 shall always be stranded.

Current transformer secondary circuits with 5A rating shall be 2.5mm^2 minimum.

Color coding of secondary wiring shall be in accordance with IEC 60446. Earth wires shall be green/yellow striped. Wiring between two terminals shall be continuous. Joints for interconnections are not allowed.

For the manufacturer's internal panel secondary wiring, other than bus wires, no more than 2 wires shall be connected under one terminal connection, Bus wires shall have only one wire connected to each terminal.

As a minimum requirement, use shall be made of all rail-mounted terminals (TS 32 rail assembly) of high-grade Melamine. Partitions shall be fitted between terminals for different voltages.

Wiring ends of stranded conductors which have to be connected into bus-type contacts of terminals shall be provided with compression type pre-insulated wire pins with insulation support. In general, when lugs, wire pens, etc., are used they shall be of the compression type.

For the termination of secondary or control wiring on components, compression-type pre-insulated push-on connectors with insulation support may also be used.

To accommodate and support the secondary wiring, covered plastic channels, insulated or plastic strips shall be used.

Secondary and control wiring shall never be mounted direct to metal. The filling factor for channels shall not exceed 70%. Where supporting of a wire is not feasible, the wire or part of it shall be as short as possible.

Termination compartments for auxiliary and control cables shall have adequate dimensions with ample accommodation for the required number of terminals. Two or more conductor terminations on one terminal are not acceptable.

Metal cable suitable for the cables specified shall be included in the supply of the assembly. There shall be adequate marshalling space between the cable glands and the terminal blocks.

All current transformer terminals of the ONOFF status of the capacitor bank shall be provided via 2nos, voltage-free IEC 80466..

Item No:- 356-365 & 437-439 & 448-450 & 465-466

17. EARTHING & LIGHTENING PROTECTION SYSTEM

Earthing system shall conform to CPWD General Specifications for Electrical Works (Part I- Internal), 2023. Earthing system shall comprise of suitable nos. of Earhpits with GI & Copper Plate electrodes, G.I. pipe as per IS-3043 & CPWD specifications.

Neutral Earthing with suitable size Copper strips and Copper plate earthpits for Transformer, DG Sets and other equipment as specified by OEMs shall be provided. earthing of all sus. The body earthing for transformers, HV & MV panels shall be done to a common earth bus connected to two separate and distinct earth electrodes.

For a single transformer Sub-station, the total number of earth electrodes shall be 4 (2 for neutral and 2 for connection to a common earth bus for body earthing). For a two transformer Sub-station total number of earth electrodes shall be 6 (4 for neutral earthing, two each for two transformers, and 2 for connection to a common earth bus for body earthing).

17.1. ELECTRODES

The earth electrodes shall be as per CPWD General Specifications for Electrical Works (Part I-Internal), 2023.

17.2. LOCATION OF EARTH ELECTRODES

Distance of earth electrode from any building and other earth electrode shall be as per CPWD specification & IS codes. Care shall be taken that the excavation of earth electrode may not affect the column footings or foundation of the building. In such

cases electrodes may be farther away from the building. The location of the electrode earth will be a place where the soil has reasonable chance of remaining moist. As far as possible, entrances, pavements and road ways, are to be definitely avoided for locating the earth electrode.

17.3.WATERING ARRANGEMENT

Method of watering arrangement shall comply with CPWD general specifications.

17.4.SIZE OF EARTH LEAD

The recommended sizes of copper earth bus lead in case of Sub-stations shall be in accordance with General Specifications for Electrical Works (Part I-Internal), 2023 amended upto date. The minimum size of earth lead shall be 25 mm x 5 mm copper or equivalent GI strip.

17.5.INSTALLATION

All joints shall be riveted and sweated. Joints in the earth bar shall be bolted and the joints faces tinned. Where the diameter of the bolt for connecting earth bar to apparatus exceeds one quarter of the width of the earth bar, the connection to the bolt shall be made with a wider piece of flange of copper jointed to earth bar. These shall be tinned at the point of connection to equipment and special care taken to ensure a permanent low resistance contact to iron or steel. All steel bolts, nuts, washers etc. shall be cadmium plated, main earth bars shall be spaced sufficiently on the surface to which they are fixed such as walls or the side trenches to allow for ease of connections. Copper earthing shall not be fixed by ferrous fittings. The earthing shall suitably be protected from mechanical injury by galvanized pipe wherever it passes through wall and floor. The portion within ground shall be buried at least 60 cm deep. The earthing lead shall be securely bolted and soldered to plate or pipe as the case may be. In the case of plate earthing the lead shall be connected by means of a cable socket with two bolts and nuts. All washers shall be of the same materials as the plate or pipe. All iron bolts, nuts and washers shall be galvanized.

17.6.TESTING

After installation, the tests as specified in CPWD General Specifications for Electrical Work (Part I-Internal), 2023 shall be carried out and results recorded

17.7.LIGHTENING PROTECTION SYSTEM

Lightening Protection System shall be provided for all buildings, blocks and facilities constructed under this contract as per IS/IEC-62305:2010 amended up to date and NBC 2016.

18. SAFETY REQUIREMENTS

Safety provisions shall be generally in conformity with appendices (A) and (C) of CPWD General Specifications of Electrical Works (Part I-Internal), 2023. In particular following items shall be provided:

(a) Insulation Mats

Insulation mats conforming to IS 15652: 2006 shall be provided in front of of all HT & LT Panels as well as other control equipments as specified.

(b) First Aid Charts and First Aid Box

Charts (one in English, one in Hindi, one in Regional language), displaying methods of giving artificial respiration to a recipient of electrical shock shall be prominently provided at appropriate place. Standard first aid boxes containing required materials should be provided in each sub-station.

(c) Danger Plate

Danger Plates shall be provided on HV and MV equipments. MV danger notice plate shall be 200 mm x 150 mm made of mild steel at least 2 mm thick vitreous enameled white on both sides and with the descriptions in signal red colour on front side as required. Notice plates of other suitable materials such as stainless steel, brass or such other permanent nature material shall also be accepted with the description engraved in signal red colour.

(d) Fire Extinguishers

Portable CO2 conforming to IS 2878: 1976/ chemical conforming to IS 2171: 1976 extinguishers, HCFC Blend A (P-IV) shall be installed in the sub-station at suitable places. Other extinguishers recommended for electric fires may also be used.

(e) Fire Buckets: Fire buckets conforming to IS 2546: 1974 shall be installed with the suitable stand for storage of water and sand.

(f) Tool Box

A Standard tool box containing necessary tools required for operation and maintenance shall be provided in the sub-station.

(g) Caution Board

Necessary number of caution boards such as “Man on Line” ‘Don’t Switch on’ etc. shall be available in the sub-station.

(h) Key Board A keyboard of required size shall be provided at a proper place containing castle keys, and all other keys of sub-station and allied areas

Item No:- 313-325, 327-341, 347-355**19. INTERNAL ELECTRIFICATION OF BUILDING****19.1. SCOPE**

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and IS: 2274-1963. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations, so far as these become applicable to the installation. Electrical work in general shall be carried out as per following CPWD Specifications with up to date amendment.

- ☐ Specifications for Electrical Works Part-I (Internal) by CPWD-2023 with latest revision
- ☐ Specifications for Electrical Works Part-II (External) by CPWD-2023 with latest revision

Wherever these specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.

19.2.DISTRIBUTION BOARDS

- ☐ 6/16 A Raw Power points- 4 nos.
- ☐ 6/16 A UPS power points – 2 Nos. shared between Two seats
- ☐ Data points – 2 Nos. shared between Two seats
- ☐ Dimmer Lights as per requirement
- ☐ Light fittings as per required Lux level (NBC- 2016, ECBC)
- ☐ Data & UPS Power points for Projector / Monitor

As a general practice MCB type double door DB shall be used. Provision of Vertical type MCB DBs is to be considered in areas where 3-phase outlets are also required:

Provisions in MCB DB:

- i) Recess/ surface type with integral loose wire box.
- ii) Phase/neutral/ earth terminal blocks for termination of incoming & outgoing wires.
- iii) DIN channel for mounting MCBs.
- iv) Arrangement for mounting incomer MCB/RCCB/RCBO/MCCB as required.
- v) Copper Bus Bar.
- vi) Earthing terminals.
- vii) Interconnection between terminal block / incoming switch/bus bar/neutral/terminal block/ earth terminal connector with specified size of FRLS pre insulated copper conductor cable duly fitted with copper lugs/thimbles.
- ix) Termination block should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq. mm.
- x) Terminal block shall be made of flame retardant polyamide material.
- xi) Coloured terminal blocks and FRLS wires for easy identification of RYB

phases, Neutral and Earth.

- xii) DB shall be provided with a detachable cassette for safe removal of MCBs, RCCBs. Terminal connectors from the DB without loosening the internal cable connections of phase and neutral circuits.
- xiii) The DB shall have peel able poly layer on the cover for protection from cement, plaster, paints etc during the construction period.
- xiv) Detachable plate with knock out holes shall be provided at the top/ bottom of board. Complete board shall be factory fabricated and pre-wired in factory, ready for installation at site. The box and cover shall be fabricated from 1.6 mm sheet steel, properly pretreated, phosphotized with powder coated finish.
- xv) DB shall be of double door construction provided with hinged cover in the front.
- xvi) DB doors shall be suitably earthed.

Distribution Board shall be standard type. Distribution boards shall contain miniature circuit breakers. Miniature circuit breakers shall be quick make and quick break type with trip free mechanism. MCB shall have thermal and magnetic short circuit protection. All miniature circuit breakers shall be of minimum 10 kA rated rupturing capacity unless otherwise specified.

Neutral busbars shall be provided with the same number of terminals, as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. All live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. A circuit identification card in clear plastic cover shall be provided for each distribution board.

MCB's shall be provided on the phase of each circuit. The individual banks of MCB's shall be detachable. There shall be ample space behind the banks of MCB's to accommodate all the wiring. All the distribution boards shall be completely factory wired, ready for connections. All the terminals shall have adequate current rating and size to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.

Earth Leakage Circuit Breaker/Residual Current Circuit Breaker shall be provided in each Distribution Board as required. Earth Leakage Circuit Breaker shall be current operated type and of 30 mA sensitivity unless otherwise specified. It shall also provide over-current and short circuit protection i.e. it shall be MCB-cum-RCCB (Residual Current Circuit Breaker). In case ELCB doesn't have inbuilt short circuit protection, same rating MCB have to be provided for short circuit protection along with ELCB. Cost of this MCB is deemed to be included in the cost of ELCB. ELCB shall be housed within the Distribution Board.

Distribution Boards shall be ready for connections and shall be inspected in the factory by Electrical Engineer- In charge before dispatch.

Before procurement of Distribution Boards, MCB's, ELCB's (incomer and outgoings) etc., the contractor has to take approval of the DB Schedule/Drawings of each DB from the

Electrical Engineer In Charge. The whole unit i.e. Distribution Board, MCB's, ELCB's etc. shall come from the manufactures premises/workshop. After inspection and clearance from the Consultant Electrical Engineer the same may be dispatched to site for installation. However if a single component (such as ELCB or MCB or DB) is required for any reason such as replacement, increase in no. of circuits in the DB, change in the load of existing circuit, change in the total load on a particular DB etc., the same may be ordered separately.

19.3. METALLIC CONDUIT WIRING SYSTEM.

19.3.1. TYPE AND SIZE OF CONDUIT

All conduit pipes shall be of approved gauge (not less than 16 SWG for conduits of sizes up to 32 mm diameter and not less than 14 SWG for conduit of size above 32mm diameter) solid drawn or reamed by welding finished with black stove enameled surface. All conduit accessories shall be of threaded type and under no circumstances pin grip type accessories shall be used. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS Code. No steel conduit less than 20mm in diameter shall be used.

19.3.2. CONDUIT JOINTS.

Conduit pipes shall be joined by means of threaded couplers, and threaded accessories only. In long distance straight run of conduits, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam nuts shall be provided. In the later case the bare threaded portion shall be treated with anti-corrosive preservative. Threads on conduit pipes in all cases shall be between 13 mm to 19 mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories.

Cut ends of conduit pipe shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductor while pulling them through such pipes.

19.3.3. PROTECTION AGAINST CONDENSATION.

The layout of conduit should be such that any condensation or sweating inside the conduit is drained out. Suitable precaution should also be taken to prevent entry of insects inside the conduit.

19.3.4. PROTECTION OF CONDUIT AGAINST RUST.

The outer surface of conduit including all bends, unions, tees, junction boxes etc. forming part of conduit system shall be adequately protected against rust when such system is exposed to weather by being painted with two coats of oxide paint applied before they are fixed. In all cases, no bare threaded portion of conduit pipe shall be allowed. Unless such bare thread portion of conduit is treated with anticorrosive preservative or covered with approved plastic compound.

19.3.5. PAINTING OF CONDUIT AND ACCESSORIES.

After installation, all accessible surface (if any) of conduit pipes, fittings etc. shall be painted with two coats of approved enameled paint or aluminium paint as required to match the finish of surrounding wall, trusses etc.

19.3.6. SURFACE CONDUIT

Conduit pipes shall be fixed by saddles, secured to suitable approved plugs with screws in an approved manner at an interval of not more than one meter, but on

either side of the couplers or bends or similar fittings, saddles shall be fixed at a distance of 30 cm from the center of such fittings. Where conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips or clamps as required by the Engineer-in-charge. In long distance straight run of conduit, inspection type couplers at reasonable intervals shall be provided, or running threads with couplers and jam nuts shall be provided. Fixing Outlet Boxes Only portion of the switch box shall be sunk in the wall, the other portion being projected out for suitable entry of conduit pipes into the box.

19.3.7. RECESS CONDUIT

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. In case of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work. Entire work of chasing the wall, fixing the conduit in chases, and burring the conduit in mortar before plastering shall form part of point wiring work.

The conduit pipe shall be fixed by means of staples or by means of saddles not more than 60cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with the long radius, which shall permit easy drawing in of conductors. All threaded joints of conduit pipe shall be treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and of facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 meters, then circular junction box shall be provided.

19.3.8. METAL OUTLET BOXES & COVERS.

The switch box shall be made of modular metal boxes with suitable size modular cover plates. Modular metal box shall be made of mild steel on all sides except on the front. The metal box (other than modular type) shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanized mild steel. Metal boxes up to 20 x 30 cm size M.S. box shall have wall thickness of 18 SWG and MS boxes above 20 x 30 cm size shall be of 16 SWG. The metallic boxes shall be painted with anticorrosive paint before erection. Clear depth of the box shall not be less than 60mm. All boxes shall be covered from top with Phenolic laminated sheet of approved shade. These shall be of 3 mm thick synthetic phenolic resin bonded laminated sheet as base material and conform to grade P-I of IS: 2036-1994.

19.3.9. ERECTION AND EARTHING OF CONDUITS.

The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested in presence of Engineer In Charge for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirement by means of special approved type of earthing clamp effectively fastened to conduit pipe in a workmen like manner for a perfect continuity between the earth and conduit.

19.4. NON-METALLIC CONDUIT WIRING SYSTEM

19.4.1. Scope

This chapter covers the detailed requirements for wiring work in non-metallic conduits. This chapter covers both surface and recessed types of wiring work.

19.4.2. Application

- ☒ Recessed conduit work is generally suitable for all applications. Surface conduit work may be adopted in places like workshops etc. and where recessed work may not be possible to be done. The type of work shall be as specified in individual works.
- ☒ Flexible non-metallic conduits shall be used only at terminations, wherever specified.
- ☒ **Special Precautions-**
 - i. If the pipes are liable to mechanical damages, they should be adequately protected.
 - ii. Non-metallic conduit shall not be used for the following applications:-
 - iii. In concealed/inaccessible places of combustible construction where ambient temperature exceeds 60 degrees C.
 - iv. In places where ambient temperature is less than 5 degrees C.
 - v. For suspension of fluorescent fittings and other fixtures.
 - vi. In areas exposed to sunlight.

19.4.3. Materials

Conduits

- ☒ All non-metallic conduit pipes and accessories shall be of suitable material complying with IS 2509 : 1973 and IS 3419 : 1989 for rigid conduits and IS 9537 (Part 5) : 2000 for flexible conduits. The interior of the conduits shall be free from obstructions. The rigid conduit pipes shall be ISI marked.
- ☒ The conduits shall be circular in cross-section. The conduits shall be designated by their nominal outside diameter. The dimensional details of rigid non-metallic
- ☒ No non-metallic conduit less than 20 mm in diameter shall be used.
- ☒ The maximum number of PVC insulated aluminium/copper conductor cables of 650/1100 V grade conforming to IS 694 : 1990 that can be drawn in one conduit of various sizes as per CPWD specification. Conduit sizes shall be selected accordingly.
 - Heavy Duty PVC conduit shall be used in the wiring.

S.No	Size of Conduit	Outer Dia. Of Conduit	Inner Dia. Of Conduit	Minimum Thickness
1	20 MM	20 MM +- 0.3	15.8 MM	1.95 MM
2	25 MM	25 MM +- 0.4	20.6 MM	2.0 MM
3	32 MM	32 MM +- 0.4	26.6 MM	2.5 MM

Conduit Accessories

- ☐ The conduit wiring system shall be complete in all respect including accessories.
- ☐ Rigid conduit accessories shall be normally of grip type.
- ☐ Flexible conduit accessories shall be of threaded type.
- ☐ Bends, couplers etc. shall be solid type in recessed type of works, and may be solid or inspection type as required, in surface type of works.
- ☐ Saddles for fixing conduits shall be heavy gauge non-metallic type with base.
- ☐ The minimum width and the thickness of the ordinary clips or girder clips shall be as per CPWD specification.
- ☐ For all sizes of conduit, the size of clamping rod shall be 4.5 mm (7 SWG) diameter.

Outlets

- ☐ The switch box shall be made of either rigid PVC molding, or mild steel, or cast iron on all sides except at the front. The regulator boxes shall however be made only of mild steel or cast iron.
- ☐ PVC boxes shall comply with the requirements laid down in IS 14772 :
2000. These boxes shall be free from burrs, fins and internal roughness.
- ☐ The thickness of the walls and base of PVC boxes shall not be less than 2 mm.
- ☐ The clear depth of PVC boxes shall not be less than 60 mm.
- ☐ 3 mm thick phenolic laminated sheet covers for all types of boxes shall be as per requirements.

19.4.4. Installation

Common Aspects for Both Recessed and Surface Conduit Works

- ☐ The erection of conduits of each circuit shall be completed before the cables are drawn in.
- ☐ Conduit Joints
 - o All joints shall be sealed/cemented with approved cement. Damaged conduit pipes/fittings shall not be used in the work. Cut ends of conduit pipes shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductors while pulling them through such pipes.
 - o The Engineer-in-charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc. after they have been prepared shall be submitted for inspection before being fixed.
- ☐ All bends in the system may be formed either by bending the pipes by an approved method of heating, or by inserting suitable accessories such as bends, elbows or similar fittings, or by fixing non-metallic inspection boxes, whichever is most suitable. Where necessary, solid type fittings shall be used.
- ☐ Radius of bends in conduit pipes shall not be less than 7.5 cm. No length of conduit shall have more than the equivalent of four quarter bends from outlet to outlet.
- ☐ Care shall be taken while bending the pipes to ensure that the conduit

pipe is not injured, and that the internal diameter is not effectively reduced Outlets.

- ☒ All switches, plugs, fan regulators etc. shall be fitted in flush pattern.

Additional Requirements for Surface Conduit Work

- ☒ Conduit pipes shall be fixed by heavy gauge non-metallic saddles with base, secured to suitable approved plugs with screws in an approved manner, at an interval of not more than 60 cm, but on either side of couplers or bends or similar fittings, saddles shall be fixed at a closer distance from the centre of such fittings.
- ☒ Slotted PVC saddles may also be used where the PVC pipe can be pushed in through the slots.
- ☒ Where the conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips as required by the Engineer in-charge. Where it is not possible to use these for fixing, suitable clamps with bolts and nuts shall be used.
- ☒ If the conduit pipes are liable to mechanical damage, they shall be adequately protected.

19.4.5. Earthing Requirements

- ☒ A protective (earth) conductor shall be drawn inside the conduit in all distribution circuits to provide for earthing of non-current carrying metallic parts of the installation. These shall be terminated on the earth terminal in the switch boxes and/or earth terminal blocks at the DBs.
- ☒ Gas or water pipe shall not be used as protective conductors (earth medium).

19.5. SWITCHES.

All 6 and 16 Amp switches shall be modular type of 240 volts A.C. grade. All switches shall be fixed on modular metal boxes. All 6 Amp socket shall be 3 pin type and 16 Amp socket shall be 5/6 pin type (unless otherwise specified) suitable for 16/6 Amp. All modular switches, sockets, telephone outlets, TV outlet etc. shall be in off white finish unless otherwise specified. The switches controlling the lights or fans shall be connected to the phase wire of the circuit. Switch boards shall be located at 1200 mm above finished floor level unless otherwise indicated on drawings or directed by Engineer-In-Charge.

In case of computer power points, Data points, telephone points etc. to be fixed on laminated partition board (furniture), same shall be fixed on laminated board (portion of laminated board meant for fixing power points) with base plate/cover plate as applicable, duly fixed with screws.

One modular switch may control maximum one, two or three light points as per requirement and as directed by Engineer-In-Charge. One light point controlled by 2 switches shall be provided in the staircases as directed by Engineer-In-Charge. Depending on area of rooms, halls etc. one or more than one switchboards shall be provided as directed by Engineer-In-Charge. At least one number 6A Socket with Switch shall be provided in each switchboard as directed by Engineer-In-Charge. Suitable power points and light points shall be provided for urinal sensors and hand

dryers in the toilets as directed by Engineer-In-Charge. 10% Light fixtures shall be provided and operated with UPS supply with switches fed from UPS Distribution Boards.

19.5.1. COVER PLATE

All modular switches, sockets, telephone outlets etc. shall be fixed on modular metal boxes with modular base plates and modular cover plates on top.

19.5.2. 6.4.13 WALL SOCKET PLATE

Each outlet shall have a switch located beside the socket preferably on the same cover plate/modular base. The earth terminal of the socket shall be connected to the earth wire.

19.6.WIRING

All PVC insulated copper conductor wires shall conform to relevant IS Codes. All wires/cables shall be stranded type irrespective of its size.

All internal wiring shall be carried out with PVC insulated Cu wires of 650/1100 Volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan. A light/fan switchboard may have more than one circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring.

Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switchboards. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red/yellow/blue colour wire shall be used for phase and black colour wire for neutral.

Circuit wiring shall be carried out with red, yellow or blue colour PVC insulated wire for RYB phase wire respectively and black colour PVC insulated Copper wire for the neutral wires. Green/Green-Yellow Colour copper wire shall be used as earth continuity conductor and shall be drawn along with other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing and jointing of copper conductor wires and cables shall be as per CPWD specifications for Electrical works (Part - I) 2023

Maximum number of PVC insulated 650/1100 V grade aluminium/copper conductor cable conforming to IS : 694 - 1990

Nominal 25mm conductor in Sq.mm.	Nominal Cross- Sectional area of conductor									
	32mm	38mm	51mm	64mm	S	B	S	B	S	B
1	4	5	6	7	8	9	10	11	12	13
1.5	10	8	18	12	-	-	-	-	-	-

2.5	8	6	12	10	-	-	-	-	-	-
4	6	5	10	8	-	-	-	-	-	-
6	5	4	8	7	-	-	-	-	-	-
10	4	3	6	5	8	6	-	-	-	-
16	2	2	3	3	6	5	10	7	12	8
25	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	3	2	6	5	8	6
50	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	4	3	5	4

NOTE :

1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
2. The columns headed 'S' apply to runs of conduits which have distance not exceeding 4.25m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.
3. Conduit sizes are the nominal external diameters.

19.6.1. JOINTS.

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits and junction boxes. Conductors shall be continuous from outlet to outlet.

19.6.2. LOAD BALANCING

Balancing of circuits in three-phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

19.6.3. COLOUR CODE FOR CIRCUIT WIRING.

Colour code for circuit and sub main wiring installation shall be Red, Yellow, and Blue for three phases. Black for neutral and yellow/green or green only for earth in case of insulated earth wire.

19.6.4. CLASSIFICATION OF POINTS.**☐ General**

Classification and measurement of Point wiring shall be as per CPWD specification for Electrical Works (Part-I- Internal) 2023.

☐ Point Wiring (Modular)

Definition of Point Wiring

A point (other than socket outlet point) shall include all work necessary in complete wiring to the light points/fan/exhaust fan/call bell point from the controlling switch/MCB. The scope of wiring for a point shall, however, include the wiring work necessary in tapping from another point in the same distribution circuit i.e. from first switch board (wiring from distribution board to first switch box is covered in the circuit wiring and is not in the scope of point wiring) to subsequent switch board(s) in the same distribution circuit. The point wiring includes all materials specified below

including chasing the wall (in case of recessed wiring in wall), fixing the conduit and making the wall good as it originally was. It also includes supply, drawing, testing and commissioning of wires.

☐ **Scope of point wiring**

Following shall be deemed to be included in point wiring.

- (a) Supply & fixing conduit & conduit accessories for the same and wiring cables (including supplying and drawing wires) between the switch box and the point outlet.
- (b) All fixing accessories such as clips, nails, screws, phil plug, rawl plug etc. as required.
- (c) Modular switches, modular base plates and modular cover plates over the same. regulators, sockets with Metal boxes etc. in recessed or surface .
- (d) Outlet boxes, junction boxes, pull-through boxes etc. but excluding modular metal boxes if any, provided the switchboards for loose wires/conduit terminations.
- (e) In case of recessed wiring in wall the scope includes chasing of wall, fixing the conduit and making the wall good as it originally was.
- (f) Control modular switch (5/6A) as specified.
- (g) Ceiling rose or connector (in case of points for ceiling/ exhaust fan point, prewired light fittings and call bells).
- (h) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.
- (i) Interconnecting wiring between points on the same circuit, in the same switch box or from another. Interconnecting wiring from first switch oard to subsequent switch board(s).
- (j) Protective (loop earthing) conductor as required from one metallic switch box to another in the distribution circuits, and from switchboard to each point (light/fan/exhaust fan/call bell etc).
- (k) Bushed conduit where wiring cables pass through wall etc.
- (l) Ceiling rose (in the case of pendants except stiff pendants).
- (m) Lamp holder (in the case of goose neck type wall bracket, batten holder and fittings which are not pre wired).
- (n) Back Plate (in the case of stiff pendants).

19.6.5. Circuit and Submain Wiring

☐ **Circuit Wiring**

Circuit wiring shall mean the wiring from the distribution board up to the tapping point for the nearest first point of that distribution circuit i.e. up to the nearest first switch box.

☐ **Submain wiring**

Submain wiring shall mean the wiring from one main/distribution switchboard to another.

19.6.6. Power Plug Wiring

6A Plug Wiring

Wiring for all 6 A Socket Outlets shall be done with 2 X 2.5 sqmm PVC

insulated copper wire in suitable size PVC Conduit (including supplying and fixing PVC Conduit) along with the earth wire. Up to 3 points may be connected to one circuit.

16A Power Plug Wiring

Wiring for all 16 A Socket Outlets shall be done with 2X4 sq mm PVC insulated copper wire in suitable size PVC Conduit (including supplying and fixing PVC Conduit) along with the earth wire, directly from the MCB-Distribution Board or from one power socket outlet to another in case of computer power points. Looping shall not be done in general 16A power points (other than computer power points).

One 16A Power outlet per 10 sq mtr of whole covered area of each floor including common area shall be Considered while designing the power point scheme.

Wiring for 20A Metal Clad Socket Outlets

Wiring for all 20A Metal Clad Socket Outlets/ Geyser point shall be done with 2X6 sq. mm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing MS Conduit) along with the earth wire directly from the MCB- Distribution Board. Measurement of wiring for 20A Metal Clad Socket outlet shall be done on linear basis i.e. complete wiring directly from MCB-Distribution Board to the socket outlet.

19.6.7. CONDUCTOR SIZE.

Wiring shall be carried out with following sizes of PVC insulated stranded single core copper conductor wire/cable.

- i. Light Point. - 1.5 sq.mm
- ii. Ceiling /Cabin/Exhaust Fan Point - 1.5 sq.mm
- iii. Call Bell Point - 1.5 sq.mm
- iv. 6A Plug Point/ UPS Computer outlets (up to 3 outlets on one ckt.) - 2.5 sq.mm
- v. Circuit Wiring - 2.5 sq.mm
- vi. General Power Point – 4 sq.mm
- vii 20A Industrial Socket Outlet – 6 Sqmm
- viii Special Power Point – 6 Sqmm
- ix A/C Box with 32A MCB- 6 Sqmm

19.7.LIGHTING FIXTURE AND FANS

19.7.1. GENERAL

- a. The Contractor shall supply and install all LED Lighting fixtures as per IS 4347.
- b. All fixtures shall be delivered to the building complete with suspension accessories, canopies, hanging devices, sockets, holders, reflectors, ballasts, diffusing material, louvers, plaster frames, recessing boxes, etc. all wired and assembled as indicated.
- d. Full size shop detail drawings of special fixture or lighting equipment, where called for in the fixtures, shall be submitted to the Engineer In Charge for approval.

- d. Fixtures, housing, frame or canopy, shall provide a suitable cover for fixture outlet box or fixture opening.
- e. Fixtures shall comply with all applicable requirements as herein outlined unless otherwise specified or shown on the Drawings.
- f. Manufacturer's name and catalogue number of light fixtures, fans, switchgears etc. shall be strictly adhered.
- g. Fixtures shall bear manufacturer's name and the factory inspection label.
- h. Fixtures shall be completely wired and constructed to comply with the IEE wiring regulations requirements for lighting fixtures, unless otherwise specified.
- i. Revamping the fixture shall be possible without having to remove the fixture from its place.
- j. Lamps of the proper type, wattage and voltage rating shall be furnished and installed in each fixture.
- k. For Labs, ICU, CCU and other Critical Areas, Clean Room LED Light Fixtures shall be provided to maintain requisite Lux level as per NBC 2016, ECBC and as directed by Engineer-In-Charge.

19.7.2. INSTALLATION

Fixtures shall be installed at mounting heights as detailed on the Drawings or as instructed on site by the Engineer-In-charge.

Pendent fixtures within the same room or area shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation.

Flush mounted recessed fixtures, shall be installed so as to completely eliminate leakage of light within the fixture and between the fixture and adjacent finish.

Fixtures mounted outlet boxes shall be rigidly secured to a fixture stud in the outlet box. Hickeys or extension pieces shall be installed where required to facilitate proper installation.

Fixtures located on the exterior of the building shall be installed with non-ferrous metal screws finished to match the fixtures.

19.7.3. LED Light Fixtures -GENERAL

LED Lighting fixtures shall provide luminous efficacy of more than 100 Lumens/ Watt, including Driver & accessories. LED Light Fixtures shall have inbuilt harmonic mechanism to mitigate harmonics.

19.7.4. BALLASTS/ Driver

Ballasts/ Driver shall be electronic type and having high power factor type. Ballasts shall have manufacturer's lowest sound level and case temperature rise rating.

19.7.5. TESTING

After all lighting fixtures are installed and are connected their respective switches, test all fixtures to ensure operation on their correct switch in the presence of the engineer.

All non-operating fixtures or ones connected to the wrong or inconveniently

located switch shall be correctly connected as directed by the Engineer In-charge. Stickers are to be placed on each light fixture w.r.t. controlling switch of respective light.

19.7.6. CEILING FANS

All ceiling fans shall be provided with suspension arrangement in the concrete/slab/roof members. Contractor to ensure that provision are kept at appropriate stage at locations shown on the drawing. Fan box with MS hook shall be as per CPWD specification. Ceiling fan shall be Heavy Duty, double ball bearing type, copper wound motor complete with canopy, down rod, blades etc. and shall conform to relevant IS Standards. Ceiling Fans shall be white in colour. Ceiling fan shall be provided with electronic regulator. Electronic Regulator shall be suitable for 240 volts A.C supply 50 Hz and shall be of continuous duty type and with BEE Star rating. Ceiling Fans shall be 5-Star BEE rated & comply to ECBC norms.

19.7.7. EXHAUST FANS

Exhaust fans shall be heavy-duty type with double ball bearing and conforming to IS 2312 (latest revision). Exhaust fan shall be complete with copper wound motor, capacitor, Louver/shutter, frame and mounting bracket. Exhaust fan shall be suitable for operation on 240 volts single phase A.C supply with BEE 5- star rating & comply to ECBC norms.

19.8. TELEPHONE SYSTEM

19.8.1. Telephone point wiring

- (a) The point wiring shall be carried out with four pair Cat6A LAN cable, in the PVC conduit Minimum Dia. of Conduit for Internal/External one Telephone Wiring - 20mm.
If more than one telephone point has to be provided at one point, multi CAT6A Cable shall be used in suitable size of conduit.
- (b) The point shall commence from the main telephone Rack and would terminate at outlet box of point.
- (c) Fixing of conduit, conduit accessories draw out boxes and outlet box etc. in concealed/surface conduit works as that of wiring for light fixtures shall be applicable for telephone wiring conduit system also.
- (d) Joint in telephone wiring (between Rack and outlet box of point) shall not be allowed and the contractor should bear the wastages of wire if resulted due to this special requirement of telephone system.
- (e) External/Internal telephone and intercom wiring can be drawn in the same conduit, provided after drawing wires, 50% of conduit cross sectional area is free. However, independent armoured Cat 6A wire shall be used for external intercom.
- (f) To identify telephone wire/cable, PVC indication numbers shall be put on both ends of wire/cable just before termination.

19.8.2. Telephone Rack

The Telephone Cat 6A cables can also be terminated in the existing LAN Rack of suitable space.

19.8.3. Telephone Instruments:

Telephone Instruments shall be provided at various locations in the Institutional and Residential as directed by Engineer-In-Charge.

Item No:- 413**20. 11/0.433 KV Oil FILLED TYPE TRANSFORMER****Outdoor Oil TYPE TRANSFORMER*****SCOPE***

The specification covers design manufacture, testing packing and delivery of 3 phase 50 Hz Oil type distribution transformer of rating 2.5MVA – 11/0.433 KV. It is not the intent to specify completely herein all the details of the design and construction of equipment.

However the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation upto the Bidder's guarantee, in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such, components shall be deemed to be within the scope of Bidder's supply irrespective of whether those are specifically brought out in this specification and / or the commercial order or not.

It is intended to embrace the latest & best technology available in the market & hence dilution in the specification below is not accepted. Any Manufacturer / Contractor shall not approach for any deviation from below specification. If found doing so, the consideration of manufacturer / contractor as bidder shall be cancelled

The manufacturer should have manufacturing base in India or should offer from product from Plant based out in Europe. Product manufactured in china, korea are not accepted

TOLERANCES:

Tolerances on all the dimensions shall be in accordance with provisions made in the relevant IS/IEC standards/ and in these specifications.

GUARANTEE:

The equipment shall be guaranteed for the period of two years from the date of commissioning. The equipment found defective within above guarantee period shall be replaced / repaired by the supplier free of cost, within one month of receipt of intimation

SYSTEM PARTICULARS:

The transformers shall be suitable for indoor installation with following system particulars and should be suitable for service under fluctuations in supply voltage as permissible under Indian Electricity Act & Rules there under.

- a) Nominal System Voltage : 11 kV
 b) Corresponding Highest System Voltage : 36kV
 c) Neutral earthing : Solidly earthed
 d) Frequency : 50Hz with $\pm 3\%$ Tolerance

SERVICE CONDITIONS:

Equipment to be supplied against the specification shall be suitably design to work satisfactorily under following tropical conditions:-

- Maximum ambient temperature (Degree Celsius) : 45
 Minimum ambient temperature (Degree Celsius) : 10
 Relative humidity (% range) : up to 95%
 Altitude : <1000metres

The climatic conditions are prone to wide variations in ambient conditions and hence the equipment shall be of suitably designed to work satisfactorily under these conditions.

STANDARDS

The materials shall conform in all respects to the relevant Indian /International Standard Specification, with latest amendments thereof, some of them are listed below:

a.	IS: 5	Colours for ready mixed paints and enamels.
b.	IS:1180	Three phase distribution transformers up to 2500 kVA and including 100kVA, 11KV
c.	IS 11171/IEC 60076-Part 11	Oil type transformer
d.	IS:2099	Bushing
e.	IS:3347	Dimensions for porcelain transformer bushing for use in normally and lightly polluted atmospheres

Material conforming to other internationally accepted standards, which ensure equal or higher quality than the standards mentioned above, would also be acceptable. In case the Bidders who wish to offer material conforming to the other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Four copies of such standards with authentic English translations shall be furnished along with the offer.

SPECIFIC TECHNICAL REQUIREMENT:

Standard kVA Ratings:-

The standard ratings of transformers shall be 2500KVA, 11/0.433KV

Nominal voltage ratings

- i) Primary voltage - 11kV
 ii) Secondary voltage - 0.433kV

The windings of the transformers shall be connected to Delta (Δ) on the primary side and

star (Y) on the secondary side. The neutral of the LT winding shall be brought out to a separate terminal. The vector group shall be Dyn11.

Percentage Impedance: 6.25% at 75degC (subject to IS tolerance)

Temperature Rise;

- i) Average winding temperature rise over an ambient temperature of 50deg. C shall not exceed 90 Deg C by resistance method. i.e. Max. temperature of winding shall not exceeds 155°C.
- ii) Core, metallic parts and adjacent material shall in no case reach a value that may damage these material or reduce their life expectancies.

DESIGN & CONSTRUCTION

CORE

The core shall be of Prime grade cold rolled grain oriented (C.R.G.O) annealed steel lamination, having low loss and good grain properties, coated with insulation, bolted together to the frames firmly to prevent vibration or noise. All core clamping bolts shall be effectively insulated. The complete design of core must ensure permanency of the core losses with continuous working of the transformers.

Transformer shall be of BOLTLESS core design

Core shall be purchased Directly from Manufacturer or from their accredited Marketing organization of Repute & not through any agent. Bidder has to submit manufacturer's name during bidding having sufficient credential & Core has to be purchased from the approved manufacturer.

Stage inspection of the core shall be done at manufacturer's premises & inspection call shall be given with following Documents

- a) Invoice of the supplier
- b) Mill's test certificate
- c) Packing list
- d) Bill of landing & Bill of Entry certificate by customs

WINDING:

H.V. & LV. Coils

- i) HV coil should be casted with epoxy resin & should be premixed with active filler which should make the coil self extinguishing.
- ii) LV Winding LV Winding shall be made from Copper with class F epoxy resin so as to have lower stray losses & higher withstand capacities under bolted short circuit conditions

CLEARANCES: Clearances provided shall be strictly as per IS 11171 / IEC 60076-Part 11 H.T. & L. T.

BUSHING:

For 33KV Bushing will be used and for 433 volts, 1kV Bushing shall be used (IS standards to be followed). Bushing of the same voltage class shall be interchangeable. Bushing with same

plain shades as per IS 3347 amended upto date shall be mounted on the side of the enclosure and not on the top cover. Only sheet metal pocket shall be provided for mounting of HV bushing and the same shall not be fixed on pipes. Sheet metal pocket shall be designed in such a way that all HT bushing shall be remain parallel and equidistance throughout. Bushing having type tested as per IS 3347amended upto date shall only be acceptable.

TERMINAL MARKING PLATES AND RATING PLATES:

Terminals shall be provided with terminal marking plates. The transformer shall provide with riveted rating plate of minimum 8SWG aluminum anodized material sheet in a visible position. The entries of the rating plate shall be indelibly marked (for example by etching, engraving or stamping).

The marking as 'DSIR.' and 'Sr. No.' of Transformer will be engraved on Transformer enclosure, below L.T. Bushings.

The name of the company, order No., capacity, month and year of manufacturing shall be engraved on the enclosure of transformer just below the nameplate clearly visible. The engraving can be done on separate plate which shall be firmly welded to enclosure and shall form integral part of the enclosure.

TECHNICAL PARAMETERS OF 2500KVA OIL TYPE 11KV/415V, THREE PHASE DISTRIBUTION TRANSFORMERS

a)	Rating –	2500 KVA
b)	Applicable standard	IS-2026
c)	Cooling	AN
e)	Rated System Voltage	11kV/433V
f)	Frequency	50Hz with $\pm 3\%$ tolerance
h)	Phases	Three
i)	Impedance	6.25% at 75deg C (subject to IS tolerance)
j)	Service	outdoor
k)	Duty	Continuous
l)	Overload Capacity	As per IS 2026
m)	Vector Group (Three Phase)	Dyn11
n)	Tap Changer	ON Load Tap changer on HV winding $\pm 7.5\%$ to -7.5% in steps of 1.25% of taps by link with RTCC Panel

o)	Core Material	The core shall be built up with thin laminations of Prime grade. Non-ageing, low loss, high permeability cold rolled super grain oriented silicon steel.
P)	No load loss	As per ECBC 2017 ammended upto date
q)	Load Losses	As per ECBC 2017 ammended upto date
r)	IP degree	As per ECBC 2017 ammended upto date
s)	Dimension	As per Manufacturer Standard

TEST AND INSPECTION:

ROUTINETESTS: Manufacturer's Lab should have NABL accreditation so as to ensure transformer's genuinely on various design parameters

- i) All transformers shall be subjected to the following routine tests at the manufacturer's works.
- ii) The tests are to be carried out in accordance with the details specified in IS 2026 or as agreed upon between the purchaser and the manufacturer.
 1. Measurement of winding resistance.
 2. Ratio, polarity and phase relationship.
 3. Impedance voltage.
 4. Load losses.
 5. No-load losses and No-load current.
 6. Insulation resistance.
 7. Induced over voltage withstand.
 8. Separate source voltages withstand.
- iii) All the routine tests shall be conducted in the suppliers 'laboratory at their cost.
- iv) Heat run test shall be arranged free of cost on the unit selected from the 1st lot by employer's representative. The test should be done at NABL accredited lab only
- v) The calculations to confirm the thermal ability as per Clause no. 9.1 of latest IS: 2026 Part-I or equivalent International Standard shall be submitted to Inspecting Engineer.
- vi) Partial discharge test shall be carried out on one transformer & value shall be less than 10 Pc

DRAWINGS :

A set of following drawings shall be submitted by the Bidder.

- i) General Dimensional drawing
- ii) Core details drawing.
- iii) Rating & Diagram Plate Drawing.
- iv) HV/LV Bushings
- v) Operation and Maintenance Manual.

CLEANING AND PAINTING:

The surface of the enclosure shall be properly pre-treated / phosphate in a seven enclosure process and shall be applied with a powder coating of 40 microns thickness. The powder coating shall be of dark admirably green colour for transformer. Powder coating shall be suitable for outdoor use only. The seven tank process facility shall be enhance to ensure proper quality for outdoor application.

The month and year of supply shall be painted in **red bold English** lettering at some conspicuous place on the transformer, which shall be clearly visible from the ground.

Acceptance tests

The transformers shall be subjected to the following routine / acceptance test in presence of purchaser's representative at the place of manufacture before dispatch without any extra charges. The testing shall be carried out in accordance with IS: 1180 and IS: 2026.

1. Checking of weights, dimensions, fitting and accessories, tank sheet thickness, oil quality, material, finish and workmanship as per GTP/ QA Plan and contract drawings.
2. Physical verification of core coil assembly and measurement of flux density of one unit of each rating, in every inspection with reference to short circuit test report
3. All tests as specified in clause 6.1

INSPECTION

All tests and inspection shall be made at the place of manufacturer and unless otherwise especially agreed upon the manufacturer and the purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities, without charge to satisfy him that the material is being furnished in accordance with specification.

The manufacturer shall provide all services to establish and maintain quality of workmanship in his works and that of his sub-contractors to ensure the mechanical / electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per latest quality standards of ISO 9000.

Along with the bid the manufacturer shall prepare Quality Assurance Plan identifying the various stages of manufacture, quality checks performed at each stage and the Customer hold points. The document shall also furnish details of method of checking, inspection and acceptance standards / values and get the approval of purchaser or his representative before proceeding with manufacturing. However, purchaser or his representative shall have the right to review the inspection reports, quality checks and results of manufacturer's in house inspection department which are not customer hold points and the manufacturer shall comply with the remarks made by purchaser or his representative on such reviews with regards to further testing, rectification or rejection etc. Manufacturer should submit the list of equipment for testing along with latest calibration certificates to the purchaser.

Purchaser shall have every right to appoint a third party inspection to carry out the inspection process. The purchaser has the right to have the test carried out at his own cost by an independent agency wherever the dispute regarding the quality of supply. Purchaser

has right to test 1% of the supply selected either from the stores or field to check the quality of the product. In case of any deviation purchaser have every right to reject the entire lot or penalize the manufacturer, which may leads to black listing among other things.

QUALITY ASSURANCE PLAN:

The Bidder shall invariably furnish following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

- i. Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in the presence of Bidder's representative, copies of test certificates.
- ii. Information and copies of test certificates as in (I) above in respect of bought out accessories.
- iii. List of manufacturing facilities available.
- iv. Level of automation achieved and list of areas where manual processing exists.
- v. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
- vi. List of testing equipment available with the bidder for final testing of equipment along with valid calibration reports shall be furnished with the bid. Manufacturer shall possess 0.1 class instruments for measurement of losses.
- vii. Quality Assurance Plan (QAP) with holds points for purchaser's inspection as per Annexure.

The successful Bidder shall within 30days of placement of order, submit following information to the purchaser.

- i. List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.
- ii. Type test certificates of the raw materials and bought out accessories.

The successful Bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing.

DOCUMENTATION

The Bidder shall furnish along with the bid the dimensional drawings of the items offered indicating all the fittings.

i. Dimensional tolerances

- ii. Weight of individual components and total weight

PACKING & FORWARDING

The packing shall be done as per the manufacturer's standard practice. However, it should be ensured that the packing is such that, the material would not get damaged during transit by Rail /Road /Sea.

The making on each package shall be as per the relevant IS

Item No:-442**21. DIESEL GENERATOR SETS & ASSOCIATED WORK****21.1. SCOPE OF WORK:**

This specification covers the design, manufacture, assembly, packing, dispatch, transportation, supply, erection, testing, commissioning, performance and guarantee testing of Diesel Gen-Sets with Acoustic Enclosure, complete in all respects with all equipment, fitting and accessories for efficient and trouble free operation as specified here under. All DG Sets shall be provided with Residential Type Silencers.

The Scope of work shall also include labour, tools, tackles and plants, hardware and consumables, steel fabrication and items as prescribed below:

- ☒ Diesel Engine and Alternator set complete with base frame and accessories.
- ☒ DG Set shall be with PCCM / Synchronizing relay suitable for auto /manual / By pass arrangements.
- Engine mounted engine control integral panel duly wired upto terminal box for engine safeties with sensors and protection for inter facing with PLC/Microprocessor based relay and SCADA System.
- ☒ Fuel Oil system including day service oil tank, piping, valves, filters etc. from engine to service day oil tank.
- ☒ Lube oil system with piping etc. (Pre-lube oil pump with controller if required).
- ☒ For types of DG sets, please refer DBR.
- ☒ Exhaust emission shall meet latest CPCB norms without catalytic converter or online scrubber and residential silencer, exhaust piping with mineral wool insulation and aluminum cladding as called for.
- ☒ Steel fabricated structure/support/hanger including fixing, grouting and bolting etc.
- ☒ Painting of steel work.
- ☒ LT Termination Box shall be suitable for suitable size Sandwich busducts through flexible tinned copper busbars of suitable ratings.
- ☒ Copper Control cabling between DG sets and respective LT Panels
- ☒ Exhaust Gas Pipes MS C Class, 6 mm thick with all accessories and hardwares.
Height of Exhaust pipes shall be provided as per relevant CPCB and CPWD norms.
- ☒ MS Stack structure for supporting DG Exhaust Pipes duly painted with 2 coats of red-oxide primer & enamel paint of approved shade.
- ☒ All DG Sets shall be provided adequate shading with polycarbonate sheets supported on MS structure duly painted.
- ☒ Body & Neutral earthing of DG Sets complete with earth pits and earth strips/wire etc as per IS-3043.
- ☒ All DG Sets shall be tested by an independent test laboratory ICAT (Manesar)/ ARAI, Pune to ascertain that DG Set will generate the net nominal full load at the stipulated ambient temperature conditions. Test Certificates for DG Sets shall be produced.

21.2. CODES & STANDARDS

The design, construction, manufacture, inspection, testing and performance shall comply with all the currently applicable statutes, safety codes, relevant Bureau of

Indian Standard (BIS), British Standards (BS), International Electro Technical Commission (IEC) publication, standards amended up to date.

Some of the applicable standards are listed below :

(A) Generating Set		
ISO 8528	Part - I	Application, rating and performances.
	Part - II	Engines
	Part - III	A.C. Generator for generating set
	Part -IV	Control Gear & Switch Gear
	Part - V	Generating Sets
	Part -VI	Test Methods
(B) Engines		
IS 10000 (Naturally Aspirated)	Part - I 1980	Methods of tests for I.C. Engines Part - I- Glossary of terms relating of test methods
	Part - IV- 1980	Declaration of power, Efficiency, fuel consumption, lubricating oil consumption.
	Part - VII- Performance Tests	
	Part - X	Test for smoke level, limit and correction for smoke level for variable speed.
ISO - 3046	Part - V 2001	Performance, Torsional vibrations.
(C) Alternator		
IS 4889/BS - 269		For declaring efficiency of electrical machines.
IS 4722 - 1992		Capability of machine to withstand over current / overload.
IS- 13364	Part I 1992	Alternator - Voltage Regulations upto 20 KVA
IS- 13364	Part II 1992	Alternator - Voltage Regulations above 20 KVA to 80 KVA
IEC 34-1 - 1983		Rotating Electrical machines - Rating & Performance
IP -21	IS - 4691/85	Alternator (Degree of Protection)
(D) Acoustics Enclosure		
IS - 8183		Insulation material for sound absorption.
ISO 3744	1998 (E)	Acoustics - Determination of sound power levels of noise sources.
ISO 9614 -	1983 Part -I	Requirement of grade - II, Accuracy for insulation.
ISO 9614 -	1983 Part -II	Requirement of grade - II, Accuracy for insulation.
(E) Control Panel / AMF Panel		
IS - 2147 1962		Degree of protection.
IS - 4722		H.V. testing for Panel

21.3. DESIGN

The design and workmanship shall be in accordance with the best engineering

practices, to ensure satisfactory performance and service life. The equipment offered by the contractor shall be complete in all respects. Any material or accessories, which may not have been specifically mentioned, but which are usual and necessary for the satisfactory and trouble free operation and maintenance of the equipment shall be provided without any extra cost to the purchaser.

The DG Sets shall be mounted on suitable anti-vibration mountings of reputed make to prevent transfer of vibration to the foundation and structures. The DG Set equipment shall be tropicalised and shall be suitable for operating at a hot humid atmosphere at an ambient temperature of 50 deg. C. Any replacement of such item with material and labour will be carried out free of cost within the warranty period. The engine alternation set shall be capable of working at ambient temperature between 0°C to 50°C and relative humidity upto 95%.

The operating capacity of each set shall be arrived at after considering a load with power factor of 0.8 lagging, and after taking into consideration suitable de-rating on account of above parameters of the station.

The engine/alternator set shall be capable of taking 10% over-load for a period of one hour during any 12 hours period, while operating continuously at full rated load.

Nominal output voltage of engine/alternator set shall be 415 volts 50 Hz AC Supply with manual adjustment at all conditions of load with coarse and fine controls with a range of $\pm 5\%$.

The frequency shall be maintained at 50 Hz $\pm 2\%$ for the set. The output wave-form shall be sinusoidal at all load conditions.

The engine/alternator set shall be selected for a high degree of performance with over all low fuel consumption for the normal life of the alternator set.

The engine/alternator set shall meet the requirements of all linear & non-linear loads, but over-sizing of the alternator in order to meet the non-linear characteristics of loads is not envisaged.

The Engine shall be capable to minimum 60% bulk load of the rating during transfer of the load from NO Load position without tripping.

SYSTEM OPERATION

The set may be idle for a long time except for periodical test whenever there is a electrical supply failure, the set may required to run continuously for period even exceeding 24 hours.

SYSTEM FEATURE

The entire work shall confirm to Bureau of Indian Standards safety standards; British Standards, and CPWD specifications.

21.4. PERFORMANCE REQUIREMENT

The equipment shall be capable of delivering power continuously at the generator Terminal, a net output not less than the specified value at 0.8-0.95 p.f. excluding auxiliary power (shall be included over and above), when operating under the site ambient conditions described in this specification. Gen Set should be capable of taking 100 % step load & it should be able to take full load in less than 25 sec. from start. (The set shall be suitable for prime duty).

The design parameters of the generator and excitation system shall be chosen that

the set is stable while running at any load between no – load and full load and also during starting of motors. It should also have synchronous speed control with load sensing governing system suitable for parallel running of D.G. sets.

Engine should be heavy duty four strokes, turbo charged after cooler 'V' construction/in line electric start. Engine should have minimum lube oil change period 500 Hrs. Bidders are required to offer the Duplex filter system for lube oil and fuel oil in case of non compliance.

The set shall have vibration limit less than 130 microns (as per BS:4999 Part – 142) & noise level shall be meet CPCB norms under all conditions of load. The set shall be dynamically balanced. The set shall be mounted directly on the inertia foundation or with foundation bolts etc. The efficient residential silencer shall be provided with or without catalytic converter on-line scrubber & the set shall meet EURO-II norms for D.G Sets, for the exhaust. Air inlet shall also be provided.

The engine shall be stationary, compression ignition, totally enclosed, water cooled, 4 stroke direct injection, cold battery starting, turbo charged and low temperature with after cooled Radiator Cooled 1500 RPM in accordance to BS 5514 and IS: 10002 complete with all accessories. The DG engine shall be suitable for quick start & should be able to pick up 100% load within optimum time.

The DG Engine & the batteries shall be designed to take up at least six starting attempts beyond which the system shall be protected by means of an over crank relay. Calculations for battery sizing and battery charger capacity shall be submitted for review of the consultants. The successful bidder will submit shop drawing of the equipments/accessories selected for this work for the approval.

21.5. SERVICE INTERVAL AND OPERATION

The set shall be capable of running at full load for not less than 500 hrs continuously. The change period both for the lube oil, lube oil filters shall be minimum 500 Hours of operations, in the event the change period for above consumables false short below the specified time period as above, bidders are required to quote for duplex type filters with oil make up systems.

21.6. DIESEL ENGINE - CONSTRUCTION

Material of construction of major parts shall be as under or as per manufacturer design.

- ☒ M.S. base frame with anti-vibration mountings.
- ☒ Crankcase – Aluminium alloys.
- ☒ Crank shaft, connecting rods –Forged Alloy Steel.
- ☒ Piston – AL alloy casting.
- ☒ Piston rings – Alloy Steel.
- ☒ Engine Block – Cast Iron
- ☒ Cylinder Liner – Cast Iron

All other material of construction shall be as per relevant standard/code.

One common base frame shall be provided for mounting the engine and alternator complete with electric suspension between D.G set and foundation bolts, leveling lines etc. as required.

All externally mounted hardware shall be high tensile steel only.

The normal speed of the engine shall be 1500 RPM and the direction of rotation shall be clearly marked on the set.

The engine shall be fitted with an exhaust gas driven turbo charger of air / water cooled type complete with its own self contained lubricating system. The turbo-charger shall be positioned at the free end of the engine preferably

The engine shall be fitted with a charge air inter cooler of the air/water type. Air from the turbo-charger compressor passes through the inter cooled and then to the engine manifold. The inter cooler shall be of tubular construction or as per manufacturer design with aluminum bronze tubes, mild sheet steel and cast iron water headers.

Fuel injection and valves shall not require frequent adjustment while in service.

All filters like fuel, lubrication oil, by pass etc shall be provided in the engine and shall be dry, paper element type.

Starting system shall be 24V DC comprising of SMF batteries (25 plates, 360 AH capacity or as recommended by OEM), Voltage Regulator and arrangement for initial charging of batteries.

Bed Plate

The bed plate shall be fabricated from M.S. channel. The welding shall be radio graphed, and the entire fabrication shall be stress relieved after welding. The bed plate shall have integral well ribbed diaphragms for supporting the main bearing housings.

Crank Case

The crank case shall be steel construction with heavy steel plates to form water compartments around the cylinder. To facilitate access for purpose of inspection, inspection ports shall be provided.

Lube-Oil Priming Pump

An A.C. motor driven intermittent operation lube-oil priming pump shall be provided. This shall also include necessary piping, fitting instruments etc. for lubrication system along with clock timers if required.

Crank Shaft

The crank shaft shall be made of high tensile strength steel forging, and shall have a suitable flange to which the flywheel shall be bolted.

The bearing journals and fillets shall be induction hardened; and fully balanced. Main And

Big End Bearings

The main and big end bearings shall be detachable shells of high grade bearing material, and shall be pre-finished. Connecting Rods

The connecting rods shall be of high grade drop forged steel I - beam section, centre to centre length. The rods shall be rifle drilled for pressure lubrication of piston pin. The rod shall be tapered at piston pin end provided to reduce unit pressures. The piston pin of suitable diameter shall be full floating and made of tubular steel, and retained by a snap ring.

Cylinder Liners

The cylinder liners shall be replaceable wet liners, cast iron alloy, and provided with specially machined grooves in their bores to give an oil retaining surface. These liners shall be easily replaceable without re-boring the block.

Piston

The piston shall be made of forged aluminum alloy, cam ground and machined on outer surface. The piston shall be fitted with an oil scraper ring, and compression rings of hardened cast iron alloy. The piston shall be oil cooled.

Camshaft

The camshaft shall be of induction hardened steel alloy with gear drive, and one of this shall be provided for each block of cylinders.

Exhaust Manifold

The exhaust manifold shall be multi-branch, of insulated design utilizing Ni-resist casting.

Flywheel

The flywheel, which shall conform to requirements of NEMA/ASA/BS codes, shall be made of mild steel statically balanced after machining and shall have graduated markings around the periphery / markings for checking of the valves can also be located on the vibration damper. Barring slots shall be provided around the flywheel rim for hand-barring/ alternatively a suitable barring arrangement should be provided.

Governing System

The governor shall be Isochronous, electronic digital type with a steady state frequency variation of +/- .25%. The transient performance shall comply with ISO 8528-5, Class G3 requirements.

It should be possible to adjust the over speed settings on the governor by means of digital signals Manual adjustments for over speed trip settings are not preferred.

21.7. HEAT EXCHANGER

The DG Set should be equipped with a Heat Exchanger/ Radiator for suitable operation.

21.8. ALARMS/TRIP (AUDIO AND VISUAL)

The following Alarm/Trip indications shall be provided as minimum with first stage as pre alarm & second stage as trip:

- ☒ High water temperature.
- ☒ Low lube oil pressure.
- ☒ Low fuel level.
- ☒ Low coolant level.
- ☒ Over crank
- ☒ Over speed

21.9. OTHER AUXILIARY EQUIPMENT/SERVICES

These shall be complete include the following:-

Silencer

Exhaust Silencer shall be residential type to reduce the noise level. Values for Pressure drop across the silencers to be indicated by the vendor.

Cooling

The engine shall be water cooled heat exchanger type or radiator cooled depending on its capacity. DG Set shall be adequately designed for continuous operation on ambient conditions at 50 deg C.

21.10. INSTALLATION OF GENERATING SET

The engine and alternator shall be mounted on specially designed common MS base plate and frame of extremely rigid welded construction, so as to provide no deflection.

The engine/alternator set shall be installed over the Dunlop-make, S-type anti-vibration cushy base in order to isolate the transmission of vibrations to the floor or building structures.

The exhaust system shall be designed and installed in such a manner that it avoids excessive stresses on the exhaust manifold of turbocharger, washing spray or any other source.

The exhaust pipe shall pass through an oversized collar, filled with glass wool when crossing floor/wall. All exposed metal parts shall be suitably painted to prohibit corrosion under the climatic conditions at site.

The installation of fuel piping, power distribution and control panels shall be carried out in accordance with the specification of respective items.

21.11. DAY SERVICE FUEL TANK

Day service fuel tank shall be made of 3 mm thick MS sheet of 990 litres capacity or as OEM standard capacity for each set with all accessories such as oil level indicator, inlet pipe connection, outlet pipe connection, trough to collect spilt oil, air vent pipe with air filter, manhole with cover, low level and full level float valve arrangements with all fittings, interconnections between tanks and engine. The tank shall be provided with suitable calibration scale. The Fuel to be used for trials and acceptance tests shall be high speed diesel. First fill of 990 litres HSD per DG set required coolant and lube oil is included in the scope of this contract at no. extra cost.

21.12. FOUNDATION

Foundation shall be casted as per the recommendations of the manufacturer in consultation with the Supplier and as per the requirements of the site. The successful bidder shall submit detailed foundation drawings for approval from client.

21.13. PAINTING

The Contractor shall paint all exposed metal parts and equipment supplied by him. All sheet metal work shall undergo a process of phosphating, passivating and then sprayed with high corrosion resistant primer. The finishing treatment shall be of two coats of synthetic enamel paint of approved color. All piping shall be color coded.

21.14. ALTERNATOR

The alternator shall be brushless synchronous and suitable for 3 phase 415 Volts, 4 wire, 50 Hz, 0.8 PF, 1500 RPM.

The alternator shall be suitable for coupling directly to the diesel engine It shall be Drip proof, screen protected as per IP-23. The alternator shall be single bearing type & self ventilating. The alternators shall be continuously rated and shall have class 'H' insulation with a temperature rise restricted to that of class F designed and built to withstand tropical conditions. It shall generally conform to BS: 5000 (Part - 99) / standards listed above. The alternator shall be suitable for sustaining a 10% overload for 1 hour in any 12 hour period without injury. The terminal arrangement for alternator shall be suitable for Cable

connections of adequate size to deliver the full load of the alternator.

The alternator shall also have a solid state type digital voltage regulator (D.V.R.) suitable for single running with control limits of 1% from no load to full load under normal load changes. It shall be of static type and complete with cross current compensation. The regulator shall be provided with voltage adjusting potentiometer, and shall be complete with all alarm contacts, internal wiring, etc.

The Engine and Alternator shall be direct coupled and mounted on a common rigid fabricated steel base frame with suitable vibration isolation system.

21.15. EXCITOR

Self excited, self regulated and providing alternator output regulation at plus or minus 0.25%. The alternator shall be provided with a pilot-excited, permanent magnet- excited generator (PMG) for superior short circuit capabilities. Bidders to specify sustained short circuit current capabilities for up to 10 seconds.

The alternator shall be provided with sealed Barings to give minimum service life of 40,000 Hours. The Bidders to specify the maximum rating of the motor that can be started direct on line without any base load, with 50% base load, restricting the Voltage depth to 20%.

21.16. INSTRUMENTATION

Instrumentation shall be provided and mounted on the Generator Set to monitor the following:

- Engine Speed
- Oil Pressure
- Oil Temperature
- Water Temperature.

A Gauge Board shall be provided with all the indicators grouped together. The generator shall be provided with a microprocessor-based controller with a facility for remote start, remote annunciation, auto / manual synchronizing and remote communication capability. It should be possible to monitor the parameters of the engine and the alternator and display the status of the faults on the DG set if any and generate a complete report on the PC individually or on SCADA network. The following minimum monitoring & protection is required for the alternators.

Alternator Monitoring

- Current. (I1, I2, I3)
- Frequency
- Voltage (L-L & L-N)
- KVA
- KVAR
- Power Factor
- Percentage alternator duty heavily i.e. actual load / KW rating. The Generator shall

be protected against the following electrical faults:

- Overload and short circuit
- Ground fault
- Over current
- Over frequency

- ☒ Under frequency
- ☒ Under Voltage
- ☒ Over Voltage
- ☒ Locked Rotor
- ☒ Reverse power protection.

It should be possible to read the data i.e. Parameters and Shutdown status locally on the D.G Set. All the above Parameters should be displayed on The Local Control Panel through appropriate meters and status on faults should be indicated through a facia annunciator. It should be possible to display all the functions as above on a personal computer.

21.17. EXHAUST SILENCER PIPING

Exhaust Piping: The exhaust silencer piping system shall be of heavy duty MS, Class-C pipes, 6 mm thick. The runs forming part of factory assembly on the engine fl exible connections up to exhaust silencer shall be exclusive of exhaust piping item. The work include necessary cladding of exhaust pipe work using 50 mm thick Loosely bound resin (LBR) mattress/ mineral wool/ Rockwool, density not less than 120 kg/m³ and aluminium cladding (0.6 mm thick) for the complete portion. The exhaust pipe work includes necessary supports, foundation etc. to avoid any load & stress on turbo charger / exhaust piping. The exhaust pipe shall be run along the existing wall of the building duly clamped/supported on independent structure for which, the design and Drawing for such structure shall be got approved from the Engineer-in-charge.

- ☒ Exhaust system should create minimum back pressure.
- ☒ Number of bends should be kept minimum and smooth bends should be used to minimize back pressure.
- ☒ Pipe sleeve of larger dia. should be used while passing the pipe through concrete wall & gap should be filled with felt lining.
- ☒ Exhaust piping inside the Acoustic Enclosure/ Genset room should be lagged with asbestos rope along with aluminium sheet cladding / insulated to avoid heat input to the room.
- ☒ Exhaust flexible shall have it's free length when it is installed. For bigger engines, 2 flexible bellows can be used.
- ☒ For engines up to 500 KVA, only one bellow is required. However, if exhaust pipe length is more than 7 m then additional bellow/ provision for expansion should be provided.
- ☒ 'C' Class MS pipes and long bend/elbows should be used.
- ☒ The exhaust outlet should be in the direction of prevailing winds and should not allow exhaust gases to enter air inlet/ windows etc.
- ☒ When tail end is horizontal, 45 Degree downward cut should be given at the end of the pipe to avoid rain water entry into exhaust piping.
- ☒ When tail end is vertical, there should be rain trap to avoid rain water entry. If rain cap is used, the distance between exhaust pipe and rain cap should be higher than diameter of pipe. Horizontal run of exhaust piping should slope downwards away from engine to the condensate trap. Silencer should be installed with drain plug at bottom.

21.18. TESTS AT MANUFACTURER'S WORK

The following tests shall be performed at manufacture's works prior to packing

and dispatch to site.

On DG Set

- ☐ Maximum power load capacity.
- ☐ Maximum motor starting capacity
- ☐ Endurance test.
- ☐ Fuel consumption at full load, 50% load, 75% load and 25% load.
- ☐ Engine - Alternator cooling air flow
- ☐ Load acceptance Test

On the Alternator

- ☐ High voltage tests on stator and rotor windings.
- ☐ Insulation resistance of stator and rotor windings.
- ☐ Temperature rise test.
- ☐ Measurement of resistance of stator and rotor windings.
- ☐ Measurement of losses.
- ☐ Mechanical balance.
- ☐ Load rejection and over speed tests.
- ☐ Stator voltage and current tests.
- ☐ Stator phase sequence check.

On the Excitor

- ☐ High voltage tests on stator and rotor winding.
- ☐ Insulation resistance of stator and rotor windings.
- ☐ Temperature rise test.
- ☐ Measurement of resistance of stator & rotor winding
- ☐ Measurement of losses.
- ☐ Response ratio test.
- ☐ Over speed test.
- ☐ Mechanical Balance test.
- ☐ On the Automatic Voltage Regulator
- ☐ Sensitivity test.
- ☐ Response time test

All routine test as per IS/BS codes shall be conducted on alternator, exciter and AVR. DG Panel shall be part of Main L.T. Panel, supplied by the Owner. However DG supplier shall do the coordination and provide all the inputs required for successful operation.

21.19. Battery/ Electrical System

Batteries supplied with Genset are generally dry and uncharged. First charging of uncharged batteries is very important and should be done from authorized battery charging centre. Initial charging should be done for 72-80 hours. Batteries should be placed on stands and relatively at cool place.

Battery capacity and copper cable sizes for various engine capacity are recommended as indicated in the table below. Cable sizes shown are for maximum length of 2 m. If length is more, cable size should be selected in such a way that voltage drop does not exceed 2 V. However capacity as recommended by manufacturer may be taken.

DG Set Capacity	Battery Capacity (AH)	Cable Size Material (Copper) Sq. mm	Electrical System (Volts)
Above 500 KVA	360	70	24
Above 125 KVA upto 500 KVA	180	70	12
Above 82.5.KVA upto 125 KVA	180	50	12
Above 62.5 KVA upto 82.5 KVA	150	50	12
Above 25 KVA upto 62.5 KVA	120	50	12
Upto 25 KVA	88	35	12

Cabling & Bus Trunking-

Power cabling between alternator to Main LT Panel shall be carried out as per recommended cable sizes upto DG set of capacity 750 KVA.

As far as possible, for DG Set of capacity 750 KVA & above connection between alternator to Main LT Panel shall be through Sandwich bus trunking. For exposed/ outdoor bus trunking protection requirement should be IP-66.

While terminating cables, avoid any tension on the bolts/ busbars (if cable is specified). While terminating R, Y& B phase notations should be maintained in the alternator and LT Panel for easy maintenance. Crimped cables should be connected to alternator and control panel through cable glands.

Multi-core copper flexible stranded cable of 2.5 Sqmm size should be used for inter connecting the engine controls with the switchgear and other equipments. External wirings, when provided for remote voltage / excitation monitoring/ droop CT etc. shall be screened sheathed type.

Alternator Termination Links-

For proper terminations between links and Cables/switchgear terminals, the contact area must be adequate. The following situations should also be avoided as they lead to creation of heat sources at the point of termination:

- (i) Point contact arising out of improper position of links with switchgear terminals
 - (ii) Gaps between busbars / links and terminals being remedied by connecting bolt/stud
- In such cases the bolt will carry the load current. Normally these bolts / studs are made of MS and hence are not designed to carry currents.

Adequate clearance between busbars / links at terminals should be maintained (IS 4232 may be referred to for guidelines). Improper termination will lead to local heat generation which may lead to failure.

21.20. INSPECTION AND TESTING AT SITE

All pre-commissioning and commissioning test and checks shall be carried out at site. The Contractor shall be required to produce manufacturer's test certificate for the particular batch of materials supplied to him by the manufacturers. The test carried out shall be as per the relevant standards. For examination and testing of materials and the works at site, the Contractor shall provide necessary testing and gauging equipment as required. All such testing and gauging equipment shall be tested for calibration at any approved laboratory as required by the Engineer In Charge. The Contractor shall give notice well in advance to the Engineer In Charge before commencement of any site testing. All materials like consumable stores, fuel oil grease, lubricating oil etc. required for the trails shall be arranged by the contractor. The Contractor shall make all necessary

hook-ups to carry out tests at site and shall furnish necessary fuel. The complete installation should be initially started and checked out for operational compliance by manufacturer's representative.

21.21. TRIALS (AT SITE):-

Preliminary Trials

After completion of erection of generating sets and before carrying out main trials, preliminary site trials shall be conducted in the presence of the Engineer In Charge. Such trials shall include the checking and adjustments of all instrument relays, timers, interlocks and meters. Insulation resistance of stator, rotor and exciter windings shall be checked and reading recorded. A check shall be made for the satisfactory working of all auxiliary motors and their starting accessories supplied with the set. Diesel & lubricating oils for establishing performance at site shall be arranged by the contractor without any extra cost.

Main Trials

The main trials shall include over 8 hours continuous run at available load. D.G. Panel shall be tested for automatic operation by injecting proper current and voltage by a separate source. The satisfactory working of automatic operation shall be tested and necessary adjustments shall be done for relays in the presence of the Engineer In Charge and the results shall be recorded in the test sheet at 30 minutes intervals. Alternator efficiencies as determined in works test shall be used as the basis of calculation for fuel consumption rate. A tolerance of 3% shall be allowed on the fuel oil consumption to cover possible errors in measurement.

Tests providing the satisfactory performance of all safety and operating controls shall be carried out. Governor trials shall be carried out as laid down in ISO: 3046. Alternator insulation resistance and commutation check shall be as per ISO: 3046. Starting time of sets shall be tested at least five times after sufficient time intervals to allow for cold start. On completion of tests, inspection doors shall be removed and running gears inspected and alignment checked.

Any further reasonable trial as suggested by the Engineer In Charge shall be carried out with no extra charges. All instruments, materials and labour required for carrying out the trials shall be provided by the Contractor. Test sheets of trials shall be forwarded in quadruplicate to Engineer In Charge.

21.22. TEST WITNESS

Tests shall be performed in the presence of Engineer In Charge. The contractor shall give at least thirty (30) days advance notice of the date when the tests are proposed to be carried out.

21.23. COOLING TOWERS AND WATER CIRCULATING EQUIPMENT

21.23.1. GENERAL

The various items of the water circulating system shall be complete in all respect and comply with the specification given below. The total sound intensity with all fans in operation shall not practically exceed noise levels as prescribed in CTI, CPWD and other relevant norms, from all around the cooling towers.

21.23.2. COOLING TOWERS (FRP CONSTRUCTION)

The cooling towers shall be of FRP, Vertical induced draft type complete with FRP basin FRP body, fan and motor assembly, fill media, distribution pipes etc.

21.23.3. GENERAL CONSTRUCTION

The body shall be made of FRP (Fibre glass reinforced plastic) section of equal segments, all bolted together. The surface on both inside and outside shall be smooth, for minimum air resistance. The fan deck shall form an integral part of the body. The structural strength of the body shall be sufficient to withstand wind velocities upto 60 m/sec. Vibrations and earth quake.

The water basin shall also be of FRP. Having an auxiliary suction tank, at the bottom. The basin shall be complete with connections for drain, overflow, makeup water, quickfill and float valve, plus hot dipped galvanized stainer.

The support structure for the tower shall be of mild steel duly hot dipped galvanized. The water diffusion deck shall be of rigid PVC fill in Honeycomb design, arranged in a suitable pattern for ease of replacement. PVC fills shall be of high efficiency. The colour of the cooling tower body shall be of the owner / architect choice.

21.23.4. WATER DISTRIBUTION SYSTEM

The hot water shall be distributed through a sprinkle system consisting of PVC sprinkler pipes, which shall be mounted on the top of the main supply stand pipe. Each cooling tower shall have twin header system coupled with gravity flow distribution system.

21.23.5. FAN ASSEMBLY

The fan shall be of axial flow type with cast aluminium multiple blades of aerofil design and adjustable pitch. The fan assembly shall be statically balanced. The fan outlet velocity shall not be less than 10 m/ s and the tip speed shall be below 4500m / minutes.

The fan shall be directly mounted on the motor or through speed reduction gears. In the latter case, the housing shall be of heavy cast iron, construction with large oil reservoir. The fan motors shall be totally enclosed fan cooled squirrel cage type confirming to IP 55 Protection for outdoor operation.

The fan guard shall be hot dipped galvanized with wire mesh screen to prevent bird nesting during idling period.

21.23.6. LADDER

All towers, whose height exceeds 2.5 mtrs, shall be provided with a ladder, made out of hot dip galvanized MS Tubes.

21.23.7. PUMP SETS

The pump sets shall be mono block type with end suction and top discharge flanged connections directly mounted on the dripproof squirrel cage induction motors and suitable starter as specified.

The impeller shall be of Bronze, single enter shrouded design, and properly balanced. Water seal shall be of mechanical type to minimized water leakage and should be easily serviceable in the field.

Motor and starter shall confirm to relevant specifications and of rating given in 'schedule of quantities'.

21.23.8. MISCELLANEOUS

The following items to be provided:

Water pressure gauge at inlet and outlet of each pump complete with gauge cocks and connected tubing.(To be priced separately)

Vibration isolation pads for each pumps.

Drain line from each pumps up to drain pit, (priced separately).

21.23.9. INSTALLATION AND TESTS

The cooling towers shall be mounted on the beam/ steel structure member, provided by Contractor and shall be unconnected with the roof slab. All nuts / bolts etc. for mounting shall be provided by the Contractor.

On installation of the capacity of the cooling towers shall be checked by measuring water flow rate, water IN and OUT temperature and the ambient W.B. Temperature and then computing the capacity and efficiency.

The pumps sets shall be mounted on cement concrete foundation which shall be provided by HVAC contractor including grouting nuts, bolts, channels etc. shall be provided by the contractor.

On installation the capacity of the pumps shall be checked by measuring water flow. Motor current and pressure difference at inlet and outlet. The reading shall be recorded to compare actual performance with the specified data. Magnetic level switches shall be provided for low level alarm, in each cooling tower.

21.23.10. PIPE WORK

All piping work shall confirm to quality standards and shall be carried out as per specifications and details given hereunder:

All pipes in sizes 200 shall M.S. E.R.W. tube (black steel) heavy class as per I.S. 1239-79, Part -1 with amendment-I. All pipes above 150 mm dia. shall be minimum 6.4 mm thick.

The dimensions of the fittings shall conform to I.S. 1239/69 Part-II unless otherwise indicated, in the specifications.

All bends in sizes up to and including 150 mm dia., shall be ready, made of heavy duty, wrought steel of appropriate class.

All bends in sizes 200 mm and larger dia., shall be fabricated from pipes of the same dia and thickness, with a minimum of 4 sections, and having a minimum centre line radius of 1.5 diameter of pipes. All fittings such as branches reducers etc. in all sizes shall be fabricated from pipes of the same dia. And thickness and its length should be at least twice the dia. of the pipe.

The branches may be welded straight to the main line without making a separate fitting, where specified on drawings or required by engineer-in-charge.

Blank ends are to be formed with flanged joints and 6 mm thick blank between flange pair for 150 mm and over, in case where, a future extension is to be made otherwise blank and discs of 6 mm thickness are to be welded on, with additional cross stiffeners from 50mm x 50mm M.S. Heavy angles, for sizes up to 350mm. All ends larger than 400 mm dia. shall have dished ends.

Flanges.

Valve :

All flanges shall be of mild steel as per I.S. 6392/71 and shall be steel slip-on-type, welded to the pipes, flanges thickness shall be to suit class-II pressures.

Flanges may be tack welded into position, but all final welding shall be done with joints dismounted. 3 mm thick gaskets shall be used with all flanges joints. The gaskets shall be filler reinforced rubber as approved by the Engineer-in-charge. Special adhesive compound shall be used between flanges of steam, air and gas lines.

Flanges shall be used as follows :-

Counter flanges for equipment having flanges connections.

Flanged pairs shall be used on all such equipment, which may require to be isolated or removed for service e.g. Pumps, refrigeration machines air handling units etc.

All thread valves shall be provided with nipples and flanged pairs on both sides to permit flange connections, for removal of valves from main line for repair/replacement.

Butterfly Valves

The butterfly valve shall consist of cast iron body preferably in two piece construction.

The discs shall consist of disc pivot and driving stem shall be in one piece centrally located.

The valve seat shall be synthetic material suitable for water duty. It shall line the whole body.

The discs should move in slides bearing on both ends with 'o' ring to prevent leakage.

The handle should have arrangement for locking in any set position.

All gate valves and check valves up to & including 65 mm dia. shall be of gunmetal screwed type, conforming to class 2 of I.S. 778. and shall be with I.S.I marking and certification.

All gate valves and check valves up to 80 mm dia . and above shall be of cast iron flanged type, conforming to class 2 of I.S. 780/69 (for sizes up to 350 mm) and of I.S. 2906/69 (for sizes 350 mm and above) marking and certification.

All gauge cocks shall be of gunmetal plug type, complete with siphon (brass chrome plated).

All drain valves shall be of gunmetal with a hose union connection of one hand.

All valves of the supply of fan coil units shall be of gunmetal ball type with integral water strainers, having (BSP) fpt inlet and flare type MPT outlet connection.

All valves on the return line of fan coil units shall be as in 5.6 but without integral water strainer.

Balancing Valves :

The balancing valves up to 80 mm dia. shall be of gunmetal screwed type conforming to B.S. 5154 or equivalent specifications.

The valves shall be cast gunmetal ASTM B-62 and complete with non rising spindle. PTFE disc seal cast metal hand wheel.

The port opening shall permit precise regulation of flow rate, by accurately measuring the pressure drop across the port.

The valves shall be complete with two ports for connection to a mercury manometer, to measure the pressure drop, as well as a drain port.

The spindle shall have shielded screw to set the flow at the desired level.

The valves shall be used wherever specified.

Strainers :

Jointing

The strainers shall either be pot type or 'Y' type with cast iron or fabricated steel body, tested up to pressure applicable for the valves as shown on the drawings.

The strainers shall have a perforated bronze sheet screen with 3 mm perforation and with a permanent magnet, to catch iron fillings.

Pot strainers shall be provided with flanged connection and 'Y' strainers shall be provided with flanged ends.

The strainers shall be designed to facilitate easy removal of filter screen for cleaning without disconnection of pipe line.

All pipes line shall be welded type.

Square cut plain ends will be welded for pipes up to and including 100 mm dia.

All pipes 125 mm dia or larger will be beveled by 35 deg before welding.

Miscellaneous :

Provide all pipe work as required to make the apparatus connection complete and ready for regular and safe operation. Unless otherwise noted, connect all apparatus and equipment in accordance with manufacture's standard details, as approved by Engineer-in-charge. Unless otherwise specified, pitch the lines of piping as follows:- All condensation drainage, including air handling unit and fan coil unit shall be pitched in the direction of flow to ensure adequate drainage, with an adequate trap seal to prevent leakage of air due to static pressure developed by air conditioning units. Pitch, 20 mm per meter wherever possible, but not less than 10 mm per meter.

Drains from other equipments shall be pitched similarly without trap seal.

Provide valves and capped connections for all low points in piping system, where necessary or required for draining system. Provide isolating valves & drain valves in all risers to permit repairs without interfering with the rest of the system.

Support piping independently of all equipment so that the equipment is not stressed by the piping weight or expansion.

To facilitate the maintenance, repair and replacement.

Provide shut-off valves where indicated and for individual equipment, units at inlet And outlet, to permit unit removal for repairs, without interfering with the remainder of The system. Additional shout-off valves shall be provided as required to enable all systems to be fully sectionalized. By-pass and stop valves shall be provided for all automatic control valves as specified.

Arrange piping for maximum accessibility for maintenance and repair, locate valves for easy access and operation. No valves shall be installed with handles pointing down, unless unavoidable.

Cut the pipes accurately according to measurements, established site & Work

into phase without springing or forging.

Pipe supports shall be adjustable for height and prime coated with rust preventive paint & finish coated with grey paint, both as approved by engineer- in-charge. The spacing of Pipe supports shall not be more than that specified below:- Nominal pipe size mm spacing (meters)

80,100,&125	2.50
150&Above	3.00

Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stresses on the pipes. Pipe hangers shall be fixed on walls and ceiling by means of metallic approved dash fasteners.

Insulated piping shall be in such a manner as not to put undue pressure on the insulation, such as providing teak wood block between pipe and support.

Where pipes are to be buried under ground, they should be coated with one coat of bituminous paints. The top of the pipes shall not be less than 75 cms. From the ground level. Where this is not practical permission of engineer-in-charge shall be obtained for burning pipes at lesser depth. The pipes shall be surrounded on all sides by sand cushion of not less than 15 cms. After the pipes have been laid and top sand cushion proved, the trench shall be refilled with the excavated soil, excess soil shall be removed from the site of work by the contractor.

Hangers & Supports :

Hangers & supports shall be provided and installed for the piping and tubing wherever indicated, required or otherwise specified. Wherever necessary, additional hangers and support shall be provided to prevent vibration or excessive deflection of piping and tubing.

All Hangers & supports shall be made of steel or other durable and non-combustible material, given two coat of primer red oxide and then painted with aluminium colour paint. Wood wire or perforated strap iron shall not be used as permanent hangers or supports.

Hangers shall be supported from structural steel, concrete inserts & pipe racks, as specifically approved.

No hangers shall be secured to underside of light weight roof decking and light weight floor glass. Mechanical equipment shall be suspended midway between steel joists and panel points. Drilling or punching of holes in steel joist members will not be permitted.

Sleeves :

Where pipes pass through floors, walls, etc provide Galvanized steel pipe sleeves 50 mm larger than outside diameter of pipe. Where pipes are insulated, sleeves shall be large enough to ample clearance for insulation.

Where pipes pass through outside walls or foundation, the space between pipe and sleeve shall be caulked with lead wool and oakum.

The centre of pipes shall be in the centre of sleeves, and sleeves shall be flush with the finished surface.

Expansion or Contraction :

The contractor shall provide for expansion and contraction of all piping installed

by the use of swing connection and expansion loops.

Arrangement and alignment of Piping :

All piping shall be arranged and aligned in accordance with the drawings as specified. Where special conditions are encountered in the field, the arrangement and alignment of piping shall be as directed by the engineer-in-charge. The piping shall be installed in a uniform manner, parallel to or perpendicular to walls or ceiling, and all changes in directions shall be made with fittings. The horizontal piping shall be run at right angle and shall not run diagonally across rooms or other piping. Wherever possible all piping shall be arranged to provide maximum head room.

All piping shall be installed as directly as possible between connecting points in so far as the work of other trades permits. Where interference occurs with another trade whose work is more difficult to route, this contractor shall reroute his pipes as required to avoid interference, at the discretion of the engineer-in-charge.

All piping shall be carefully installed to provide for proper alignment, slope and expansion.

The stresses in pipe lines shall be guided and pipes shall be supported in such a manner that pipe lines shall not creep, sag or buckle

Anchors and supports shall be provided wherever necessary to prevent any misalignment of piping.

Small tubing gauges, controls or other equipment installed on any apparatus, shall not be coiled nor Excessive in length, but shall be neatly, carefully bent at all change in direction, secured in place and properly fastened to equipment at intervals to prevent sagging.

Testing:

The piping shall be grouped wherever practical and shall be installed uniformly in straight parallel lines in either vertical or horizontal positions.

In general, tests shall be applied to piping before connection of equipment and appliances. In no case shall the piping, appliance be subjects to pressures exceeding their test ratings.

The tests shall be completed and approved before any insulation is applied. Testing of segments of pipe work will be permitted, provided all open ends are first closed, by blank offs or flanges. After tests have been completed the system shall be drained and flushed 3 to 4 times and cleaned of all dust and foreign matter. All strainers, valves and fitting shall be cleaned of all dirt, filling and debris.

All piping shall be tested to hydraulic test pressure of at least one and half times the maximum operating pressure but not less than 10 kg/sq. cm for a period of not less than 12 hours. All leaks and defects in the joints revealed during the testing shall be rectified to the satisfaction of the engineer-in-charge, without any extra cost.

All the piping system shall be tested in the presence of the engineer-in-charge or their authorized representative. Advance notice of test dates shall be given all equipments, labour, materials required for inspection, and repairs during the test shall be provided by the contractor. A test shall be repeated till the entire systems are found to be satisfactory to the above authority. The tests shall be carried out for a part of work if required by engineer-in-charge in order to avoid hindrance in the work of the insulation contractor.

All steam and condensate pipes shall be tested and proven tight under hydrostatic pressure of 20 kg/sq.cm, unless otherwise stated, for a minimum period of 4 hours without drop in pressure.

Miscellaneous piping, tests with air at 10.5kg/sq.cm for a minimum of 24 hours without drop in pressure.

Painting:

All pipes supports, hangers, etc, shall be given two coats of red oxide primer.

All pipes, which are not to be insulated, shall then be given one coat of finish paint, of a type and colour, as per ISI code.

21.23.11. EXHAUST SILENCER PIPING

The Exhaust piping system for the DG set shall be as per CPWD Specifications meeting the requirements of CPCB Norms. The exhaust silencer piping system shall be of heavy duty MS pipes conforming to class B. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendation of the manufacturer. MS screws flanges and bends shall be used as per site requirements. Exhaust pipe inside the building shall be lagged with heat resistive glass wool of 48 kg / meter cube and then clad with Al. foil all along the pipe.

Exhaust Stack Height- In order to dispose exhaust above building height, minimum exhaust stack height should be as follows:-

(a) For DG Sets up to 1000 KVA - $H = h + 0.2\sqrt{KVA}$
where H = Height of Exhaust stack, h = Height of building

(b) For DG set above 1000 KVA - 30 M or 3M above the building height, whichever is higher The Exhaust Piping stack shall be supported by suitable MS steel structure with twin aviation light at the top of the exhaust piping.

21.23.12. COOLING TOWER CAPACITIES

The cooling towers of adequate capacity to be installed at the terrace of the complex from where the common header of the cooling towers shall be brought down to the DG room in the basement. Soft water is required to be filled up in makeup water tank for closed circuit cooling of engine. The contractor has to obtain the data from the Manufacturer for the requirement of the cooling tower capacity of the DG sets.

The inlet temperature to the cooling tower shall be of 43.3 degree C or as per design requirements.

The inlet temperature from cooling tower shall be of 32.3 degree C or as per design requirements

There shall be two common cooling tower for the DG sets. On the basis of data the size of common header and Pumps size min two nos with third no. standby shall be designed. the common header shall have temperature meters and butterfly/ Non return valves as required. While designing the Header of DG set shall be taken from the manufacturer.

21.23.13. Synchronization System

The synchronization panel shall be complete in all respects for auto operation of D.G. Sets. The minimum requirement for D.G. set operation shall be as detailed below, however, the vendor shall indicate in details the additional features and facilities being offered by them.

The parallel operation of D.G. set in Synchronization mode shall be completely through Power Control Center Module (PCCM). The PCCM shall be mounted on DG SETs outside the Building (the supplying and fixing of the PCCM is in the scope of Supplying and fixing of DG vendor Set). The PLC for the further operation shall be mounted on the Synchronizing panel with SLC 5/03 processor, kw transducer & suitable input /out put card,8 channel analog card Power Monitors – IV . The wiring between the DG Sets, PCCM and Synchronizing Panel is included in the scope.

During the parallel operation, the system take care of the load sharing i.e. active and reactive both for all the D.G. sets. and issue soft commands for voltage / frequency raise / lower, Depending upon the load requirements, the system shall start / stop the D.G. sets.

Monitoring & logging of the electrical data and events through existing P C. This will be achieved by using microprocessor based PC controller or equivalent networking kits & required hardware like GCM, modlon convertor ,communication cable.

Alarms and necessary remedial commands for D.G. and electrical system fault. D.G synchronizing panels . Local Control and Manual Synchronization (Common for all D.G. Sets Part of the Synchronizing Panel)

The minimum equipment shall be as follows:

- a. DG selector switch
- b. PLC / manual selector switch
- c. Double scale voltmeter
- d. Double scale frequency meter
- e. Synchronoscope
- f. Check synchronization relay
- g. Synchronization lamps
- h. Solo parallel selector switch
- i. Manual synchronization circuit “ON”/”OFF” selector switch
- j. Push buttons & indicating lamps
- k. Control PT
- l. Mimic

The following components shall be provided for each DG Set :

- a. Breaker control Switch except for DG Incomer.
- b. Automatic battery charger having inbuilt Trickle /boost facility selector switch for battery charger
- c. DC digital Ammeter and Voltmeter selector switch
- d. Auto/Manual selector switch for priming pump
- e. Breaker control switch (only for one number bus-coupler required)

- f. Indicating lamps (LED type) for following:
- g. R1Y1B, phase indication
- h. D.G breaker “ON”/”OFF” spring charged
- i. Neutral contactor “ON” /”OFF”
- j. Engine running
- k. Battery charger “ON”
- l. Control supply healthy
- m. Priming pump “ON” /”OFF”
- n. Speed raise /low joystick
- o. Voltage raise / low joystick
- p. 12 window annunciator with alarm Accept/Test/Reset push buttons, Hooter.
- q. Temperature Scanners for RTD and BTM
- r. Beacon light
- s. Hour meter
- t 5 Nos. Under voltage relay for mains feeder
- t. 5 Nos. Over Voltage relay for mains feeder
- u. Stand by Earth fault relay
- v. Reverse power relay (reactive)
- w. Trip circuit supervision relay
- x. Master trip relay
- y. 5 H.P, DOL starter for oil priming pumps for D G Set
- z. Power factor meter (Analog)
- aa. Frequency meter (Digital)
- bb. Ammeter (Digital)
- cc. Voltmeter (Digital)
- dd. KW and KVA meter (Digital)
- ee. Kwh meter (Digital)
- ff. D.C. Ammeter (digital)
- gg. D.C. Voltmeter (digital)
- hh. Breaker Control Switch for bus coupler
- ii. Battery Charger on / off switch with boost and trickle charger facility
- jj. Trickle / booster charger selector, switch
- kk. Push buttons (lot)
- ll. P. T
- mm. Aux. Contactor (lot)
- nn. transducers

21.23.14. Automatic Generator Sequencing

- a) Automatically start & stop gen sets based on plant load or bus on process demand.
- b) Configurable plant bus demand start / stop levels and timers.
- c) On line engine priority sequence configurability from any synch. Unit or PC to equalize run time of all DG Sets.

21.23.15. SYNCHRONISING PANEL

The technical specification and details of the microprocessor based PLC

controller for the DG set synchronizing and load sharing shall be as follows:

The microprocessor based PLC panel shall be suitable for use with AVR and electronic speed governor to protect and monitor DG sets.

Double Frequency Meter and Double Voltmeter shall be provided in synchronizing panel.

Synchrony check relay also shall be provided.

The PLC shall be provided with following features and audible alarm:

- o Engine pre glow control
- o Fuel solenoid control
- o Engine starter control
- o KVA controlled cool-down timer
- o Speed monitoring
- o Over speed protection
- o Oil pressure monitoring, alarm and shutdown of the engine.
- o Water temperature monitoring, alarm and shutdown of the engine
- o Battery voltage monitoring
- o Over speed monitoring and alarm.
- o 3 attempt start failure alarm
- o Under/Over Frequency
- o Reserve Power (Inverse time delay)
- o Loss of excitation
- o Over current (inverse time delay)
- o Loss of utility power detection
- o Load surge
- o Current unbalance
- o Voltage unbalance
- o Mains Protection (vector shift, df/dt ROCOI)
- o True RMS power calculations accurate control
- o Configurable loading/unloading ramp rates
- o Isochronous load sharing of up to 4 units using percentage based load sharing
- o Base load control for optimum fuel efficiency
- o Import export control using a watt transducer
- o Soft utility transfer function
- o Digital signal processing to eliminate harmonic issues
- o Adjustable phase window, Voltage and dwell time
- o Safe dead bus closing logic internal to the control
- o Synchronization across generator and mains breakers
- o Multiple short re-closing with adjustable time delay
- o Manual voltage and speed adjusts for manual synchronizing
- o VAR sharing on isolated busses using percentage based reactive load sharing
- o Power factor or VAR control when base loaded
- o Externally adjustable VAR or PF set point levels.
- o The DG set shall start and stop automatically based on plant bus demand.

The PLC system shall be provided with built in relays for protection of the following:

- o Reverse Power
- o Reverse KVAR
- o Over current
- o Under and over voltage
- o Under and over frequency
- o Synchronization check and earth fault relay.

The PLC system shall be suitable for load sharing by sensing active and reactive power.

The PLC system shall comprises of the following:

- o Main processor unit
- o Power module for power supply to the processor and the system
- o Power monitor to monitor voltage, KVA, KVAR, KW, KWH, KVAH, KVARH.
- o 16/32 channel Digital input module
- o 16/32 channel Digital output module
- o EEPROM for main processor unit
- o Computer to PLC communication card with necessary cables.
- o Window based operator interface Software Package
- o Mounting chassis for the equipment

The microprocessor based main processor of the system shall be suitable for 128 digital I/P and 128 O/P and comprises of the following:

The main processor unit shall be suitable for operation on 24 Volts DC with integrated memory. The integrated Ram memory shall be 20 K Words for program, data and constants plus data memory and flash EPROM of 16 K works for backup application program, communication card and real time clock. 4 Nos. discrete combination module (Input/output Module) shall be provided and the same shall be suitable for operation on 24 volts DC system. Combination module shall be with 16/32 inputs and 16/32 output channels as per the actual requirement.

- o 1 No. 2 slot extension rack
- o 1 No. Ram back up battery unit
- o 8/4 Nos. digital input module
- o 8/4 Nos. digital output module

The CPU display unit shall be suitable for 4 lines of 40 characters. The display shall be with back lit LCD. Clarity shall be not less than 5 x 7 pixels. The height of the characters shall be not less than 5 mm. The data entry shall be with the help of 24 function keys. In addition to this there shall be 10 service keys and 12 alphanumeric keys. The system shall be provided with RS 232 communication port.

21.23.16. OPERATION AND COMMUNICATION

The PLC shall monitor the bus bar load continuously. In event of mains failure the PLC shall give signal to select and start the generator, which is closer to the load sensed during the last 60 seconds. In case the load at the time of main failure is more than the highest rating DG set, the PLC shall give command to start 2 Nos. DG sets to suit the load, synchronize the sets and

give command to close the breaker on the main LV panel.

If load starts reducing the PLC shall give command to turn off the DG sets through cool down timer. On restoration of main power supply, the PLC shall check the voltage and frequency and if they are stabilized and within the permissible tolerances, the PLC shall give command to shut down the DG sets through cool down timer.

The control and monitoring of the cooling tower and fan and feed pump shall be done through PLC control system. Necessary control wiring between cooling tower, pumps and PLC panel shall be carried out within the scope of work.

21.23.17. SYNCHRONIZING MODULE

The synchronizing module shall be a microprocessor based intelligent unit, which shall monitor the electrical parameters and shall be able to communicate with the PLC control unit in the process of synchronizing and load management. The system shall be suitable for dynamic synchronization. The synchronizing module shall be suitable for programming and set the preferred difference between DG set and bus bar.

The synchronization module shall monitor and fulfill the following conditions before the system synchronizes the DG set to mains.

Feed back signal from the DG breaker on main LV panel that the breaker is in open condition.

- o Bus bar voltage is present
- o Generator voltage is present

The frequency regulator in the system shall start when the generator voltage and the bus bar voltage is over 50% of normal voltage. The voltage regulator in the system shall start when the frequency is within 90% of the normal system frequency.

The system shall close the breaker on the power panel without carrying out synchronization when all the below mentioned conditions are fulfilled.

Feedback signal from the DG breaker on main LV panel that the breaker is in closed condition.

- o Bus bar voltage is present
- o Generator voltage is present

The synchronizing module shall transmit all monitored electrical parameters to the PLC unit and the PLC unit shall start controlling the synchronization of the DG sets and its load management. The data logging, monitoring and controlling shall be through a PC based SCADA station.

Item No:- 383-401**24. FIRE ALARM SYSTEM & PA SYSTEM****24.1. GENERAL**

1.1 The system shall include all materials, equipment and wiring required to install the complete Fire Detection and Alarm System. The system shall include but not be limited to one or more control panels, repeater panels, sensors, call points, audible and visual alarm indicating devices and relays.

The installation shall include the laying of all cables required for connection of the detection, alarm indicating and other devices along with connections to the power supply as appropriate to the design. All cabling shall conform to the requirements and recommendations of the Fire Alarm Control Panel manufacturer.

The system shall be designed such that no more than 80% of the available signalling / detection loop capacity is employed to allow for future requirements.

The bidder should be able to demonstrate their competence to design, install and commission the Fire Alarm System by providing references of executed projects.

Fire Alarm Control Panel (FACP)

The Fire Alarm Control Panel shall be independently certified as complying with requirements of EN54 / UL.

Functional Description

The FACP shall be the central controller of the complete system. It shall receive and process analogue information from the detection devices, provide audible and visual indication of alarm and other conditions to the user, automatically initiate alarm response sequences and provide the user interface for interrogation and user programming of the system.

Updates to the FACP operating software shall be simple to undertake and shall not require the use of replaceable components. The operating program and configuration memory shall be stored in non-volatile memory and shall not rely on batteries for retention.

The FACP shall provide a user interface from which; controls can be operated, manual operations can be carried out, indications are audible and/or visible and system information can be obtained. It shall also be capable of unambiguously indicating the following functional conditions: Quiescent condition, fire alarm condition, fault warning condition and disablement condition. Furthermore, the fire alarm condition shall always be capable of clearly being indicated without any prior manual intervention at the FACP.

The FACP shall be easy to configure all basic operating characteristics and variables through the user interface on the FACP to satisfy the detection zone and output mapping of the premises. A PC Tool operating under the Windows™ operating system shall also be available to fully program the panel.

The FACP shall support minimum 120 Detector/ devices on the signalling single loop.

The FACP shall fully support the sub-addressing capabilities of the relevant input and output

devices. **The FACP shall be equipped with a white backlit display (840 Character/240 x 64 pixel resolution/10" Touch screen) graphical LCD Display**

The FACP shall contain of one, one to two or one to four signalling loop drivers depending on the system design requirements. Each signalling loop shall be capable of supplying at least 500mA of power for loop-based sounders or other output devices. The Fire Alarm Control Panel software and hardware loop driver, without modification, shall be compatible with the analogue detectors, call points, input and output devices.

The FACP shall fully support radio based/ wireless devices within each loop. It shall be possible to connect both wireless and wired devices in same loop.

The FACP shall provide a diagnostic monitoring feature for all signalling loop, alarm device output and auxiliary supply output circuits to monitor voltage, current load etc. In addition, diagnostic monitoring of the signalling loop return current pulses shall be provided.

The FACP shall incorporate a real-time clock for time stamping of events in the event history log and for scheduling of time related functions.

It shall be possible to install a network communications card to allow connection of up to 200 control panels, remote terminals, mimic displays or other peripheral devices. The network shall offer peer-to-peer operation and have a fault tolerant capability. The time to propagate a fire alarm condition across the network shall not exceed 3 seconds.

A single FACP shall have the capability for configuration and operation of 200 fire alarm zones. In a network system, the overall system shall have the capability for up to 2000 zones.

It shall be possible to adjust sensitivity settings for all detection devices based on a time clock. It shall be possible to select device modes for both active and inactive time periods for multi-sensor detectors.

It shall be possible to connect optional equipment in accordance with the requirements of EN54-2 Standardised I/O such as mimic panels and remote control terminals/ repeater panels.

It shall be possible to connect remotely to Fire Alarm System through ethernet and access the Fire Alarm System via an internet-based program (web browser)

The housing shall meet IP30 minimum ingress protection classification finished in RAL 7035. It shall not be possible to open the enclosure without a key or special tool.

The Fire Alarm Control Panel shall be capable of networking up to 32 Nodes on a standard network and up 200 Network Nodes on a secure network

A zoning facility to allow the networked system to share up-to 2000 zones giving non-confusing indication and allowing true peer-to-peer cross panel report, control and site-wide cause and effect functionality.

Simply adding and connecting a network card will allow any node/control panel or remote terminal to be networked. All other nodes on the system will be instantly aware of a panel as soon as it is given a valid network node address, allowing additional panels to be added at

any time with a minimum amount of reprogramming with the facility to prevent the transmission of fires or faults during commissioning on network systems.

It shall be possible to connect remotely to Fire Alarm System through ethernet and access the Fire Alarm System via an internet-based program

A PC Configuration Tool shall be available for configuration of the FACP and for retention of configuration data.

The PC Configuration Tool shall operate under Windows™ operating systems.

Software tools available shall have Configuring and programming of FACP, Bitmap format for customer/end-user branding

Power Supplies

All power supplies (integral to the fire alarm control panel or remote) shall be certified to EN54-4 /UL and shall be capable of supporting 72 –hour standby requirements. The FACP shall have a built-in or remote battery temperature sensor.

All power supplies shall be capable of operating from a main supply of 200-240VAC 50/60Hz.

Detectors and Devices

The system shall be compatible with and fully capable of using all the features of the following detection, alarm indicating and other devices.

The Devices shall be independently certified as complying with requirements of **EN 54 / UL**.

The system must utilise digital transmission techniques combined with suitable error checking and fast response capability using flag setting and grouping options.

All devices must use soft/safe or hard addressing methods and shall have non-volatile memory within the main body of the device.

There must be provision on the addressable loop for a capacity dependent on the protocol of at **least 120 detector/ devices** each with a capability for control and monitoring.

Detectors shall incorporate a double dust trap to reduce the incidence of false alarms.

Devices shall incorporate bi-directional short circuit isolators. (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)

Detectors shall be designed to operate over a system loop voltage range of 17 to 35V DC

Optical Smoke Detectors

The device should provide bi-colour LED status indication with 360 degree cone of view that can flash green if preferred under normal conditions, but which will illuminate red under alarm activation. This option and can be programmed via a PC configuration tool.

Optical detector shall incorporate **bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device).**

The photoelectric smoke detector shall offer a broad range response capability and be third party certified to **EN54/Vds/ UL**

Smoke detectors shall feature a precision moulded screen to prevent ingress of larger airborne contaminants or insects to the chamber.

Smoke detectors shall offer the option to select one of four sensitivity levels related to the type of application, accessible via programmer or panel.

Detectors shall allow interrogation remotely via the panel or via a hand-held programmer to determine level of contamination and production data.

Multisensor Detectors

The device should provide bi-colour LED status indication with 360 degree cone of view that can flash green if preferred under normal conditions, but which will illuminate red under alarm activation.

Multisensor detector shall incorporate bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)

The detector shall be third party certified to EN54/Vds/ UL

A multi-criteria detector shall provide software algorithms that integrate the inputs from the individual sensors whilst also offering a choice of minimum five response levels.

The detector shall provide software control to allow response to be switched via the panel to select multi-criteria, smoke only or heat detection only based upon application requirements.

The smoke detection capability shall feature a precision moulded screen to prevent ingress of larger airborne contaminants or insects to the chamber.

Detectors shall employ a single high sensitivity thermistor as the temperature sensing element.

Detectors shall allow interrogation remotely via the panel or via a hand-held programmer to determine analogue values and production data.

Thermal Detectors

The device should provide bi-colour LED status indication with 360 degree cone of view that can flash green if preferred under normal conditions, but which will illuminate red under alarm activation.

Multisensor detector shall incorporate **bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)**

The heat detector shall offer Class P performance capability, allowing it to be set via software to either a fast Class A1R or higher temperature Class B response level and be third party certified to **EN54/Vds/ UL**

Heat detectors shall employ a single high sensitivity thermistor as the temperature sensing element.

Detectors shall allow interrogation remotely via the panel or via a hand-held programmer to determine analogue values and production data.

Detector Bases

Detector bases shall incorporate an option to lock the detector in place to restrict opportunity for tampering as well as provide a deep base and relay base option.

Each detector base shall have the standard facility for a remote output (for LED etc) which shall be separately controllable from the control panel providing a minimum of 20mA output.

Input / Output Modules

The protocol must utilise digital transmission techniques combined with suitable error checking and fast response capability using flag setting and grouping options

Devices must use soft addressing methods with the address held in non-volatile memory within the main body of the device.

The device shall provide bi-colour LED status indication under panel control that can flash green if preferred under normal conditions, but which will illuminate red under alarm activation.

Devices shall incorporate **bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)**

The Line Modules must offer low current consumption of less than 500 μ A in quiescent and nominal 6mA in alarm conditions.

The Line Modules shall be third party certified to EN54/Vds/ UL

The Input Module variants shall provide for both open and short circuit fault supervision of the monitored circuit wiring.

The Output Module variants should include both volt-free changeover relay and fully supervised load switching versions, both rated 30VDC 2A.

Combined multi-way modules shall combine input and output module functionality in the same device but still allowing independent panel control by allocating separate addresses for the circuits.

The device shall allow interrogation remotely via the panel or via a hand-held programmer to determine status and production data.

Line Modules shall be available in a choice of mechanical housings to cater for different application needs, including surface mount and mini “in box” options.

Line Modules shall be provided with pluggable terminal blocks to aid field wiring termination.

Device software shall feature a distinctive Type ID to allow the panel configuration software to identify the device type for group monitoring and control purposes.

Manual Alarm Call Points (MCP)

The protocol must utilise digital transmission techniques combined with suitable error checking and fast response capability using flag setting and grouping options.

The device must use soft addressing methods with the address held in non-volatile memory within the main body of the device.

The device should provide bi-colour LED status indication that can flash green if preferred under normal conditions, but which will illuminate red under alarm activation.

MCP Devices shall incorporate **bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)**

MCP Devices must offer low current consumption of in both quiescent and alarm conditions.

The MCP shall be third party certified to both EN54/ UL/Vds

All MCP shall be type ‘A’ and must be resettable with a clearly visible alarm flag when operated and employ a custom reset key that provides a positive rotating action to return an operated element to the normal condition.

MCP devices shall allow interrogation remotely via the panel or via a hand-held programmer to determine status and production data.

They shall be designed to operate over a system loop voltage range of 17 to 35V DC.

MCP Devices shall provide capability for both surface and flush mounting and a security cover option should be available.

Wall Sounders

The protocol must utilise digital transmission techniques combined with suitable error checking and fast response capability using flag setting and grouping options.

The device must use soft addressing methods with the address held in non-volatile memory within the main body of the device.

Devices shall incorporate **bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)**

The Wall Sounder must offer low current consumption of less than 500 μ A in quiescent and nominal 5mA in alarm conditions.

The Wall Sounder shall be third party certified to **EN54/ UL/Vds**

The Wall Sounder shall provide facility for volume adjustment together with offering a maximum sound pressure output of up to 98dBA.

The Wall Sounder shall provide a choice of tone settings enabled via software selection through the panel configuration.

Sounder tones shall be capable of being synchronised under panel control. The device shall allow interrogation remotely via the panel or via a hand-held programmer to determine status and production data. The Wall Sounder shall be designed to operate over a system loop voltage range of 17 to 30VDC.

The Sounder shall provide a surface mount capability with a back box that incorporates 20mm cable gland connection options.

The Sounder body shall be moulded from impact resistant Red thermoplastic.

Device software shall feature a distinctive Type ID to allow the panel configuration software to identify the device type for group monitoring and control purposes.

Wall Sounder Beacon

The protocol must utilise digital transmission techniques combined with suitable error checking and fast response capability using flag setting and grouping options. The device must use soft addressing methods with the address held in non-volatile memory within the main body of the device.

Devices shall incorporate **bi-directional short circuit isolators (For Detectors/Device without inbuilt isolator, Fault Isolator or Isolator base to be provided with each detector/device)**

The Wall Sounder beacon must offer low current consumption of less than 500 μ A in quiescent and nominal 9mA in alarm conditions. The Wall Sounder beacon shall be third party certified to EN54 / UL/ Vds. The Wall Sounder beacon shall provide facility for volume adjustment together with offering a maximum sound pressure output of up to 98dBA.

The Wall Sounder beacon shall provide a choice of tone settings enabled via software selection through the panel configuration. The Wall Sounder beacon shall provide a flash rate of 0.5Hz or 1 Hz The device shall allow interrogation remotely via the panel or via a hand-held programmer to determine status and production data. The Wall Sounder beacon shall be designed to operate over a system loop voltage range of 15 to 30VDC. The Sounder shall provide a surface mount capability with a back box that incorporates 20mm cable gland connection options. The Sounder body shall be moulded from impact resistant Red thermoplastic. Device software shall feature a distinctive Type ID to allow the panel configuration software to identify the device type for group monitoring and control purposes.

Beam Detector

Addressable or conventional type beam detector. All required modules and power supply should be considered for conventional type. Low level system controller shall be provided for carrying out configuration and alignment. The beam detector shall be reflective type, auto aligned and shall be configurable from 8m to 100m. Each system controller shall support two detectors.

The controller shall provide separate fire and fault relays per detector.

The beam detector shall be third party certified to EN54 / UL/ Vds

PUBLIC ADDRESSABLE SYSTEM AND TALKBACK SYSTEM

1. General description

The contractor shall supply, install, test, connect and commission a high quality fast-acting Public Address and Voice Alarm System complying strictly with BS 5839 part8 and EN 60849. The Public Address and Voice Evacuation System shall comprise of Audio Matrix Units, High quality speakers, Audio rack all mounted on a 19” Rack and fully connected and integrated on the fire alarm loop. The system shall be used for Professional Sound Reproduction for all the areas where possible special events take place.

Prior to placing an order for any equipment, the contractor shall submit comprehensive document comprising working drawings, catalogues and descriptive literature of components. The contractor shall be required to train and instruct client's personnel in the correct use, operation and supervision of the system, preferably prior to the handing over of the project.

In order to ensure whole site integration capability, the fire and voice alarm system will be awarded to a single specialist local supplier who will be responsible for the design, global operation, management and interfacing of the system. The contractor shall make sure that all power tapping of the speakers must be carried out as specified, even if the acoustic calculations indicate less power tapping. The contractor must endure a minimum of 10dB above the ambient noise levels are achieved.

The system shall be fully programmed to accommodate fire alarm and voice communication zones as indicated on the drawings and schematics. The system shall be configured to allow on site modifications with the minimum of disruption using the PC based software to facilitate future changes or alterations to the buildings.

2. Scope of Work

The scope of work under this head shall include designing, supplying and installing of Public Address System. The work under this system shall consist of furnishing all materials, equipment and appliances and labor necessary to install the said system, complete with Speakers, Amplifiers, Mike, Zone Selection Panel for interfacing with other systems.

The PA system is designed to serve the dual purpose of making general announcement and Voice Evacuation at the time of Fire alarm activation.

System shall have following functions:

- Voice Evacuation and Public Address system integration includes paging system and background music system.
- Monitoring of microphone, controller, amplifier, fireman microphone, source modular, and amplifier changeover, AC&DC power Supply, Loudspeaker Line and Volume Control.
- The Amplifier shall be used only Class-AB with Digital switching power technology
- System shall have facility for Backup amplifier for at least one backup amplifier over 8 Working Amplifier.

3. Amplifiers

All amplifiers shall be power amplifier with High quality speech and Music broadcast. The power amplifiers shall have adequate continuous (RMS) power output to meet the requirement of the configuration. The unit shall be capable of delivering the rated output power with less than 0.1% harmonic distortion in the design bandwidth. The amplifier shall have a broad band frequency response of 40 Hz to 20 KHz. The output voltage and impedance shall meet with the system requirements. Amplifiers shall be protected against over loads and output shorts and a special thermal overload on the heat sink.

The Amplifier shall have rated power 120/160W /250W/480W. The Amplifier shall have switch power technology for power electricity saving, Separate PFC design for highest reliability, separate power supply system for each channel, Separate cooling system, sleep mode is automatically enabled when no signal input is detected.

Amplifier shall have AC 230V power supply and DC 24/36V input, having separate fuse for each channel. The Amplifier shall be connected through balanced audio input and shall work on 100V Speaker Line.

4. 6W Ceiling Mounted Speaker

The ceiling mounted 6 W speakers shall be installed as depicted in the drawing. The Ceiling speaker shall work on 100V line so that it can reduce line losses over long distance and allow easy parallel connection of multiple loudspeakers. The Speaker shall have multiple tapping for different application according to room size and ambient noise environment. The Speaker shall have aluminium grille and metal baffle and shall have spring clip clamp for easy installation.

Technical Data Sheet

Rated Power	6W
Transformer Taping	6W - 3W - 1.5W
Input Power	70V/100VAC
SPL at 1W (at 1 KHz, 1m)	92 dB
Impedance	1667/3333/6666 ohm
Frequency range	60 Hz ~ 15KHz

Dimensions	208mm (OD) x 80mm (H)
Material	ABS with metal grill
Color	White/Black (as per requirement)

5. **6W Wall Mount Speaker**

The Wall mounted 6 W speakers shall be installed as depicted in the drawing. The speaker shall work on 100V line so that it can reduce line losses over long distance and allow easy parallel connection of multiple loudspeakers. The Speaker shall have multiple tapping for different application according to room size and ambient noise environment. The Speaker shall have Metal grille and ABS Enclosure and shall be closed cabinet.

Technical Specification:

Rated Power	6W
Transformer Taping	6W, 3W, 1.5W)
Impedance	1667/3333/6666 ohm
Input Power	70V/100VAC
Speaker Unit	5" Cone Type
SPL at 1W (at 1 Khz, 1m)	92 dB
Frequency Response	120Hz-16KHz
Mounting Method	Flash-mounted spring-loaded clamp
Dimensions	(LX W X H)100X 75X 55 mm
Enclosure	Open frame type

6. **Remote Paging Microphone**

The user interface to the entire public address system shall be the Zone Selection Panel. It shall be able to address 6-64 Zones. the Microphone shall have min. 16 button .

The microphone allow remote control for system voice message, information and zone paging by users, it shall allow zone paging up to 64 zones and can be extended by adding keypad easily.

Microphone shall have following features

- One Press to select for easy operation
- Parallel transmission and can be expandable easily by using CAT-5/6 Cable.
- Microphone shall be capable for indication of system fault and status.
- Microphone shall have line audio input and adjustable input volume.
- Paging Button Mode & PTT mode should be available
- It shall control BGM, Call & Zones

- LED display for the status and working of Microphone.
- 7Segment display for zone number display.
- Operates on 24VDC

7. Voice Alarm Controller

The central controller shall be the integrated solution for BGM and emergency voice alarm system. The voice alarm system shall be designed for public address and emergency evacuation. All the essential EVAC functionality – such as system monitoring, spare amplifier switching, loudspeaker line surveillance, digital message management and a fireman’s panel interface – shall be combined.

It shall have the following functions:

The system shall provide for emergency call (EMG), business call and BGM audio, up to more than 256 zones, 6-8 call stations. It shall be compatible with BGM sources and 100 V Class-D/AB amplifiers. It shall be capable of connecting to EVAC compliant loudspeakers and accessories for an integrated public address and voice alarm solution.

The system shall be fully IEC 60849 compliant. It shall have full system supervision, loudspeaker line impedance supervision, a supervised emergency microphone on the front panel and a supervised message manager for EVAC and ALERT Message.

The system shall be capable of integrating with Fire alarm evacuation and public address system functions like voice programmable broadcast, evacuation message, playing programs, background music timing playing. Controller shall be able to operate and configure easily.

The controller shall have capability to integrate 1 independent music player, shall support timing, fixed, playback modes, Support MP3 and WMA audio format.

Controller shall support zone selection, zone distribution, and grouping operation and it shall have capability to control volume independently. This shall have capability to customized zone name, group name, host name, easy to operate and manage. This shall support following features: event trigger, timing trigger control output, zone monitoring, equipment status real time check, line redundant wiring, real time diagnosis, support sound, light alarm and prompt maintenance and troubleshooting.

Controller shall have the capability to transmit 1 pre recorded messages simultaneously in different zones.

Technical Specification:

Switching Signal Level	100V (nominal)
Inputs (Nominal)	1 x Mic (1mV/4.7k) Speech Amp (100V)
Display	Zone Selection LEDs, Power ON/OFF. switch
Power Supply	AC 220-240V, 50/60Hz

Stand by Power Supply	24V dc
Current Consumption	200 to 300mA@24Vdc

Item No:- 428-436**CLEAN AGENT SYSTEM TECHNICAL SPECIFICATIONS****1 CLEAN AGENT BASED(NOVEC 1230(3M)) LOCAL FLOODING SYSTEM FOR ELECTRICAL PANEL****General**

The scope covers Supply, Installation, Testing and Commissioning of Automatic clean agent based Novec 1230(3M) local flooding system complete for electrical panels with flexible Fire trace detection tubing, cylinder, valves, integration with Main Fire Alarm Control Panel for status monitoring etc. The scope of work includes, but not limited to the following.

- Providing clean agent Novec 1230(3M) flooding system with flexible fire detection/ discharge tubes inside panels.
- Clean agent storage cylinder valve assembly
- Audio-visual annunciation devices for indicating incidence of fire.
- Any other item required to the successful commissioning of the system.
- Complete system should be LPCB/UL/VDS approved
- Vendor has to submit project specific authorization letter issued by the OEM at time of bidding.
- The Cylinder must be filled in a UL/FM/PESO approved plant owned by the system OEM.

The electrical panel fire suppression system shall be complete with Direct Clean Gas storage cylinders for required capacities, extinguishing agent as specified, fire detection tubing, filling and end-of-line adaptors, pressure switches, control equipment, Clean Agent Cylinder/Valve Assembly, Cylinder Mounting Bracket and all necessary accessories to protect the Electrical panel in case of fire. The system will have an interface with Main Fire Alarm and Control Panel. In case of fire in the concerned panel, indication of Fire/discharge status should come in Main Fire Alarm and Control Panel.

Design Requirements

1. All the detecting devices, alarm, indicating devices, containers and other related equipment shall have required approvals & Authorization.
2. All installations shall conform to LPCB requirements.
3. Clean Agent Novec 1230(3M) should be used with below mentioned properties
 - The Clean Agent should have Zero Ozone Depletion Potential. (ODP = 0)
 - The Clean Agent should not have Global Warming Potential of more than 1 day.
 - The Clean Agent should be a low pressure.

System Equipment

The tube should be UL Listed (UL-521) and shall be installed throughout the Electrical Panel with one end connected to the top of the Clean Agent container valve. The tubing shall be pressurized with Dry Nitrogen to 195 psig. The tube shall burst at temp of 100-120 degree C. Tube should be red colour marked with OEM name and shall perform below three functions:

1. Heat Detection,
2. System Activation and
3. Clean Agent discharge.

Clean agent Container

1. All cylinders shall be approved to DOT (NFPA) and PESO requirements. Containers shall be standard model and size of ease of replacement and addition.
2. Each storage container shall be equipped with a nickel-plated brass valve, a pressure gauge to monitor container pressure, and a quarter-turn ball valve that interfaces with the detection tubing. The quarter-turn ball valve shall be kept closed at all times when the container is not in service.
3. All container valves shall be equipped with a pressure relief valve (rupture disc) device in compliance with DOT requirements.
 - The clean agent based Pre-Engineered automatic direct fire suppression system should be UL/LBCP/VDS approved.
 - Each clean agent pre-engineered automatic system is equipped with its own detection/discharge tubing. Vendor to submit detailed drawings & calculations based on design specifications of Approval agency.
 - The unit shall be a self-contained and shall be equipped with its own non-electric automatic detection system to detect the fire and agent release system into the Electric panel to suppress the fire.
 - The Clean Agent is stored in DOT/PESO approved steel cylinders as a liquefied compressed gas, super-pressurized with Dry Nitrogen to 195psig at 70°C F. The ambient operating temperature range for all system components should be 0 degree C to 54 degree C.
 - Each container is equipped with a nickel-plated brass valve, a pressure gauge to monitor container pressure, and a quarter-turn ball valve that interfaces with the Detection Tubing. In addition, the container valve shall be equipped with a pressure relief (rupture disc) device in compliance with DOT/PESO requirements.
 - Provide wall-mounted painted steel bracket to mount the container/valve assembly in a vertical (upright) position. Each bracket should be equipped with at least two integral quick-clamp straps as per manufacturer standard practice.
 - Distribution of Detection Tubing shall be ensured in each compartment of the Panel viz. Busbar Section, Switchgear Section and Cable Alleys etc. with routing on any two sides. Mounting/ installation of the detection tube to be as per manufacturer design.

Item No:- 402-408

25. CCTV & SURVEILLANCE SYSTEM

The Entire surveillance system is proposed and designed to control and monitors the different buildings of GBU Gandhinagar Campus. All the buildings shall have IP Based Dome/Bullet Camera indoor/Outdoor type and PTZ Cameras for outdoor surveillance.

The different types of cameras shall be provided at locations as mentioned in Design Basis Report.

The Dome Cameras and Bullet Cameras are proposed to be installed at all Entry & Exit Points, corridors, Lift Lobby & staircase entrances in buildings and at all floors.

All the outdoor cameras shall be in IP 66 Housing and Junction box, power supply unit, media converter etc are proposed in dust proof housing The existing LAN network switches would be used for CCTV connectivity and will be connected to central CCTV server & cameras shall have POE connectivity ports. The power supply to LAN switches will be on UPS. The video recording shall be non embedded based recording server of reputed make with video management software.

Control Room shall be located in the Security /Control Room. The wiring inside the building shall be with CAT 6A cable in PVC conduit and Armoured fiber Optic Cable and Outdoor connectivity shall be under ground in HDPE pipes with suitable Manholes for proper Maintenance of the system. PTZ cameras will be placed on roof top and Street light Poles in external areas. The video management server should have **minimum 30 days** storing capacity for all cameras from day 1.

Technical Specification of IP CCTV System

Technical Specification of Dome camera

1. 5 MP IP Fix Lens DOME CAMERA

Parameter	Minimum Specification Requirement	Compliance
		(Y/N)
Type	IP Fixed Lens IR Rugged Dome Camera	
Resolution (No of Pixels)	5 MP (2592 x 1944)	
Image sensor	1/2.8-inch CMOS, Progressive Scan	
Focal length	2.8mm, F1.4	
Lens	Fixed Lens	
Iris	DC-IRIS	
Removable IR-Cut Filter	Auto ICR	
Minimum illumination	Color: 0.005 Lux @F1.6 B/W: 0Lux (IR on)	
IR distance	Smart IR 40m, Day and Night mode switching based on IR sensor or schedule.	
Electronic Shutter	Auto/Manual, 1/100000s ~ 1/3s	
Wide Dynamic Range	130dB True WDR	
Back Light Compensation	Required	
High Light Compensation	Required	
Noise Reduction	2D-3D DNR	
Signal to Noise ratio	55 dB	
Video compression	H.265 HEVC, H.264, MJPEG, Smart Codec	
Angle of View	H:96.5° V:73.8°	

Protocols supported	Pv4, IPv6, TCP/IP, HTTP, HTTPS, RTSP/RTP/RTCP, IGMP/Multicast, SMTP, SNMP, DHCP, NTP, DNS, DDNS, CoS, QoS, 802.1X, UPnP, mDNS(Bonjour), UDP, ICMP, ARP, TLS, SFTP	
Number of Streams supported	Quad Video Streams @ H.265; Each stream independently configurable with different resolution and frame rate	
Stream Resolution	Main Stream: 5MP and lower resolutions Second Stream: 3MP and lower resolutions Third Stream: 720p and lower resolutions Fourth Stream: VGA and lower resolutions	
Frame rate	Main Stream: Max@50fps Second Stream: Max@50fps Third Stream: Max@50fps Fourth Stream: Max@50fps	
Features	Color, Brightness, Sharpness, Contrast, Automatic white balance, Gain control, Fine tuning of behavior at low light, Rotation, Character overlay and all other Image Settings in Web UI	
Built-in Video Analytics	Motion Detection, Scene Change, Tamper Detection, Smart Motion, Smart Intrusion, Smart Loitering, Smart Line Crossing Detection, Unattended Object Detection, Missing Object Detection, People Counter, Queuing, Crowd Gathering, Heat Map, Face Detection	
Defog	Required	
Image Stabilization	Electronic Stabilization	
G-Sensor	Required	
Event Type	Analytics alarm, Disk alarm, Recording alarm, Tampering	
Event Linkage	Email, SD card recording, SFTP recording, NAS recording	
Security	Firmware encrypted & Signed, User account and password protection, HTTPS, IP Filter, Digest authentication, Device Certificate, TLS 1.2 & 1.3, Stream encryption, AES128/256, SSH/Telnet closed, Secure boot, Prevent brute-force attack, Audit User Access/System/Event log management	
Prohibited Protocols	Port 21 (FTP), Port 23 (Telnet), GB/T 28191, SSH. There should not be any provision to enable or disable these protocols in the default firmware from manufacturer. Any special firmware developed to disable these features will not be allowed.	
Privacy masking	5, definable areas	
Region of Interest	6, definable regions	
Local storage	Micro SD/SDHC/SDXC card slot (2TB), SD card encryption with AES-256	
Max. User Access	10 users	
Network	RJ45 (10 Base-T/100 Base-TX)	
Environmental Protection	IP66, IP67	
Impact protection	IK10	
Gore Vent	Required	
Housing Material	Aluminum + Polycarbonate	
Input voltage	12 VDC/24 VAC, PoE (IEEE 802.3 af)	
Power Consumption	Max 10W	

Operating Temperature	-30°C to 60°C (IR OFF)	
Operating Humidity	less than 95% (non-condensing)	
Certifications/ Compliances	ONVIF: Profile S, G, T, M	
	Cyber Security: Secure by Default, PCI-DSS	
	Reliability: IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-4, IEC 60068-2-11, IEC 60068-2-27, IEC 60068-2-64	
	Safety: UL 62368-1, BIS IS-13252 (Part 1)/IEC 69050-1	
	Emission: FCC PART 15, CE (EN 55032), ICES-003	
	Immunity: CE (EN 50130-4, EN 55035)	
	Environment: RoHS, REACH, WEEE	
	Regulatory Compliance: BIS-ER, STQC	
	NDAA: Sec 889	

2. SMP MFZ Dome Camera

Parameter	Minimum Specification Requirement	Compliance
		(Y/N)
Type	N IP MFZ Lens IR Rugged Dome Camera	
Resolution (No of Pixels)	5 MP (2592 x 1944)	
Image sensor	1/2.8-inch CMOS, Progressive Scan	
Focal length	2.7 ~ 13.5 mm, (F 1.4 ~ F 3.6)	
Lens	Motorized Focus and Zoom	
Iris	DC-IRIS	
Removable IR-Cut Filter	Auto ICR	
Minimum illumination	Color: 0.005 Lux @F1.6 B/W: 0Lux (IR on)	
IR distance	Smart IR 50m, Day and Night mode switching based on IR sensor or schedule.	
Electronic Shutter	Auto/Manual, 1/100000s ~ 1/3s	
Wide Dynamic Range	130dB True WDR	
Back Light Compensation	Required	
High Light Compensation	Required	
Noise Reduction	2D-3D DNR	
Signal to Noise ratio	55 dB	
Video compression	H.265 HEVC, H.264, MJPEG, Smart Codec	
Angle of View	H:100° ~ 28.5° V: 73° ~ 21.4°	
Protocols supported	Pv4, IPv6, TCP/IP, HTTP, HTTPS, RTSP/RTP/RTCP, IGMP/Multicast, SMTP, SNMP, DHCP, NTP, DNS, DDNS, CoS, QoS, 802.1X, UPnP, mDNS(Bonjour), UDP, ICMP, ARP, TLS, SFTP	
Number of Streams supported	Quad Video Streams @ H.265; Each stream independently configurable with different resolution and frame rate	
Stream Resolution	Main Stream: 5MP and lower resolutions Second Stream: 3MP and lower resolutions Third Stream: 720p and lower resolutions Fourth Stream: VGA and lower resolutions	

Frame rate	Main Stream: Max@50fps Second Stream: Max@50fps Third Stream: Max@50fps Fourth Stream: Max@50fps	
Features	Color, Brightness, Sharpness, Contrast, Automatic white balance, Gain control, Fine tuning of behavior at low light, Rotation, Character overlay and all other Image Settings in Web UI	
Built-in Video Analytics	Motion Detection, Scene Change, Tamper Detection, Smart Motion, Smart Intrusion, Smart Loitering, Smart Line Crossing Detection, Unattended Object Detection, Missing Object Detection, People Counter, Queuing, Crowd Gathering, Heat Map, Face Detection, Audio Detection	
Defog	Required	
Image Stabilization	Electronic Stabilization	
G-Sensor	Required	
Event Type	Analytics alarm, Disk alarm, Recording alarm, Tampering, Alarm input	
Event Linkage	Email, SD card recording, SFTP recording, NAS recording, Digital output	
Security	Firmware encrypted & Signed, User account and password protection, HTTPS, IP Filter, Digest authentication, Device Certificate, TLS 1.2 & 1.3, Stream encryption, AES128/256, SSH/Telnet closed, Secure boot, Prevent brute-force attack, Audit User Access/System/Event log management	
Prohibited Protocols	Port 21 (FTP), Port 23 (Telnet), GB/T 28191, SSH. There should not be any provision to enable or disable these protocols in the default firmware from manufacturer. Any special firmware developed to disable these features will not be allowed.	
Privacy masking	5, definable areas	
Region of Interest	6, definable regions	
Local storage	Micro SD/SDHC/SDXC card slot (2TB), SD card encryption with AES-256	
Audio	Two-way, Full Duplex, Line in/out, Built-in Mic supporting G.711, H.726, AAC	
Alarm	1 In and 1 Relay out	
Max. User Access	10 users	
Network	RJ45 (10 Base-T/100 Base-TX)	
Environmental Protection	IP66, IP67	
Impact protection	IK10	
Gore Vent	Required	
Housing Material	Aluminum + Polycarbonate	
Input voltage	12 VDC/24 VAC, PoE (IEEE 802.3 af)	
Power Consumption	Max 11W	
Operating Temperature	-30°C to 60°C (IR OFF)	
Operating Humidity	less than 95% (non-condensing)	
Certifications/ Compliances	ONVIF: Profile S, G, T, M Cyber Security: Secure by Default, PCI-DSS	

	Reliability: IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-4, IEC 60068-2-11, IEC 60068-2-27, IEC 60068-2-64	
	Safety: UL 62368-1, BIS IS-13252 (Part 1)/IEC 69050-1	
	Emission: FCC PART 15, CE (EN 55032), ICES-003	
	Immunity: CE (EN 50130-4, EN 55035)	
	Environment: RoHS, REACH, WEEE	
	Regulatory Compliance: BIS-ER, STQC	
	NDAA: Sec 889	

3. 5MP MFZ Bullet Camera

Parameter	Minimum Specification Requirement	Compliance
		(Y/N)
Type	IP MFZ Lens IR Rugged Bullet Camera	
Resolution (No of Pixels)	5 MP (2592 x 1944)	
Image sensor	1/2.8-inch CMOS, Progressive Scan	
Focal length	2.7 ~ 13.5 mm, (F 1.4 ~ F 3.6)	
Lens	Motorized Focus and Zoom	
Iris	DC-IRIS	
Removable IR-Cut Filter	Auto ICR	
Minimum illumination	Color: 0.005 Lux @F1.6 B/W: 0Lux (IR on)	
IR distance	Smart IR 70m, Day and Night mode switching based on IR sensor or schedule.	
Electronic Shutter	Auto/Manual, 1/100000s ~ 1/3s	
Wide Dynamic Range	130dB True WDR	
Back Light Compensation	Required	
High Light Compensation	Required	
Noise Reduction	2D-3D DNR	
Signal to Noise ratio	55 dB	
Video compression	H.265 HEVC, H.264, MJPEG, Smart Codec	
Angle of View	H:100° ~ 28.5° V: 73° ~ 21.4°	
Protocols supported	Pv4, IPv6, TCP/IP, HTTP, HTTPS, RTSP/RTP/RTCP, IGMP/Multicast, SMTP, SNMP, DHCP, NTP, DNS, DDNS, CoS, QoS, 802.1X, UPnP, mDNS(Bonjour), UDP, ICMP, ARP, TLS, SFTP	
Number of Streams supported	Quad Video Streams @ H.265; Each stream independently configurable with different resolution and frame rate	
Stream Resolution	Main Stream: 5MP and lower resolutions Second Stream: 3MP and lower resolutions Third Stream: 720p and lower resolutions Fourth Stream: VGA and lower resolutions	
Frame rate	Main Stream: Max@50fps Second Stream: Max@50fps Third Stream: Max@50fps Fourth Stream: Max@50fps	

Features	Color, Brightness, Sharpness, Contrast, Automatic white balance, Gain control, Fine tuning of behavior at low light, Rotation, Character overlay and all other Image Settings in Web UI	
Built-in Video Analytics	Motion Detection, Scene Change, Tamper Detection, Smart Motion, Smart Intrusion, Smart Loitering, Smart Line Crossing Detection, Unattended Object Detection, Missing Object Detection, People Counter, Queuing, Crowd Gathering, Heat Map, Face Detection, Audio Detection	
Defog	Required	
Image Stabilization	Electronic Stabilization	
G-Sensor	Required	
Event Type	Analytics alarm, Disk alarm, Recording alarm, Tampering, Alarm input	
Event Linkage	Email, SD card recording, SFTP recording, NAS recording, Digital output	
Security	Firmware encrypted & Signed, User account and password protection, HTTPS, IP Filter, Digest authentication, Device Certificate, TLS 1.2 & 1.3, Stream encryption, AES128/256, SSH/Telnet closed, Secure boot, Prevent brute-force attack, Audit User Access/System/Event log management	
Prohibited Protocols	Port 21 (FTP), Port 23 (Telnet), GB/T 28191, SSH. There should not be any provision to enable or disable these protocols in the default firmware from manufacturer. Any special firmware developed to disable these features will not be allowed.	
Privacy masking	5, definable areas	
Region of Interest	6, definable regions	
Local storage	Micro SD/SDHC/SDXC card slot (2TB), SD card encryption with AES-256	
Audio	Two-way, Full Duplex, Line in/out, Built-in Mic supporting G.711, H.726, AAC	
Alarm	1 In and 1 Relay out	
Max. User Access	10 users	
Network	RJ45 (10 Base-T/100 Base-TX)	
Environmental Protection	IP66, IP67	
Impact protection	IK10	
Gore Vent	Required	
Housing Material	Aluminum + Polycarbonate	
Input voltage	12 VDC/24 VAC, PoE (IEEE 802.3 af)	
Power Consumption	Max 11W	
Operating Temperature	-30°C to 60°C (IR OFF)	
Operating Humidity	less than 95% (non-condensing)	
Certifications/ Compliances	ONVIF: Profile S, G, T, M	
	Cyber Security: Secure by Default, PCI-DSS	
	Reliability: IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-4, IEC 60068-2-11, IEC 60068-2-27, IEC 60068-2-64	
	Safety: UL 62368-1, BIS IS-13252 (Part 1)/IEC 69050-1	
	Emission: FCC PART 15, CE (EN 55032), ICES-003	

	Immunity: CE (EN 50130-4, EN 55035)	
	Environment: RoHS, REACH, WEEE	
	Cyber Security: BIS-ER, STQC	
	NDAA: Sec 889	

Technical Specification of Network Storage Management system

S.No.	Technical Specification		Compliance YES / NO
1	No of Desktop Client License	Min 10 concurrent	
2	No of Monitor Per Client Workstation	Min 2 or 4 Monitor per Client Workstation	
3	Recording Performance	2MP resolution 128 Cameras @ 25fps each	
4	Video Stream Supported	Web Client: Live - 64 streams, Playback - 32 streams.	
5		Desktop Client: Live - 256 streams, Playback sessions - 32.	
6		Sync playback - 9 streams.	
7		Mobile App: 16 streams of 1080p HD @ 5 fps each.	
8	Playback Speed	FWD/REV Play x (1, 2, 4, 8, 16) Slow FWD/REV Play x (1/2, 1/4, 1/8)	
9	Archival Support	Yes, 100 mbps	
10	Processor	Intel Xeon Silver 4210 2.2 GHz or Better Xeon	
11	RAM	32GB	
12	OS Drive	Minimum 2 x 240GB SSD in RAID 1	
13	Operating System	Microsoft® Windows 10 or Windows 10 IoT Enterprise or Windows Server 2019	
14	Networks Interface	4 Network Card 1Gbps	
15	Monitor Resolution	Video resolution 1280x1024 pixels, 32 bit	
16	Keyboard Mouse	102-key keyboard and mouse	
17	Storage Hard Drives	12 filed upgradable SATA/SAS hard drives , Each disk capacity up to 20TB	
18	Storage Capacity	240 Raw, Video should be configured in RAID 5 as min,	
19	VIDEO STORAGE DRIVES	Enterprise drive, 7200 RPM SATA/SAS recommended	
20	RAID Controller	Hardware RAID, Data RAID Level: 0, 1, 5, 6, 10	
21	Power Supply	750W Redundant Power Supply	
22	Operating Temperature	10°C to 30°C (50°F to 86°F)	
23	Relative Humidity	10-80% non-condensing	
24	Hardware Chipset Security	TPM2.0	
25	Codec	MPJEG, MPEG4, H.264, H.265	
26	ONVIF	Onvif S, G & T	
27	Audio Support	2 -Way	

28	Screen Layout	Desktop Client - Full, 2x2, 1x5, 3x3, 2x8, 1x12, 4x4. Web Client - 2x2.1x1,1x2,1x3. Mobile app (Phone) - 2x2,2x4,1x2, 1x1. Mobile app (Tablet) - 3x3, 2x2, 1x1	
29	Image Controls	Sharpness, blur, brightness, contrast, hue, saturation, maintain aspect ratio, stretched, original size and picture mirror	
30	Video Search	Time/date timeline, time jump FWD/REV, bookmarks, calendar, preview, film strip, event search and SMART Motion Search	
31	Video Export	Native Format with Clip Player for faster and secure exports. WMV with digital certificate for authentication playable with Windows media player. ASF for faster exporting of longer than an hour backup clips in native compression format	
32	Video Clip Security	Digital Certificate and/or Tool provided to check the clip tampering	
33	Regulatory		
34	Emissions	FCC Part 15 ClassA, EN 55032, EN 55024, EN 61000-3-2, EN 61000-3-2	
35	Safety	UL 60950-1, EN 62383-1, EN 62368-1	
36	RoHS	CE (EN 63000)	

Technical Specification of Video Management System

S.No.		Technical Specification	Compliance YES / NO
1	Platform	VMS should support and run on 64-bit Windows® Server 2019/ Server 2016 / Server 2012 STD	
2	Scalability	VMS shall include a fully scalable enterprise-class media management system to enable simultaneous live monitoring from multiple stations and be configurable for storage both on and off site	
3		The number of recorders and switchers shall be scalable within a network to handle any size of installation.	
4	License	License for cameras and clients should be bundled with the software, keeping in view of future expansion. Any additional server / hardware required to cater to these licenses must be provided at no extra cost. All Camera firmware upgrades to be free during warranty period as well as CAMC period.	
5	Compatibility	Latest standard of ONVIF Profile S, G & T	
6	Redundancy	VMS should support Database redundancy for unforeseen/maintenance scenarios	
7		Support for N+1/N+M Recorder failover and failback automatically or manually	

8	Functionality	Capable of managing pentaplex user operations of attached recording devices simultaneously, including live viewing, recording, playback, archiving of video data to an external storage device, and handling the exchange of data between the server and a remote workstation.	
9		Should also be able to perform System configuration and Alarm management from operator workstation	
10	Configurator	The operator (with Administrator privileges) shall have the option to configure VMS. VMS shall support live updates of all configurations. The following configurations shall be possible:	
11		Option to add/edit/delete Recorders, Cameras, Monitors, Keyboard, Site, Workstation, Partition and Event group.	
12		Associate cameras to a recorder or switcher and map to a site, partition or event group.	
13		Add monitor to a site, partition, event group or keyboard. It shall provide an option to add a digital monitor and associate it with a workstation with provision to configure a digital monitor with a default salvo and startup in full screen.	
14		Support of bulk event association to enable/disable and adjust events for recorders and inputs in bulk.	
15		System Macro Configuration: Option to add/edit/delete macros. Option to restore macros. Execute button option to trigger selected macros provides mechanism for testing written macros.	
16	Recording	Should support Audio / Video recording.	
17		Continuous, scheduled, manual, event and alarm-based recording. All modes shall be disabled and enabled using scheduled configuration.	
18		Different recording speeds (fps) and resolution for each recording mode for each camera shall be possible.	
19		Software Should support ANR (Automatic Network replenishment) Feature where camera should Record to Camera SD card during it gets disconnects from Storage. Once connection is established recording in SD card can be replenished automatically to storage.	
20		The Recording System, once configured, shall run independently of the Video Management system and continue to operate if the Management system is off-line.	
21	Video Compression	Simultaneous use of multiple video compression including H.264, H.265 (including camera dependent smart codec support), MPEG-4 and MJPEG	
22		VMS should support H.265 GPU rendering.	
23	Storage	Multi-level storage: should support multi-level	

		storage (live recording on primary disk, archiving on secondary, and so on).	
24		Should delete video after configurable duration (FIFO based).	
25		Provision to configure different retention periods for every camera.	
26		Should Support NAS/IP SAN through iSCSI transfers.	
27	Archiving	Support for Custom Video Archival period for every camera maximum upto 5 years on FIFO basis	
28	User Logins	VMS Server and Workstation shall have the option of two modes of user logins	
29		Windows Authentication: Uses the Windows logged-in user name.	
30		Active Directory user authentication	
31		User DB Authentication: Uses a preconfigured user name and password	
32	User Management	Users and Roles: Option to add/edit/delete roles and associate to predefined privileges.	
33		Add/edit/delete users and associate users with roles	
34	Viewer	Simultaneous Live view and Playback from different cameras by multiple users.	
35		Viewing screen should be capable of showing 1x1, 2x2, 3x3, 4x4, 5x5, 6x6, 7x7,8x8,1x5, 2+8, and 1+12 layouts of video	
36		Capable of saving current View as a Salvo and/or Shared Salvo to be accessible to other operators.	
37		Capable of selecting a particular camera or salvo by using the mouse to drag it onto the main video viewing screen	
38		Perform Motorized Zoom and focus for all supported cameras (ptz, bullet, dome etc...) remotely from client workstations or control room	
39		Capable of independently adjusting the contrast, brightness, and saturation settings for each camera.	
40		Remote Monitor: This facility shall allow operators to control a remote monitor connected to another workstation and perform review capabilities so that both the local operator and the remote viewer can simultaneously watch the same video	
41		Innovative “One-Click” or “Mouse Drag” 3D PTZ control experience that does away with legacy PTZ controls of continuous clicking	
42		Support for 360° de-warping of fisheye camera into multiple tile views from operator work station	
43		Operator messaging: allowing operators to communicate with each other. Operators can	

		exchange text, images and annotated video sources. Operators can hand over a video source to another operator using messaging	
44		Surrounding Camera View: VMS Client application shall have facility of surrounding camera view.	
45		In a surround view, video from a specific/intended device shall be playing in the Centre and the other videos will be from surrounding devices.	
46		Every video device can be mapped with 12 cameras.	
47		It shall support setting presets in surrounding cameras.	
48		Scan Sequences: Capable of configuring and running scan sequences. Sequence view shall consist of camera view, which can be cycled on a timed basis. There shall be no limit to number of cameras that can be assigned to a single sequence. There shall be no limit on the number of available sequence views.	
49		Create and save virtual cameras in layout for live viewing by digitally zooming into the field of view of camera. These virtual cameras should not require any additional license and operators should be able to create multiple such views.	
50		Adaptive Network Throttling by auto-switching of camera streams to lower resolution / FPS	
51		Body pixilation and blurring in live view to protect customer and employee privacy from abuse of surveillance data	
52		Option to perform various other operations through the context menu on a particular video (live/recorded/sequence). These operations include: Full screen, point and drag, maintain aspect ratio, toggle text, digital PTZ, start/stop recording, save image.	
53	Bookmarks	Operator should be add/delete bookmarks for Live, Recorded videos	
54		Should have provision to add comments to Bookmarks	
55		Support for bookmark searches based on cameras, time duration, and comments	
56	Time Line	Ability to display/manage the timeline of the recording device, which provides camera recording statistics with Min 8 color recording indications,	
57		Mark in/out (with looping facility), snapshot, time slider, time search, time jump, and play controls.	
58		Timeline control shall also include dedicated buttons for step reverse and step forward and keyboard shortcuts for playback operations.	
59	Event Management	Register event associated video and alert operator	
60		Motion detection and camera tampering events	

		should be alerted to the operator	
61		Ability to slue PTZ cameras to alarm-generated areas	
62		In case of an alarm operator should be able to view the video during pre-alarm, on-alarm, post-alarm, and also view live video from the camera which triggered the alarm through a single 2x2 salvo	
63	Search and Playback	Should be able to search video based multiple filters like Recorders, Cameras, Date/Time, Type/Event	
64		Calendar Search with thumbnail image preview of recording and quick export of video clips	
65		Should have advanced, smart search function performing quick Motion Detection search on recorded video for multiple user defined region of interest	
66		Should support sync playback between multiple recorders	
67		Playback with speeds ranging from 1/64X to 256X.	
68		Support for smooth reverse playback at 2x (Recorder Dependent)	
69		4-Eye dual user authentication for playback	
70		of original video record	
71	Export Clip/Video	The VMS shall export video and audio data optionally in ASF/MOV/WMV format to a CD/DVD drive, a network drive, or a USB drive. The exported data in ASF/MOV/WMV format may be played back using standard software such as Windows Media Player.	
72		The VMS shall export video and audio data optionally in its native recording format to a CD/DVD drive, a network drive, or a direct attached drive. Viewer software shall be included with the export.	
73		The video management system shall write a digital signature to the exported video. This shall allow the viewing client to verify, that the imported video has not been tampered. The utility/verification tool shall provide a warning in case that the video has been tampered. This shall be done by means of the checksum of the digital signature.	
74		It shall be possible to password protect the video export. The export can then only be opened and viewed when the corresponding password is entered.	
75		Salvo clip export provide a clip export option to create an instant clip while maintaining the salvo information	
76		Incident management mode: allows export of recording by selecting multiple cameras at	

		different times to create a single clip to play the cameras back in order (sequentially)	
77	Maps	System shall support Map based surveillance.	
78		Maps navigation with site / building / floorplan hierarchy	
79		Easy configuration: Drag and drop a camera on to a floorplan	
80		Provision to Zoom In or Zoom Out the map	
81		Camera alarm indication and alarm status (latest 10) on map	
82		Analyze the alarms and playback the associated video	
83		Perform PTZ and preset actions on relevant cameras	
84		Instant Playback with easy forward/reverse enhanced with calendar selection	
85		Undock Popup View: Drag freely across map to avoid overlapping / covering other icons and views	
86		Full Screen View of Cameras to capture details of HD video	
87	Cyber Security	Enhanced password security – non-recoverable passwords, enforcing complex passwords, password expiry, and no default passwords.	
88		Secured firewall configuration.	
89		Secured Web client – enabled HTTPS and TLS 1.2, and protection from CSRF and XSS attacks.	
90		Restricted folder and Registry access to operators.	
91		Secured Assemblies – Digital signing.	
92		Secure communication with Cameras using TLS 1.2	
93	Report	It shall be possible to get reports on past events by querying the databases.	
94		System Report - Event history reports for cameras, Monitors, Recorders	
95		Operator Log reports based on operator activities like log In / Log Out , creating clip, adding bookmark etc	
96		Health Report	
97		Failover Reports	
98		Configuration reports	
99		Create and save custom reports as per pre define and frequent format with in VMS or Various other format	
100		Log reports shall be exported in RPT, XLS, DOC, RFT, PDF formats and	
101		Email for alarms and failover	
102	Integration with other systems	Seamless integration with electronic access control systems	
103		Integration with video analytics and a data management utility.	

104	OEM Authorization Letter - Manufacturer Authorization Form (MAF)	Vendor has to submit MAF along with the Technical Specification.	
105	VMS Server Specification		
106	Processor	Intel® Xeon® E-2236 3.4GHz, Chipset Intel® C246	
107	OPERATING SYSTEM	Windows® Server IoT 2019	
108	SQL	Express	
109	Power Supply	Dual 350W Hot-plug Redundant Platinum power supplies	
110	SYSTEM MEMORY (RAM) GB	16 GB DDR4	
111	DVD DRIVE	Optional	
112	DISK	Dual (RAID1) 480GB SSDs for OS	
113	VIDEO ADAPTER/CARD	Matrox G200	
114	NETWORK CONNECTION	2 x RJ45	
115	VIRTUAL ENVIRONMENT	As required.	
116	Input Voltage	100~240 VAC 50/60 Hz	

Technical Specification of Professional Display

S.No.	Technical Specification		Compliance YES / NO
1	SCREEN SIZE	65" or 163 cm diagonal	
2	ASPECT RATIO	16:09	
3	RESOLUTION	UHD (3840*2160)	
4	VIEWING ANGLE (HORIZONTAL / VERTICAL)	178°/178° (H/V)	
5	AV IN	Yes	
6	USB INPUT (2.0 SUPPORT)	2*Side (USB2.0)	
7	HDMI INPUT	3*Side (HDMI 2.0)	
8	HEADPHONE OUT	1*Side	
9	RJ-45	1*Side	
10	USB DEVICE SUPPORT	USB Supported HDD	
11	AUDIO OUTPUT POWER (RMS)	20 W (10+10 W)	
12	BLUETOOTH	Yes	
13	INBULIT WIFI	Yes	

Technical Specification of Workstation/Client PC

S.No	Technical Specification	Compliance YES / NO
.		

1	PROCESSOR	Intel® Core™ i7 10700 , Chipset Intel® Q470	
2	OPERATING SYSTEM	Windows® 10 IoT Enterprise	
3	COMPUTER TYPE	WorkStation	
4	SYSTEM MEMORY (RAM)	16 GB (2 x 8 GB)	
5	DVD DRIVE	DVD +/- RW	
6	DISK	500 GB SSD	
7	NETWORK CONNECTION	1 x RJ-45 10/100/1000 Mbps (Rear)	
8	USB	1 x USB 2.0 port with Power Share	
9		1 x USB 3.2 Gen 1 Type-A port	
10		1 x USB 2.0 port	
11		1 x USB 3.2 Gen 2 Type-C port , REAR :- 2 x USB 2.0 ports with Smart Power On	
12		4 x USB 3.2 Gen 1 Type-A ports	
13		Monitor OutPut	2 x DisplayPort 1.4 (Rear)
14	Audio	1 x 3.5mm Universal Audio Jack (Front)	
15		1 x 3.5mm Line-out re-tasking	
16		Line-in audio port (rear)	
17	Input Voltage	100~240 VAC 50/60 Hz	

Testing & Commissioning :

All CCTV work shall be considered commissioned after checking the installation of CCTV with proper numbered on Cameras and on final drawings, including verification of all VMS features, Analytics etc. All fiber, Copper laying, Media Converter, PoE injector, Fiber splicing, Outdoor (IP 66) Fiber Joint enclosure, storage box at pole etc. shall be the part of the installation of the CCTV system. CCTV system shall be of same make as of existing system for smooth connectivity and operation. Nothing extra shall be paid on CCTV system.

Item No:- 381-382

30. IPABX SYSTEM

IP Based Central IPABX of initially capacity of 800 Telephones & expandable up to 2000 telephones shall be located at a central location in the campus at GBU Gandhinagar. All the Telephone in the Complex will be IP Based and will use the proposed LAN Network for the communication within the complex as well as for outside the complex. All Rack Panels of Individual buildings shall be connected to Central EPABX system through Optical Fiber Cable to be laid underground in HDPE Pipe of suitable size. Manholes with covers shall be provided in the underground HDPE pipe at suitable lengths for easy

pulling & maintenance of cables.

A. The following are the specifications of the proposed IPABX System for the GBU Gandhinagar:

Technical Specification of IP-PBX System

S.No.	Technical Specification	Compliance YES / NO
1	IP Telephony System Architecture	
	The IP telephony system must be based on a pure IP technology that is a software-only solution.	
	The IP telephony system must support unified communication (UC) server & gateways architecture for SIP, Digital and Analog trunks connectivity.	
	The System must be TEC Approved with GR Number.	
	The system must be capable of supporting Analog, Digital, IP Telephones, and SIP based video desk phones.	
	The communication servers must work in an Active/Active redundancy mode. It should be possible to define servers load balancing mode.	
	All servers must be provided in a cluster mode. If one cluster server fails, one of the other cluster servers in the network must be able to take the complete load of the calls automatically (without any manual intervention) and without dropping any existing calls (IP, TDM & PRI) or data (CDR, CTI). Management of all servers in cluster should be from same web page. All servers should have same database.	
	The telephony system must be able to register SIP phones/SIP video phones and MGCP phones directly to it	
	System should have Distributed Architecture	
	It should be possible to install Telephony system in VMware ESXi 5.5 or higher.	
	All Data (Numbers, COS, Routing, Applications) should reside in all the Servers	
	Database replication in All servers should be automatic and real time	
	Should support N+1 Redundancy Architecture as well as 1+1 redundancy Architecture	
	Should support Remote Survival Nodes	

	In case of failure of one server, the SIP Phones, SIP Gateways, MGCP Phones should register with second Server automatically	
	System Diagnostics should be done in Server	
	Hot Standby for SIP Phones and Gateways i.e SIP Phones and Gateways should register automatically to next available telephony server.	
	COTS - commercial off-the-shelf Servers should be used for telephony system	
	Telephony system should use Linux Operating System	
	system should support CSTA phase III Protocol	
	Full continuation for call signaling and media must be supported	
	Calls must not be disconnected, and control must remain throughout the swap to an alternate server including full call control (transfer, conference actions, continuation of CDR data for the existing call).	
	Load Balancing of end points must be possible by the administrator	
	There must be no restriction on the number of endpoints being backed up in case of one server failure.	
	UC platform servers must provide full failover and redundancy	
	System should support the following SIP RFCs:	
	RFC 3261 (SIP: Session Initiation Protocol)	
	RFC 3262 (Reliability of Provisional Responses in Session Initiation Protocol)	
	RFC 3263 (Locating SIP Servers)	
	RFC 3264 (An Offer/Answer Model with Session Description Protocol (SDP))	
	RFC 3265 (Specific Event Notification)	
	RFC 2327 (SDP- Session Description Protocol)	
	RFC 1889 and 1890 (RTP/RTCP)	
	RFC 3515 (REFER)	
	RFC 2833 (DTMF over IP)	
	Scalability	
	It should be possible to add more sites and users without the need to change the software and existing configuration.	

	The system must be scalable to at least 25,000 endpoints in a single cluster architecture.	
	Each server must support a minimum of 1000 endpoints	
	The call signalling server must handle traffic at a minimum of 100K BHCC.	
	The system must be modular, scalable and distributable	
	System Survivability	
	The UC platform must consist of one or many servers where each server in the cluster provides complete 100% application functionality.	
	In case of a failed server, all endpoints registered with that server need to register instantly with a different server in the cluster with no interruption to on-going calls.	
	Media Gateways must have survival mechanisms that allow them to maintain 100% of the telephony services for their users in case of failure in the WAN links when the signaling with the call server drops.	
	The life cycle of the entire system being provided must be at least Ten (10) years.	
	The system gateway must be able to restart automatically without human intervention when the external AC power supply is resumed after complete power failure (even after the batteries are discharged).	
	The telephony system must be capable of providing 99.999% availability.	
	Distributed Architecture	
	The UC platform must have distributed architecture and centralized control for all the sites in the network.	
	The proposed solution must support Hybrid cloud solution in order to guarantee business continuity with overall survivability regardless of a failure at any single location.	
	The proposed solution must enable part of the cluster to be hosted in a Cloud Service Provider (CSP) to run all applications.	
	The proposed solution must have built in redundancy using a cloud solution to provide automatic disaster recovery option.	
	The proposed solution should have provision to be installed using an image of the application an easily implemented on the Cloud Service Provider servers.	

	Quality of Service (QOS)	
	The voice and signaling frames must be marked [tagged] in order to be recognized.	
	Server – Physical Attributes	
	COTS – Commercial Off-the-Shelf servers must be used.	
	The redundant server must have separate hardware, not sharing elements like hard drives and RAM etc., to avoid a single point of failure.	
	The server should have AC power supply.	
	The system must be based on server gateway architecture with external appliance servers	
	No card based processor systems / soft switch should be quoted.	
	The call processor must run on Linux OS.	
	Minimum Server Specifications:	
	The CPU must be from the Intel® Xeon® processor	
	The server must have at least 8GB RAM	
	The server must have Hard Drives (1TB) of storage	
	The server must have a Dual 1GB network interface.	
	Form Factor for physical server (Not Virtual Machine) should be 1 U	
	Gateways	
	The media gateways shall be capable of being centrally managed via the telephony management application. The system should support multiple gateways.	
	The system gateway should be able to restart automatically without human intervention when the external ac power supply is resumed after complete power failure	
	The system gateways should support the following type of extensions:	
	Analog	
	Digital	
	Cordless (DECT) Extension	

	SIP	
	MGCP	
	The system gateway should support the following type of trunks:	
	Analog: E&M (2W), E&M (4W), DC loop signaling, decadic, DTMF	
	Digital: 2Mb stream with the following signaling protocols (Digital CEPT, R2MFC)	
	Standard ISDN BRI, PRI	
	SIP and MGCP on VOIP	
	ISDN (30B+D / 23B+D / 2B+D)	
	SS7	
	ISDN QSIG (30B+D / 2B+D)	
	Q-sig over IP	
	Security	
	Administration of the system should be using HTTPS	
	It should support the Interop with leading SBC	
	System should use TLS (Transport Layer protocol) to encrypt SIP, HTTP, FTP and SRTP (Secure Real-time Transport Protocol) and SRTCP to encrypt RTP and RTCP	
	System should have auto Provisioning profiles contain pre-configured sets of features that must automatically polls and updates registered phones with the latest phone firmware and configuration files.	
	Mobility	
	The system should have Call Back feature. If the user dials his own extension from predefined number (mobile/landline) then system should disconnect the call and then system should call the user to provide the dialtone so that user can make intercom or PSTN calls.	
	The system should have Call Through feature. If the user dials his own extension from predefined number then system should provide dialtone to make intercom or o/g calls.	
	The system should have Flexi Call (Forking, reach-me-anywhere) feature. Users should be able to receive calls on any of their phones, from almost anywhere. An incoming call rings on all or specific phones until the user	

	answers the call. The user can transfer the call, establish a conference, and so on, whether the answering device is an internal device, an external phone, or a cellular handset. If the answering phone is an external device, the call automatically becomes an authorized mobility call.	
	The system should support SIP Client on smart phone.	
	SIP Endpoints	
	All SIP phones must support the standard SIP protocol. No proprietary protocols are allowed to be used.	
	SIP phones must support the configuration of programmable buttons with functions such as Break-in, Conference call, Deflect, silent monitoring and more.	
	SIP phones must work in conjugation with the following applications:	
	1. Contact Centre (Agents Phones)	
	2. Attendant Console	
	3. Managed Audio Conferencing	
	4. Managed Video Conferencing	
	5. UC clients	
	ACD	
	System should have built in Automatic Call Distribution (ACD) with following features:	
	Busy ACD Group announcement	
	Hunt Group Release	
	IVR-ACD	
	Log In / Log Out	
	Multiple Announcements:	
	1. Mandatory announcement - All incoming callers to an ACD/HUNT group must be able to hear an introductory announcement in its entirety usually explaining about the company, product, or campaign.	
	2. First announcement - If all agents are busy, callers must be able to hear this announcement once usually informing them that their call has been placed in queue. (The system must be able to cut short this announcement if an agent becomes available to attend to the caller.)	

	3. Music - If no agents are available after the first announcement (or no First and Periodic announcers have been configured), the caller must be able to hear background music while in queue.	
	4. Periodic announcement - Alternating with background music, these announcements can also be played to callers in queue according to the Periodic Announcement Interval (see above) until the ACD/HUNT call is answered.	
	Release / Resume	
	Wait Queue	
	Wrap-Up Time	
	Automatic Release of ACD Agent	
	Automatic Call Distribution (ACD) Extended Overflow	
	Zone Page	
	A phone user must be able to simultaneously broadcast a message over all types of endpoints.	
	The maximum quantity of endpoints in one zone should not be less than 100.	
	System Administration	
	System administration should be web based.	
	All programming of system should be done through a web-based GUI interface.	
	The administrator should have Dynamic Profiles.	
	The system should allow for complete multi-level administration. The administrator must be able to define at least five (5) different administration level profiles that can be applied to allow subsets of users to access and manage particular pages in the systems Web Portal	
	Certification Requirements	
	1.The OEM must comply with ISO 9001 certification in all the company's activities.	
	System Features	
	ANI (Caller ID) Restriction	
	ARS (Automatic Route Selection)	

Auto Attendant	
Call Forward at Night/Holiday	
Call Forward Destinations	
Call Forward for Undefined Stations	
Call Forward on Busy	
Call Forward on DND (Do Not Disturb)	
Call Forward on Logout	
Call Forward on No Answer	
Caller id based routing for individual extension	
Deflect (Divert) Call	
Digit Train Conversion	
Direct-In-Dial	
Direct-In-Line (DIL)	
Hot Line	
Interactive Voice Response (IVR)	
Least Cost Routing	
Look Ahead Routing (LAR)	
Numbering Plan	
Personal Routing Rules based on caller id and DNIS	
Predetermined Night Answer	
Toll Restriction – Digit Analysis	
Toll Restriction – Trunk Groups	
Trunk to Trunk Connection	
Trunk Transfer Restriction	
Classes of Service	
Night Answer Central Bell / UNA Pickup	

	Page Queue	
	Recall	
	Recall / Incomplete Destination	
	Second Ring back Tone	
	Speed Dial Public (System) and Private	
	Virtual Numbers	
	Music On Hold	
	Voice Page	
	Silent Monitor	
	Zone Page	
	Barge In	
	Wake up	
	Extension Features	
	Answer Call Waiting by Transfer	
	Auto Set Relocate	
	Auto-Answer	
	Automatic Disconnect	
	Automatic Number Identification (ANI) Display	
	Browse Personal Directory	
	Busy Lamp Field	
	Call Forward All	
	Call Hold	
	Call Log	
	Call Parking and Call Pickup	
	Call Waiting	
	Caller ID Control	

Caller-ID Screening	
Caller id based routing for individual extension	
Calling Number and Name	
Camp-on Idle	
Configurable DSS Buttons	
Direct Dial without Off Hook (Hands Free)	
Directed Call Pickup	
Display Automatic Number Identification (ANI)	
Display Dialed Number and Name	
Display Dynamic Call Divert Information	
Display Select Hold Display	
Display Time/Date Function	
Do Not Disturb (DND)	
DSS/BLF	
Elapsed Time Display	
Group Call Pickup	
Hands Free	
Hands-Free Announce and Reply (Idle State)	
Last Number Redial	
Login and Logout	
Message Waiting Indication	
Multi Appearance (Call Waiting)	
Multiple Line Appearance	
On-Hook Dialing	
Placing Multiple Calls on Hold	
Privacy – ANI Restriction	

	Reminder/wake up Call	
	Restrictions – Station	
	System Non-Exclusive Hold	
	Transfer with Consultation	
	Transfer without Consultation (Blind)	
	Voice Page	
	Emergency Redemption	
	Listen to Paging while in a call (Busy Condition)	
	ULA - User Line Appearance (ULA)	
2	Emergency communication	
	The Emergency communication resource should be from the same telephony server and have the facility to automatic dial out to connect up to 100 participants in a single conference. System should also have 100 party managed meet me conference. It should be possible to further divide 100 party conference bridge into any combination like 10 X 10 party, 5 x 20 party etc. if required. The meet me conference should be secured means to enter to the conference bridge, the user should enter the password.	
	The emergency communication management should be from Web Browser/HTML5 based GUI based interface from Windows PC and Touchscreen Devices.	
	The emergency communication must be controlled by a user defined as Group Operator from the web-based GUI.	
	The Group Operator should have following features as below:	
	1.The Group Operator must be able to add / remove members	
	2.The Group Operator must be able to add other conference members	
	3. The Group Operator must be able to mute / unmute (User, None, All)	
	4. The Group Operator must be able to lock / unlock the conference	
	5. The Group Operator must be able to close the conference	
	6. It must be possible to dial out a pre-defined group (or multi-groups) of participants/numbers by simply pressing the pre-assigned virtual key on PC.	

	7. Each pre-set conference must have its own unique dial number such that when this group number is dialled; all the number stations will ring simultaneously.	
	8. Any combination of stations and external numbers must be able to be defined as members of the Group Call.	
	9. Participants may join a conference in the audible or in the mute mode, if in mute mode, the right to speak must be selectively offered to attendees per their request by a special signal sent to the Group Operator by the attendees.	
	10. Attendees must be able to be added or excluded at any time by the Group Operator	
	11. The conference must be terminated when the Group Operator leaves (auto terminate if all members left are muted).	
	12. The Group Operator must be able to barge into an existing user call based on pre-emption predefined rules.	
	13. Group operator must have two SIP phones so that if one phone is busy in conference, the second phone can be used to add participants.	
	14. Both group operator SIP phones should be controlled by web-based conference management GUI for telephony feature like answer, hold, transfer etc.	
	15. The same Group operator should also function as operator console	
3	Specification of Type -1 IP phone	
	SIP phone should be from the same OEM of IP telephony system	
	Graphical LCD	
	1 VoIP accounts	
	XML remote phonebook	
	Auto provision via FTP/TFTP/HTTP/HTTPS for mass deployment	
	Anonymous call, anonymous call rejection	
	PoE, Headset, Wall-Mountable	
	Volume adjustment, ring tone selection	
	Voicemail, MWI	

	Call park, call pickup	
	DTMF: In-band, out-of-band (RFC 2833) and SIP INFO	
	VAD, CNG, AEC, PLC, AJB, AGC	
	Full-duplex hands-free speakerphone	
	SIP v1 (RFC2543), v2 (RFC3261)	
	NAT Traversal: STUN mode or 3rd party SBC	
	DTMF: In-Band, RFC2833, SIP Info	
	IP Assignment: Static/DHCP/PPPoE	
	1xRJ9 handset port	
	1xRJ9 headset port	
	Transport Layer Security (TLS)	
	LED for call and message waiting indication	
	2xRJ45 10/100M Ethernet ports	
	Power over Ethernet (IEEE 802.3af)	
4	Specification of Type -2 IP phone	
	SIP phone should be from the same OEM of IP telephony system	
	Graphical LCD with backlight	
	2 VoIP accounts	
	Local phonebook up to 100 entries	
	Auto provision via FTP/TFTP/HTTP/HTTPS for mass deployment	
	SRTP/ HTTPS/ TLS, 802.1x	
	PoE, Headset, Wall-Mountable	
	Volume adjustment, ring tone selection	
	Voicemail, MWI	
	Call Park, call pickup	

	Narrowband codec: G.711, G.723.1, G.726, G.729AB	
	VAD, CNG, AEC, PLC, AJB, AGC	
	Full-duplex hands-free speakerphone	
	SIP v1 (RFC2543), v2 (RFC3261)	
	NAT Traversal: STUN mode or 3rd party SBC	
	DTMF: In-Band, RFC2833, SIP Info	
	IP Assignment: Static/DHCP/PPPoE	
	1xRJ9 handset port	
	1xRJ9 headset port	
	Transport Layer Security (TLS)	
	LED for call and message waiting indication	
	2xRJ45 10/100M Ethernet ports	
	Power over Ethernet (IEEE 802.3af)	
5	Help desk specification	
	1.1 General capabilities	
	1.1.1 The proposed solution must be embedded within the platform, not installed on a separate server and should be from the same OEM of the telephony system.	
	1.1.2 The system must be an All in one solution that provides a one server solution for UC&C and 5 agent license for help desk.	
	1.1.3 Single server deployment with intuitive and central management capabilities should support true multimedia.	
	1.1.4 Help desk managers must be able to easily prioritize customers and incoming contacts regardless of the media used.	
	1.1.5 The same set of business and routing rules can be applied to voice / chat calls, emails, and faxes if required.	
	1.1.6 The help desk must support multi-layer routing including Priority, Skill Based, Statistical, Business Rules, and Customer Defined Values.	

1.1.7	Help desk must have embedded IVR, enabling managers to design routing plans and accurately assess help desk activity trends.	
1.1.8	The IVR application must be a GUI application that can be managed by the customer.	
1.1.9	The customer must have the ability to build new self-services applications like new IVR flow for new service.	
1.1.10	Customer must have the ability to define/change routing rules by himself based on customer's profile.	
1.1.11	The help desk must support Outbound, Call-back and Campaigns – including preview, progressive and automated outbound dialling.	
1.1.12	The supervisor must be able to see the status of help desk agents in real-time in his PC like logout, busy, free, release, non ACD etc. in graphical form in pie chart / bar chart.	
1.2	Help desk facilities	
1.2.1	Real-time Monitoring – must provide supervisors with statistical information about the current status of the help desk with on line refresh (1sec). The application must include pre-defined list of reports and the customer (end user) should be able to choose reports as needed.	
1.2.2	The Real Time application must provide the ability to build/change the workspace for each user and by user (not vendor or distributor).	
1.2.3	The RT must provide the ability to move agents to/from different groups/queues for current login only.	
1.2.4	Historical Reports – must be able to collect all information from call entry to call termination. Call profile details for internal investigation purposes should be part of the contact center solution.	
1.2.5	The help desk solution must have an embedded Management Information System (MIS) suite that monitors all help desk activities, generating reports that summarize the past performance of the system over a given time period, and providing statistical analysis of the help desk within a specified period. Real-time and historical reports provide:	
	Help desk agent should be able to do following activities from agent application installed on PC:	
	Login/Logout from group	
	Release/Resume	

	Ready	
	Wrap-up Code	
	Release for Break	
	Release for Meeting	
	Control Wrap Up	
	Supervisor Help	
	Agent Board	
	Answer	
	Hold	
	Retrieve	
	Hang Up	
7	PRI Gateway specification	
	PRI gateway should have Configuration – 1 PRI (30 Channels) or 2 PRI (60 Channels) and should be from the same OEM of telephony system.	
	Voice Processing – G.711, G.729A, G.723.1, GSM, iLBC;echo cancellation: G.168 with 64ms echo tail; dynamic jitter buffer; VAD and CNG	
	Calling Control – called/calling party number translation; second stage dialing; voice detection; auto dialing with DTMF; ring back tone generation and detection; voice announcement	
	Voice Proxy – RTP voice proxy function for NAT/firewall traversal	
	Fax Relay – T.30 transparent mode, T.38 fax relay	
	Call Handling – configurable dialing plan, up to 500 routing rules	
	Configuration Interface – Web Utility	
	Remote Management – Telnet, HTTP, TR069	
	PSTN – ISDN PRI standard: ANSI, NI-2, DMS, 5ESS	
	SIP – RFC3261, RFC2976, RFC3515, RFC3581	
	DTMF – tone detection generation and detection; DTMF relay: RFC2833, INFO (SIP)	

	DTMF detection and progress tone detection	
	Play ring-back tone	
	T.30 and T.38	
	RTP proxy for NAT traversal	
	Ethernet – RJ-45, 10/100 Base-T	
	Trunking Interface – RJ-45	
	System Memory – 128MB or higher	
	System Flash – 16MB or higher	
	Power Input – 220V AC or - 48 VDC , should have dual AC/DC power supply	
	Operation Humidity – 10% to 90% (non-condensing)	
	Operation Temperature – 0 to 40°C	
8	Specification of Soft client	
	The soft client should be from the same OEM of IP telephony system. Wifi facility for smart phone to be provided by the customer.	
	Soft client should be available for Windows PC, Android Phone and IOS phone	
	It should support Windows 7, Windows 8, Windows 10	
	it should be freely downloadable from Google Play / Apple store	
	it should support following features:	
	Make a call	
	Hold	
	Retrieve	
	transfer	
	"Presences (User Select) -	
	Change status: Available, Busy No Answer, Busy call waiting, DND, Logoff, Forward to VM "	
	Dial users number - Internal, External, Mobile	

	"Instant messaging - IM with another soft client User, IM with a Multi Destination, Search on IM sessions, Save IM sessions, IM to groups"	
	3 way audio conference	
	call divert	
	camp on	
	view missed call	
	Contacts synchronized with the PBX directory	

Testing & Commissioning of Passive Components:

All the features of the EPABX system shall be checked to Engineer In Charge. After installation & features verification Commissioning of the EPABX components shall be completed

Item No:- 367-380

31. LAN NETWORKING & WIFI SYSTEM SPECIFICATIONS

General:

RJ 45 data outlets are proposed to be provided for Computers, networking, telephones, Wi-Fi, CCTV etc. as per requirement in rooms and other areas at various floors in all the blocks / Buildings.

The Data Outlet points shall be connected to Rack Panel/Computer hub with 4 pair Cat-6 wiring in recessed conduit / Raceways.

The maximum Length of the Cat 6A cable from end user point to the Hub or Edge switches shall not be more than 90Mtr. Beyond this length Fiber Optic Cable shall be used. UPS Power supply to these computers will also run through conduits/ floor trunking.

The Rack Panel/computer hub at various floors will be connected to Main rack of the building/ block with fiber optic cable through conduit or raceways on surface/in recess. The main server shall be connected to Distribution switch through Optical fiber cable of 40 Gbps and Distribution switch shall be connected to Edge switches of each building/ block with fiber cable of 10 Gbps link in underground HDPE pipe of suitable size in outside connectivity or in cable raceway/conduit inside the buildings. Brick masonry manholes with covers shall be provided at suitable lengths to facilitate easy wire pulling & Maintenance.

Wireless access points for Wi-Fi connectivity are proposed in Hostel blocks, SAC block,

Director Residence etc. All types of hostel shall have only Wi-Fi connectivity whereas other buildings in the complex shall be with wired data outlets along with the Wi-Fi connectivity.

The LAN SYSTEM comprises of Passive components and Active Components. The Technical specifications of both the components are given below:

B. PASSIVE COMPONENTS

PASSIVE PRODUCTS SPECIFICATIONS FOR GBU GANDHINAGAR

Eligible Criteria for OEM		
S.No.	Description	Compliance (Yes / No)
1	The OEM of Passive Network Components should be present in the India for at least last 10 Years. (Document proof Required - Proof of Incorporation should be attached)	
2	Should have Technical / Telephonic support centre in India	
3	OEM must have ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018 or latest	
4	Factory Test report must be provided for the product during supply.	
5	All the components/raw materials used must be RoHS-verified	
6	OEM should have its Manufacturing units, Components and Finished Goods Warehouse & R&D labs in India.	
7'	OEM should have at least four dedicated Presales manpower in India for after sales support	
8'	25-year Performance warranty; Warranty to cover Bandwidth of the specified and installed cabling system	
9'	All networking passive material (Fiber Cable, Copper Cables, Networking Racks and their connectivity components) should be from one OEM make only.	
10	The Proposed OEM should be a member of TIA and BICSI and should have a CDCP, ITIL and a PMI-PMP / RCDD on the OEM's payroll sitting in India whose services can be utilized for this project. Valid Certificates of the OEM employees along with a letter from the OEM HR Department verifying that the employees are in fact sitting in India should be submitted. (Details must be provided).	
12	Quoted product part numbers must be available on OEM's official website	

SITC of CAT6 U/UTP LSZH Cable having minimum technical specification as mentioned below :

S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	CAT6 U/UTP, 23 AWG solid bard copper, Unshielded Twisted 4 Pair, Category 6, confirming to ANSI-TIA 568.2-D for Category 6 & ISO/IEC 11801 for Class E.	
2	Conductors	Solid bare copper 23 AWG	
3	Pair Separator	+ Shape Spline	
4	Packing	Box of 305 meters	
5	Cable Outer Diameter	6.0 ± 0.2 mm	
6	Delay Skew	< 45 ns	
7	Conductor Resistance	≤ 93.8 Ω/km	
8	Pulling Force	25 lb	
9	Nom. Velocity of Propagation	69%	

10	Temperature Range Storage	-20 °C to +70 °C	
11	Flame Properties	Flammability Test : IEC 60332-1	
		Acid Gas Emission Test : IEC 60754-1	
		Smoke Density Test : ASTM 2843	
12	Jacket Colour	Grey	
13	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 350Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relivent Document to be shared)	
		OEM should be registered under an NRTL approved lab follow-up program	
		The Proposed OEM should be a member of TIA and BICSI and should have a CDCP, ITIL and a PMI-PMP or an RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	
		The OEM should be CE Certifed and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
14	Test Reports	OEM factory test reports must be provided.	
15	Make & Model	Bidder to specify	
SITC of 24 Port, 1U Category 6 Staggered Patch Panel, Unloaded as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Quoted Make	To be Specified by the Bidder	
2	Quoted Model	To be Specified by the Bidder	
3	Type	24 Port, 1U Staggered Patch Panel, Unloaded - 1U	
4	Type	24 Port 1U Unloaded ZigZag / Staggered Patch Panel The design reduces Alien Crosstalk to support IEEE 802.3an and ANSI/TIA 568.2-D.	
		Patch panels IDC (IDC of Information Outlet) Connectivity Snap in Type should be at rear end & RJ-45 jack on front panel, 19" rack mountable.	
		Patch panels Ports should be individually replaceable & Consistent port-to-port performance and includes grounding bolt	

5	Availability	Patch Panel should be available with 24 Ports in 1U	
6	Cable management	The panel should have an integrated rear cable management bar that allows bunching of 6 cables and properly dressing the cables and tying them using a Velcro Tape to the rear cable management bar.	
7	Compatibility	Patch Panel should be able to accept Cat6A, Cat6 and Cat5e information outlets for backward and forward compatibility	
8	Height	1U (1.75")	
9	Storage Temperature Range	-40Deg C to +70 Deg C	
10	Operating Temperature range	-10Deg C to +60 Deg C	
11	Humidity	10% - 90% RH	
12	Color and Material	Metal SPCC, Black, plastic inserts, Double layer - 1.5mm, provided with mini cable ties, cage nuts & rare cable management.	
13	Regulatory Compliances	Should be UL/ETL channel performance verified with a MTP link even when termination is within 15 Mtrs. this ensuring eliminating short resonance for 4-connector channel as per ANSI/TIA-568.2-D and ISO/IEC 11801 Standards (Relivent Document from UL/ETL Report for 4 Connector need to be submitted which mentions quoted part code).	
		Shall be UL Listed and tested for corrosion as per ASTM B117: 2019. (Relivent Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	
14	Test Reports	OEM factory test reports must be provided against each drum / roll of fiber cable.	
15	Make & Model	Bidder to specify	
SITC of Cat6 Modular Jack, Keystone Style having min. technical specs. as mentioned below			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	CAT6 RJ45 Modular Jacks shall meet and exceed channel specification of ANSI/TIA 568.D-2, IEC/ISO 11801 & IEC 60603-7-4 when used as a component in a properly installed UTP channel.	
2	Housing Material	High impact Fire Proof ABS UL94V-0	

3	Front Connection	RJ 45 : PCB, 50 μ Phosphor bronze gold over nickel plating contacts	
4	IDC Connector	Phosphor bronze , Tin-plating contacts	
5	PCB Material & Thickness	FR-4, 1.2mm thickness	
6	Termination Interface	Front Mated Connection: 750 Cycles	
		Rear Mated Connection: 200 Cycles	
7	Plug and Outlet Contact force	\geq 100 Grams with FCC Compliant RJ-45 plug	
8	Plug retention Force	\geq 11lbf	
9	Jack wire material and thickness	0.35mm Phosphor bronze gold over nickel plating	
10	IDC Conductor	0.5mm Phosphor bronze , Tin-plating	
11	Contact Compatibility	Accommodates 23 to 26AWG solid	
12	Termination Pattern	TIA / EIA 568 A and B and Shall not have an integrated spring shutter as the shutter malfunctions and causes operational issues.	
13	Storage Temperature :	-40° to +70°C	
14	Electrical Performance	Insulation Resistance : \geq 500m Ω	
		Contact Resistance : \leq 10m Ω	
		Current rating : 1.5 Amps	
		DC Resistance : \leq 0.1 Ω	
		DC/AC Volt Endurance : DC1000V/AC750V 1min	
15	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 350Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relivent Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	
		The OEM should be CE Certified and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
		All networking passive material (Fiber Cable, Copper Cables, Networking Racks and their connectivity components) should be from one OEM make only & should be manufactured as per latest TIA/EIA or ISO/ IEC standard and have 25 years of channel performance.	

16	Make & Model	Bidder to specify	
SITC of Shielded Keystone Outlet having minimum technical specification as mentioned below			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	Category 6A Shielded Keystone Outlet	
2	Type	Modular Jacks shall meet and exceed channel specification of ANSI/TIA 568.D-2, IEC/ISO 11801 & IEC 60603-7-41 when used as a component in a properly installed within a channel.	
		Shielded	
3	Shield Material	Zinc alloy	
4	Contact Material	Phosphor Bronze, Tin (8Pins- Gold Plating)	
5	Plastic Housing	PC UL94V2	
6	Plastic Parts type	High impact flame retardant plastic	
7	PCB Material & Thickness	FR-4,1.2mm thickness	
8	Features	Small form RJ45 foot print design	
		IDC punch down with 180-degree termination	
		Wiring diagram and conductor cap supplied and the Direction marks on the side of the Keystone Jack	
9	Termination Interface	Plug Insertion Life (RJ45 Contacts) \geq 750 Cycles	
		Durability (IDC Life) 200 termination cycles	
10	Plug and Outlet Contact force	\geq 100 Grams with FCC Compliant RJ-45 plug	
11	Plug retention Force	\geq 11lbf	
12	Jack wire material and thickness	0.35mm Phosphor bronze gold over nickel plating	
13	IDC Conductor	0.5mm Phosphor bronze , Tin-plating	
14	Contact Compatibility	Accommodates 23 to 26AWG solid	
15	Termination Pattern	TIA / EIA 568 A and B	
16	Operating Temperature	-10° to +60°C	
17	Storage Temperature :	-40° to +68°C	
18	Operating Humidity :	10% to 90% PH	
19	Electrical Performance	Insertion Loss: Max. 0.45 dB	
		NEXT: Min. 34 dB	
		FEXT: Min. 29.1 dB	
		RL: Min. 14 dB	
		PSANEXT: Min 56.5 dB	
		PSACRF: Min 53.0 dB	
		TCL: Min 14 dB	
		Insulation Resistance : \geq 500m Ω	
		Contact Resistance : \leq 10m Ω	
		Current rating : 1.5 Amps	
		DC Resistance : \leq 0.1 Ω	
DC/AC Volt Endurance : DC1000V/AC750V 1min			

20	Regulatory Compliances	Should be ETL Listed in a 04-Connector Shielded Channel Tested upto 635Mhz with MTPL Plug as well as performance testing as per IEEE 802.3bt (All Report should be submitted along with bid) and UL Listed (Relevant Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	
		The OEM should be CE Certified and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
		All networking passive material (Fiber Cable, Copper Cables, Networking Racks and their connectivity components) should be from one OEM make only & should be manufactured as per latest TIA/EIA or ISO/ IEC standard and have 25 years of channel performance.	
21	Make & Model	Bidder to specify	
SITC of Cat6 Unshielded LSZH Patch Cords for Work Stations & Rack End having min technical specs as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	CAT6 Unshielded LSZH rated Modular Cord shall meet and exceed channel specification of ANSI/TIA 568.2-D, ISO/IEC 11801 Class E, IEC 61156-6 and IEC 61935-2 Standard.	
2	Conductor	Flexible Stranded Bare Copper, 24 AWG	
3	Insulation / Diameter	PE (0.95 ± 0.05 mm)	
4	Feature	Transparent Strain Relief easy latch-cover boot design for easy depression	
		Backward compatible for easy integration with any network component that uses a RJ45 connection	
5	Length	2 / 3 / 5 Meter & Customized length	
6	Connectors	High Grade 50 µ gold plated RJ45 Connectors	
7	Conductor Material	Stranded Bare Copper	
8	Storage Temperature Range :	-20 °C to +70°C	
9	Cable Diameter	5.86 ± 0.3mm	

10	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 350Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relivent Document to be shared)	
		Should be ETL tested for a cabling configuration performance to the requirements of IEEE Std 802.3 for Type 4 remote powering applications	
		OEM should be registered under an NRTL approved lab follow-up program	
		OEM should a minimum on 01 patent in their name. All Related documents to be submitted.	
11	Test Reports	OEM factory test reports must be provided.	
12	Make & Model	Bidder to specify	
SITC of Cat6 LSZH Patch Cords for Uplink having min technical specification as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Make	To be Specified by the Bidder	
2	Type	CAT6 Unshielded LSZH Patch Cord Cable	
3	Type	Modular Cord shall meet and exceed channel specification of ANSI/TIA 568.2-D, ISO/IEC 11801 Class E & IEC 61156-6 Standard.	
4	Conductor	Flexible Stranded Bare Copper, 26 AWG	
5	Insulation	PE (0.95 ± 0.05 mm)	
6	Insulation Thickness	0.16 mm	
7	Feature	Transparent Strain Relief easy latch-cover boot design for easy depression	
		Backward compatible for easy integration with any network component that uses a RJ45 connection	
		Auto lock the jack by inserting the lockable patch cord and to unlock you should use the key.	
		Bright Traceable LED Light for easy Visual Identification	
8	Length	2 / 3 / 5 Meter & Customized length	
9	Connectors	High Grade 50 μ gold plated RJ45 Connectors	
10	Conductor Material	Solid Bare Electrolytic Grade Copper	
11	Operating Temperature Range	-10 °C to +60°C	
	Storage Temperature Range :	-20 °C to +70°C	
	Installation Temperature :	0 °C to +50°C	
12	Sheath Material	LSZH	

13	Cable Diameter	6.23 ± 0.3mm	
14	Electrical Specification :	Conductor DC Resistance : 14Ω / 100m	
		Resistance Unbalance : 4%	
		Impedance : 100Ω ± 15%	
		Frequency : 250MHz	
15	Performance	Patch Cords which will give guaranteed higher bandwidth will be preferred.	
16	Regulatory Compliances	The OEM should be CE Certified and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
		The OEM shall be recognized by the Department for Promotion of Industry and Internal Trade under the 'Telecommunication & Networking' Industry and 'Network Technology Solutions' sector by Government of India.	
		OEM offered must be in India / SAARC for at-least 10 years or more.Should have Indian Technical Support Centre, Warehouse and RMA centre in India.	
		OEM should a minimum on 01 patent in their name. All Related documents to be submitted.	
17	Test Reports	OEM factory test reports must be provided.	
18	Make & Model	Bidder to specify	
SITC of Field Mount Modular RJ45 Plug for WiFi, CCTV, etc. having min technical spec as below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	Field Terminate RJ45 Plug complies to Complies to EN 50173 & ISO/IEC 11801, IEC 60512-99-001:2012 & IEC 60512-9-3:2011, Permanent Link & Channel ANSI/TIA-568.2-D for connectivity an IP-enabled IoT devices / PoE enabled devices and support high-speed applications like 5Ghz Wi-Fi and High resolution Video cameras	
2	Termination	Developed under MPTL and designed for use on Solid cable assemblies and strand conductors of sizes from AWG 23 through AWG 26	
3	Housing Material	Zinc – alloy fully shielded	
4	Plug Contact	0.35mm phosphor bronze	
5	Contact Area	Gold over nickel plating	

6	IDC Contact	0.4mm phosphor bronze, Sn over nickel plating	
7	Features	IP20 rated Field Terminable Plug	
		360 degree shielding for better EMI/EMC	
		Qualified Screened Class 6A Component Durability : 1000 mating cycles	
8	Plug Contact	RJ 45 : PCB, 50µ Phosphor bronze gold over nickel plating contacts	
9	IDC Connector	Phosphor bronze , Sn over nickel plating contacts	
10	Power over Ethernet - Applications	PoE+ type I & II IEEE 802.3at IEC 60512-99-001 (2012-08) IEC 60512-9-3 (2011-06)	
11	Operating Temperature Range	-40 °C to +70°C	
12	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 635Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relevant Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	
		The Proposed OEM should be a member of TIA and BICSI and should have a CDCP, ITIL and a PMI-PMP or an RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	
		OEM offered must be in India / SAARC for at-least 10 years or more.Should have Indian Technical Support Centre, Warehouse and RMA centre in India.	
13	Test Reports	OEM factory test reports must be provided.	
14	Make & Model	Bidder to specify	
SITC of CAT6A U/UTP LSZH Cable having minimum technical specification as mentioned below			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	CAT6A U/UTP, 23 AWG solid bard copper, Unshielded Twisted 4 Pair, Category 6, confirming to ANSI-TIA 568.2-D for Category 6 & ISO/IEC 11801 for Class Ea.	
2	Conductors	Solid bare copper 23 AWG	
3	Pair Separator	+ Shape Spline	
4	Packing	305 meters in MDF Spool	

5	Cable Outer Diameter	7.03 ± 0.05 mm	
6	Delay Skew	< 45 ns	
7	Conductor Resistance	≤ 93.8 Ω/km	
8	Pulling Force	100N	
9	Nom. Velocity of Propagation	69%	
10	Temperature Range Storage	-20 °C to +70 °C	
11	Flame Properties	Flammability Test : IEC 60332-3-22	
		Acid Gas Emission Test : IEC 60754-2	
		Smoke Density Test : IEC 61034-2	
12	Jacket Colour	Grey / Blue / Yellow	
13	Regulatory Compliances	Should be UL/ETL channel performance verified with a MTP link even when termination is within 15 Mtrs. this ensuring eliminating short resonance for 4-connector channel as per ANSI/TIA-568.2-D and ISO/IEC 11801 Standards (Relivent Document from UL/ETL Report for 4 Connector need to be submitted which mentions quoted part code).	
		OEM should be registered under an NRTL approved lab follow-up program	
		The Proposed OEM should be a member of BICSI and should have a CDCP, ITIL and a PMI-PMP / RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	
		The OEM should be CE Certified and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
14	Test Reports	OEM factory test reports must be provided.	
15	Make & Model	Bidder to specify	
SITC of 24 Port, 1U Category 6 Staggered Patch Panel, Unloaded having min technical spec as below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Quoted Make	To be Specified by the Bidder	
2	Quoted Model	To be Specified by the Bidder	
3	Type	24 Port, 1U Staggered Patch Panel, Unloaded - 1U	
4	Type	24 Port 1U Unloaded ZigZag / Staggered Patch Panel The design reduces Alien Crosstalk to support IEEE 802.3an and ANSI/TIA 568.2-D.	

		Patch panels IDC (IDC of Information Outlet) Connectivity Snap in Type should be at rear end & RJ-45 jack on front panel, 19" rack mountable.	
		Patch panels Ports should be individually replaceable & Consistent port-to-port performance and includes grounding bolt	
5	Availability	Patch Panel should be available with 24 Ports in 1U	
6	Cable management	The panel should have an integrated rear cable management bar that allows bunching of 6 cables and properly dressing the cables and tying them using a Velcro Tape to the rear cable management bar.	
7	Compatibility	Patch Panel should be able to accept Cat6A, Cat6 and Cat5e information outlets for backward and forward compatibility	
8	Height	1U (1.75")	
9	Storage Temperature Range	-40Deg C to +70 Deg C	
10	Operating Temperature range	-10Deg C to +60 Deg C	
11	Humidity	10% - 90% RH	
12	Color and Material	Metal SPCC, Black, plastic inserts, Double layer - 1.5mm, provided with mini cable ties, cage nuts & rare cable management.	
13	Regulatory Compliances	Should be UL/ETL channel performance verified with a MTP link even when termination is within 15 Mtrs. this ensuring eliminating short resonance for 4-connector channel as per ANSI/TIA-568.2-D and ISO/IEC 11801 Standards (Relivent Document from UL/ETL Report for 4 Connector need to be submitted which mentions quoted part code).	
		Shall be UL Listed and tested for corrosion as per ASTM B117: 2019. (Relivent Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	
14	Test Reports	OEM factory test reports must be provided against each drum / roll of fiber cable.	
15	Make & Model	Bidder to specify	
SITC of Cat6A Modular Jack, Keystone Style having min technical specs as mentioned below			
S. No.	Parameter	Specification	Compliance (Yes/No)

1	Type	CAT6A RJ45 Modular Jacks shall meet and exceed channel specification of ANSI/TIA 568.D-2, IEC/ISO 11801 & IEC 60603-7-41 when used as a component in a properly installed UTP channel.	
2	IDC Connector	0.5mm Phosphor bronze , Tin-plating contacts	
3	PCB Material & Thickness	FR-4, 1.2mm thickness	
4	Jack wire material and thickness	0.35mm Phosphor bronze gold over nickel plating	
5	Termination Interface	Front Mated Connection: 750 Cycles Rear Mated Connection: 200 Cycles	
6	Plug and Outlet Contact force	≥ 100 Grams with FCC Compliant RJ-45 plug	
7	Plug Retention Strength	13.5kg	
8	Contact Compatibility	Accommodates 23 to 26AWG solid	
9	Termination Pattern	TIA / EIA 568 A and B and Shall not have an integrated spring shutter as the shutter malfunctions and causes operational issues.	
10	Retention Strenght	5kgs between Jack and Plug	
11	Storage Temperature :	-40° to +68°C	
12	Electrical Performance	Insulation Resistance : ≥ 500mΩ	
		Contact Resistance : ≤10mΩ	
		Current rating : 1.5 Amps	
		DC Resistance : ≤ 0.1Ω	
		DC/AC Volt Endurance : DC1000V/AC750V 1min	
13	Regulatory Compliances	Should be UL/ETL channel performance verified with a MTP link even when termination is within 15 Mtrs. this ensuring eliminating short resonance for 4-connector channel as per ANSI/TIA-568.2-D and ISO/IEC 11801 Standards (Relivent Document from UL/ETL Report for 4 Connector need to be submitted which mentions quoted part code).	
		The OEM should be CE Certified and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
		OEM offered must be in India / SAARC for at-least 10 years or more.Should have Indian Technical Support Centre, Warehouse and RMA centre in India.	

		All networking passive material (Fiber Cable, Copper Cables, Networking Racks and their connectivity components) should be from one OEM make only & should be manufactured as per latest TIA/EIA or ISO/ IEC standard and have 25 years of channel performance.	
14	Make & Model	Bidder to specify	
SITC of Cat6A Unshielded LSZH Patch Cords having min technical spec as below			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	CAT6A Unshielded LSZH Modular Cord shall meet and exceed channel specification of ANSI/TIA 568.2-D, ISO/IEC 11801 Class E & IEC 61156-6 Standard.	
2	Conductor	Flexible Stranded Bare Copper, 24 AWG	
3	Insulation / Diameter	PE (1.05 ± 0.05 mm)	
4	Feature	Transparent Strain Relief easy latch-cover boot design for easy depression	
		Backward compatible for easy integration with any network component that uses a RJ45 connection	
5	Length	2 / 3 / 5 Meter & Customized length	
6	Connectors	High Grade 50 μ gold plated RJ45 Connectors	
7	Conductor Material	Stranded Bare Copper	
8	Plug Retention Strength	13.5kg	
9	Storage Temperature Range	-20 °C to +70°C	
10	Cable Diameter	5.9 ± 0.3mm	
11	Electrical Specification :	Conductor DC Resistance : 14Ω / 100m	
		Resistance Unbalance : 4%	
		Impedance : 100Ω ± 15%	
		Frequency : 500MHz Maximum	
12	Performance	Patch Cords which will give guaranteed higher bandwidth will be preferred.	
10	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 635Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relivent Document to be shared)	
		Should be ETL tested for a cabling configuration performance to the requirements of IEEE Std 802.3 for Type 4 remote powering applications	
		OEM should be registered under an NRTL approved lab follow-up program	
		OEM should a minimum on 01 patent in their name. All Related documents to be submitted.	

11	Test Reports	OEM factory test reports must be provided.	
12	Make & Model	Bidder to specify	
SITC of Field Mount Modular RJ45 Plug for WiFi, CCTV, etc. having minimum spec as below			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Type	Field Terminate RJ45 Plug complies to Complies to EN 50173 & ISO/IEC 11801, IEC 60512-99-001:2012 & IEC 60512-9-3:2011, Permanent Link & Channel ANSI/TIA-568.2-D for connectivity an IP-enabled IoT devices / PoE enabled devices and support high-speed applications like 5Ghz Wi-Fi and High resolution Video cameras	
2	Termination	Developed under MPTL and designed for use on Solid cable assemblies and strand conductors of sizes from AWG 23 through AWG 26	
3	Housing Material	Zinc – alloy fully shielded	
4	Plug Contact	0.35mm phosphor bronze	
5	Contact Area	Gold over nickel plating	
6	IDC Contact	0.4mm phosphor bronze, Sn over nickel plating	
7	Features	IP20 rated Field Terminable Plug	
		360 degree shielding for better EMI/EMC	
		Qualified Screened Class 6A Component Durability : 1000 mating cycles	
8	Plug Contact	RJ 45 : PCB, 50μ Phosphor bronze gold over nickel plating contacts	
9	IDC Connector	Phosphor bronze , Sn over nickel plating contacts	
10	Power over Ethernet - Applications	PoE+ type I & II IEEE 802.3at IEC 60512-99-001 (2012-08) IEC 60512-9-3 (2011-06)	
11	Operating Temperature Range	-40 °C to +70°C	
12	Regulatory Compliances	Should be ETL channel performance verified on a 04-Connector channel or more, tested upto 635Mhz or more with an MTPL Plug as per ANSI/TIA-568.2-D (Part Code to be mentioned in report and should be submitted along with bid) and UL Listed (Relevant Document to be shared)	
		Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	

		The Proposed OEM should be a member of BICSI and should have a CDCP, ITIL and a PMI-PMP / RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	
		OEM offered must be in India / SAARC for at-least 10 years or more.Should have Indian Technical Support Centre, Warehouse and RMA centre in India.	
13	Test Reports	OEM factory test reports must be provided.	
14	Make & Model	Bidder to specify	
SITC of Face Plate, UK Style, Almond Color, Square with Shutters having min technical spec as below			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Quoted Make	To be Specified by the Bidder	
2	Quoted Model	To be Specified by the Bidder	
3	Type	UK Style with Built-in Dust Covers / Shutters	
4	Material	Fire-retardant Plastic, ABS + PC, White color, UK Style.	
5	Acceptability	Should be able to accept Cat6A, Cat6 and Cat5e information outlets, Modules, Keystones and Adaptors to suit all installation requirements	
6	Approvals	UL 94V-0	
7	No. of plates	2 Plates/Pieces Face Plate for better aesthetic look	
8	Mounting screws	Include mounting screws and Label Holders with Plastic covers	
9	Available	Single/Dual/Quad network faceplate	
10	Dimensions	(H x W x D) 86 x 86 x 14.42 mm	
11	Regulatory Compliances	Compliant as per RoHS Directive 2011/65/EU and (EU) 2015/863 and the OEM shall be a Class 1 local supplier as defined in public procurement (Preference to Make in India), .	
		The Proposed OEM should be a member of TIA and BICSI and should have a CDCP, ITIL and a PMI-PMP or an RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	
		The OEM should be CE Certified and its manufacturing facility must adhere to Environmental Management Systems (EMS) through ISO 14001:2015 and adhere to Occupational Health and Safety (OH&S) management system through ISO 45001:2018 (Certificates to be Enclosed)	
12	Make & Model	Bidder to specify	

SITC of Backbox for Face Plate, UK Style having minimum technical specification as mentioned below			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Quoted Make	To be Specified by the Bidder	
2	Quoted Model	To be Specified by the Bidder	
3	Type	Back Box for UK Style Faceplate	
4	Material	White High impact plastics.	
5	Entry	Adjustable cable entries	
6	Dimensions	38 x 87 x 87 mm	
7	Compatiable	Back box allows for mounting a various ports of Faceplates	
8	Regulatory Compliances	All networking passive material (Fiber Cable, Copper Cables, Networking Racks and their connectivity components) should be from one OEM make only & should be manufactured as per latest TIA/EIA or ISO/ IEC standard and have 25 years of channel performance.	
		The Proposed OEM should be a member of TIA and BICSI and should have a CDCP, ITIL and a PMI-PMP or an RCDD on the OEM's payroll sitting in India whose services can be utilized for this project.	
		The OEM shall be recognized by the Department for Promotion of Industry and Internal Trade under the 'Telecommunication & Networking' Industry and 'Network Technology Solutions' sector by Government of India.	
9	Make & Model	Bidder to specify	
SITC of Reuseable Velcro Tie with Accessories having min technical specs as mentioned below :			
S. No.	Parameter	Specification	Compliance (Yes/No)
1	Make	To be Specified by the Bidder	
2	Type	19" Velcro Reusable Ties are perfect for organising your cables and cords at home or in the office.	
3	Feature	They are soft, adjustable and easy to use.	
		Ideal for securing and sorting the cable mess behind your computer, television and stereo.	
		They can also be used to wrap around appliance cords and extension leads for a tidy storage solution.	
		A safe and reusable alternative to cable ties, tapes and wires.	
		Suitable for use on cords of all sizes and small everyday household objects.	

4	Make & Model	Bidder to specify	
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1. 12 U Rack

TECHNICAL SPECIFICATION	Compliance (Yes/No)	Remarks
Rack should be 12U Floor Standing Rack (600 x 530)		
Front glass toughened and tinted with easy detachable hinges and rear split perforated doors with "Honeycomb" type of perforation for maximum air circulation and stiffness. Perforation area should be 70% at least of the total door area.		
Rack Should have removable side panels with ventilation provision		
Rack Should have castor wheels set of 4 with front wheels Brake provision		
Rack should have adjustable mounting slots		
Rack should have cable insertion on Top & Bottom panel to provide easy cable entry.		
Rack should have 5 sockets 3pin 5A.PDU-2Nos.		
Rack Should have 2 Fans to maintain the temp of equipment		
Rack should have 3 Trays for equipment		
Rack should have back door with lock.		
Rack should have hardware kit.		
Rack should have compatible with 19" International standards		
Should be RoHS complied and ISO Certified manufacturing plants.		
Earthing kit from top to bottom for proper earthing.		
Confirm to DIN 41494 or EIA 310D standards		

15/12 U Closed wall mount Rack

Standard Compliance	Compliance (Yes/No)
2 Post 19" Closed Wall Mount Rack (15U/12U) with copper & fiber cable management accessories	
1 No. Horizontal PDU with 5/15Amp Universal Sockets with 32Amp MCB	
Front mounting PVC Cable managers/ guide	
Integral Cable management ducts/ arms (on either side) with covers	
Cantilever Tray x 1 (19" / 1U/ 255mm - D)	
Cable retention bobbins X 5 (both sides) + Window Molding x 6	
Cable Hangers (set of 3) x 2 (Right & left side one set each)	
Bar, Earthing 15U	

Mounting Hardware (Pack of 10) x 5	
IP65 Rated Outdoor if used in outdoor environment (Weather resistant)	

2. 24U Rack

TECHNICAL SPECIFICATION	Compliance (Yes/No)	Remarks
Rack should be 24U Floor Standing Rack (600 x 600)		
Front glass toughened and tinted with easy detachable hinges and rear split perforated doors with “Honeycomb” type of perforation for maximum air circulation and stiffness. Perforation area should be 70% at least of the total door area.		
Rack Should have removable side panels with ventilation provision		
Rack Should have castor wheels set of 4 with front wheels Brake provision		
Rack should have adjustable mounting slots		
Rack should have cable insertion on Top & Bottom panel to provide easy cable entry.		
Rack should have 5 sockets 3pin 5A.PDU-2Nos.		
Rack Should have 2 Fans to maintain the temp of equipment		
Rack should have 3 Trays for equipment		
Rack should have back door with lock.		
Rack should have hardware kit.		
Rack should have compatible with 19" International standards		
Should be RoHS complied and ISO Certified manufacturing plants		
Earthing kit from top to bottom for proper earthing.		
Confirm to DIN 41494 or EIA 310D standards		

3. 32U Rack

TECHNICAL SPECIFICATION	Compliance (Yes/No)	Remarks
Rack should be 32U Floor Standing Rack (600 x 1000)		
Front glass toughened and tinted with easy detachable hinges and rear split perforated doors with “Honeycomb” type of perforation for maximum air circulation and stiffness. Perforation area should be 70% at least of the total door area.		
Rack Should have removable side panels with ventilation provision		
Rack Should have castor wheels set of 4 with front wheels Brake provision		
Rack should have adjustable mounting slots		
Rack should have cable insertion on Top & Bottom panel to provide easy cable entry.		
PDU 19' Octagonal socket 12 X 5/16 Amp with 16Amp MCB & Indicator		

with 3MTR cable and Industrial plug.		
Rack Should have 4 Fans to maintain the temp of equipment		
Rack should have 3 Trays for equipment		
Rack should have back door with lock.		
Rack should have hardware kit.		
Rack should have compatible with 19" International standards		
Should be RoHS complied and ISO Certified manufacturing plants		
Earthing kit from top to bottom for proper earthing.		
Confirm to DIN 41494 or EIA 310D standards		

4. 42 U Rack

TECHNICAL SPECIFICATION	Compliance (Yes/No)	Remarks
Rack should be 42U Floor Standing Rack (800 x 1000)		
Front glass toughened and tinted with easy detachable hinges and rear split perforated doors with "Honeycomb" type of perforation for maximum air circulation and stiffness. Perforation area should be 70% at least of the total door area.		
Rack Should have removable side panels with ventilation provision		
Rack Should have castor wheels set of 4 with front wheels Brake provision		
Rack should have adjustable mounting slots		
Rack should have cable insertion on Top & Bottom panel to provide easy cable entry.		
PDU 19' Octagonal socket 12 X 5/16 Amp with 16Amp MCB & Indicator with 3MTR cable and Industrial plug.		
Rack Should have 4 Fans to maintain the temp of equipment		
Rack should have 3 Trays for equipment		
Rack should have back door with lock.		
Rack should have hardware kit.		
Rack should have compatible with 19" International standards		
Should be RoHS complied and ISO Certified manufacturing plants		
Earthing kit from top to bottom for proper earthing.		
Confirm to DIN 41494 or EIA 310D standards		

Testing & Commissioning of Passive Components:

All the passive components shall have their Testing reports from the OEM with Batch No. and all standard parameters for GBU Gandhinagar complex. There shall be the proper ferruling and Numbering on the Cat 6A/fiber cables. There shall be proper dressing of the cables and equipment management inside the racks. The splicing of fiber, numbering termination etc. shall be the part of installation of the fiber cables. The Cat 6A cable installation measurements shall be done through penta scanning with standard parameters and shall have the OEM certification for the installation of all the components.

The optical fiber cable installation shall be checked by the OTDR machine and the reports shall meet all the parameters of the technical data sheet of the Cable and shall have the OEM certification for the installation.

After installation & OEM certification Commissioning of the passive components shall be completed.

C. ACTIVE COMPONENTS

TECHNICAL SPECIFICATIONS FOR ACTIVE COMPONENTS

Technical Specification of Firewall

S.No.	Technical Specification		Compliance YES / NO
1	Interfaces and Module		
	Hardware Accelerated GE RJ45 Ports	Minimum 16	
	Hardware Accelerated GE RJ45 Management/ HA	1 / 1	
	10GE SFP+ Slots	4	
	Hardware Accelerated GE SFP Slots	8	
2	System Performance — Enterprise Traffic Mix		
	IPS Throughput	Min. 4 Gbps	
	NGFW Throughput	3 Gbps	
	Threat Protection Throughput	2.5 Gbps	
2	System Performance and Capacity		
	IPv4 Firewall Throughput (1518 / 512 / 64 byte, UDP)	24 / 24 / 10 Gbps	
	Firewall Latency (64 byte, UDP)	4.78 μ s	
	Firewall Throughput (Packet per Second)	15 Mpps	
	Concurrent Sessions (TCP)	2.5 Million	
	New Sessions/Second (TCP)	2,00 000	
	IPsec VPN Throughput (512 byte)	12 Gbps	
	Gateway-to-Gateway IPsec VPN Tunnels	2000	
	SSL Inspection Throughput (IPS, avg. HTTPS)	3 Gbps	
	Application Control Throughput (HTTP 64K)	10 Gbps	
	CAPWAP Throughput (HTTP 64K)	15 Gbps	194

3	Dimensions and Power		
	Form Factor(supports EIA/non-EIA standards)	Rack Mount, 1 RU	
	AC Power Supply	100–240V AC, 50/60 Hz	
	Current (Maximum)	100V / 2A, 240V / 1.2A	
	Power Supply Efficiency Rating	80Plus Compliant	
4	Operating Environment and Certifications		
	Operating Temperature	32°–104°F (0°–40°C)	
	Storage Temperature	-31°–158°F (-35°–70°C)	
	Humidity	20%–90% non-condensing	
	Noise Level	49.9 dBA	
	Operating Altitude	Up to 7400 ft (2250 m)	
	Compliance	FCC Part 15B, Class A, CE, RCM, VCCI, UL/ cUL, CB, BSMI	
	Certifications	USGv6/IPv6	
5	Reliability Features	IPS Service, Web Security — URL and web content, Video and Secure DNS Filtering, Anti-Malware Protection (AMP) — Antivirus, Mobile Malware, Botnet,	
		Toll free number for support in India	

Technical Specification of Core Switch

S.No.	Technical Specification		Compliance YES / NO
1	Port Density	26 X 1/10G SFP Ports 2 x 40/100 G QSFP28 Ports	
2	Power Supply	Redundant Hot Swappable Power Supply - AC/DC	
3	Virtual Chassis/ Stacking Option	Upto 6 Switches or more	
4	RAM	8 GB or better	
5	Flash and Buffer	32GB or better and 32MB Packet Buffer	
6	Switching Capacity and forwarding Rate	900 Gbps or better and 600 Mpps or better	
7	Latency & MTBF	Latency: <650 ns MTBF: 384,636 h	
8	MAC Address	64K	
9	Routes	IPv4 - 32k or better IPv6 - 16k or better	

10	Quality of Service	Support for Egress rate limiting, eight egress queues per port, IEEE 802.1Q, 802.3x, DiffServ, Jumbo frame	
11	Protocol Support	IGMP Snooping V1, V2, V3, MLD, PIM-SM/PIM-SSM/PIM-DM/PIM-Bidirectional, DVMRP, RIPv1 & v2, RIPv2, OSPFv3, RIP, BGPv4, MP-BGP, GRE, IS-IS, ITU-T G.8032, IEEE 802.1s, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP), Ipv4/Ipv6, DHCP Option 82, BPDU, STP Root Guard, SIP detection, SPB-M or MPLS, IEEE 802.1ae, MIB, NTP, Built-in CPU protection against malicious attacks, The Switch Should have 1+N redundant supervisor manager in Virtual chassis with In-Service Software Upgrade (ISSU), VXLAN, ARP Poisoning detection, Policy based routing (PBR), SDN support through Restful API and OpenFlow 1.3.1	
12	Management	SNMP V1, V2, V3, Web GUI, CLI, USB or equivalent memory card, IPv6 management feature on open standards, IEEE802.1ag, TDM or equivalent standards	
13	Security	Should support Access Control Lists (ACLs), DHCP snooping, IEEE802.1x based port authentication, RADIUS/ TACACS+, SSL, SSH, port mirroring, IEEE 1588, AES, Syslog, MD5, LLDP-MED, BPDU Blocking, BFD, Unified management, control and fabric-mesh virtual chassis technology, Autosensing IEEE 802.1X multi-client, multi-VLAN support for bridging and SPBM/VXLAN services, MAC-based authentication for non-IEEE 802.1X hosts, MAC address lockdown, Prevention from ARP attacks	
14	Resiliency	IEEE802.1q, IEEE802.1d, IEEE802.1s, IEEE802.1w, ITU-T G.8032 ring resilience/ring protection, VRRPv2,	
15	Operating Temperature and Humidity	Temperature: 0 to 45Deg Humidity: 5% to 95% (non-condensing)	
16	Safety Certifications	CE, EN 55022, RoHS	
		US UL 60950, CSA22.2	
		FIPS 140-2, EAL2 & NCPP Certified	
		EN 60825-1/2 Laser	
17	SFP	SFP should be of same make as switch.	
18		Vendor to be present in Gartner Magic Quadrant.	
19		The Switch shall work with on-premises and cloud-based NMS without change in hardware/software/OS Image. The Switch should be EAL2/NDPP certified	
20		Toll free number for support in India	

Technical Specification of Distribution Switch

S.No.	Technical Specification		Compliance YES / NO
1	Port Density	24 x 100/1000 BaseX, SFP and 4 x 1/10G SFP+ 4 x 10/25G SFP28	
2	Power Supply	Redundant Hot Swappable Power Supply - AC/DC	
3	Virtual Chassis/ Stacking Option	Upto 8 Switches or more with 2 x 100G QSFP28 Virtual Chassis/Stacking ports per Switch	
4	RAM	4 GB or better	
5	Flash and Buffer	16 GB or better and 32MB Packet Buffer	
6	Switching Capacity and forwarding Rate	728 Gbps or better and 540 Mpps or better	
7	Macsec Support and MTBF	Macsec Support: All SFP ports should be macsec capable MTBF: 138,559 h	
8	MAC Address	64K	
9	Routes	IPv4 - 144k or better IPv6 - 72k or better	
10	Quality of Service	Support for Egress rate limiting, Eight egress queues per port, IEEE 802.1Q, 802.3x, DiffServ, Jumbo frame	
11	Protocol Support	IGMP Snooping V1, V2, V3, MLD, PIM-SM/PIM- SSM/PIM-DM/PIM-Bidirectional, DVMRP,RIPv1 & v2,RIPing ,OSPFv3, RIP, BGPv4, MP-BGP,GRE, IS- IS, ITU-T G.8032, IEEE 802.1s, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP), Ipv4/Ipv6, DHCP Option 82, BPDU, STP Root Guard, SIP detection, SPB-M or MPLS, IEEE 802.1ae, MIB, NTP, Built-in CPU protection against malicious attacks, The Switch Should have 1+N redundant supervisor manager in Virtual chassis with In-Service Software Upgrade (ISSU), VXLAN, ARP Poisoning detection, Policy based routing (PBR),SDN support through Restful API and openflow 1.3.1	
12	Management	SNMP V1,V2,V3, Web GUI, CLI, USB or equivalent memory card, IPv6 management feature on open standards, IEEE802.1ag, TDM or equivalent standards, Smart continuous switching technology	
13	Security	Should support Access Control Lists (ACLs), DHCP snooping, IEEE802.1x based port authentication, RADIUS/ TACACS+, SSL, SSH, port mirroring, NTP, IEEE 1588, AES, Syslog, MD5, LLDP-MED, BPDU Blocking, BFD, Unified management, control and fabric-mesh virtual chassis technology, Autosensing IEEE 802.1X multi- client, multi- VLAN support for bridging and SPBM/VXLAN services, MAC-based authentication for non-IEEE 802.1X hosts, MAC address lockdown, Prevention	

		from ARP attacks	
14	Resiliency	IEEE802.1q, IEEE802.1d, IEEE802.1s, IEEE802.1w, ITU-T G.8032 ring resilience/ring protection, VRRPv2, MVRP, VRF and Virtual Network Profiles (VNP), Software-controlled VXLAN hardware VTEP gateway	
15	Operating Temperature and Humidity	Temperature: 0 to 45Deg Humidity: 5% to 95% (non-condensing)	
16	Safety Certifications	CE, EN 55022, RoHS	
		US UL 60950, CSA22.2	
		FIPS 140-2, EAL2 & NDcPP Certified	
		EN 60825-1/2 Laser	
17	SFP	SFP should be of same make as switch.	
18		Vendor to be present in Gartner Magic Quadrant.	
19		The Switch shall work with on-premises and cloud-based NMS without change in hardware/software/OS Image. The Switch should be EAL2/NDPP certified	
20		Toll free number for support in India	

Technical Specification of 24 Port PoE+ Switch

S.No.	Technical Specification		Compliance YES / NO
1	Port Density	24 X 1G RJ-45 PoE+ Ports with 380W power budget 2 x 1G/10G SFP+ Ports and 2 x 1G SFP/Base-T Combo Ports upgradable to 2 x 10G SFP+ Ports	
2	Power Supply	Internal Power Supply	
3	Virtual Chassis/ Stacking Option	Upto 4 Switches or more	
4	RAM	1 GB or better	
5	Flash	1 GB or better	
6	Switching Capacity and forwarding Rate	128 Gbps or better and 68 Mpps or better	
7	Latency & MTBF	Latency: < 4 μ s MTBF: 1447 k hours	

8	Layer 2 Features	Mac Address:16K or more VLAN: 4K or more System Policies: 1.5K or more Max Jumbo Frame: 9216 bytes Multicast Group: up to 1000	
10	Quality of Service	Auto QoS for switch management traffic, Policy-based QoS, Traffic Prioritization, Priority Queues: Eight hardware-based queues per port, SPQ, WRR	
11	Protocol Support	Static Routing, MSTP, RSTP, PVST+,IPv6 Tunneling, LACP, LAG, IGMPv3, DHCP, DHCP82,DHCP Relay for IPv4/IPv6,Multiple microcode image support with fallback recovery, ARP,SDN support through Restful API and openflow 1.3.1	
12	Management	Loopback IP address support for management per service, Policy- and port-based mirroring, Remote port mirroring, sFlow v5 and Remote Monitoring (RMON), Unidirectional Link Detection (UDLD), Digital Diagnostic Monitoring (DDM), LLDP-MED, NTP, MVRP, SNMP, sflow or equivalent	
13	Security	Dynamic change of authentication (CoA), MAC-based authentication for non-IEEE 802.1X hosts, MAC address lockdown, Prevention from ARP attacks, Web based Authentication, Autosensing IEEE 802.1X multi-client, multi-VLAN support, RFC 1321 MD5, RFC 2284 PPP EAP, RFC 1826/1827/4303/4305 Encapsulating Payload (ESP) and crypto algorithms, RFC 2104 HMAC Message Authentication, Built-in CPU protection against malicious attacks	
14	Resiliency	Unified management, control and virtual chassis technology, Virtual Chassis 1+N redundant supervisor manager, Virtual Chassis In-Service Software Upgrade (ISSU), Smart continuous switching technology, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP) and static LAG groups across modules	
15	Operating Temperature and Humidity	Temperature: 0 to 45Deg Humidity: 5% to 95% (non-condensing)	
16	Safety Certifications	CE, EN 55022, RoHS, WEEE	
		US UL 60950, CSA22.2	
		FIPS 140-2	
		EN 60825-1/2 Laser, IEC 62368-1	
17	SFP	SFP should be of same make as switch.	
18		Vendor to be present in Gartner Magic Quadrant.	
19		The Switch shall work with on-premises and cloud-based NMS without change in hardware/software/OS Image.	

20		Toll free number for support in India	
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Technical Specification of 48 Port PoE+ Switch

S.No.	Technical Specification		Compliance YES / NO
1	Port Density	48 X 1G RJ-45 PoE+ Ports with 760W power budget. It should support Multigig on minimum 2 Ports out of 48 Ports. 2 x 1G/10G SFP+ Ports and 2 x 1G SFP/Base-T Combo Ports upgradable to 2 x 10G SFP+ Ports.	
2	Power Supply	Internal Power Supply	
3	Virtual Chassis/ Stacking Option	Upto 4 Switches or more	
4	RAM	1 GB or better	
5	Flash	1 GB or better	
6	Switching Capacity and forwarding Rate	182 Gbps or better and 135 Mpps or better	
7	Latency & MTBF	Latency: < 4 μ s MTBF: 789 k hours	
8	Layer 2 Features	Mac Address:16K or more VLAN: 4K or more System Policies: 1.5K or more Max Jumbo Frame: 9216 bytes Multicast Group: up to 1000	
10	Quality of Service	Auto QoS for switch management traffic, Policy-based QoS, Traffic Prioritization, Priority Queues: Eight hardware-based queues per port, SPQ, WRR	
11	Protocol Support	Static Routing, MSTP, RSTP, PVST+,IPv6 Tunneling, LACP, LAG, IGMPv3, DHCP, DHCP82,DHCP Relay for IPv4/IPv6,Multiple microcode image support with fallback recovery, ARP,SDN support through Restful API and openflow 1.3.1	
12	Management	Loopback IP address support for management per service, Policy- and port-based mirroring, Remote port mirroring, sFlow v5 and Remote Monitoring (RMON), Unidirectional Link Detection (UDLD), Digital Diagnostic Monitoring (DDM), LLDP-MED, NTP, MVRP, SNMP, sflow or equivalent	

13	Security	Dynamic change of authentication (CoA), MAC-based authentication for non-IEEE 802.1X hosts, MAC address lockdown, Prevention from ARP attacks, Web based Authentication, Autosensing IEEE 802.1X multi-client, multi-VLAN support, RFC 1321 MD5, RFC 2284 PPP EAP, RFC 1826/1827/4303/4305 Encapsulating Payload (ESP) and crypto algorithms, RFC 2104 HMAC Message Authentication, Built-in CPU protection against malicious attacks	
14	Resiliency	Unified management, control and virtual chassis technology, Virtual Chassis 1+N redundant supervisor manager, Virtual Chassis In-Service Software Upgrade (ISSU), Smart continuous switching technology, IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP) and static LAG groups across modules	
15	Operating Temperature and Humidity	Temperature: 0 to 45Deg Humidity: 5% to 95% (non-condensing)	
16	Safety Certifications	CE, EN 55022, RoHS, WEEE	
		US UL 60950, CSA22.2	
		FIPS 140-2	
		EN 60825-1/2 Laser, IEC 62368-1	
17	SFP	SFP should be of same make as switch.	
18		Vendor to be present in Gartner Magic Quadrant.	
19		The Switch shall work with on-premises and cloud-based NMS without change in hardware/software/OS Image.	
20		Toll free number for support in India	

Technical Specification of 04 Port Industrial Grade PoE Switch

S.No.	Technical Specification	Compliance YES / NO
1	Fanless equipment	
2	Non-blocking equipment (for layer 2 and layer 3 in all ports)	
3	Support of the mounting options: DIN, Wall and Panel	
4	Maximum Height of 15 cm (5.9 in)	
5	Maximum Width of 8 cm (3.15 in)	
6	Maximum Depth (without Power supplies) of 15 cm (5.9 in)	
7	Maximum Weight (without Power supplies) of 2.08 Kg (4.6 lbs)	
8	Minimum of 4 ports 10/100/1000 Base T RJ45	
9	Minimum of 2 SFP ports (1 Gbps)	
10	Minimum of 2 ports 10/100/1000 Base T with support of RJ45 PoE+, 803.3at and also 60W HPoE	

11	Minimum PoE budget of 150 Watt capable	
12	Minimum support of 1 Alarm Relay Contact (1 in, 1 out)	
13	Surge protection in the RJ45 of 6KV	
14	Minimum support of 4 ports 10/100/1000 with MACSec capable	
15	Minimum support of 2 ports SFP with MACSec capable	
16	Minimum support of 4 ports 10/100/1000 with 1588v2 capable	
17	Minimum support of 2 ports SFP with 1588v2 capable	
18	Minimum switching capacity (Gbps): 12 Gbps	
19	Minimum Processing Capacity (Mpps): 9.9 Mpps	
20	Operating Temperature: -40°C to 75°C (-40°F to 167°F)	
21	Humidity (operation): 5% to 95% non-condensing	
22	Minimum MTBF in hours (switch only): 1.452.904	
The switch must support the following Resiliency and high availability functionalities:		
23	Unified management, control and virtual chassis technology	
24	Virtual Chassis 1+N redundant supervisor manager	
25	Minimum number of units in VC per line model of: 4	
26	Smart continuous switching technology	
27	IEEE 802.1s Multiple Spanning Tree Protocol (MSTP) encompasses IEEE 802.1D Spanning Tree Protocol (STP) and IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)	
28	Per-VLAN spanning tree (PVST+) and 1x1 STP mode	
29	IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP) and static LAG groups across modules	
30	Dual-home link support for sub-second link protection, without STP	
31	ITU-T G.8032/Y1344 2010: Ethernet Ring Protection	
32	Virtual Router Redundancy Protocol (VRRP) with tracking capabilities	
33	IEEE protocol auto-discovery	
34	Redundant and hot-swappable power supplies	
35	Built-in CPU protection against malicious attacks	
36	Split Virtual Chassis protection	
The switch must support the following L3 IPv4 routing features and capacity:		
37	Static routing	
38	RIP v1 and v2	
39	Virtual Router Redundancy Protocol (VRRPv2)	
40	DHCP Relay (including generic UDP relay)	
41	DHCPv4 server	
42	Address Resolution Protocol (ARP)	
43	Policy-based routing and server load balancing	
The switch must support the following L3 IPv6 routing features and capacity:		
44	Internet Control Message Protocol version 6 (ICMPV6)	
45	Static routing	
46	Virtual Router Redundancy Protocol (VRRPv3)	
47	DHCPv46 server	
48	Policy-based routing and server load balancing	
The switch must support the following layer-2 capabilities and services:		
49	Up to 16k MAC Addresses	

50	Up to 4000 VLANs	
51	Total number of IPv4 routes:128	
52	Max Frame: 9216 bytes jumbo frame size, for 1 Gbps	
53	Ethernet services support using IEEE 802.1ad Provider Bridges (also known as Q-in-Q or VLAN stacking)	
54	Ethernet OAM (802.1ag, ITU-T Y.1731): Connectivity Fault Management (L2 ping & Link trace)	
55	Ethernet in First mile: Link OAM (802.3ah)	
56	Ethernet network-to-network interface (NNI) and user network interface (UNI)	
57	Service Access Point (SAP) profile identification	
58	Service VLAN (SVLAN) and Customer VLAN (CVLAN) support	
59	VLAN translation and mapping including CVLAN to SVLAN	
60	Port mapping	
61	DHCP Option 82: Configurable relay agent information	
62	Multiple VLAN Registration Protocol (MVRP)	
63	Customer Provider Edge (CPE) test head traffic generator and analyzer tool	
64	TR-101 Point-to-Point Protocol over Ethernet (PPPoE) Intermediate Agent allowing for the PPPoE network access method	
65	Service Assurance Agent (SAA) for proactively measuring network health, reliability and performance.	
66	Bridge Protocol Data Unit (BPDU) blocking	
67	STP Root Guard	
The switch must support the following IPv4/IPv6 multicast protocols and features:		
68	IGMPv1/v2/v3 snooping to optimize multicast traffic	
69	Multicast Listener Discovery (MLD) v1/v2 snooping	
The switch must support the following security features:		
69	Autosensing IEEE 802.1X multient, multi-VLAN support	
70	MAC-based authentication for non-IEEE 802.1X hosts	
71	Web based authentication (captive portal): a customizable web portal residing on the switch	
72	Dynamically provide pre-defined policy configuration to authenticated clients — VLAN, ACL, BW	
73	Secure Shell (SSH) with public key infrastructure (PKI) support	
74	Terminal Access Controller Access- Control System Plus (TACACS+) client	
75	Centralized Remote Access Dial- In User Service (RADIUS) and Lightweight Directory Access Protocol (LDAP) administrator authentication	
76	Centralized RADIUS for device authentication and network access control authorization	
77	Learned Port Security (LPS) or MAC address lockdown	
78	Access Control Lists (ACLs); flow based filtering in hardware (Layer 1 to Layer 4)	
79	DHCP Snooping, DHCP IP and Address Resolution Protocol (ARP) spoof protection	
80	ARP poisoning detection	
81	IP Source Filtering as a protective and effective mechanism against ARP attacks	

82	LLDP Security mechanism for rogue device detection and restriction	
The switch must support the following Quality of Service (QoS) features:		
82	Eight hardware based queues per port for flexible QoS management	
83	Flow-based QoS traffic policing and bandwidth management	
84	32-bit IPv4/128-bit IPv6 non-contiguous mask classification	
85	Egress traffic shaping	
86	DiffServ architecture	
87	Congestion avoidance: Support for End- to-End Head-Of-Line (E2E-HOL) Blocking Protection	
88	IEEE 802.1Qbb Priority-based Flow Control (PFC)	
89	IEEE 802.3X Flow Control (FC)	
90	Auto QoS for Generic Object-Oriented Substation Events (GOOSE) messages	
The switch must support the following manageability and configuration features:		
91	Intuitive CLI in a scriptable Python & BASH environment via console, Telnet or Secure Shell (SSH) v2 over IPv4/IPv6	
92	Powerful WebView Graphical Web Interface via HTTP and HTTPS over IPv4/IPv6	
93	Network Automation and Programmability Abstraction Layer with Multivendor (NAPALM) support	
94	Fully programmable RESTful web services interface with XML and JSON support. API enables access to CLI and individual MIB objects	
95	Full configuration and reporting using SNMPv1/2/3 to facilitate third party network management over IPv4/IPv6	
96	File upload using USB, TFTP, FTP, SFTP or SCP using IPv4/IPv6	
97	Human-readable ASCII-based configuration files for off-line editing, bulk configuration and out-of-the-box auto-provisioning	
98	Non-volatile memory for start-up configuration	
99	Multiple microcode image support with fallback recovery	
100	Dynamic Host Configuration Protocol (DHCP) relay for IPv4/IPv6	
101	IEEE 802.1AB Link Layer Discover Protocol (LLDP) with Media Endpoint Discover (MED) extensions	
102	Network Time Protocol (NTP)	
Switch must support the following Monitoring and troubleshooting features:		
103	Local (on the flash) and remote server logging (Syslog): event and command logging	
104	IP tools: ping and trace route	
105	Dying Gasp support via SNMP and syslog messages	
106	Loopback IP address support for management per service	
107	Policy- and port-based mirroring	
108	Remote port mirroring	
109	sFlow v5 and Remote Monitoring (RMON)	
110	Unidirectional Link Detection (UDLD), Digital Diagnostic Monitoring (DDM)	
Switch must support the following Compliance and Industrial Certifications:		
Industrial environment:		
111	IEC 60870-2-2 (operational temperature)	

112	IEC 60068-2-1 (temperature type test - cold)	
113	IEC 60068-2-2 (temperature type test - hot)	
114	IEC 60721-3-1: Class 1K5 (storage temperature)	
115	IEC 60068-2-30: 5% to 95% non-condensing humidity	
116	IEC 60255-21-2 (mechanical shock)	
117	IEC 60255-21-1 (vibration)	
Industrial safety:		
118	UL 508	
119	UL 61010	
120	EN 50021	
121	Hazardous location - ISA 12.12.01 (UL 1604)	
122	Hazardous location - CSA22.2/213	
123	IP30	
Industrial emission:		
124	EN 61805-3	
125	EN 55032 (Emission Standard)	
126	EN 61000-3-2	
127	EN 61000-3-3	
128	EN 55024/EN 55035 (Immunity Standard)	
129	EN 61000-4-2 to EN 61000-4-8	
130	EN 61000-4-11	
131	EN 61000-4-12	
132	EN 61000-4-16	
133	EN 61000-4-17	
134	EN 61000-4-29	
135	IEC 60255-5	
136	IEEE 61850-3	
Commercial EMI/EMC:		
137	47 CRF FCC Part 15: 2015 Subpart B (Class A)VCCI (Class A, with UTP Cables)	
138	ICES-003:2012 Issue 5, Class A	
139	AS/NZS 3548 (Class A) - C-Tick	
140	CE marking for European countries (Class A)	
CE Emission:		
141	EN50581 (RoHS Recast)	
142	EN 55032 (EMI & EMC requirement)	
143	EN 55024 (Immunity Characteristics)	
144	EN 61000-3-2(Harmonic Current emissions)	
145	EN 61000-3-3	
146	EN 61000-4-2	
147	EN 61000-4-3	
148	EN 61000-4-4	
149	EN 61000-4-5 (Surge Immunity, Class 4)	
150	EN 61000-4-6	
151	EN 61000-4-8	
152	EN 61000-4-9	
153	EN 61000-4-11	
154	IEEE802.3: Hi-pot Test (2.25 KV DC on all Ethernet Ports)	
Commercial safety:		

155	UL 60950-1, 2nd Ed	
156	IEC 60950-1; all national deviations and amendments	
157	EN 60950-1; all deviations	
158	CAN/CSA-C22.2 No. 60950-1-03	
168	EN 60825-1 Laser	
169	EN 60825-2 Laser	
170	CDRH Laser	
171	RoHS & WEEE directives compliant	
172	REACH directive	

Technical Specification of Indoor Access Point

S.No.	Technical Specification	Compliance YES / NO
1	Indoor Wireless Access Point	
2	Proposed solution will be Controller less/HW Controller based/SW Controller based but all the Access Points managed centralized.	
3	The WLAN solution shall propose an Indoor 802.11ax Wifi 6 MU-MIMO indoor dual radio AP Access Point (2.4, 5G)	
4	AP to support 4X4:4 on 5 Ghz and 2X2:2 on 2.4 Ghz.	
5	Access Point shall offer up to 2400 Mbps throughput on the 5Ghz band (low and high bands) and up to 573 Mbps throughput on the 2.4GHz band.	
6	1 x 10/100/1000Base-T autosensing (RJ-45) port and 1x 10BASE-T/100BASE-TX/1000BASE-T/2500BASE-T IEEE 802.3 compliant autosensing (RJ-45) port. Both ports should support 802.3at PoE, 1x USB 2.0 Type C	
7	AP should support ACL, wIPS/wIDS and DPI application, 802.11i, 802.1x	
8	Access Point shall propose a Factory reset button.	
9	Access Point shall support up to 32 SSIDs (16 per radio) with 1024 Clients and should support BLE 5.1/Zigbee Integrated. Single AP can act in dual mode (WLC/Client Serving) with controller to support 256 Access Points in single cluster.	
10	Distributed Radio Management, Radio Dynamic Adjustment (RDA), Transmit Power Control @ 18 dBm(TPC), DFS, VHT20,40,80,160	
11	L2 Roaming	
12	802.11r Roaming, 802.11K, 802.11v	
13	Operating temperature must be 0°C to 50°C	
14	Humidity must be 10% to 90% non-condensing.	
15	WFA, UL2043 Plenum rating, EMI, RoHS, REACH, WEEE	
16	FCC and CE approval and certificates,	
17	The AP shall work with on-premises and cloud based WLC without change in hardware/software/OS Image	
18	Toll free number for support in India	

Technical Specification of Wireless (Wi-Fi) Controller

S.No.	Technical Specification	Compliance YES / NO
	Architecture	

1	Controller should be appliance or server (physical or virtual) based to support upto 4000 AP or more. The proposed solution should be premise based and not cloud based	
	Access Control	
2	Authentication and Encryption For this “large deployment” scenario, the WLAN solution shall include a built-in RADIUS server for 802.1x and MAC authentication that shall not be proposed as a separate product.	
3	The built-in RADIUS server shall support at least following EAP types: EAP-PEAP, EAP-GTC, EAP-TLS, EAP-TTLS.	
4	The wireless LAN solution shall support following link layer encryption standards: WPA2_AES, WPA2_TKIP, WPA_AES, WPA_TKIP, DYNAMIC_WEP, WPA_PSK_AES, WPA_PSK_TKIP, WPA_PSK_AES_TKIP, WPA2_PSK_AES, WPA2_PSK_TKIP.	
5	The wireless LAN solution shall support following 802.1x supplicants: Windows 7, 10, MAC OS, IOS, Android, Chromebook	
6	the wireless LAN solution shall propose a “Guest” management solution based on an embedded and built-in Captive Portal providing web based authentication for guests and visitors.	
7	The Guest management solution shall allow non-IT staff (e.g., a receptionist) to create temporary guest accounts.	
8	the WLAN solution shall allow guest self-registration and employee sponsored access.	
9	the Guest management solution shall allow setting a validity period for an authenticated device, in order to avoid entering credentials each time a guest access the network	
10	the WLAN solution shall support BYOD and be able to provide device onboarding that is as simple as possible and without requiring additional thirdparty components	
11	The on-boarding process of employee devices shall be based on employee corporate accounts.	
12	The BYOD application shall allow setting the validity period for the device, and the maximum number of devices per account.	
13	The licensing model of the BYOD application shall be based on the number of on-boarded devices.	
	Intrusion Detection and Prevention	
14	The WLAN solution have wIDS/wIPS capabilities with no additional and dedicated equipment nor additional license.	
15	The WLAN solution shall be able to identify Interfering APs.	
16	The WLAN solution shall be able to identify and contain Rogue APs.	
17	The WLAN solution shall allow the definition of flexible policies to classify an AP as a Rogue AP.	
18	the WLAN solution shall be able to blacklist a WLAN client, either manually or automatically after a client attack has been detected.	
19	the WLAN solution shall allow to configure a blacklist duration.	
20	the WLAN solution shall allow to configure an authentication failure times threshold.	
	RF Management	
21	The WLAN solution shall allow automatic and/or manual RF management (channel and power).	
22	The WLAN solution shall support Short Guard Interval.	

23	If no band/channel (2.4GHz/5GHz) is overloaded (high medium utilization) or crowded (high client count), an AP shall by default guide a new client to the 5GHz band.	
24	Even if the 5GHz band is not overloaded but is crowded (high client count), an AP shall guide a new client to the 2.4GHz band.	
25	If all bands/channels (2.4GHz/5GHz) are overloaded (high medium utilization) and the 5GHz is crowded, an AP shall guide a new client to the 2.4GHz band.	
26	When a new client discovers multiple APs to associate to, the new client shall be guided to the AP that has the fewest associated clients, thus allowing smart/dynamic load balancing.	
27	The WLAN solution shall deny connection to an AP when the signal of the client becomes too weak and disconnect a client when the signal becomes too weak.	
28	The WLAN solution shall propose APs that have the ability to scan the air in order to provide interfering/rogue APs and wireless attacks detection, and shall not rely on dedicated scanning equipment.	
29	The scanning function of the APs shall not impact active voice or video calls (SIP and H.323).	
	Mobility & LBS	
30	The WLAN solution shall support both Opportunistic Key Caching (802.11k).	
31	The WLAN solution shall comply to the 802.11r standard.	
32	the centralized management function shall allow to display the Wi-Fi coverage quality within a given area (“Heat Map”).	

Technical Specification of Network Management System (NMS)

S.No.	Technical Specification	Compliance YES / NO
	GENERAL	
1	A solution that shall include a client/server Network Management System that is WEB 2.0 based, providing a WEB GUI for different types of PCs, tablets and smartphones.	
2	The NMS shall offer a single and consolidated interface for network deployment, troubleshooting, performance analysis and configuration operations.	
3	The NMS shall offer northbound interface RESTful APIs for application interoperability	
4	The NMS shall allow real-time monitoring and analysis of critical network performance indicators through visual and customizable widgets	
5	The proposed solution should be premise based and should support seamless migration to cloud without change in hardware/firmware of the switch. This should be based on standard server (Physical/Virtual)	
6	The centralized management function shall allow to display the physical topology of the network.	
7	The centralized management function shall be able to handle wired equipment (switches) and wireless (Acces Point) management for a “unified management” approach.	

8	The solution shall be able to automatically discover new Switch or APs added to the network.	
9	The solution shall be able to blacklist a client, either manually or automatically after a client attack has been detected.	
10	The centralized management function shall allow per equipment configuration and software backup and restore, and bulk backup and restore.	
	TOPOLOGY	
11	The NMS shall build and present a visual topology for both logical and physical infrastructure with actual neighbour linkage info (IP subnet, layer 2, LLDP adjacency protocols) and live device status	
12	The NMS shall present logical maps based on user-defined filters (IP subnet, location...).	
	NOTIFICATION MANAGER	
13	The NMS shall allow monitoring and analyzing alerts, notifications and network performance from network equipment from any vendor	
14	The NMS shall offer advanced alert capabilities through customizable filtering and sorting capabilities.	
15	The NMS shall allow remediation and notifications actions based on predefined conditions with a single click	
	LOCATOR	
16	The NMS shall be able to locate devices in the network based on MAC address or IP Address, irrespective whether the device is located on a fixed or wireless network.	
	RESSOURCE MANAGER	
17	The NMS shall allow mass programmable equipment configuration by the mean of scripts.	
18	The NMS shall allow infrastructure-wide software image update for baseline version management	
	UNIFIED ACCESS	
19	The NMS shall offer a unified user interface for wired and wireless role profiles for user-based access	
20	The NMS shall offer a wired and wireless cohesive authentication configuration and end-user profile definition for appropriate network access rights and dynamic policies	
	ADDITIONAL FEATURES	
21	The centralized management function shall allow access to all wIPS/wIDS features.	
22	The centralized management function shall offer, on the basis of an application signature file, insight at application layer (e.g. facebook.com, youtube.com, salesforce.com...) even if the applications run on top of the HTTP or HTTPs protocols. It shall also allow control of those applications.	
23	The solution should allow the admin to easily provision, manage and maintain a network infrastructure with alarms, unified access security policies	
24	The solution should provide full visibility into wireless, devices and applications, as well as predictive analysis for forward planning	
25	The management solution should act as comprehensive tools for infrastructure configuration, monitoring, security, device configuration, alert management, to accelerate, downtime resolution, and overall management.	
26	It should be web based interface with customizable dash board	

27	Provide details about problematic devices including temperature, memory etc	
28	Monitor network bandwidth and end device traffic pattern	
29	Provide top applications/users usage analytics real time and historical	
30	Port utilisation details and threshold limits	
31	Provides threat mitigation through a secure perimeter against intrusion and malware attacks	
32	Should support third party network devices for basic SNMP and report	

Testing & Commissioning:

All Active components shall have the OEM test reports and shall have the 5 years OEM warranty/ Guarantee Card. All equipment's installation shall be considered completed after verifying all the features of the system as mentioned in the specifications and as per the standards.

All equipment shall be replaced if there is any fault in the hardware or in software within two to three hours. The Agency shall have the spares of the main equipments in the stock so that the work of the complex shall remain smooth & undisturbed. All equipment's installation shall be considered completed after verifying all the features of the system as mentioned in the specifications in the Tender and as per the standards.

Item No:- 440-441

35. SOLAR PV SYSTEM

GENERAL

This section specifies the Design, engineering, supply, delivery to site, installation, testing, commissioning and maintenance of solar power plant as described in the Content.

TECHNICAL SPECIFICATION FOR SOLAR POWER PLANT

S.no	Items Description	Specifications												
1. Solar Photovoltaic Modules														
1.1	SPV Module	"The Photo Voltaic Module Should be 72 Cell, Poly Crystalline Type with a total array capacity of for "&M4&N4&" SPV Power Plant - Power output under STC should be "&M4&N4&" and having technical specification mentioned below:"												
		<table border="1"> <thead> <tr> <th>S.no</th> <th>Descriptions</th> <th>Specification</th> </tr> </thead> <tbody> <tr> <td>1.1.1</td> <td>Output power Pmax (Watt peak)</td> <td>: 325 Wp, Tolerance 0 ~ + 3 %</td> </tr> <tr> <td>1.1.2</td> <td>Voltage at Pmax</td> <td>: ≤ 38 V</td> </tr> <tr> <td>1.1.3</td> <td>Current at Pmax</td> <td>: ≤ 8.8 Adc</td> </tr> </tbody> </table>	S.no	Descriptions	Specification	1.1.1	Output power Pmax (Watt peak)	: 325 Wp, Tolerance 0 ~ + 3 %	1.1.2	Voltage at Pmax	: ≤ 38 V	1.1.3	Current at Pmax	: ≤ 8.8 Adc
S.no	Descriptions	Specification												
1.1.1	Output power Pmax (Watt peak)	: 325 Wp, Tolerance 0 ~ + 3 %												
1.1.2	Voltage at Pmax	: ≤ 38 V												
1.1.3	Current at Pmax	: ≤ 8.8 Adc												

	1.1.4	Open circuit voltage	:	≤ 46.2 V
	1.1.5	Short circuit current	:	≤ 8.92 A
	1.1.6	Maximum system voltage (Volts)	:	1000 V DC
	1.1.7	Type of solar PV cell	:	Poly - Crystalline silicon
	1.1.8	Module output	:	MC4 electronics plug (Male and female)
	1.1.9	Efficiency	:	≥16%
	1.1.10	Warranty	:	(a)10-year product warranty (b)25-year Linear performance warranty
	1.1.11	Compliance	:	IEC 61215 ,IEC 61701, IEC 61730

2. Grid Tie Solar Inverter

2.1(a))	Grid Tie Solar Inverter	Solar Grid Tie String Inverters should have MPPT for optimum generation with wide input voltage range and should have anti-islanding feature. Inverter should have the specifications as mentioned below.			
		2.1.1	60 KW Grid Tie String Inverter (Three Phase)-		
		2.1.1.1	Max Input PV Power	:	66000
		2.1.1.2	Max. DC Power per MPPT	:	22000W (530-800V)
		2.1.1.3	No. of independent MPPT	:	3
		2.1.1.4	No. of DC inputs	:	4/4/4 for each MPPT
		2.1.1.5	Max. input voltage	:	1000V
		2.1.1.6	MPPT Voltage Range	:	250-960V
		2.1.1.7	Start-up input voltage	:	350V
		2.1.1.8	DC Reverse-Polarity Protection	:	Yes
		2.1.1.10	Rated AC Power Output	:	60000W
		2.1.1.11	Maximum AC Power Output	:	60000W
		2.1.1.12	Maximum Continuous Output Current (per Phase)	:	90 A
		2.1.1.13	Nominal Grid Voltage	:	3/N/PE, 3/P E, 230 V / 400 V ac
		2.1.1.14	Output frequency Range	:	45/53 HZ
		2.1.1.15	MPPT Efficiency	:	> 99.9%
		2.1.1.17	Product Warranty	:	Standard 10 year warranty
		2.1.1.18	Degree of Protection	:	IP65
		2.1.1.19	Operating temperature	:	-25 to +60 ⁰ C
		2.1.1.20	Noise Level	:	<60 db
		2.1.1.22	Supported Communication Interfaces	:	RS485, Wifi, SD Card, Multi-function relay
		2.1.1.23	SPD	:	MOV : Type III standard / Type II optional
		2.1.1.24	Safety protection	:	Anti-islanding, RCMU, Ground fault monitoring
		2.1.1.25	Compliance	:	IEC 62116, IEC 61727, IEC 61683, IEC 60068 (1, 2,

				14, 30), IEC 62109-1/2, IEC 61000.
4. Main AC Distribution Box Panel				
5	Main AC Distribution Box Panel	AC Distribution box for combining all above Grid Tie Solar inverter with suitable aluminium bus bar of rating for (RYB), Input and output glands complete with 1 Nos. Class I + II Surge Protective Device, 1 Nos. Multi-Function Meter Class 0.5 complete with CTs, Incomers MCB /MCCB & Outgoing MCCB/ACBs as per required capacity , suitable for cable, IP 55 Enclosure complete all as specified and directed.		
6. Module Mounting Structure				
6.1	Module Mounting Structure Suitable for RCC type Roof	Module Mounting Structure with Hot Dip Galvanized Mild Steel 80micron thickness, designed for wind load of 180 KMPH. The following technical specification is as follows:-		
		S.no	Descriptions	Specification
		6.1	Profile of Roof	: RCC
		6.2	Type	: Fixed tilt structure, Roof mounted
		6.3	Configuration	: 4 or 6 Modules As per Site Conditions
		6.4	Material	: Hot Dip Galvanized Mild Steel
		6.5	Height of Structure	: As per Site Conditions
		6.6	Fixing type	: GI/SS304 fasteners
		6.7	Foundation	: Concrete foundation/Ballast system .Concrete of M15/M 20 grade shall be used.
		6.8	Warranty	: 5 Years
7. Cables				
7	LT Cables	Cables suitable for Solar Power Plant as per below Specification		
		S.no	Descriptions	Specification
		7.1	Solar Cable - For String Connections	1 C X 4/6 Sq mm Tinned Copper Cables, UV resistant, Solar Cable , TUV certified; 1800 Vdc
		7.2	AC Cables (Inverter to AC Distribution Box Panel)	4 C X 10/16/25/35 Sq mm m, Power cables Cu conductor, XLPE insulation, un-armoured, PVC outer sheath, 1100V
		7.3	AC Cables (AC Distribution Box Panel to Main LT Panels)	3.5C X 240/300/ Sq mm m, Power cables AL conductor, XLPE insulation, un-armoured, PVC outer sheath, 1100V
8. Cable Tray				
8	Cable Trays	8.1	Cable Tray made of perforated sheets /Ladder type of pre-galvanized or hot dip galvanized sheet of minimum 1.2 mm	

			thickness and the cable tray width should be based on cable size and run.
		8.2	25 mm conduit pipe use for Modules interconnection.
9. Earthing System			
9	Earthing system with Lighting arrestor	9.1	1CX16 sq mm, Copper conductor Unarmoured Cable for Earthing AC & DC System.
		9.2	Earthing Chemical gel earthing Kit
		9.3	Lighting Arrestor along with Mounting structure.
		9.4	25 X 3/5 Gi Strip for Earthing Lighting Arrestor
10. MISC ITEMS			
9.1	MC4 Connectors Misc. Components		MC4 connectors (Male & Females) required for solar power system complete all as directed.
9.2			Termination kits, lugs, sign boards, conduits, Washers , Nut Bolts required for above said project etc.
* The Quantities shall be based on actual site conditions which can be estimated after conducting site survey.			
* Internet Connection should be available on site			

PQ Criteria-

- 1) The Solar inverter & Solar PV Module should be of same make.
- 2) The supplier should have office and service center in the state.
- 4) remote monitoring of system should be provided free for 25 years
- 5) Standard inverter warranty should be 10 years
- 6) Inverter should had inbuilt DC SPD inside the inverter.
- 7) The Solar PV Module should be BIS approved.
- 8) the Solar Inverter should IEC Certifications as per MNRE Guidelines
- 9) The Solar Inverter should had Wi-Fi Communication port for transferring the generation date to online portal via Wi-Fi network.

10. FIRE EXTINGUISHERS:

The fire-fighting system for the proposed power plants for the fire protection shall be consisting of:

- CO2 type 4.5 kg fire extinguishers in the control room for fire caused by electrical short circuits.
- Sand buckets in the control room. The installation of fire Extinguishers should confirm to TAC regulations and BIS standards. The fire extinguishers shall be provided in the control room housing the batteries and PCUs.

PROTECTION

There shall be required number of suitable lightning arrestors installed in the array field.

EARTHING PROTECTION

Each array structure of the PV yard should be grounded properly. In addition the lightning arrester/masts should also be provided inside the array field. Provision should be kept for shorting and grounding of the PV array at the time of maintenance work. All metal casing/shielding of plant should be thoroughly grounded in accordance with Indian Electricity Act./IE Rules. Earth resistance should be tested in presence of the representative of Engineer In Charge.

13. DANGER BOARDS

Danger board should be provided as and where necessary as per IE act/IE rules as amended up to date.

14. DRAWING & MANUALS

- 5 copies of Engineering, electrical drawings and installation and O&M manuals are to be supplied with each Plant.
- Bidders shall provide complete technical data sheets for each equipment giving details of the specifications along with make/makes in their bid along with basic design of the power plant and power evacuation, along with protection equipment. Approved ISI and reputed makes for equipment to be used.
- For complete electro - mechanical works, bidders shall supply complete design details and drawings for approval before progressing with the installation work.

15. QUALITY AND ADAPTABILITY OF THE EQUIPMENT:

Bidders must verify the grid behavior, solar insolation levels, and general site conditions on their own before bidding. The bidder shall accordingly ensure that the equipment and the design submitted shall be able to perform as per guaranteed performance levels in the available site conditions. The design of the plant and the equipment offered by the bidders shall be evaluated for its quality and adaptability to the site conditions based on the purchasers past experience, projects earlier executed by the bidders and from other sources. Bidders must submit detailed technical operational parameters and latest performance indicator

Item No:- 409 - 412**TECHNICAL SPECIFICATION - LIFTS**

The scope of work shall cover design, supply delivery, installation, testing and commissioning of passenger lifts/ passenger cum bed lifts/Service lifts. All lifts shall be VVVF operated, gearless, central opening and with Machine room. The Lifts shall be with facility for duplex/triplex selective/collective operation. Car enclosure finish shall be SS (as per OEM) scratch proof moon rock/honeycomb. SS handrail not less than 600mm long at 900mm above floor level, to be provided inside the lift car as per requirement. Suitable lights and fans as per requirement shall be provided. Lift car size, Lift well size, Lift pit overhead, entrance width, car height etc. shall be as per NBC

2016 or OEM standards. The dimensions of Lift well shown in tender drawings are only indicative and EPC contractor shall provide the same as required by OEM.

Item No:- 409 - SITC of 20 passengers Basement, Ground plus 9 upper floors with Rated Speed of 2.0 /2.5 m/sec with micro price/PLC control and ACVVVF. drive . (B) With General PLUS ADDITIONAL SPECIAL FEATURES attached herewith. Prem. Cat.

GEAR LESS LIFT DRIVE (MRL) comprising of High Starting torque Lift 3 phase 440 V A. C. Permanent Magnet Synchronous motor of proper rating with high efficiency shall be used.[2] Micro processor based / PLC, ACVVVF, vector control drive with encoder feedback closed loop system shall be used for lift car and door operation which shall be full collective selective operation hall call demand response, UP/DOWN hall stops, Main, Up/ Down Contactor with overload and phase reversal relay and safety controls. [3] Car with M S platform with bracings of adequate size and to sustain the impact load cabin + passenger with safety factor of fire for steel and side panels of Stainless steel of sheet of grade 304 duty. Car ceiling will be S.S. finishes with aesthetic appearance with LED ceiling lights. Car flooring shall be of anti skid PVC with choice of colour of engineer in charge. Car doors shall be of stainless steel grade 304, hairline finish with centre opening / telescopic automatic doors. Car panel will also be S.S. 304 finished with emergency stop device, mechanical door safety device, facility of auto/ attended mode. All car panel buttons and all floor switches must be with brail language as per lift act. [4] All landing doors must be fire rated for 2 hour shall be fully automatic centre opening/ telescopic opening made of hairline finish steel grade of 304 with key holes and infrared curtains with Unlocking facility from outside [5] Appropriate battery operated emergency light in the car along with alarm switch shall be provided. Also, Emergency Light & Fan should start immediately without any Time Delay as soon as power fails.

[6] Digital scrolling indicator system for up-down arrow along with floor position indicator shall be provided inside the car and at all floors.

[7] Full height infra red curtain with multiple cross / crossing light beams shall be provided.[8] Automatic Rescue Device (ARD) shall be provided accordingly of passenger capacity with Manual Rescue Operation (Manual Cranking Facility).

[9] Audio visual indication in the lift car showing over loading shall be provided such that doors kept open till excess load is removed. [10] Spring buffers/PU

Buffers shall be provided.

[11] Car fan as per passenger capacity with automatic sleep timer shall be provided.

[12] Voice annunciator with suitable music shall be provided in lift car.

[13] Self diagnostics system for operational and safety parameters shall be provided in control panel.

[14] Mechanical over speed governor with governor calibration as per actual site parameters and submission of calibration certificate submission, door key holes in the floor doors, fireman switch shall be provided.

[15] Lift machine hoisting arrangement in the lift machine room and monkey ladder for lift pit should be provided by the lift agency, along with the other steel structure works, foundations for the machine etc...

[16] In the hoist way fascia plate shall be provided without any extra cost, where ever required as / if directed by engineer in charge. [17] Permanent wiring with necessary safety devices like RCCB in all circuit, Over Voltage Under Voltage protection and THD eliminator in circuit for lift machine room and lift well with proper numbers of light points, with fixtures, exhaust fan and plug points shall be provided by the agency. Only 3 phase Power Supply shall be made available by department in lift machine room. Necessary Earthing as per Lift Act/Rules shall be arranged by Lift Agency.

[18] Any civil/ electrical works for additional and alteration in lift shaft and machine room related to erection of lift shall be made by lift agency without any extra cost. (granite/marble fixing around all landing door openings are not in lift agency's scope.)

[19] Agency has to provide all working drawings and documents and liaison services for obtaining all necessary permission from lift inspector and other authorities. [20] acrylic transparent licence/display A4 size holder in lift car. [20A] As per statutory requirement of Govt. Of Gujarat lift & escalator act 2000, lift agency has to provide

1. Car top safety barricade

2. Push & talk communication system.

3. Fireman's switch operation at Ground Floor. 4. carrying out third party lift inspection during/after lift erection and provide report by third party authorized by concern licensing authority 5. agency has to provide third party insurance upto completion of free maintenance period and submit the document for the same. [21] Car Panel Operating Buttons with floor position indicator/buttons must be of Auto Glow type clearly visible when view from inside cabin.

[22] For Physically Handicapped person Full Length Handrails of hairline finish steel grade of 304 should be provided at appropriate height on the Rear & Side Wall Panels in Lift Car.

(B) SPECIAL FEATURES DESCRIPTION OF LIFTS for PREMIUM category- 1. Advanced control system dual 64 bit embedded microprocessor with CANBUS Serial Communication mode including Regenerative power efficient operation, on site programming facility, Anti nuisance, Pte-opening, BMS/RMS with necessary online real time monitoring system having necessary connectivity for remote monitoring & other suitable supporting hardware & software devices to fulfil the purpose. 2. Floor Indication LCD Display with call registration & brail mark with arrival gong and hall lantern & TFT Screen in the car with MP3 Voice Announcer. 3. CAR Panel should be Scratch resistive SS Moonrock finish / Hair Line / Honeycomb for car and all Doors, All landing doors must have fire rating up to 2 hours and car door must have multi-level crisscross beam door protection. 4. To & fro communication system & wiring (i.e. car , control room & guard room) and Each elevator are equipped with remote monitoring system. agency has to

provide mobile app and user id and password for monitoring.

Item No:- 410 -

SITC of 13 Passengers, Basement, Ground plus 9 upper floors with Rated Speed of 2.0 / 2.5 m/sec., -(B) With General PLUS ADDITIONAL SPECIAL FEATURES attached herewith. Prem. Cat.

GEAR LESS LIFT DRIVE (MRL) comprising of High Starting torque Lift 3 phase 440 V A. C. Permanent Magnet Synchronous motor of proper rating with high efficiency shall be used.[2] Micro processor based / PLC, ACVVVF, vector control drive with encoder feedback closed loop system shall be used for lift car and door operation which shall be full collective selective operation hall call demand response, UP/DOWN hall stops, Main, Up/ Down Contactor with overload and phase reversal relay and safety controls. [3] Car with M S platform with bracings of adequate size and to sustain the impact load cabin + passenger with safety factor of fire for steel and side panels of Stainless steel of sheet of grade 304 duty. Car ceiling will be S.S. finishes with aesthetic appearance with LED ceiling lights. Car flooring shall be of anti skid PVC with choice of colour of engineer in charge. Car doors shall be of stainless steel grade 304, hairline finish with centre opening / telescopic automatic doors. Car panel will also be S.S. 304 finished with emergency stop device, mechanical door safety device, facility of auto/ attended mode. All car panel buttons and all floor switches must be with brail language as per lift act. [4] All landing doors must be fire rated for 2 hour shall be fully automatic centre opening/ telescopic opening made of hairline finish steel grade of 304 with key holes and infrared curtains with Unlocking facility from outside [5] Appropriate battery operated emergency light in the car along with alarm switch shall be provided. Also, Emergency Light & Fan should start immediately without any Time Delay as soon as power fails. [6] Digital scrolling indicator system for up-down arrow along with floor position indicator shall be provided inside the car and at all floors. [7] Full height infra red curtain with multiple cross / crossing light beams shall be provided.[8] Automatic Rescue Device (ARD) shall be provided accordingly of passenger capacity with Manual Rescue Operation (Manual Cranking Facility). [9] Audio visual indication in the lift car showing over loading shall be provided such that doors kept open till excess load is removed. [10] Spring buffers/PU Buffers shall be provided. [11] Car fan as per passenger capacity with automatic sleep timer shall be provided. [12] Voice annunciator with suitable music shall be provided in lift car. [13] Self diagnostics system for operational and safety parameters shall be provided in control panel. [14] Mechanical over speed governor with governor calibration as per actual site parameters and submission of calibration certificate submission, door key holes in the floor doors, fireman switch shall be provided. [15] Lift machine hoisting arrangement in the lift machine room and monkey ladder for lift pit should be provided by the lift agency, along with the other steel structure works, foundations for the machine etc... [16] In the hoist way fascia plate shall be provided without any extra cost, where ever required as / if directed by engineer in charge. [17] Permanent wiring with necessary safety devices like RCCB in all circuit, Over Voltage Under Voltage protection and THD eliminator in circuit for lift machine room and lift well with proper numbers of light points, with fixtures, exhaust fan and plug points shall be provided by the agency. Only 3 phase Power Supply shall be made available by department in lift machine room. Necessary Earthing as per Lift Act/Rules shall

be arranged by Lift Agency.

[18] Any civil/ electrical works for additional and alteration in lift shaft and machine room related to erection of lift shall be made by lift agency without any extra cost. (granite/marble fixing around all landing door openings are not in lift agency's scope.)

[19] Agency has to provide all working drawings and documents and liaison services for obtaining all necessary permission from lift inspector and other authorities.[20] acrylic transparent licence/display A4 size holder in lift car.
[20A] As per statutory requirement of Govt. Of Gujarat lift & escalator act 2000, lift agency has to provide

1. Car top safety barricade

2. Push & talk communication system.

3. Fireman's switch operation at Ground Floor. 4.carrying out third party lift inspection during/after lift erection and provide report by third party authorized by concern licensing authority 5.agency has to provide third party insurance upto completion of free maintenance period and submit the document for the same. [21] Car Panel Operating Buttons with floor position indicator/buttons must be of Auto Glow type clearly visible when view from inside cabin.

[22] For Physically Handicapped person Full Length Handrails of hairline finish steel grade of 304 should be provided at appropriate height on the Rear & Side Wall Panels in Lift Car.

(B) SPECIAL FEATURES DESCRIPTION OF LIFTS for PREMIUM category- 1. Advanced control system dual 64 bit embedded microprocessor with CANBUS Serial Communication mode including Regenerative power efficient operation, on site programming facility, Anti nuisance, Pte-opening, BMS/RMS with necessary online real time monitoring system having necessary connectivity for remote monitoring & other suitable supporting hardware & software devices to fulfil the purpose. 2. Floor Indication LCD Display with call registration & brail mark with arrival gong and hall lantern & TFT Screen in the car with MP3 Voice Announcer. 3. CAR Panel should be Scratch resistive SS Moonrock finish / Hair Line / Honeycomb for car and all Doors, All landing doors must have fire rating up to 2 hours and car door must have multi-level crisscross beam door protection. 4. To & fro communication system & wiring (i.e. car , control room & guard room) and Each elevator are equipped with remote monitoring system.agency has to provide mobile app and user id and password for monitoring.

Item No:- 411 -

SITC of 1 Ton Goods Lifts, Basement, Ground plus upper 4 floor with rated speed of max 1 MPS with all necessary accessories complete as required.

GEAR LESS LIFT DRIVE (MRL) comprising of High Starting torque Lift 3 phase 440 V A. C. Permanent Magnet Synchronous motor of proper rating with high efficiency shall be used.[2] Micro processor based / PLC, ACVVVF, vector control drive with encoder feedback closed loop system shall be used for lift car and door operation which shall be full collective selective operation hall call demand response, UP/DOWN hall stops, Main, Up/ Down Contactor with overload and phase reversal relay and safety controls. [3] Car with M S platform with bracings of adequate size and to sustain the impact load cabin + passenger with safety factor of fire for steel and side panels of Stainless steel of sheet of grade 304 duty. Car ceiling will be S.S. finishes with aesthetic appearance with LED ceiling lights. Car flooring shall be of anti skid PVC with choice of colour of engineer in charge. Car doors shall be of stainless steel grade 304, hairline finish with centre opening

- / telescopic automatic doors. Car panel will also be S.S. 304 finished with emergency stop device, mechanical door safety device, facility of auto/ attended mode. All car panel buttons and all floor switches must be with brail language as per lift act. [4] All landing doors must be fire rated for 2 hour shall be fully automatic centre opening/ telescopic opening made of hairline finish steel grade of 304 with key holes and infrared curtains with Unlocking facility from outside
- [5] Appropriate battery operated emergency light in the car along with alarm switch shall be provided. Also, Emergency Light & Fan should start immediately without any Time Delay as soon as power fails.
- [6] Digital scrolling indicator system for up-down arrow along with floor position indicator shall be provided inside the car and at all floors.
- [7] Full height infra red curtain with multiple cross / crossing light beams shall be provided.[8] Automatic Rescue Device (ARD) shall be provided accordingly of passenger capacity with Manual Rescue Operation (Manual Cranking Facility).
- [9] Audio visual indication in the lift car showing over loading shall be provided such that doors kept open till excess load is removed. [10] Spring buffers/PU Buffers shall be provided.
- [11] Car fan as per passenger capacity with automatic sleep timer shall be provided.
- [12] Voice annunciator with suitable music shall be provided in lift car.
- [13] Self diagnostics system for operational and safety parameters shall be provided in control panel.
- [14] Mechanical over speed governor with governor calibration as per actual site parameters and submission of calibration certificate submission, door key holes in the floor doors, fireman switch shall be provided.
- [15] Lift machine hoisting arrangement in the lift machine room and monkey ladder for lift pit should be provided by the lift agency, along with the other steel structure works, foundations for the machine etc...
- [16] In the hoist way fascia plate shall be provided without any extra cost, where ever required as / if directed by engineer in charge. [17] Permanent wiring with necessary safety devices like RCCB in all circuit, Over Voltage Under Voltage protection and THD eliminator in circuit for lift machine room and lift well with proper numbers of light points, with fixtures, exhaust fan and plug points shall be provided by the agency. Only 3 phase Power Supply shall be made available by department in lift machine room. Necessary Earthing as per Lift Act/Rules shall be arranged by Lift Agency.
- [18] Any civil/ electrical works for additional and alteration in lift shaft and machine room related to erection of lift shall be made by lift agency without any extra cost. (granite/marble fixing around all landing door openings are not in lift agency's scope.)
- [19] Agency has to provide all working drawings and documents and liaison services for obtaining all necessary permission from lift inspector and other authorities. [20] acrylic transparent licence/display A4 size holder in lift car.
- [20A] As per statutory requirement of Govt. Of Gujarat lift & escalator act 2000, lift agency has to provide
1. Car top safety barricade
 2. Push & talk communication system.
 3. Fireman's switch operation at Ground Floor.
 4. carrying out third party lift inspection during/after lift erection and provide report by third party authorized by concern licensing authority
 5. agency has to provide third party insurance upto completion of free maintenance period and submit the document for the same.
- [21] Car Panel Operating Buttons with floor position indicator/buttons must be of Auto Glow type clearly visible when view from inside cabin.
- [22] For Physically Handicapped person Full Length Handrails of hairline finish

steel grade of 304 should be provided at appropriate height on the Rear & Side Wall Panels in Lift Car.

(B) SPECIAL FEATURES DESCRIPTION OF LIFTS for PREMIUM category- 1. Advanced control system dual 64 bit embedded microprocessor with CANBUS Serial Communication mode including Regenerative power efficient operation, on site programming facility, Anti nuisance, Pte-opening, BMS/RMS with necessary online real time monitoring system having necessary connectivity for remote monitoring & other suitable supporting hardware & software devices to fulfil the purpose. 2. Floor Indication LCD Display with call registration & brail mark with arrival gong and hall lantern & TFT Screen in the car with MP3 Voice Announcer. 3. CAR Panel should be Scratch resistive SS Moonrock finish / Hair Line / Honeycomb for car and all Doors, All landing doors must have fire rating up to 2 hours and car door must have multi-level crisscross beam door protection. 4. To & fro communication system & wiring (i.e. car , control room & guard room) and Each elevator are equipped with remote monitoring system. agency has to provide mobile app and user id and password for monitoring.

Item No:- 412 -

SITC of 1 Ton Goods Lifts, Basement, Ground plus upper 9 floor with rated speed of max 1 MPS with all necessary accessories complete as required.

GEAR LESS LIFT DRIVE (MRL) comprising of High Starting torque Lift 3 phase 440 V A. C. Permanent Magnet Synchronous motor of proper rating with high efficiency shall be used. [2] Micro processor based / PLC, ACVVVF, vector control drive with encoder feedback closed loop system shall be used for lift car and door operation which shall be full collective selective operation hall call demand response, UP/DOWN hall stops, Main, Up/ Down Contactor with overload and phase reversal relay and safety controls. [3] Car with M S platform with bracings of adequate size and to sustain the impact load cabin + passenger with safety factor of fire for steel and side panels of Stainless steel of sheet of grade 304 duty. Car ceiling will be S.S. finishes with aesthetic appearance with LED ceiling lights. Car flooring shall be of anti skid PVC with choice of colour of engineer in charge. Car doors shall be of stainless steel grade 304, hairline finish with centre opening / telescopic automatic doors. Car panel will also be S.S. 304 finished with emergency stop device, mechanical door safety device, facility of auto/ attended mode. All car panel buttons and all floor switches must be with brail language as per lift act. [4] All landing doors must be fire rated for 2 hour shall be fully automatic centre opening/ telescopic opening made of hairline finish steel grade of 304 with key holes and infrared curtains with Unlocking facility from outside [5] Appropriate battery operated emergency light in the car along with alarm switch shall be provided. Also, Emergency Light & Fan should start immediately without any Time Delay as soon as power fails.

[6] Digital scrolling indicator system for up-down arrow along with floor position indicator shall be provided inside the car and at all floors.

[7] Full height infra red curtain with multiple cross / crossing light beams shall be provided. [8] Automatic Rescue Device (ARD) shall be provided accordingly of passenger capacity with Manual Rescue Operation (Manual Cranking Facility).

[9] Audio visual indication in the lift car showing over loading shall be provided such that doors kept open till excess load is removed. [10] Spring buffers/PU Buffers shall be provided.

[11] Car fan as per passenger capacity with automatic sleep timer shall be provided.

[12] Voice annunciator with suitable music shall be provided in lift car.

[13] Self diagnostics system for operational and safety parameters shall be provided in control panel.

[14] Mechanical over speed governor with governor calibration as per actual site parameters and submission of calibration certificate submission, door key holes in the floor doors, fireman switch shall be provided.

[15] Lift machine hoisting arrangement in the lift machine room and monkey ladder for lift pit should be provided by the lift agency, along with the other steel structure works, foundations for the machine etc...

[16] In the hoist way fascia plate shall be provided without any extra cost, where ever required as / if directed by engineer in charge. [17] Permanent wiring with necessary safety devices like RCCB in all circuit, Over Voltage Under Voltage protection and THD eliminator in circuit for lift machine room and lift well with proper numbers of light points, with fixtures, exhaust fan and plug points shall be provided by the agency. Only 3 phase Power Supply shall be made available by department in lift machine room. Necessary Earthing as per Lift Act/Rules shall be arranged by Lift Agency.

[18] Any civil/ electrical works for additional and alteration in lift shaft and machine room related to erection of lift shall be made by lift agency without any extra cost. (granite/marble fixing around all landing door openings are not in lift agency's scope.)

[19] Agency has to provide all working drawings and documents and liaison services for obtaining all necessary permission from lift inspector and other authorities. [20] acrylic transparent licence/display A4 size holder in lift car. [20A] As per statutory requirement of Govt. Of Gujarat lift & escalator act 2000, lift agency has to provide

1. Car top safety barricade

2. Push & talk communication system.

3. Fireman's switch operation at Ground Floor. 4. carrying out third party lift inspection during/after lift erection and provide report by third party authorized by concern licensing authority 5. agency has to provide third party insurance upto completion of free maintenance period and submit the document for the same. [21] Car Panel Operating Buttons with floor position indicator/buttons must be of Auto Glow type clearly visible when view from inside cabin.

[22] For Physically Handicapped person Full Length Handrails of hairline finish steel grade of 304 should be provided at appropriate height on the Rear & Side Wall Panels in Lift Car.

(B) SPECIAL FEATURES DESCRIPTION OF LIFTS for PREMIUM category- 1. Advanced control system dual 64 bit embedded microprocessor with CANBUS Serial Communication mode including Regenerative power efficient operation, on site programming facility, Anti nuisance, Pte-opening, BMS/RMS with necessary online real time monitoring system having necessary connectivity for remote monitoring & other suitable supporting hardware & software devices to fulfil the purpose. 2. Floor Indication LCD Display with call registration & brail mark with arrival gong and hall lantern & TFT Screen in the car with MP3 Voice Announcer. 3. CAR Panel should be Scratch resistive SS Moonrock finish / Hair Line / Honeycomb for car and all Doors, All landing doors must have fire rating up to 2 hours and car door must have multi-level crisscross beam door protection. 4. To & fro communication system & wiring (i.e. car , control room & guard room) and Each elevator are equipped with remote monitoring system. agency has to provide mobile app and user id and password for monitoring.

Item No:- 451 - 459**EXTERNAL STREET LIGHTING SYSTEM:****Scope of Work:**

The scope of works under External Street Lighting System requires illumination of all external areas like streets, roads, entrance gates, boundary walls, parks, gardens, landscaping, porches, building facades, walkways, pathways etc., which shall be illuminated conforming to NBC 2016, ECBC 2017 and CPWD specifications maintaining required Lux levels. Suitable LED fixtures shall only be used with inbuilt harmonic suppression mechanism for external area illumination. Solar and conventional street light poles, bollards, gate lights, post-top lantern etc. shall be used for this purpose keeping in view aesthetical and architectural requirements. The external lighting shall be fed from outdoor type feeder panels and automatically controlled through 24-hour Digital/ Astronomical Timers.

All solar & conventional street light poles of single arm /double arm/triple arm, as required shall be GI Octagonal with heights as per relevant IS Codes, NBC Code & ECBC.

Standard Galvanised Octagonal Poles

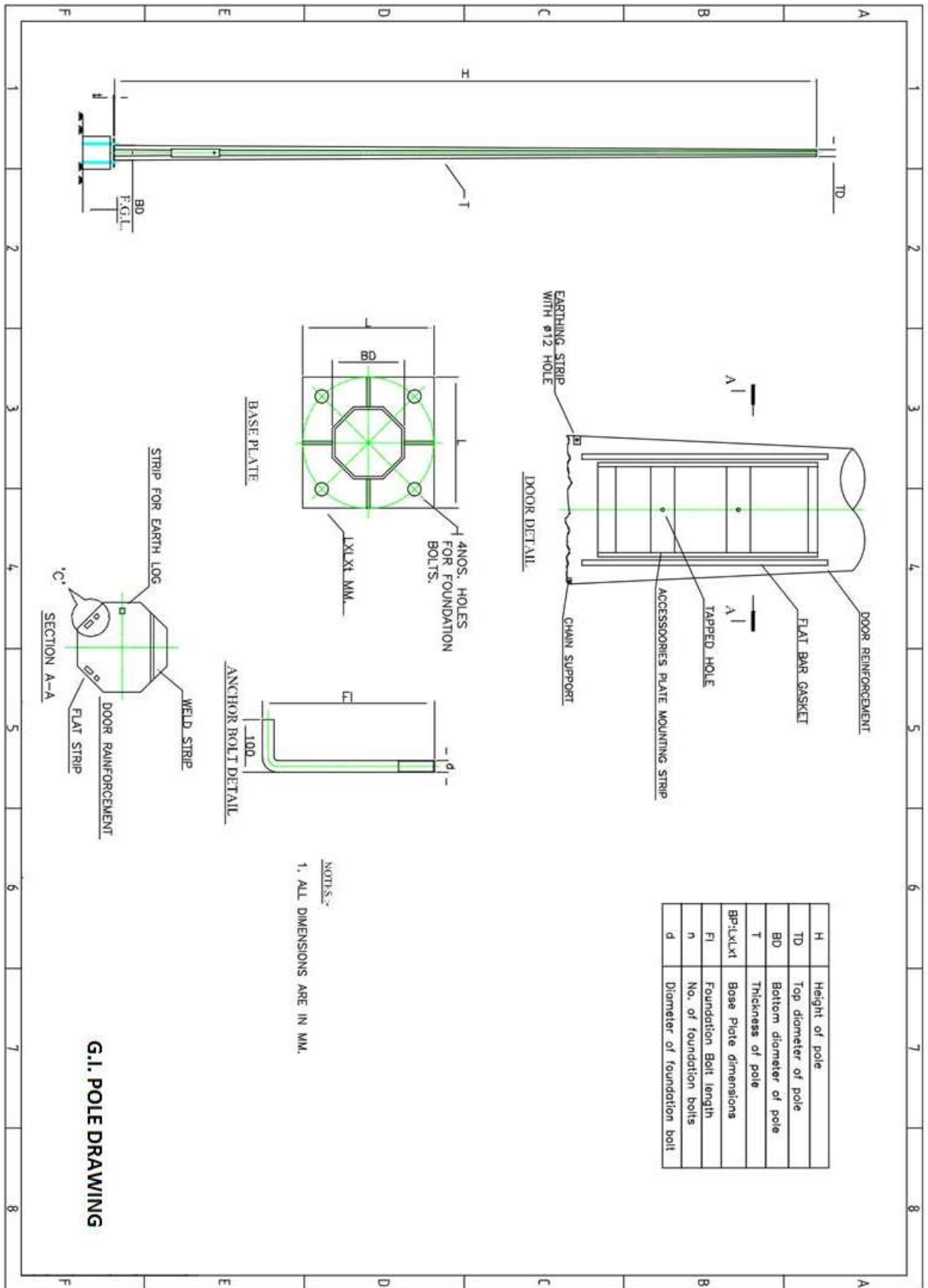
Octagonal poles shall be designed as per ILE TR7 & BS5649 for structural design & as per IS875 (Part III), 1987 for dynamic loading.

The pole shaft shall be made single piece MS structure continuously tapered having polygonal (8/12 sides) cross section and a single longitudinal welding. The welding will be done as per BS 5135 / IS 9595. No circumferential welding shall be allowed in the pole shaft. The MS shall conform to BSEN 100025/100027. The structure shall be single hot dip galvanized as per BS 729 / IS 2629. A suitably designed door shall be provided at approximate 700mm height from the pole base. The door opening will be suitably reinforced for structural strength. The door shall be flushed with pole external surface and shall provide easy access for electrical connections at a maintainable height. A Suitable base flange will be welded and plate reinforcements will be provided between base flange & pole. Foundation accessories will be as per IS 1367.

POLE DESCRIPTION	POLE DETAILS				BASE PLATE	FOUNDATION BOLT		
	HEIGHT	TOP	BOTTO M	THICKNE SS		LENGTH	NO S	DIA.
	H	T	B	T		F	N	D
3 MTR GI OCTAGONAL	3000	7	130	3	200 X 200X	450	4	1
4 MTR GI OCTAGONAL	4000	7	130	3	220 X 220X	450	4	2
5 MTR GI OCTAGONAL	5000	7	130	3	200 X 200 X	600	4	2
6 MTR GI OCTAGONAL	6000	7	130	3	220X 220 X	600	4	2

7 MTR GI OCTAGONAL	7000	7	130	3	220 X 220 X	700	4	2
8 MTR GI OCTAGONAL	8000	7	135	3	225 X 225 X	750	4	2
9 MTR GI OCTAGONAL	9000	7	155	3	260 X 260 X	750	4	2
10 MTR GI OCTAGONAL	10000	7	175	3	275 X 275 X	750	4	2
11 MTR GI OCTAGONAL	11000	9	210	3	300 X 300 X	750	4	2
12 MTR GI OCTAGONAL	12000	9	240	3	320 X 320 X	750	4	2

NOTE: ALL DIMENSIONS IN MM



Solar Street Lighting System

Scope of Work:

Solar Street Lighting System shall comprise of Solar Panel Module, LED Luminaires, Solar Charge Controller /LED driver in a single PCB, SMF Battery with 36 hours back up, Hybrid Charger etc. Mounting System shall include, panel frame, panel holder, Battery Box, Battery Box Stand, Luminaire arm, GI Octagonal pole etc.

Maximum Power Point Tracking (MPPT) System shall be provided with charge controllers for extracting maximum available power from PV module under certain conditions. MPPT (18 W – 45W) Solar Charge Controller with maximum efficiency shall be provided as per Lux level requirements to maximise the generation of solar power.

Features of Solar Street Light

Poles:

Features of Solar Street Light Poles:

S.No.	Description	Features Availability
1	Product	Solar All in One Street Light
2	System Rated Wattage	60W + - 10% maximum rated
3	Solar PV Module	100 Wp monocrystalline at STC
4	Battery (Life P04) with BMS	Lithium Ferro Phosphate rate 12.8 V/42 Ah @25deg.C
5	Housing	Aluminium extrusion housing with mounting bracket provided
6	Back Up	Upto 24 hours with intelligent Dimming on fully charged battery & AIO installed as per product manual instruction & AIO maintained as per product manual instructions by customer.
7	Protection Standard	IP 65 / IK 07
8	Solar Charge controller	MPPT with Auto dusk to dawn feature inbuilt
9	Efficiency	> 90% @ maximum power consumption
10	CRI	>70
11	System Luminous Efficacy	>= 160 lm/w at maximum rated wattage
12	Visual Angle	upto 120 Deg
13	CCT	5700 K
14	Other protections	a. Over Charge protection b. Deep Discharge protection c. Over Current protection d. Short circuit protection

		e. Over Voltage protection
15	Dimming	Factory programmed intelligent Dimming profile
16	Hybrid Feature	Provided, in case of low battery state, LED is powered from AC source.
17	Pole Height	8 mtr (included)
18	indications	Charging Indication (Green), Low battery / Fault (Red).
Environmental	Load OVP	To be Provided
	Battery under Voltage Fault	To be Provided
	Operating Temperature Range	-0°C to +50°C
	Storage Temperature Range	-20°C to +85°C
	Humidity	95%RH
	Battery Temperature Compensation	To be Provided
Ingress Protection	Ingress Protection	IP66
Embossing	Luminaire must be embossed with original equipment Manufacturer name	To be Provided
Dimming Feature	50% auto Dim after 5hrs.	To be Provided

Power cabling for External illumination:

The power shall be fed to Street Light Poles, High Mast Poles, Hybrid Solar street Light Poles, Bollards, Post Top lanterns, Gate Lights, Façade Lights, Walk way lights etc through suitable size aluminium armoured XLPE insulated power cables, laid underground as per CPWD Specifications. Suitable Feeder Pillars shall be provided to feed various circuits of street lights.

Street Light Pole Height & distance between poles:

Street Light Poles, High Mast Poles, Hybrid Solar street Light Poles, Bollards, Post Top

Lanterns of suitable height shall be provided to achieve illumination with required Lux levels in the external areas as per CPWD, NBC 2016 & ECBC norms. Distance between street light poles shall be as per CPWD, NBC 2016 & ECBC norms as applicable.

Inspection: Street Light Poles, High Mast Poles, Hybrid Solar Street Light Poles etc shall be offered for inspection by Consultant Engineers at manufacturer's works before final dispatch to site as per terms of the contract.

Drawings: Site Layout drawings and Single Line diagrams shall be prepared and submitted for approval of Engineer-In-charge by the contractor for the Street Light Poles, High Mast Poles, Hybrid Solar street Light Poles, Bollards, Post Top lanterns, Gate Lights, Façade Lights, Walk Way lights etc. The drawings shall be got approved from Engineer-In-charge before commencement of works at site.

Applicable IEC Standards:

- i. IEC 61215 latest: Solar Panel
- ii. IEC 61347-2-13 : LED driver safety
- iii. IEC 62384 : LED driver performance
- iv. CISPR 15 : Radio disturbance characteristics
- v. IEC 61547 : EMC immunity requirements
- vi. IEC 60598 : General requirements and tests